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SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT III

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C O N T E N T :

PLENARY SECTION
***First day*, 15th December 2022.**

PLENARY SECTION

***Second day,* 16th December 2022.**

WORKING SECTION

PREFACE

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The Thematic Proceedings addresses the wider audience by being scientifically and practically focused on all segments of sustainable agriculture and rural development.

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THEMATIC PROCEEDINGS

PLENARY SECTION

***First day*, 15th December 2022**

POLICY MAKING FOR REGRET AVERSE AGENTS

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Abstract

Policy interventions require understanding the behavior of players and predicting how they respond to the interventions to prevent economic losses. Thus, when designing policy interventions, it is imperative to incorporate insights from behavioral sciences such as behavioral biases into account. In this study, we analyze a policy design problem that aims to foster the adoption of a sustainable technology by regret averse decision makers. The sustainable technology involves a potentially large loss that deters regret averse decision makers, but is more welfare-enhancing compared to the traditional technology. We show how the policy should be designed when the decision makers are regret averse. The main insight is that regret aversion might hinder the adoption of the sustainable technologies when it is welfare enhancing and so, there is room for policies that induce the decision makers to adopt sustainable technologies. We show that regret aversion increases the burden of uncertainty, i.e., the more regret averse the decision makers, the higher the cost of the policy that is required to induce them to adopt the sustainable technology. However, once opting for the sustainable technology, incentive to exert costly effort is not affected by regret aversion.

Key words: *regret aversion, sustainable technology adoption, Policy making.*

Introduction

Modern economies rely on markets for the efficient allocation of resources. Well-functioning markets are indeed considered to be the magic ingredients of prosperous nations' institutions. However, well-functioning markets rarely arise spontaneously. The economic literature provides theoretical and empirical accounts of market failures where the outcomes of markets are either inefficient, from an economic or social perspective, or the markets seize to

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operate at all. Indeed, the functioning of markets, like other institutions, rely on the set of governing rules that affect the incentives of players. Efficient markets often require a set of rules that align the incentives of players with the objectives of the society within which it operates. This opens the scope for policy interventions aimed at steering the market outcomes away from what society deems to be suboptimal. Well-designed policy interventions, in turn, require understanding the behavior of players and predicting how they respond to the interventions. Prediction of individual' response is of paramount importance since the realization of the desired outcomes depends on how individuals respond to policy interventions. Policy literature is full of examples where the policy makers are disappointed to see how well-meaning interventions backfired and resulted in social and economic loss (Richman, 2004). As a result, when it comes to design policies and devise interventions, it is imperative to incorporate insights from behavioral sciences such as behavioral biases, into account. Behavioral biases are beliefs or behaviors that deviate from those of the rational agents used in classical economics. These biases can unconsciously influence our decision-making process (Seager-Scott, 2018). These biases matter in domains such as finance, health and agriculture especially when decision makers operate in environment where uncertainty features prominently. For example, Streletskaya et al. (2020) show that the behavioral biases of decision making under risk, time discounting, and social preferences/learning, can influence decision making in context of adoption of agricultural sustainability innovations. This paper explores the possibilities of designing polices and interventions affecting individuals who are prone to regret aversion. A person shows regret aversion, if that person feels negative emotions when, in hindsight, the outcome of a choice is worse than the outcome of an alternative choice, that was not chosen (Bleichrodt & Wakker, 2015) . We do this in the context of sustainability where producers have to choose between a sustainable environmental-friendly technology and a traditional unsustainable technology. The sustainable technology is socially and individually superior but exposes the adopters to a remarkable potential loss. The possibility of incurring such a loss makes regret averse decision makers wary of the sustainable technology. We investigate how policy makers, who are willing to encourage the decision makers to adopt the sustainable technology, can design policies that result in decision makers adopting the sustainable technology. This is done by investigating the mechanism through which regret aversion affects decisions and the reaction of regret averse decision makers to the policy initiatives.

The rest of the paper is organized as follows. In the next section, we briefly review regret aversion. Then, we review a motivating case that shows the importance of regret aversion in the agri-food industry in Section III. In the Section IV, we present the model by using a simple example that highlights the main effect of regret aversion on decision making. We then proceed with analyzing the policy options and investigate how these policies should be adjusted when practical considerations are incorporated. Finally, the last section summarizes the paper and discusses the implications of assumptions of the model.

II - Regret aversion

The basic idea behind regret theory is that when choosing between prospects, people care not only about the outcome that they receive, but also about the outcomes that they would have received, had they chosen a different prospect. As a result, when the outcome of the choice is worse than the outcome of the alternative prospect, that is not chosen, they feel negative emotions. Regret aversion is introduced by Loomes & Sudgen (1982) and also by Bell (1982). The theoretical and behavioral foundation of regret aversion is investigated by Sarver (2008); Bikhchandani & Segal (2014); Qin (2015); Diecidue & Sumasundaran (2017) and Strack & Viefers (2021) among others. Bleichdrot & Wakker (2015) provide a recent overview of regret aversion. The application of regret aversion in a number of areas such as health (Boeri, Grisolía, Hutchinson & Kee, 2013), finance (Frydman & Camerer, 2016; Frydman, Hartzmark & Solomon, 2018; Fogel & Berry, 2010), investment (Michenaud & Solnik, 2008; Muermann, Mitchell & Volkman ,2006) and auctions (Hayashi & Yoshimoto (2016); Filiz-Ozbay & Ozbay, 2007; Fioretti, Vostroknutov & Coricelli, 2022)have shown that regret aversion results in decisions that are in sharp contrast with what standard rationality based decision theories predict.

The formulation of regret theory, according to Loomes and Sugden (1982), is as follows. Consider two prospects f and g. There are n possible states (events) with event i having probability p_i. The possible outcomes of prospects f and g are $f_1, f_2, \dots f_n$ and $g_1, g_2, \dots g_n$, respectively. Preferences are stated as

$$f \succcurlyeq g \Leftrightarrow \sum_{i=1}^{n} p_i Q(u(f_i) - u(g_i)) \geq 0 \quad (1)$$

In the above, u is utility function, and the function Q captures the regret that a decision maker feels. This increasing function amplifies the utility differences between the outcomes. In case Q is convex, then the person shows regret aversion. This implies that this decision maker, with convex Q, might refrain from choosing a prospect that generates a large regret. In the next section, we show how regret aversion affects decision making using the case of a firm that has to decide to produce a traditional animal-protein based hamburger or a more sustainable plant-protein based hamburger.

III-Motivating case: Plant-based protein production

There is increasing consumer interest in food products with improved sustainability and healthfulness. This is reflected in the increased interest of food companies to design and produce plant-protein based products that can replace animal-protein based products. Several of such plant-based meat alternatives are currently on the market, many others are being developed. Similarly, several technologies for their production have been implemented, but others are in development. Because plant-based meat-replacers have only fairly recently entered the market, markets that exist are relatively small, and many technologies are new or still under development, it is difficult to rely on past market data as a sound proxy for future market development as a basis in investment decisions. This holds both for the market of the final product, i.e., the meat-replacer, but also for the market of the ingredients used to produce the meat-replacer. Therefore, we have selected the case study of the investment decision of a company to launch a new plant-based hamburger. Because the hamburger is new, the company has no idea about the size of future consumer demand for their plant-based hamburger, which we call deep uncertainty. In recent years, demand for plant-based proteins has been growing steadily. Consumers' environmental and health concerns are expected to further stimulate the consumer demand for plant-based proteins. But, this is no certainty. Consumers might want to stick to animal-based protein more than expected or the consumer price of a plant-protein hamburger might need to be higher than that of an animal-protein hamburger due to higher ingredient costs. Thus, although prospects to make a good profit are favorable for the plant-based protein hamburger, there are potential scenarios in which profit are negative and the company might feel regret for not having chosen to produce the animal-based hamburger.

IV-The model

We analyze decision making by considering producers who must choose between two production technologies. The first choice is the traditional production technology that is less sustainable and also involves less uncertainty. Alternatively, the producers might opt for the sustainable technology that, as the name suggests, is more sustainable but also involves more uncertainty.

The profit of each option depends on factors that are not under the control of the producer such as demand, input prices, etc. To account for these factors, we suppose that there are three possible events, or states, whose likelihood of realization are known ex ante. We call these events L (lucky), N (normal) and B (bad luck) and assume that they are equally likely to happen. Think of the lucky event as a situation in which the demand for the products produced by sustainable technology surpasses the demand for products produced by the unsustainable technology due to increases sustainability awareness, tax levied on unsustainable technology, etc. Normal event corresponds to the current situation where the sustainable technology is slightly more profitable than unsustainable technology. Finally, the bad luck represents a situation where consumers have a preference for the products produced with unsustainable technology. Assume that the producers are risk neutral, i.e., expected utility equals the expected value. Table 1 shows the profits of sustainable and unsustainable technologies in different events. The numbers reflect final profits.

Table 1. *Profit of the choices*

Choice - Event	**P(L)=1/3**	**P(N)=1/3**	**P(B)=1/3**
Sustainable Technology	45€	40€	0
Unsustainable Technology	30€	30€	20€

Note that the expected value of the sustainable technology is higher than the expected value of the traditional technology.

Expected value of sustainable technology = $1/3\times45+1/3\times40+1/3\times0=\frac{85}{3}$

Expected value of unsustainable technology= $1/3\times30+1/3\times30+1/3\times20=\frac{80}{3}$

Therefore, a rational producer, i.e., expected utility maximizer, would choose the sustainable technology. If the producer is regret averse, however, the choice might be different. This can be shown using the formula in (1). Recall

that producers are assumed to be risk neutral. Therefore, utility of money equals the money, i.e., $u(x)=x$. According to (1), unsustainable technology can be preferred to sustainable technology if

$$\frac{1}{3}Q(45-30)+\frac{1}{3}Q(40-30)<\frac{1}{3}Q(20-0) \qquad (2)$$

It can happen when the function is sufficiently convex. Intuitively, a regret averse producer feels the difference between 0 and 20 much stronger than the difference between 40 and 30 and the difference between 45 and 30. In other words, when choosing the technology, a regret averse producer *anticipates* that choosing the sustainable technology will result in a very strong sense of regret in state B. That is, the producer knows that if sustainable technology is adopted and state B realizes, she will feel a strong sense of loss/regret. The example shows how regret aversion result in refraining from the adoption of the sustainable production technology despite the fact that the expected profit of it is higher than the unsustainable technology.

Result 1: Regret aversion results in making decisions that are different than what a rational expected utility maximizer decision maker would make.

Given the effect of regret aversion on decision making, we now analyze whether a policy can be designed to encourage regret averse producers to adopt the sustainable technology. Note that a non-regret averse producer does not need to be encouraged to choose the sustainable technology. So, the optimal policy for a rational producer is no policy.

Policy analysis for regret averse decision makers

The first step in designing policy is identifying the societal value of sustainable production technology. That is, we need to know the value of the positive externality of the sustainable technology. This matters because the cost of the policy should not exceed the value of the positive externality if it aims to enhance societal welfare. Assume that the monetary value of the positive externality of sustainable technology, compared to the unsustainable technology equals D per producer. This amount can be thought of as the damage costs associated with unsustainable technology such as emissions, water contamination, soil degradation, etc. Importantly, this cost is not internalized by the producers; otherwise there was no point for the policy makers to intervene.

How should a policy encourage regret averse producers to adopt sustainable technology? Recall from (2) that the reason a regret averse producer does not adopt the sustainable technology is that the profit becomes 0 in case state B realizes. Therefore, if a policy can pay an amount to a producer who adopts the sustainable technology in state B, then the producer might be willing to adopt sustainable technology. From (2), the minimum amount, denote it by M, that is needed is such that the producer becomes indifferent between adopting the sustainable and unsustainable technologies. This means that M is the minimum number that satisfies the following condition;

$$1/3Q(45-30)+1/3Q(40-30)\geq 1/3Q(20-M)$$

Such a policy persuades the producers to adopt sustainable technology. Note that this policy is economically feasible if its expected benefit, D, is equal or larger than its expected cost, M. That is, the policy is feasible if and only if M<D. Otherwise, spending the money on restoration of the damages, resulting from unsustainable technology, is more cost-effective.

We showed that in an economic setting described in Table 1 paying M to regret averse producers in state B results in adopting the sustainable technology. In the rest of the paper, we enrich the analysis by making it more realistic and check how the optimal policy needs to change accordingly. This is done in multiple steps such that each step makes the problem closer to the real - world setting.

To make the analysis more general, we denote the absolute value of the difference between the outcomes of sustainable and unsustainable technologies in states L, N and B by D_L, D_N and D_B, respectively. The case when rational producers choose sustainable technology and regret averse producers choose unsustainable technology corresponds to averse producers choose unsustainable technology corresponds to $D_L + D_N > D_B$ and $Q(D_L) + Q(D_N) < Q(D_B)$.

M is defined as the minimum payment such that

$$Q(D_L)+Q(D_N)\geq Q(D_B-M) \qquad (3)$$

Profit depends on effort

Deterministic Income

Note that in our example the profit in state B is zero regardless of how hard a producer tries. That is, the realization of profit is independent of the producer's actions. If this is not the case, i.e., the profit is a function of effort, then the policy makers need to adjust the policy.

Suppose that the profit in states L and N are independent of the effort. In the bad state B, however, it depends on whether the producer exerts effort or not. Suppose that effort does not require spending money but requires attentiveness that puts a modest private burden to the producer[4]. If the producer exerts effort, then the profit in state B is $\pi < M$. If the producer does not exert effort, then the profit will be zero. Effort is not observable. That is, it is not possible, or is prohibitively costly, to know whether or not a producer has tried or not. Does this case complicate the policy? The answer is no, as long as it can be verified that the bad state happens and the profit is π, the policy can be adjusted such that the compensation in state B adjusts to

$$Q(D_L) + Q(D_N) \geq Q(D_B - M - \pi) \quad (3a)$$

By doing this the policy makers ensure that producers who opted for sustainable technology have proper incentives to exert effort in the bad state. Denote the minimum value of M that results in (3a) holding by M_1. Comparing (3) with (3a), we see that $M_1 < M$.

There are two points worth mentioning here. First, the effect of the additional income π is amplified by the convex function Q. That is, the difference between Q(D_B-M) and Q(D_B-M- π) is more than π due to the convexity of Q. As a result, $M_1 \leq M - \pi$. In words, with a regret averse decision maker, the subjective value of the additional income of π is more than its face value. Second, note that here generating a profit fully reveals the effort. In economic parlance, the extra income is a perfect signal of the effort and therefore, the revenue perfectly reveals the effort. As a result, the policy makers can achieve the efficient outcome (first best) simply by adjusting the compensation. So, we state the following result.

4 The private cost of the effort, denoted by $\varepsilon > 0$, is such that $\varepsilon << \pi$.

Result 2: With regret aversion, the social return to the private effort is strictly positive. If exerting effort is efficient and the extra income is a perfect signal of effort, then the efficient outcome can be achieved by conditioning the payment on extra income generation.

The problem arises when revenue becomes a noisy signal of effort. That is, when exerting effort might or might not result in generating a profit. We review this case in the next step.

Probabilistic income

Suppose that exerting effort in the bad state results in an extra income π with probability p and 0 with the complement $(1-p)$. Now the signal becomes noisy. That is, the income of 0 does not show whether a producer has exerted effort or not with certainty. The payment is paid only in case of income generation to ensure that the adopters exert effort. The probabilistic income increases the minimum payment that is required to induce regret averse producers to adopt sustainable technology and exert effort. To see why, note that paying M_1, the minimum that is required with deterministic extra income, to a profit generating producer and zero to non-profit generating producer results in the expected profit of pM_1 which is less than M_1, the minimum amount that is required for regret averse producers to adopt sustainable technology.

If the policy makers would like to introduce a policy to encourage producers to adopt the sustainable technology, then the compensation scheme needs to change. To show this formally, note that with the extra income being probabilistic, (3a) becomes

$$Q(D_L) + Q(D_N) \geq Q(D_B - M - p\pi) \qquad (3b)$$

Comparing (3a) and (3b), we see that their left hand sides are identical, but the right hand sides are different. The right hand side of (3b) can be stated as

$$Q(D_B - p\pi - M)$$

Whereas the right hand side of (3a) equals

$$Q(D_B - \pi - M)$$

Given that the left hand sides are identical, the minimum value of M that is required in (3b) is larger than the minimum value of M in (3a). In addition, the

difference between the functions of the arguments is larger than the difference in the arguments due to the convexity of Q. That is,

$$Q(D_B - p\pi - M) - Q(D_B - \pi - M) > (1-p)\pi$$

In words, regret aversion implying Q being convex, amplifies the effect of probabilistic extra income. That is, producers' subjective evaluation of the reduction in the extra income is larger than its objective reduction, i.e., reduction in expectation. The wedge between the subjective and objective reduction in the extra income increases with the convexity of Q, i.e., producers' regret aversion. An immediate consequence is that the required increase in the payment of the policy is larger than the expected decrease in income of the producers. In other words, probabilistic income is disproportionately costly for the society who is ultimately paying for the policy.

Result 3: Probabilistic income generation increases the cost of the policy disproportionately. Regret aversion amplifies this effect. That is, the more regret averse the producers, the higher the cost of the policy for the same probability of income generation.

Contingent payments

We showed that, with probabilistic extra income generation, the total income of producers in state B should increase compared to the deterministic case. However, we did not specify the structure of the payments. That is, we did not determine the amount of payment when the extra income is generated and when it is not generated. We briefly explain the payment structure here and elaborate it in the next section. Note that the payments in state B can be contingent on whether a producer has generated an income or not. Let us introduce a notation to further explore this point. Denote by M_R and M_N the amount of money that is paid to an income generating and non-income generating producer, respectively. We know from the discussions leading to (3a) and (3b) that these payments should be such that the producers find the sustainable technology profitable ex-ante, i.e., when evaluating it before making the decision. It means that two numbers should satisfy the following condition

$$(M_R + \pi)p + M_N(1-p) \geq M \qquad (4)$$

That is, the compensations should be such that the expected profit of a producer is at least equal to M where M is taken from (3). There are many combinations of M_R and M_N that satisfy (4) in equality, the cheapest policy. All the possible

combinations can be viable as long as their expected cost is equal or less than the value of the positive externality D and they also induce exerting effort.

To make the analysis explicit, let us assume that effort involves monetary expenditure. Exerting effort might correspond to taking additional cautionary measures, like working extra time, hiring additional labor or paying for consultancy service. These activities involve costs. Let us denote these costs by C. In addition, suppose that the positive externality of the sustainable technology in state B realizes only if producers exert effort. These assumptions are closer to real world problems and thus make the example closer to the practical policy issues.

When effort is costly, the policy makers need to make sure that producers have incentive to exert effort. This happens because effort is not observable and the extra income is a noisy signal of effort. That is, there is no way to know whether a producer who did not generate an income did not try hard enough or has tried but has been unlucky. With unobservable effort and noisy signal, the policy should be such that producers find exerting effort in their best interests. If , then a producer who adopts the sustainable technology has sufficient incentive to exert effort. If and , then the producer does not sufficient incentive to exert effort but effort is welfare enhancing. The reason is that the producer incurs the costs but does not fully absorb the benefits[5]. We assume that this is indeed the case

Assumption 1:

$$p\pi < C < p\pi + D$$

Given assumption 1, a producer who opted for the sustainable technology prefers exerting effort, to not exerting effort, when

$$Q(\{p(\pi + \pi_R) + (1-p)\pi_N) - C\} - \pi_N) \geq 0$$

The terms inside the curly brackets represent the expected payoff of exerting effort. The expected payoff of not exerting effort is just . Since Q is increasing, the inequality holds whenever the arguments are non-negative. That is,

$$p(\pi + \pi_R) + (1-p)\pi_N - C - \pi_N \geq 0 \qquad (5)$$

5 The positive externality, denoted by D, is the benefit to the society. So, the producer receives a tiny fraction of it. The cost C, however, is fully borne by the producer.

This constraint ensures that producers have proper incentive to exert effort. So, (5) is an incentive compatibility (IC) constraint. As we see, regret aversion does not affect the incentive compatibility constraint. In other words, the incentive compatibility constraint for regret averse producers is identical to non-regret averse producers who opt for the sustainable technology.

Next, with costly effort, we need to make sure that the expected profit of a regret averse producer who exerts effort is sufficiently high to persuade her/him to adopt the sustainable technology. With effort costs, we need to modify (3b) by adding the effort cost to the expected profit. Using the notations for contingent payments, we can state (3b) as

$$Q(D_L) + Q(D_N) \geq Q(D_B - [p(\pi + M_R) + (1-p)M_N - C]) \qquad (6)$$

This inequality ensures that adopting the sustainable technology, given that effort is exerted, is in the best interests of the producers. That is, producers who are regret averse but otherwise rational, find the sustainable technology profitable. In the language of contract theory, (6) is an individual rationality (IR) constraint.

Finally, recall that the positive externality of the sustainable technology is equal to D. For the policy to be welfare enhancing, the financial burden of the policy cannot exceed the total benefit of it. Therefore, the following feasibility constraint (FC) ensures that the expected cost of the policy does not exceed the societal benefit of the technology it supports.

$$pM_R + (1-p)M_N \leq D \qquad (7)$$

In short (5) ensures that a producer who chooses the sustainable technology has sufficient incentive to exert effort, (6) ensures that a regret averse producer is willing to adopt the sustainable technology and, (7) ensures that the policy is economically viable for society. Any combination of M_R and M_N that satisfies (5), (6) and (7) is a viable policy option. As we can see, (6) depend on the function Q, the regret aversion function, whereas (5) and (7) do not. In the next section, we construct the feasible policy space, i.e., the parameter space where (5), (6) and (7) are simultaneously satisfied by assuming various types of the function Q and discuss how the policy space changes according to the intensity of regret aversion. We first consider the case where the producer is not regret averse, Q is linear, and then compare it to case where Q is convex and see how the convexity affects the results.

The benchmark: policy space when Q is linear

The simplest case with a linear Q can be assumed when *Q(x)=x*. Obviously, (5) does not change as it does not depend on Q. So, we restate it as

$$p(M_R - M_N) \geq C - p\pi \qquad (5a)$$

It is straightforward to check that (6) transforms to

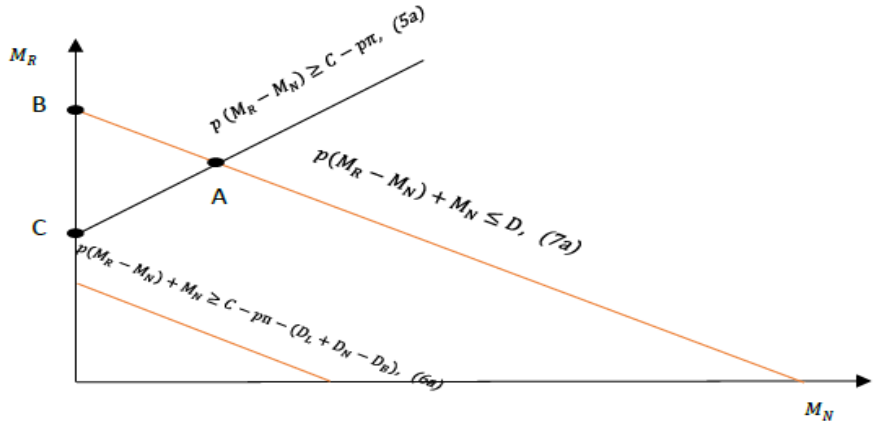
$$p(M_R - M_N) + \pi_N \geq C - p\pi - (D_L + D_N - D_B) \qquad (6a)$$

Finally, (7) does not change as it does not depend on Q in the first place. It can be restated as

$$p(M_R - M_N) + \pi_N \leq D \qquad (7a)$$

First of all, note that the left hand sides of (6a) and (7a) are identical. Therefore, unless the right hand side of (7a) is equal or larger than the right hand side of (6a), the problem has no solution. Let us assume that $0 < C - p\pi - (D_L + D_N - D_B) < D$ so that the problem has a solution. In addition, suppose π_R and π_N are non-negative, that is, producers are not going to be fined. Figure 1 depicts the feasible area determined simultaneously by (5a) and (6a). The triangle ABC shows the policy space where all the constraints are satisfied. Any point inside this triangle is a viable policy option.

Figure 1. *Policy space when Q is linear. The triangle ABC is the space where all the constraints are satisfied simultaneously.*



Point C is the policy option with the lowest costs for the society. That is, this point is the most cost-effective policy option. It involves paying nothing to producers

who do not generate a profit and paying the minimum that is required to incentivize profit generating producer to exert effort. Points A and B are similar in terms of being the least cost-effective policies (together with many other policies corresponding to points along the line segment BA). That is, these are expensive policy options; they pay the total social surplus to the producers. There is, however, a remarkable difference between A and B. Policy A pays the highest value to a producer who does not generate a profit. That is, point A offers the highest possible value of . Policy B pays nothing to producers who do generate a profit but pays the entire social surplus to profit generating producers. Policy A might be preferable to policy B from an egalitarian perspective.

Result 4: When Q is linear, i.e., producers are not regret averse, point C represents the most cost-effective policy option. Point A represents the most egalitarian policy option and point B represents the most inegalitarian policy option.

Policy Space with Regret Aversion

We now analyze how the policy space changes when Q is convex. That is, when the producers are regret averse. As we saw before, (5) and (7) are not affected by Q. It is only (6) that depends on the regret aversion function Q. To see how the policy space changes with Q, let us rewrite (6) as

$$Q(D_L) + Q(D_N) \geq Q(D_B + C - p\pi - [p(M_R - M_N) + M_N]) \quad (6b)$$

Note that a policy corresponds to a value for the pair (M_R, M_N). Therefore, to understand how the policy space changes with Q, we need to know how the possible values for the pair (M_R, M_N) change when Q changes in (6b). We do this in two steps. First, we show that

$$Q(D_L) + Q(D_N) < Q(D_B + C - p\pi)$$

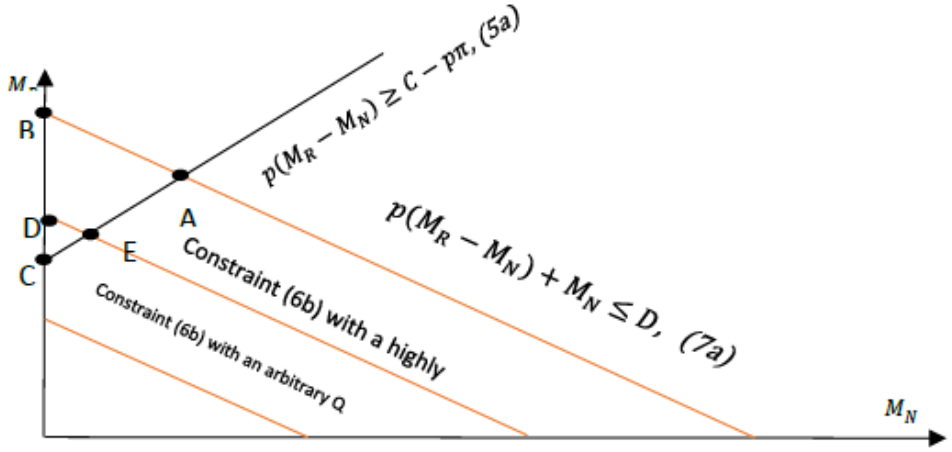
That is, absent the policy the producers are not willing to adopt the sustainable technology and exert effort. Second, we show the minimum payments that induce them to adopt sustainable technology and exert effort, $p(M_R - M_N) + M_N$ in (6b), changes with the convexity of Q.

Step one. Recall that absent the policy, regret averse producers are not going to choose the plant based technology, that is, $Q(D_L) + Q(D_N) < Q(D_B)$. Next, from Assumption 1 we have $C - p\pi > 0$. As a result,

$$Q(D_L) + Q(D_N) < Q(D_B + C - p\pi) \quad (9)$$

Step two. The difference between (9) and (6b) is that the later has the extra term, $p(M_R - M_N) + M_N$, on the right hand side. Therefore, for (6b) to hold, the terms $p(M_R - M_N) + M_N$ should be large enough. We analyze how the minimum value of $p(M_R - M_N) + M_N$ that is required for (6b) to hold changes with the convexity of Q. Recall from, (6a), that when Q is linear, the minimum value for $p(M_R - M_N) + M_N$ is $C - p\pi - (D_L + D_N - D_B)$. How does this minimum value change when Q becomes convex? To answer this question note that as Q becomes more convex, the difference between the left and right hand sides of (9) increases. That is, if (9) holds for any convex Q, the difference between $Q(D_L) + Q(D_N)$ and $Q(D_B + C - p\pi)$ further increases with the convexity of Q. Consequently, the minimum value that is required for $p(M_R - M_N) + M_N$ for (6b) to hold increases with the convexity of Q. Figure 2 shows this graphically. As Q becomes more convex, constraint (6) becomes more restrictive shrinking the policy space. A highly convex Q eliminates the triangle CDE from the policy space making a cost-effective policy C infeasible. With the new policy space, the most cost-effective policies correspond to points in the line segment DE. Note that when (6) was not binding, the most cost-effective policy, C, involved paying only to profit generating producers. With the new policy space, however, the most cost-effective policies involve payment to producers who do not generate a profit, like point E.

Figure 2. *Policy space when Q is convex and all the constraints are satisfied simultaneously. The triangle DCF is not feasible due to the convexity of Q.*



Recall that the convexity of Q is related to the degree of regret aversion of the producers. Our analysis, therefore, shows that regret aversion increases the cost of the policy by making the most cost-effective policy options that are feasible absent regret aversion, infeasible. This is evident from Figure 2 and the fact that the line segment that corresponds to constraint (6b) moves up, inside the triangle ABC, as Q becomes more convex and this in turn implies higher minimum amounts for both M_R and M_N. Second, we saw in (5), that regret aversion does not affect incentive compatibility constraint. Intuitively, incentive compatibility requires that the difference between the rewards, of generating a profit and not generating a profit, is large enough to offset the effort cost that is necessary for profit generation. If the difference is large enough to induce a non-regret averse producer to exert effort, then it is a fortiori enough for a regret averse producer as well. The reason is that regret aversion increases the subjective evaluation of the difference between the rewards. So, a regret averse producer feels the difference between the rewards stronger than a non-regret averse producer.

Next, the maximum payment to non-profit generating producer decreases with p. This is evident from Figure 2 where the line $p(M_R - M_N) = C - p\pi$ moves upward as p decreases. Finally, note that the line segment AB is the last section, of the policy area, that remains feasible. Therefore, when the policy makers are not sure about how regret averse the producers are, they can choose points from the line AB. If the policy option corresponding to AB does not induce the producers to adopt sustainable technology, then no other policy would induce them to do so.

Result 5: Regret aversion increases the minimum cost of the policy that is required to induce producers to adopt plant-based technology. Regret aversion does not affect the incentive system that is required to induce the producers to exert effort. Table 2 summarizes the results of this section.

Table 2. *Summary of Results*

Cause	Effect on Regret Averse Producer
Sustainable technology involves a large potential loss despite being profitable in expectation	Does not adopt sustainable technology absent a policy
Effort results in extra income with certainty	The cost of the policy drops by less than the value of the income
Effort results in probabilistic extra income	The cost of the policy drops less than the expected value of the extra profit
Effort is costly	Exerts effort whenever a non-regret averse exerts effort
Increase in regret aversion	The policy becomes more costly

Conclusions and discussion

This paper studies decision making when the decision makers are regret averse and analyzes policy design aiming to counteract the effect of regret aversion. This is done in the context of sustainability where producers have to choose among an unsustainable technology and a sustainable technology. The difference between these technologies is that the sustainable technology has positive environmental and bioecological benefits whereas the unsustainable technology does not. In addition, the sustainable technology, unlike the unsustainable one, involves a large potential loss despite being more profitable than the unsustainable technology, in expectation. We show that an excessive fear of potential loss in the future, called regret aversion, results in choosing the unsustainable technology despite the fact that the sustainable technology is more profitable. We then analyze how a policy can be designed to induce the decision makers to adopt the sustainable technology and how the degree of regret aversion affects the policies.

We showed that regret aversion implies the subjective evaluation of uncertainty in profit generation. That is, as the decision makers become more regret averse, they become more distressed by the possibility of not generating a profit. Consequently, the policy that induces them to adopt the sustainable technology needs a higher compensation and is therefore more costly for the public. Next, we show that regret aversion does not affect the policy when profit generation requires costly effort and compensation is contingent on profit generation. That is, any policy that induces exertion of costly effort, by making contingent payments, for non-regret averse decision makers will do the same

for regret averse decision makers. This somehow counterintuitive result can be explained better if we understand the mechanism of effect of regret aversion. For a regret averse decision maker, the subjective evaluation of the difference between potential outcomes is higher than the difference between the values of the outcomes. That is, for a regret averse producer, the difference between the expected payments resulting from exerting effort and not exerting effort is felt larger than the difference itself. As a result, a contingent payment that is high enough to induce a non-regret averse decision maker to exert effort, is more than enough for a regret averse decision maker.

Finally, we showed that the overall effect of regret aversion on policy making can be summarized as follows. An increase in regret aversion increases the cost of the policy by making the most effective policy options, compared to a less regret aversion scenario, infeasible. As a result, the policy options that are more costly, pay more to the producers are more robust to the variations in regret aversion. Another way of saying is that any policy that is feasible for more regret averse producers will also be feasible for less regret averse producers. The reverse, however, is not true.

We now discuss some assumptions that we made and see how they affects the analysis. We assumed that the value of the externality to the society is known for the policy makers. Knowing the value of the externality or at least having a reliable estimation of it is necessary for policy making. Significant overestimation of the value of the externality will result in policies that result in the society paying more to prevent the damage than the value of the damage itself. Underestimation is also welfare decreasing as it results in foregoing policy options that are effective in curbing the externalities.

Another assumption is that the policy makers can verify if the bad state B occurred. That is important because the policy compensates the decision makers only in the bad state. We think this assumption is realistic in many industries for two reasons. First, bad state usually refers to incidence of unfavorable events such as extreme climate conditions, recession, war and the like that are verifiable for policy makers. Second, even if the bad state is not verifiable, for example, failure of an innovative technology that can be verified only by the insiders, it can be inferred from the financial performance of claimants. There are, of course, cases when a bad state is neither verifiable nor can be inferred. This creates a serious problem for the policy as it enables the claimants to take advantage of the policy by claiming that the bad state has happened when it has not.

Finally, we treated regret aversion with a convex function Q and analyzed how the policy changes with the convexity of Q. While the results do not depend, qualitatively, on the specific forms of the regret function, the function matters as it determines the policy space. More specifically, the function Q determines the most cost-effective policies. Therefore, the policy makers need to have an idea of the intensity of regret aversion when designing the policy. Economic literature provide some estimates that might be helpful in this regard (Bleichrodt, Cillo & Diecidue, 2010). A related issue is that different decision makers might have different degrees of regret aversion. In this case, the policy makers need to decide about the coverage of their policy. That is, if the policy makers intend to induce as many decision makers as possible, then the preference of the most regret averse decision makers should be taken into account. This is not, however, always and even desirable. The policy makers may focus on specific groups with the highest value of externality and tailor the policies toward them.

Literature

1. Bell, D. E. (1982). Regret in decision making under uncertainty. *Operations research*, *30*(5), 961-981.
2. Bikhchandani, S., & Segal, U. (2014). Transitive regret over statistically independent lotteries. *Journal of Economic Theory*, *152*, 237-248.Bleichrodt, H., Cillo, A., & Diecidue, E. (2010). A quantitative measurement of regret theory. *Management Science*, *56*(1), 161-175.
3. Bleichrodt, H., Cillo, A., & Diecidue, E. (2010). A quantitative measurement of regret theory. *Management Science*, *56*(1), 161-175.
4. Bleichrodt, H., & Wakker, P. P. (2015). Regret theory: A bold alternative to the alternatives. *The Economic Journal*, *125*(583), 493-532.
5. Boeri, M., Longo, A., Grisolía, J. M., Hutchinson, W. G., & Kee, F. (2013). The role of regret minimisation in lifestyle choices affecting the risk of coronary heart disease. *Journal of Health Economics*, *32*(1), 253-260.
6. Diecidue, E., & Somasundaram, J. (2017). Regret theory: A new foundation. *Journal of Economic Theory*, *172*, 88-119.Filiz-Ozbay, E., & Ozbay, E. Y. (2007). Auctions with anticipated regret: Theory and experiment. *American Economic Review*, *97*(4), 1407-1418.
7. Filiz-Ozbay, E., & Ozbay, E. Y. (2007). Auctions with anticipated regret: Theory and experiment. *American Economic Review*, *97*(4), 1407-1418.

8. Fioretti, M., Vostroknutov, A., & Coricelli, G. (2022). Dynamic regret avoidance. *American Economic Journal: Microeconomics, 14*(1), 70-93.

9. Fogel, S. O. C., & Berry, T. (2010). The disposition effect and individual investor decisions: the roles of regret and counterfactual alternatives. In *Handbook of Behavioral Finance*. Edward Elgar Publishing.

10. Frydman, C., & Camerer, C. (2016). Neural evidence of regret and its implications for investor behavior. *The Review of Financial Studies, 29*(11), 3108-3139.

11. Frydman, C., Hartzmark, S. M., & Solomon, D. H. (2018). Rolling mental accounts. *The Review of Financial Studies, 31*(1), 362-397.

12. Hayashi, T., & Yoshimoto, H. (2016). Risk-& regret-averse bidders in sealed-bid auctions. *Available at SSRN 2400092*.

13. Loomes, G., & Sugden, R. (1982). Regret theory: An alternative theory of rational choice under uncertainty. *The economic journal, 92*(368), 805-824.

14. Michenaud, S., & Solnik, B. (2008). Applying regret theory to investment choices: Currency hedging decisions. *Journal of International Money and Finance, 27*(5), 677-694.

15. Muermann, A., Mitchell, O. S., & Volkman, J. M. (2006). Regret, portfolio choice, and guarantees in defined contribution schemes. *Insurance: Mathematics and Economics, 39*(2), 219-229.

16. Qin, J. (2015). A model of regret, investor behavior, and market turbulence. *Journal of Economic Theory, 160*, 150-174.

17. Richman, B. D. (2004). Behavioral economics and health policy: understanding Medicaid's failure. *Cornell L. Rev., 90*, 705.

18. Sarver, T. (2008). Anticipating regret: Why fewer options may be better. *Econometrica, 76*(2), 263-305.

19. Seager-Scott, B. (2018). Are Behavioural Biases Affecting Your Investment Decisions. *Tilney. Available at: https://www. tilney. co. uk/news/ are-behavioural-biases-affecting-yourinvestment-decisions*.

20. Strack, P., & Viefers, P. (2021). Too proud to stop: Regret in dynamic decisions. *Journal of the European Economic Association, 19*(1), 165-199.

21. Streletskaya, N. A., Bell, S. D., Kecinski, M., Li, T., Banerjee, S., Palm-Forster, L. H., & Pannell, D. (2020). Agricultural adoption and behavioral economics: Bridging the gap. *Applied Economic Perspectives and Policy, 42*(1), 54-66.

STUDY ON YIELD AND OIL OF F1 HYBRID COMBINATIONS OF OILSEED SUNFLOWER UNDER THE CONDITIONS OF SOUTH DOBRUDZHA

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Abstract

In sunflower breeding, it is essential to determine the morphological parameters, which affect the seed yield and which can be used as criteria for selection (Hladni et al., 2008b). The correlation of seed yield with the morphological parameters is easiest to determine through correlation analysis (Skoric, 1974; Marinković, 1992; Hladni et al., 2006). Seed yield and oil yield are the two most important economic criteria, which determine the introduction of new varieties and hybrids in production. They are, however, strongly influenced by environmental factors and have low heritability. Therefore, the correlations between the individual parameters, which affect seed yield, should be studied well within the breeding programs. When developing new high-yielding sunflower hybrids, it is necessary to find out morphological and physiological traits that are easy to improve and which have positive correlation with the parameters seed yield and oil yield. These correlations will be used as criteria for selection of parental forms. The modern sunflower hybrids possess high adaptability to changeable environments so the yield from them is used as a criterion for their genetic adaptation. When studying the inherited differences in productivity and the causes for the heterosis effect, seed yield is the most important complex parameter for evaluation of the studied genotypes. The genotype x environment interaction is a key moment in the realization of the genetic potential of sunflower. It is necessary to determine the stability of the yield over the period of study. A decisive prerequisite for the development of a good sunflower hybrid is the production and selection of good parental components, which give in their hybrid progeny (F_1) a combination of high productivity and very good resistance to biotic and abiotic factors (Cheres et al., 2000).

Key words: *sunflower, yield, type of inheritance, heterosis*

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Introduction

Seed yield of sunflower is the product from the interactions between the genotype and the factors of the environment occurring during the vegetative growth of the plants. In sunflower breeding, it is of paramount importance to determine the morphological parameters, which affect seed yield and which can be used as selection criteria (Hladni et al., 2008b).

The correlation of seed yield with the morphological parameters is easiest to determine through correlation analysis (Skoric, 1974; Marinković, 1992; Hladni et al., 2006).

Seed yield and oil yield are the primary economic criteria, on which the introduction of new varieties and hybrids in production depends. They, however, are under the constant strong influence of the environmental factors and possess low heritability. Therefore, the correlations between the individual parameters affecting the seed yield should be studied in detail in the breeding programs. When developing new high-yielding sunflower hybrids, it is necessary to find out which are the morphological and physiological peculiarities that are easy to improve and which reveal positive correlations with the parameters *seed yield* and *oil yield*. These correlations can be used as criteria for selection of parental lines.

Materials and methods

The investigation involved 5 sterile lines, 11 fertility restorer lines and 23 hybrid combinations. The studied lines were sown in three replications, the size of the plot being 10.25 м^2. Two-way dispersion analysis (ANOVA – analysis of variances) was applied.

Results and discussion

The modern sunflower hybrids possess high adaptability to changeable environments so that the yield from them is used as a criterion for their genetic adaptability. When studying the heritability differences in productivity and the causes of the heterosis effect, seed yield is the most important complex parameter for evaluation of the investigated genotypes. The interaction *genotype x environment* is a key moment in the realization of the genetic potential of sunflower. It is necessary to determine the stability of the yield over years. A decisive prerequisite for developing of a good sunflower hybrid is

the development and selection of suitable parental components, which in their hybrid progeny (F1) combine high productivity with very good resistance to biotic and abiotic factors (Cheres et al., 2000).

The obtained results from the two-way dispersion analysis and the summarized mean data, presented in Tables 1, give the seed yield from the tested hybrid combinations during the investigated period, 2012 – 2015. The data show that the yield from some genotypes varied over years under the effect of the environmental conditions. Comparatively lower yields were obtained from all hybrid combinations in 2012 due to the lower rainfalls during the second half of the vegetative growth of the sunflower plants. This year when of the investigation was characterized by the lowest precipitation in comparison to the rest of the years.

The above differences were statistically significant and resulted from the interaction *genotype x climatic conditions*.

Table 1. *Dispersion analysis of parameter seed yield (kg/da) of hybrid combinations in* F_1

Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Genotype	138603.4	25	5544.13	3.462812	4.4E-07	1.559094
Years	18907.48	3	6302.492	3.936474	0.009249	2.648008
Gen x Y	478148.7	75	6375.316	3.981959	2.33E-15	1.351792
Error	333018.4	20	1601.05			
Total	968678	31				

Three hybrids were involved as standards in the study: San Luka, Veleka and PR64F50. Out of the total of 26 tested hybrid combinations, 8 hybrids exceeded the standard by the parameter *seed yield* during the four years of study; in seven of these combinations the exceeding was from 1 to 10 % (Table 2).

Table 2. *Number of hybrid combinations exceeding the standards during 2012-2015*

	Over 100%	**100-105%**	**106-110%**
Number of hybrid combinations in F_1 exceeding the standards	8	7	1

Among the hybrids tested during the four years of investigation, cross 217A x 87R gave the highest seed yield (381.4 kg/da on the average), the exceeding

according to the standards being over 6%. A slightly lower seed yield was determined in hybrid combinations 217A x 88R (371.2 kg/da on the average), 217A x 98R (371.5 kg/da on the average) and 217A x 85R (374.9 kg/da on the average).

The variation of seed yield in all hybrid combinations was from 308.1 kg/da to 381.4 kg/da.

Regarding seed yield from the hybrid combinations (342.9 kg/da), high heterosis effect was observed according to the parental components (120.2 kg/da). The lowest yield according to the standards was obtained from cross 1017A x 99R (308.1 kg/da on the average).

According to our researches, the high heterosis effect of the parameter seed yield (kg/da) in the hybrid combinations, which exceeded the standard, was due to a set of parameters inherited differently in F1; depending on their effect, they can be divided into two groups:

1. The parameters head diameter, number of seeds per plant, weight of seeds per plant, 1000 kernel weight and seed set had the highest influence on the heterosis effect;

2. The parameters plant height, number of leaves, leaf area and percent of kernel had lower impact on heterosis.

Table 3. *Average seed yield (κg/da) of the studied hybrid combinations during 2012-2015*

Hybrid	Yield, kg/da	% from the mean standard
217A x 84R	361,2	101
217A x 85R	374,9 ***	104,8
217A x 87R	381,4 ***	106,6
217A x 88R	371,2 ***	103,7
217A x 97R	338,4	94,6
217A x 98R	371,5 ***	103,8
217A x 99R	343,4	96
217A x 100R	361,2	101
217A x RW666	326,2	91,2
1017A x 84R	334,5	93,5
1017A x 87R	308,5	86,2
1017A x 98R	326	91,1
1017A x 99R	308,1	86,1

Hybrid	Yield, kg/da	% from the mean standard
813A x 98R	357,4	99,9
813A x 99R	337	94,2
813A x 100R	321,7	89,9
2003A x 84R	345,3	96,5
2003A x 88R	356,4	99,6
2003A x 98R	344,3	96,2
2003A x 99R	355,7	99,4
2003A x 100R	361,3	101
2008A x 84R	361,9	101,1
2008A x 85R	308,1	86,1
2008A x 98R	318,3	89
2008A x 99R	338,4	94,6
2008A x 100R	330,5	92,4
San Luka	363,3	103,9
Veleka	*360,3*	*103,0*
PR64F50	*349,7*	*100*
Mean standard	357,8	100
LSD5%	7,7	
LSD1%	10,2	
LSD0.1%	13,1	

Figure 1. *217A x 87R*

Figure 2. *217A x 88R*

The correlations of parameter seed yield in the hybrid combinations F1 are presented in Table 4 and 5.

During the three years of the investigation (2013 – 2015), high positive and negative correlations of the parameter seed yield with the other parameters that were statistically significant, were not obtained. These correlations in the hybrid combinations allow following the interaction of these parameters with seed yield.

Table 4. *Correlation analysis of the quantitative and qualitative parameters of the F1 hybrid combinations in 2013.*

NL	LA	Yield	% of kernel	Protein %	Oil %	M 1000	HD	PH	
NL	1								
LA	-0.004	1							
Yield	-0.048	0.110	1						
% of kernel	0.136	0.018	-0.027	1					
Protein %	0.055	0.011	-0.219	0.102	1				
Oil %	0.116	0.010	0.088	0.232	-0.111	1			
M 1000	0.054	0.068	-0.013	0.051	-0.050	0.014	1		
HD	0.027	-0.036	0.050	-0.027	-0.003	-0.034	-0.111	1	
PH	-0.019	0.037	0.050	0.007	-0.034	0.081	0.002	-0.067	1

Key:

NL – Number of leaves per plant; LA – Leaf area (cm2); Yied – Seed yield (кg/dka); Kernel % - Percent of kernel (%); Protein % - Percent of protein (%); Percent of oil % - Масло (%); M1000 - 1000 kernel weight (g); HD – Head diameter (cm); HP- Height of plant (cm)

In 2013, the obtained data revealed negative correlations between the parameters kernel % (-0,027), protein % (-0,21), 1000 kernel weight (-0,013) and seed yield. In this year, too, there was a positive effect of the parameters oil percent (0,088), head diameter (0,050), and plant height (0,050) on seed yield. Similar results were reported by Doddamani et al. (1997), Chaudhary and Anand (1993), Georgiev (2016).

In 2014, two negative correlations were obtained of parameters kernel percent (-0,070) and plant height (-0,054) with parameter seed yield. In this year, with the increase of 1000 kernel weight (0,128), seed yield increased, too.

Table 5. *Correlation analysis of qualitative and quantitative parameters of hybrid combinations in F1 during 2015.*

	NL	**LA**	**Yield**	**Kernel %**	**Protein %**	**Oil %**	M **1000**	**HD**	**HP**
NL	1								
LA	-0.143	1							
Yield	0.042	0.115	1						
Kernel %	0.004	-0.005	-0.144	1					
Protein %	-0.131	0.066	0.069	0.148	1				
Oil %	0.057	-0.012	-0.011	-0.010	-0.058	1			
M1000	-0.261	-0.079	-0.047	-0.112	-0.086	0.078	1		
HD	-0.059	-0.015	0.061	-0.053	-0.087	0.142	0.069	1	
HP	-0.114	0.077	-0.076	0.068	0.033	0.069	0.193	-0.153	1

Key:

NL – Number of leaves per plant; LA – Leaf area (cm2); Yied – Seed yield (кg/dka); Kernel % - Percent of kernel (%); Protein % - Percent of protein (%); Percent of oil % - Масло (%); M1000 - 1000 kernel weight (g); HD – Head diameter (cm); HP- Height of plant (cm)

In 2015, due to the low rainfalls in combination with high temperatures, as compared to the other years of this investigation, more negative correlations occurred between the parameters kernel % (-0,14), oil % (-0,011), 1000 kernel weight (-0,047), plant height (-0,076) and seed yield. Similar results were also reported by Hladni et al. (2010). There were positive correlations only between parameter seed yield and parameters protein % (0,069) and head diameter (0,061). Among the correlations obtained during the three years of study, a low positive effect of leas area (0,11) and number of leaves per plant (0,061) on seed yield was found. These results are also confirmed by Hladni et al. (2004), Marinković (1992), Gonzales et al. (2000).

Conclusions

The low correlation coefficient at genotype level proved that the inheritance of the studied parameters was controlled by different genes. There was no pleiotropy and gene linkage in this parameter. The higher seed yield per unit area was affected by the sum of the parameters, which were investigated in this research. Each parameter was controlled by different genes acting unilaterally. Linkage and recombination of genes was also observed in some of the studied parameters, where dominance, overdominance and heterosis effect according to the parental forms were found in F1.

Literature

1. Chaudhary, S.K., and I.J. Anand. 1993. Correlation and path-coefficient analysis in F1 and F2 generations in sunflower (Helianthus annuus L.). Int. J. Trop. Agric. 11:204-208.
2. Cheres M. T., J. F. Miller, J. R. Crane, S. J. Knapp, 2000. Genetic distance as a predictor of heterosis and hybrid performance within and between heterotic groups in sunflower. Theoretical and Applied Genetics, 100: 6, 889-894.
3. Doddamani, I.K., Patil, S.A, Ravikumar, R.L., 1997. Relationship of autogamy and self-fertility with seed and yield components in sunflower (Helianthus annuus L.). Helia 20(26): 95-102.
4. Georgiev G., 2016. Characterization of the Bulgarian sunflower hybrid Valin. Agricultural Science and Technology, volume 8, number 3, 183-188.

5. Gonzales, J., Mancuso, N. and Oliva, C., 2000. Factores geneticos ambientales y corelaciones entre rendimiento y calidad de girasol. In: Proc. 15th Intl. Sunflower Conf., Toulouse, France, 12-15 June 2000. Intl. Sunflower Assoc., Paris, France II: 105-110.

6. Hladni N., D., Kraljevi -Balalic M., (2004): Linija x tester analiza za prinos semena po biljci suncokreta (Helianthus annuus L.). Zbornik radova 45.Savetovanja industrije ulja, Petrovac, 45, 45-51.

7. Hladni N., D. Škorić, and M. Kraljević-Balalić (2005): Heterosis for seed yield and yield components in sunflower. – Genetika, Vol. 37, No. 3, 253-260

8. Marinkovic, R, 1992. Path-coefficient of sunflower (*Helianthus annuus* L.). J. Sci. Agric. Res.55 (197): 3-9.

9. Skoric. D., 1974. Correlation among the most important characters of sunflower in F_1 generation. Proc. Of the 6^{th} Int. Sunfl. Conf., Bucharest, 271-283.

DETERMINANTS OF FARMERS' ASSOCIATION IN ROMANIA

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Abstract

*The present paper studies the complex phenomenon of the association of agricultural producers, presenting the results of a survey aimed at identifying the willingness of farmers to associate. Cooperatives and other associative forms are important for empowering Romanian farmers all across the food chain, considering the fact that the size of their business is small, the agricultural area of 14 milion hectares is exploited by over 4 million farmers, resulting a medium size of the farm of 3.18 hectares. The research answers the question of what factors determine the association of agricultural producers, starting from the premise that socio-demographic and economic variables influence this decision. The objectives of the research are to identify the determinants of the association process and the extent to which they influence the association decision of farmers. The results show that type of activity and form of organization have strong influence on farmers' decisi*on to cooperate, and that the other variables influence their decisions less.

Key words: *cooperatives, groups of producers, farmers' association*

Introduction

Agricultural cooperation is a topic of debate espcalialy in countries and agricultural sectors where the size of the structural entities is small and farmers

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do not have sufficient power along the food chain. The research is part of the thematic area of agri-food chains, in an attempt to increase the performance of economic activities, so that agri-food products reach from producers to consumers in safe and efficient conditions and in fair ways for every participants to the chain.

On the supply chain, there are processes of integration of activities, both horizontally and vertically. Horizontal integration, or cooperation, occurs between participants at the same stage of the supply chain, and the motivation is to increase negotiation power with upstream and downstream structures. Cooperation appears, in general, between agricultural producers and is based on their perception that the process of sharing power along the chain is not equal (Ion, 2005). In addition, in a cooperative, the agricultural producer is relieved of the concern of selling the production, focusing on obtaining it. The cooperative can provide various services, such as supplying material resources, selling agricultural products, crediting farmers, storing products, sharing machines and equipment etc.

Cooperative management seems to be the weak point of associative forms in Romania. Also, farmers' resistance to association is a characteristic of the Romanian agricultural system, as several authors have observed in their works (Marin et al., 2018). Thus, the topic becomes relevant to be studies, further more assuming that the association of economic operators within a cooperative can lead to the consolidation of social and economic relations in rural communities (Popa, 2022).

Currently, the phenomenon of association is limitted in Romania. The reports of the Ministry of Agriculture and Rural Development show that there are 2,274 cooperatives, 23 organizations of vegetable and fruit producers and 354 groups of producers. Given that the potential of Romanian agriculture is much higher, the cultivated area in 2021 being 8,263,827 hectares (National Institute of Statistics of Romania), we consider that the phenomenon of cooperation is still below its potential. The government policy supports the association process financially. Among the 20 rural development measures proposed by Regulation no. 1305/2013, the most relevant for the establishment of short chains and local markets is specified in Article 35 - Cooperation. The cooperation measure provides explicit support for short chain actors to establish and develop supply in the absence of local markets, and for promotion in the local context. Support is granted only to cooperation projects, carried out over a period

of seven years. For the 2014-2020 programming period, the cooperation measure attracts 1.84% of the value of all public funding for rural development.

In the National Rural Development Program, there are forms of support to facilitate cooperation between actors involved in rural development - Measure 16 - with the following objectives: the sale of locally obtained food products; the consolidation and diversification of local food chains in Romania; identifying new ways of marketing a larger volume of own products and attracting new categories of consumers; the development of links between the agri-food and tourism sectors.

There are numerous previous studies that researched the phenomenon of horizontal integration on the supply chain, cooperation and association of agricultural producers (Malassis et al., 1992, Manole et al., 2005a, Manole et al., 2005b, Turek et al., 2007, etc.). This paper brings new information regarding the current situation of cooperation in agriculture and the changes produced in the inclination of farmers to cooperate.

The work is structured in four parts. After the introduction, the research methods are presented and the data collected from the survey are analyzed. In the third part, the data are processed with the help of computer programs and the relationships between the dependent and independent variables are studied. In the last part of the paper, conclusions are drawn up.

Materials and methods

The purpose of the research is to know the perceptions of agricultural producers on association and cooperation with other producers, considering that, in this way, economic performance can be improved at the microeconomic, farm, mesoeconomic, supply chain, and macroeconomic levels, in the entire agri-food system. To achieve this goal, a quantitative research was carried out, using the survey as an investigation technique, and the questionnaire as an instrument. It was distributed at the national level, the sampling respecting the quota method regarding the region, the age of the respondents and the form of organization of the activity.

The researched collective consists of 109 farmers from Romania, aged between 18 and 65 years, male and female, who carry out agricultural and processing activities, in most agricultural areas in Romania. The survey unit is represented by the farmer, called the respondent during the research. Inclusion

in the sample was achieved through the voluntary, freely expressed consent of natural persons, legal representatives of agricultural and/or food processing businesses. Inclusion in the sample was made taking into account the following sampling criteria: gender, age, education, educational specialization, professional specialization, form of organization and the environment in which the activity is carried out. These, along with the area and the ownership of livestock, represent the independent variables of the research.

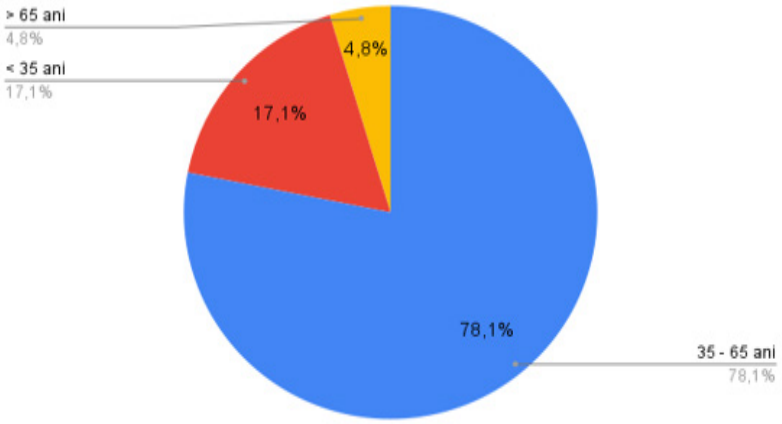
According to the results of the questionnaire, the sample consists of farmers with the following socio-demographic and economic characteristics. Most of the respondents are represented by men (52.4%). But the percentage of women is also very close to half of the respondents (47.6%).

Figure 1. *Respondents' gender*

Source: results of the survey

The largest share of respondents is between 35-65 years old (78.13%), followed by those under 35 years old (17.1%), while 4.8% are over 65 years old (Figure 2).

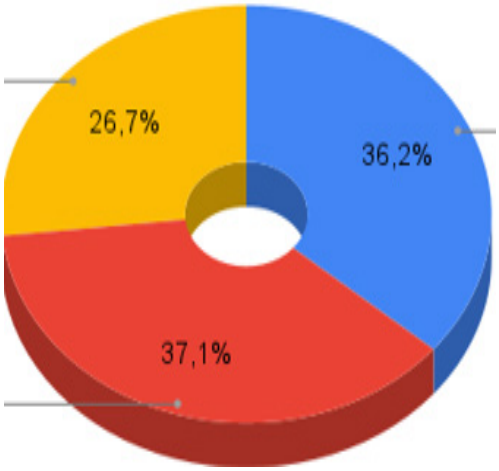
Figure 2. *Respondents' age*



Source: results of the survey

The level of education of the respondents is structured as follows: 37.1% university studies, 36.2% postgraduate studies, 26.7% high school studies (Figure 3).

Figure 3. *Respondents' education*

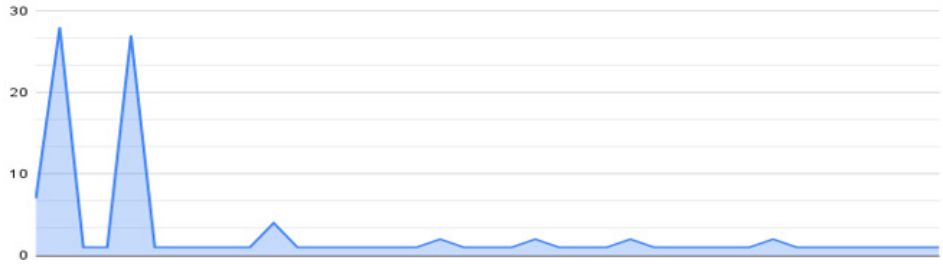


Source: results of the survey

Regarding specialization in education, most of the respondents are active in agriculture 28%, 26% in food industry, 7% in horticulture, and a percentage of 39% are distributed under percentage of 2% to other specializations that

may or may not be related with the agri-food field, agricultural mechanics, chemistry, ecology, agricultural administration, animal husbandry, engineering, sociology, law, construction, etc.

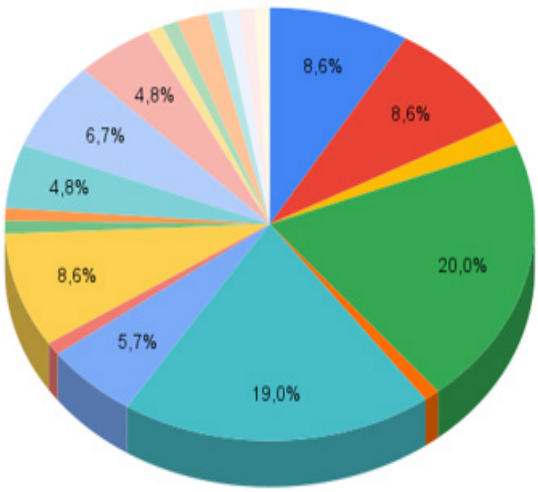
Figure 4. *Respondents' field of education*



*Source***:** results of the survey

In terms of occupational specialization, 20% work in processing industry, 19% are raw material producers, 4.8% work in trading, distribution, 4.8% processing, trade, transport/distribution. It can be found from the analysis of the questionnaire that respondents who process carry out all the activity on the supply chain, both distribution and transport, thus participating in a short chain, the product reaching from the producer to the consumer through a small number of intermediaries.

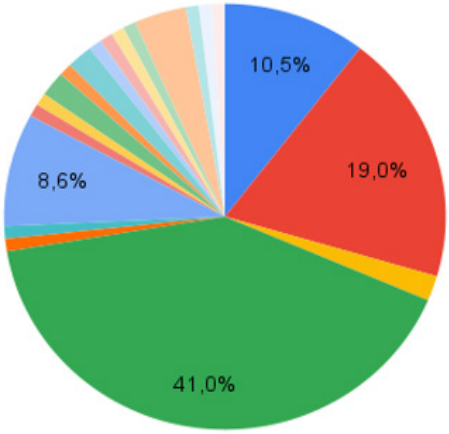
Figure 5. *Respondents' field of activity*



Source: results of the survey

Regarding the form of organization of the economic activity, most of the respondents operate as Limited Liability Organization (41%), 19% Physical Person with producer certificate, 10.5% Authorized Physical Person, 1% family enterprise, 1% individual enterprise, the difference up to 100% other forms of organization (agricultural cooperative, research, employee, multinational company).

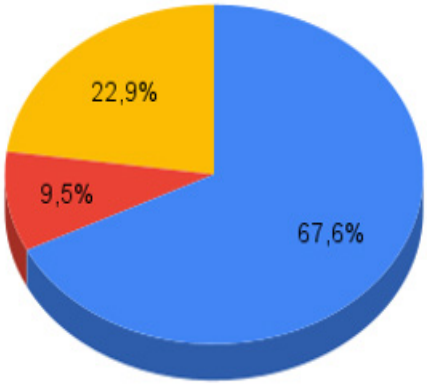
Figure 6. *Respondents' form of organization*



Source: results of the survey

Regarding the environment, most of the respondents carry out their production activity: 67.6% rural, 22.9% urban and 9.5% do not carry out production activity (this includes consultants, civil servants, managers, etc.).

Figure 7. *Respondents' environment*

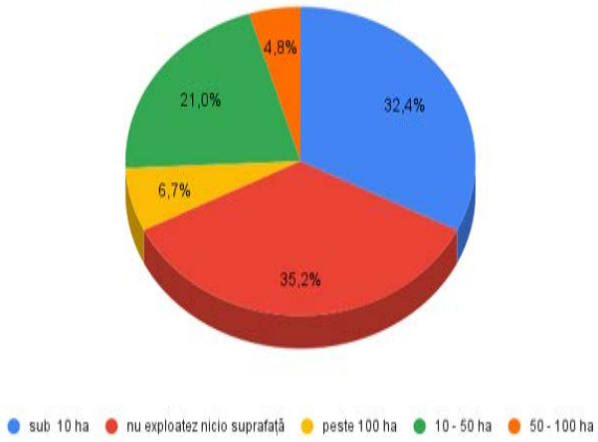


Source: results of the survey

As regards the area of the farm owned/leased: most of the respondents, 35% do not operate any agricultural area, while 32.4% own/lease an area of less than 10 ha, 21.0% own/lease an area between 10 - 50 ha, 4.8% own/rent an area between 50 - 100 ha, and a percentage of 6.7% own/rent an area of more than 100 ha.

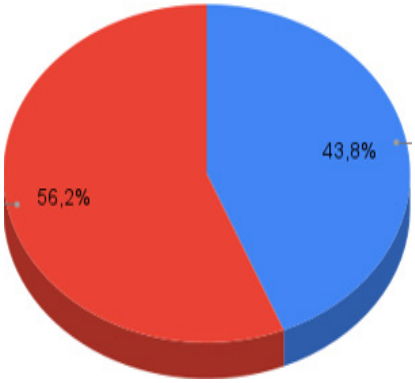
Finally, the ownership of animals reveal that most of the respondents, 56.2%, do not own animals and 43.8% have animals.

Figure 8. *Respondents' land owned / rented*



*Source***:** results of the survey

Figure 9. *Respondents' livestock exploited*



Source: results of the survey

Dependent variables are membership of an associative form (question 7) and willingness to be part of an associative form (question 8). Question 7 - Form of organization of the economic activity - Most of the respondents, over 60%, are part of various forms of association, respectively 32% are part of producer groups recognized by the ministry of agriculture, 22% are members of a cooperative, 18% are part of local action groups, applicant groups and 40% answered that it is not necessary to be in an associative form.

To the Question 8, If you are not now part of an associative form, do you consider association in the future and if not the answer what would be the reason?, most of the respondents, over 60%, mentioned that they would consider in future participation in an associative form. Among the reasons for not participating in an associative form, with a response weight of approximately 18%, are the following: no, because of additional taxes and fees; no, due to the lack of legislation to support such approaches; no, because of the difficulty in accessing European funds; no, because of the lack of preferential interest loans for farmers; no, because of the difficulty of making decisions in associative form; others, and 22% answered that "no, because I am responsible for all the activity alone, from production to marketing", this shows the respondents' interest in being responsible for the entire short chain in order to know the consumer's expectations, but also of the marketing method.

Results and discussions

Using the statistical program SPSS (using the options: Analyze – Descriptive Statistics – Crosstabs – Statistics – Chi-square / Contingency coefficient), it was analyzed if there is a correlation between the dependent variables (questions 7, 8) and the independent ones. In the case of the studied variables, the value of the chi-square test did not exceed the value of 0.05. The link between the variables was analyzed according to the value of the contingency coefficient (Phi or Cramer's V), this can be a weak intensity link, if the contingency coefficient is below 0.3, average if it is located between 0.4-0, 6 or a strong link at a coefficient value between 0.7-0.9.

Association or contingency tables were analyzed based on two nominal categorical variables between the independent and dependent variables. In our case, it is analyzed with SPSS, through the steps Analyze → Descriptive statistics → CrossTables, the table with the frequency distribution between each independent and dependent variable is obtained, respectively - the socio-de-

mographic characteristics (gender, age, professional training) , the activity carried out, the category to which each respondent's activity is classified, the place where the activity is carried out (rural, urban) with the farmers' membership in an associative form (question 7) and with the option of whether in the future participation in a form of association (question 8). At the same time, it was opted in SPSS to obtain the Phi Coefficient that shows the association between two nominal variables.

Table 1. *Verification of the hypothesis „The socio-demographic characteristics, the form of activity and the location of the production activity of the respondents influence the decision to belong to an associative form in the agri-food sector"*

Independent variable	Dependent variable	Phi coefficient value	Contingency coefficient value	Relationship intensity
Gender	Associative form membership	0.565	0.492	Medium
Age		0.381	0.356	Weak
Level of education		0.385	0.359	Weak
Field of education		0.731	0.910	Strong
Type of activity		0.630	0.884	Strong
Form of business organization		0.631	0.884	Strong
Environment (urban/rural)		0.377	0.471	Medium

*Source***:** results of the survey

In Table 1 the results obtained are presented in terms of the link between membership of an associative form in the agri-food field (Group of producers recognized by the ministry of agriculture, Association, for example local groups, applicant groups, NGOs, etc., Cooperative, Not applicable, Others), respectively, the reasons to be part of an associative form following the questionnaire completed by the respondents and their socio-demographic characteristics, the activity and the location of the respondents' production activity. Note that contingency coefficient values were calculated for hi2 test values below the 0.05 threshold.

Table 2. *Verification of the hypothesis „The socio-demographic characteristics, the form of activity and the location of the production activity of the respondents influence the decision to belong to an associative form in the agri-food field, in the future".*

Independent variable	Dependent variable	Phi coefficient value	Contingency coefficient value	Relationship intensity
Gender	Willingness to be part of associative forms in the future	0.524	0.464	Medium
Age		*0.531*	*0.600*	Medium
Level of education		0.652	0.546	Strong
Field of education		0.673	0.951	Strong
Type of activity		0.486	0.912	Medium
Form of business organization		0.594	0.939	Strong
Environment (urban/rural)		0.801	0.625	Strong

*Source***:** results of the survey

Conclusions

Farmers' willingness to cooperate depends on several variables, whose influence is strong, medium or weak. Age and education have weak influence on farmers' willingness to associate, gender and the environment have medium influence and filed of study, type of activity and form of organization have strong influence. It has been noticed that women are more willing to form groups of producers and men are oriented towards cooperatives. Respondents with studies in the field of agriculture and food industry choose the associative forms.

In those regarding future cooperation intentions, these are strongly influence by the field and level of education, form of business organization and the environment. Medium influences have been noticed to gender, age and type of activity. The results of the survey show that respondents with studies in the field of agriculture and food industry want to choose the form of association in the future.

These results are similar to others found in specialized studies (Andrei et al., 2019), who argued that the affiliation of Romanian farmers to associative forms is determined by the type of activity, the dimension of the holding and the level of education.

The findings can be used for underpinning macroeconomic measures in Romania, especially when speaking about significant amount of money appointed through the National Program of Rural Development to cooperation.

Literature

1. Andrei, J., Ion, R.A., Chivu, L., Pop, R. E., & Marin, A. (2019*). Investigations on farmers' willingness to associate and join in environmental responsible short supply chain in Romania.* Applied Ecology and Environmental Research, 17(2):1617-1639, doi:10.15666/aeer/1702_16171639
2. Ion, R.A. (2005). *Performanta economica a sistemului agroalimentar românesc. [The economic performance of the Romanian agri-food system]*. Ceres, Bucharest.
3. Malassis, L., Ghersi, G., collectif. (1992). *Initiation a l'economie agro-alimentaire.* Haitier, Paris.
4. Manole, V., Istudor, N., Boboc, D., & Ion, R., A. (2005). *Filiere agroalimentare. [Agro-food chains]*. ASE, Bucharest.
5. Manole V., Stoian M., Boboc D., Ion R. A., Berevoianu R., & Turek A. (2005). *Marketingul pe filiera vinului în România. [Marketing on the wine chain in Romania],* ASE, Bucharest.
6. Marin, A., Ion, R. A., Chetroiu R., & Iurchevici L. (2018). *Ghid practic pentru înființarea unui lanț scurt de valorificare a producției de legume si fructe. [Practical guide for the establishment of a short value chain for the production of vegetables and fruits]*. ASE, Bucharest.
7. Popa, 2022. *Modele de lanțuri scurte pentru produsele agroalimentare. [Short chain models for agri-food products],* PhD thesis, The Bucharest University of Economic Studies.
8. Regulation (EU) no. 1305/2013 of the European Parliament and of the Council of 17 December 2013 regarding support for rural development granted from the European Agricultural Fund for Rural Development (EAFRD) and repealing Regulation (EC) no. 1698/2005 of the Council, https://eur-lex.europa.eu/legal-content/RO/TXT/?uri=CELEX-%3A32013R1305
9. Turek Rahoveanu, A., Zahiu, L., Turek Rahoveanu, M., Alexandri, C., Popescu A., Dachin, A., & Ion, R. A. (2007). *Competitivitatea pe filiera cerealelor panificabile.[Competitiveness in the grains sector].* Ceres, Bucharest.

RURAL TOURISM AS AN APPROACH TO SUSTAINABLE RURAL DEVELOPMENT: CASE OF THE STAVROPOL REGION

Irina Shakhramanian[1], *Anna Ivolga*[2]

Abstract

Rural tourism is one of the subspecies of domestic tourism, which is currently gaining popularity among tourists and subjects of rural tourism, largely due to grant programs of state support. It should be noted that rural tourism is an effective mechanism for the socio–economic development of rural areas all over the world, and not just one of the types of tourism. In the context of the reduction of the agricultural sector of the economy, rural tourism is important from the point of view of creating opportunities to improve the financial and economic condition of rural residents, and allows increasing the level of employment, improves the quality of work and living conditions of the rural population. The results of the study and the study of the experience of other countries show that the development of this area not only allows rural residents to receive additional income, but also creates opportunities for them to receive other benefits of a socio-cultural nature. Rural tourism is a classic variant of sustainable tourism: contributes to the development of rural infrastructure, improving the quality of life in rural areas, increasing rural incomes, creating jobs, supporting and preserving traditions and culture, preserving the environment. The article describes the trends in the development of rural tourism in the world and Russia, identifies the need for interdepartmental and intersectoral cooperation for the successful development of rural tourism. Also, a cluster approach to the organization of rural tourism for the achievement of sustainable development of rural areas is proposed.

Key words: *sustainable development, rural areas, rural population, rural tourism, employment, clusters.*

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Introduction

The current situation in rural areas, based on socio-economic indicators of the level of well-being of the rural population, is quite critical. This is mainly due to the low level of efficiency of agriculture, which until recently remains the main source of income for rural residents. Therefore, the issue of diversification of entrepreneurial activity in rural areas in order to increase the incomes of the rural population is on the agenda. One of these areas may well be the development of rural tourism, as evidenced by the practice of most countries of the world, where it has been widely developed. This determines the high relevance of the study of the essence and prospects for the development of this direction, especially in the southern regions of Russia, where its development is potentially facilitated by an organic combination of the specifics of agricultural production, rural population and natural and historical-ethnic-cultural values.

The urgency of the problem of rural tourism development causes considerable interest in it from foreign and domestic researchers. However, in the scientific literature and in practice, there is still no unambiguity regarding the understanding of the mechanism of development of rural tourism as one of the types of tourism and an alternative type of activity in rural areas. Rural tourism in our country is just beginning to develop, and this introduces some confusion into the scientific apparatus and, accordingly, complicates the solution of related problems. With the development of rural tourism, more and more questions naturally arise that require finding ways to solve them in accordance with the dynamics of changes in the state of the economic environment in the country. And this creates a fairly wide field for further scientific research of rural tourism and determines the high level of their relevance.

Every year rural tourism in Russia is gaining more and more popularity. This is a relatively new and promising direction in tourism for our country, especially in the conditions of external sanctions pressure, as a result of which there is an urgent need to develop domestic tourism. One of the subspecies of domestic tourism is rural tourism, which allows urban residents to relax in nature, join the traditional way of life of villagers, get acquainted with the historical, cultural and natural heritage, taste local products, communicate with animals, take part in folk festivals and so on.

Methods of the research

The theoretical and methodological basis is the modern economy, scientific works of domestic and foreign scientists in the field of tourism development and rural tourism, in particular. The study was conducted on the basis of abstract-logical and comparative methods using the analysis of official statistical information. The information and empirical basis is the data of the annual statistical reports of the Federal State Statistics Service and monitoring data of the tourism industry at various levels.

Results

As the experience of many countries shows, rural tourism often makes a greater contribution to the economy than outbound tourism. According to the World Tourism Organization (UNWTO), rural tourism (agrotourism) is among the five main strategic directions of tourism development in the world [6]. In developed European countries, rural tourism ranks second in popularity after beach tourism.

The share of income from rural tourism in the total income structure of the tourism industry in the EU and the USA varies from 10 to 30%. For example, the annual income from rural tourism in the USA is $52915 million, in France – $ 14578 million, in Germany – $ 12051 million, in Italy – $10179 million [7].

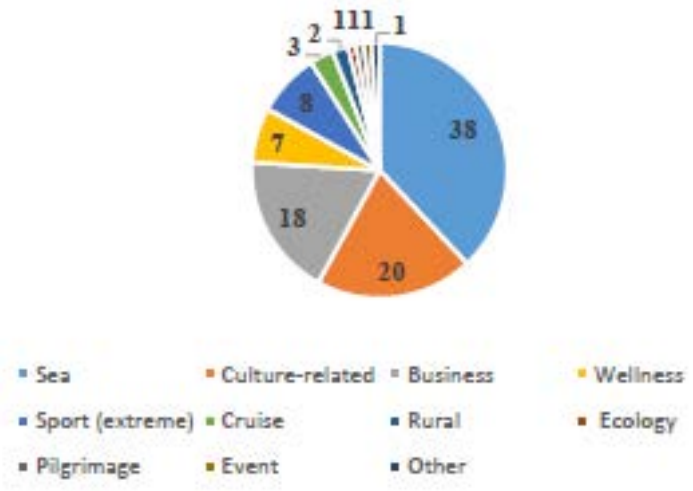
In Europe, about 50 million people annually become "rural tourists", and the turnover of the industry exceeds 30 billion euros (Figure 1). And in the United States, almost two-thirds of adult citizens (which is about 90 million people) have visited the "village" at least once as tourists over the past 3 years.

Figure 1. *Leading countries by the number of nights spent by tourists in collective accommodation facilities in rural areas for 2019, number of nights*

Source: compiled by the authors.

The potential for the development of rural tourism in Russia is also very high. The "Strategy for the Development of tourism in the Russian Federation until 2035", the "Comprehensive Program for the Development of rural areas" consider rural tourism as one of the promising areas of development. At the same time, the share of rural tourism in the total volume of tourist services in our country remains relatively low: it is estimated at 2% of the total turnover of domestic tourism (Figure 2) [4].

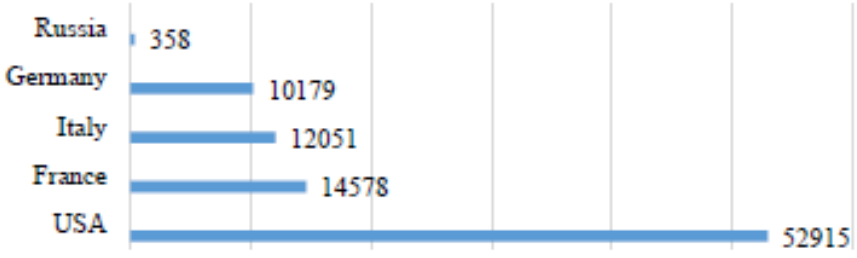
Figure 2. *Types of tourism and their share in the Russian market, %*



Source: compiled by the authors.

Annual revenues from rural tourism in Russia differ enormously from similar incomes of foreign countries – $ 358 million, which is about 30 times less than European incomes (Figure 3).

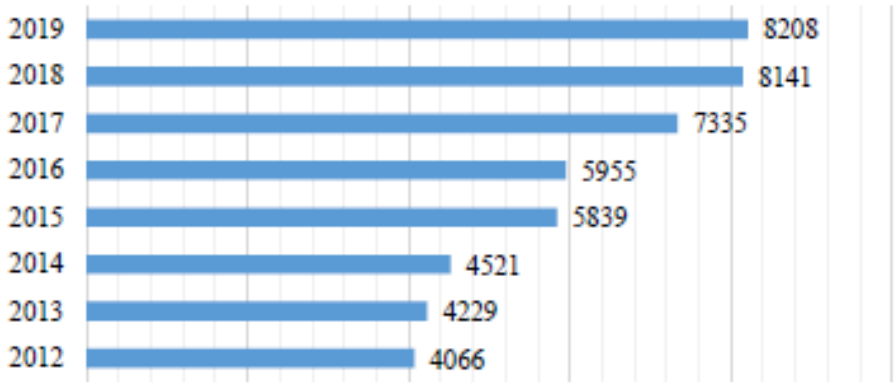
Figure 3. *Annual income from rural tourism in Russia and abroad, USD million*



Source: compiled by the authors.

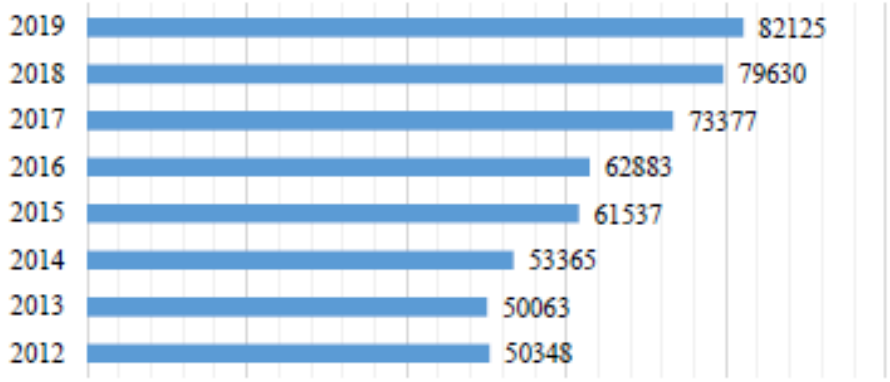
However, there is a positive trend in the development of this type of tourism: both the number of DAC in rural areas in Russia and the number of nights spent by tourists in DAC in rural areas in Russia is steadily growing (Figure 4, Figure 5) [2].

Figure 4. *The number of collective accommodation facilities in rural areas of Russia for the period from 2012 to 2019.*



Source: compiled by the authors.

Figure 5. *The number of nights spent by tourists in the collective accommodation facilities in rural areas in Russia for the period from 2012 to 2019.*



Source: compiled by the authors.

Especially, interest in rural tourism has grown in the conditions of the pandemic and external sanctions pressure, as evidenced by the results of a study of the impact of the COVID-19 pandemic on the preferences of consumers of

rural and eco-tourism services conducted by the Agency for the Development of Rural Initiatives in 2021 [1].

The implementation of the Agrotourism grant program can also play a positive role in the development of rural tourism in the Russian Federation [1]. According to experts' forecasts, as a result of the successful implementation of this program, the number of travelers to rural areas may reach 8 million people per year, and the potential financial effect will be up to 55 billion rubles.

The need to develop this area has long been identified by the scientific community.

Rural tourism is a classic variant of sustainable tourism, which is based on the preservation of the cultural and natural heritage of rural areas, reliance on local resources, maximum involvement of local residents [7].

Both for villages and their inhabitants, and for rural areas, rural tourism is a powerful impetus for the development, diversification of the economy and growth of the quality of life [3].

State, public and scientific support for the development of rural tourism is aimed at achieving sustainable development goals.

The main functions of rural tourism are closely intertwined, because any of them is directly related to the economic function, which is important both for those who rest and for those who provide conditions for highly effective recreation. For example, the social function of rural tourism manifests itself not only in the fact that it allows the owners of agrotourist estates to feel needed by people, but also in terms of creating additional jobs in rural areas, and not only at the expense of members of the agrotourist family. And the ecological function of rural tourism is directly related to its recreational and entertainment function in the sense of environmental friendliness. From the point of view of the environmental friendliness of products that are produced in the agro–tourism economy, the economic (production) function is logically and objectively attached to them - demand forms supply.

Rural tourism is an effective mechanism of socio–economic development of rural areas working all over the world, and not just one of the types of tourism. This is a complex field of activity, for which in many states the department responsible for the development of rural areas is responsible [8].

The experience of European countries suggests that the successful development of rural tourism is possible only with interdepartmental and intersectoral cooperation [9].

The essence of the approach is the obligatory interaction of three parties (government, science, business), without each of which the development of rural tourism is impossible (Figure 6):

1) state and local self-government bodies;

2) profile NGOs: associations, resource centers for rural tourism development, other NGOs, as well as educational and expert organizations;

3) subjects of rural tourism: owners of facilities, tour operators (it should be noted the high importance of the selected subject due to the lack of skills and a mechanism for creating a ready-made tourist product from other subjects offering rural tourism services), rural residents, CBT activists, etc.

Figure 6. *Model of intersectoral and interaction on the development of rural tourism*

Source: compiled by the authors.

At the moment, individual instruments and mechanisms of state policy operate separately, not coordinated. As a result, the potential of rural areas is not being used, although it could solve a whole range of problems, and the demand for rural tourism remains unsatisfied [5].

In our opinion, to manage the development of rural tourism, it is necessary to create an Interdepartmental Coordinating Council for the Development of Rural Tourism.

Similar tips exist in countries where rural tourism is successfully developed. It is important to include representatives of all these parties in such a council. The main task of the council is to coordinate the interaction of all authorities, as well as other parties (NGOs, business, etc.) to address issues whose common goal will be the development of rural tourism. The participation of all key federal agencies in the work of the Council is important.

Tasks – work with all supervising federal agencies, regional executive authorities, local governments, NGOs, businesses, universities and directly with rural residents as individuals. Distribution of funding, selection of winners of competitions of grants and subsidies.

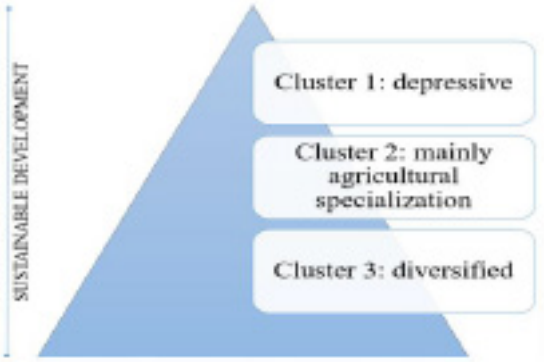
Separately, we will highlight the importance of working with the rural population, since it is the locals who can contribute to the development of rural tourism, of course, with a certain motivation. One of the main problems of rural areas remains the problem of labor resources, namely their preservation, retention and attraction. In order to solve this problem, it is necessary to develop a set of measures aimed at involving rural residents in the tourism industry. In our opinion, it is the villagers who, like no one else, know all the subtleties of their territory, its advantages and heritage. With a clear work with the population, with the setting of motivation, it is possible to achieve a high return from them, which will help the development of rural tourism.

It is advisable to conduct work on the organization of rural tourism at the local level not only in relation to administrative-territorial units (districts, rural settlements), but also at the level of inter-district and inter-settlement rural-tourist clusters.

Conclusion

As a result of the study, the resource potential of rural areas of the Stavropol Territory was assessed and several clusters were identified (Figure 7).

Figure 7. *Cluster approach to the organization of rural tourism*



*Source***:** compiled by the authors.

Description of the depressive cluster:

The depressive cluster includes villages with a low population (less than 200 people), and there are no agricultural enterprises. Rural infrastructure is poorly developed or undeveloped at all, however, there are many attractive places in the territories (forests, clearings, reservoirs, etc., not subject to anthropogenic influence). Houses in the territories belonging to this cluster are often idle. Such an area is characterized by natural attractions and free space.

For the development of rural tourism in this cluster, it is advisable to propose developing a specific subspecies of it – rural recreational tourism. The Haussitting travel model can also help attract tourists. Remote rural settlements are favorable for tourists to stay for the weekend.

Description of a cluster of predominantly agricultural specialization:

There is a large agricultural holding on the territory, which employs no more than 5% of the local population. It is obvious that there is no direct interest of the agricultural holding in the development of the village: the village continues to "hide", the quality of life does not improve. In the territories included in this cluster, agricultural production does not affect the development of tourism. However, unlike the depressive cluster, the local population still lives in this area, migration is not so bright. For the development of rural tourism in this cluster, emphasis should be placed on "returning to traditions and culture". It is necessary to develop rural educational/cognitive and rural cultural tourism to attract tourists.

Description of a diversified cluster:

In the territories included in the cluster, village-forming agricultural enterprises are located; the bulk of the local population works there, population migration is low. Developed rural infrastructure, high population density, many rural households can potentially be involved in rural tourism. In such territories it is possible to develop all subspecies of rural tourism.

As a result of the cluster approach to the organization of rural tourism, it is possible to achieve sustainable development of rural areas through the use of different tools and approaches, depending on the resource potential of the area.

So, rural tourism is carried out in rural areas and provides its participant with the opportunity to directly participate in the implementation of technological processes for the production of agricultural products in combination with recreation, wellness and obtaining comprehensive satisfaction. This interpretation of rural tourism is understandable for the direct consumer of its product – the tourist.

For a service provider, rural tourism is a type of alternative non-agricultural activity to provide a tourist with a package of these services based on the use of a base in the form of material, land and labor resources. In other words, rural tourism is a form of cheap and effective recreation for tourists, which has health and cultural effects. For rural residents, it is an additional source of income. The socio-economic environment also "consumes" rural tourism as a factor in improving its ecology, developing social and industrial infrastructure.

Rural tourism is a type of business that can develop in parallel with other types of business, that is, provide significant additional funds for the development of the main branches of agricultural production and solving social issues. Moreover, the latter has two sides: firstly, the development of this type of tourism can contribute to the development of agricultural production as a source of additional cash receipts that can be used in agricultural production, and secondly, rural tourism itself is a market for agricultural food products - fruits, vegetables, milk, meat, honey.

In addition, the development of rural tourism is of macroeconomic importance, since it contributes to filling the state budget both directly from its development and from the development of industries and the entire infrastructure associated with it.

Rural tourism is a significant factor not only in the economic, but also in the socio-cultural revival of rural areas. As one of the types of non-agricultural activities in rural areas, which, in the context of the reduction of the agricultural sector of the economy, is important today in terms of creating opportunities to improve the financial and economic condition of rural residents, rural tourism allows to increase the level of employment, improves the quality of work and living conditions of the rural population. The results of the conducted research and the study of experience in other countries show that the development of this area not only allows rural residents to receive additional income, but also creates opportunities for them to receive other benefits of a socio-cultural nature.

Literature

1. Lebedeva, I. V., Kopylova, S. L., Lebedeva, T. A. (2021). Analiticheskij otchet «Issledovanie vliyaniya pandemii COVID-19 na predpochteniya potrebitelej uslug sel'skogo i ekologicheskogo turizma» [Analytical report «Study of the impact of the COVID-19 pandemic on the preferences of consumers of rural and ecological tourism services»]. Moscow : ANO ARSI. (In Russ.).
2. Lebedeva, I. V., Kopylova, S. L. (2019). Rezul'taty issledovaniya «Tekushchee sostoyanie sel'skogo turizma v Rossii. Vyyavlenie problem i perspektiv v razvitii sel'skogo turizma v strane [The results of the study "The current state of rural tourism in Russia. Identification of problems and prospects in the development of rural tourism in the country]. Moscow : ANO ARSI. (In Russ.).
3. Oborin, M. S. (2020). Sistemnoe razvitie sel'skogo turizma kak faktor social'no-ekonomicheskogo razvitiya sel'skih territorij Rossii [Systemic development of rural tourism as a factor of socio-economic development of rural areas of Russia]. Servis v Rossii i za rubezhom [Service in Russia and abroad], 14 (1). 117-126. (In Russ.).
4. Romanova Yu.A., Malina V.V. (2020). Sovremennoe sostoyanie sel'skogo turizma v Rossijskoj Federacii [The current state of rural tourism in the Russian Federation]. Aktual'nye issledovaniya [Actual research], 6 (9). 25-28. (In Russ.).
5. Sobol K.N. (2017). Konceptual'nye podhody k probleme razvitiya sel'skogo turizma [Conceptual approaches to the problem of rural tourism development]. Ekonomika i predprinimatel'stvo [Economics and entrepreneurship], 1 (78). 584-591. (In Russ.).

6. Stroeva A.G., Ivolga A.G., Elfimova Yu.M. (2021). Sel'skij turizm kak perspektivnoe napravlenie razvitiya sel'skih territorij regionov Rossii [Rural tourism as a promising direction for the development of rural territories of the regions of Russia]. Servis v Rossii i za rubezhom [Service in Russia and abroad], 15 (94).11-120. (In Russ.).

7. Shakhramanyan I. D., Trukhachev A.V. (2021). Teoreticheskie aspekty razvitiya sel'skogo turizma v Rossii [Theoretical aspects of rural tourism development in Russia]. Servis v Rossii i za rubezhom [Service in Russia and abroad], 15 (5). 25-36. (In Russ.).

8. Ivolga A.G., Ryazantsev I.I., Stroeva A.G., Gornostaeva Zh.V., Mandritsa O.V. (2018). Innovative approach to sustainable development of rural tourism. Scientific Journal of Pharmaceutical, Biological and Chemical Sciences, 9 (6). 1588-1593.

9. Trukhachev A., Ivolga A., Varivoda V.S. (2018). Analysis of agrotourism and study of its development potential. Scientific Journal of Pharmaceutical, Biological and Chemical Sciences, 9 (3). 792-801.

IOT SMART SENSOR SYSTEM FOR SOIL CHARACTERISTICS MONITORING IN VINEYARD

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Abstract

The optimization in agricultural operation is an important issue associated with production and sustainability. In this work the conditions of air and soil associated with vineyards are investigated using an IoT smart sensor system that provides capabilities for continuous monitoring. Thus, for soil characteristics are presented a set sensing node with accurate measurement of moisture, pH, electrical conductivity, and temperature and macronutrients concentration. The relation between some of soil and air condition is also highlighted through the air temperature and air relative humidity measurements. The interdependencies of different measurements that affect the accuracy of estimation for macronutrients concentration is discussed. Validation results of the system for the particular case of vineyard soil are included in the paper.

Key words: *IoT, vineyard, soil macronutrients, air conditions, data science*

Introduction

Smart agriculture requires smart monitoring particularly applied in the vineyard as part of the project SAMRT Farm Colab activities. In this work the main objective is to present solutions on multimodal data collection, fusion and integration systems and to support intelligent decision making in agricultural operations. Special attention is granted to in-situ measurement based on IoT system implementation. This research also serves as a layer of perception and data sources as starting point of smart applications development that can conduct to smart products associated to the Portuguese precision agriculture needs.

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In this line, the perception is based on in-situ and remote sensing as important component of project development. Thus, measurements in the agricultural field will be associated with the data coming from different cameras mounted on Unmanned Autonomous Vehicles (UAVs) (e.g., multispectral camera) (UAV survey), that are used for low-altitude monitoring (Feng et al., 2021).

Regarding the in-situ measurement a set of requirements such lighting, humidity, temperature, soil moisture, pH, and nutrient contents may be considered. Thus, laboratory testing and validation of the multichannel measurement system is mainly followed by measurements of the soil characteristics. Different dependencies may be observed between the soil characteristics and plant development. Thus, low soil moisture, impairs plant development and can be related with the raise soil salinity (Tal et.al, 2016). High levels of soil salinity can reduce root respiration, affect the root growth and produce soil degradation problems (S. Grashey-Jansen, 2014). The soil micronutrients and macronutrients are very important for the plants. Macronutrients Nitrogen (N), Phosphorous (P) and Potassium (K), which are consumed in larger quantities by plants, may not always be present in the right concentration, as well as in proportion to each other, although these nutrients may be provided by other plant species (Bohlool et al., 1992). The balance of macronutrients on the level of soil must be assured and to do this measurement of these nutrients might be effective. Soil physical parameters are also very important. Thus, the soil pH affects the nutrient availability to plants which in turn impact the plant's development and health. The temperature is also very important for seed germination and growth. Extreme temperature values may damage the plant's tissue or suffocate it (Hatfield et.al., 2015). To measure the soil physical parameters and soil macronutrients concentration, laboratory or in-situ instruments are commonly used. Taking into account the aim of interaction and knowledge delivery to current agriculture agricultural systems about nutrient and watering optimization measurements may be carried out in the specific agricultural field (vineyard in considered case) using a set a set of smart sensors nodes that can provide in-situ measurements (Wu et.al, 2012).

An important component to be referred in this work is the applied data science that is used to support technical and operational decisions and create guidelines for business development in the context of precision agriculture.

Methodology

The soil and air characteristics were measured using a set of designed and implemented smart sensors.

Regarding soil physical parameters such as moisture, pH or electrical conductivity are very important to evaluate the quality of a soil and the appropriateness for a successful plant culture, such as the vine in this work. In these conditions a robust and largely applied measurement technique is time domain reflectometry (TDR). The technique is based on the measurement of propagation velocity of high-frequency signals (e.g., 50 MHz range) through waveguides (rods) in the soil. The velocity is related to the dielectric permittivity of the soil, where water content plays an important role affecting the pulse propagation time (TDR time). If the rods are placed into a material with higher permittivity, the TDR time is longer (Kafarski, et.al. 2018). However, if a material is of lower permittivity, the TDR time is also shorter, for the present case the reduced moisture will affect the measurement accuracy considering that shorter TDR times might be measured.

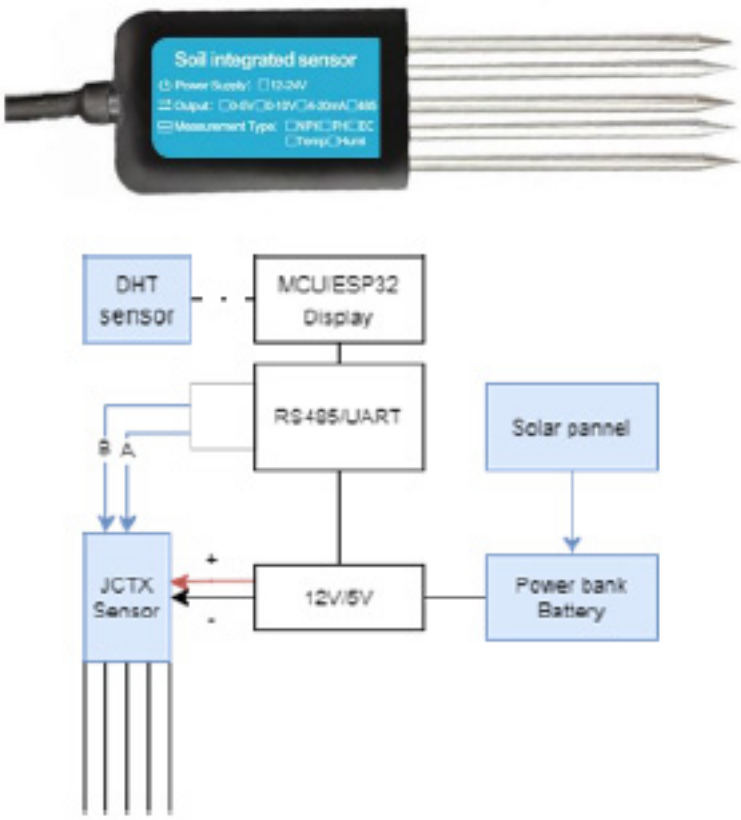
The TDR probes are considered as the sensing part of wireless smart sensing node of the IoT ecosystem considering the robustness of TDR sensor.

The TDR technique has been mainly used to estimate the soil moisture content, through the addition, specific analysis of reflected wave can used to extract multiple characteristics of the soil such as pH and electrical conductivity/salinity. Regarding wired communication protocols an RS485 multidrop network implementation that supports MODBUS Protocol has been used. In the present implementation TDR sensing probes (JCTX, 2022) provide multiple soil characteristics.

In this particular case of vineyard soil in situ monitoring, the chosen TDR probe (Fig. 1. top) is characterized by five spikes (rods) which enable the measurement of up to four soil physical parameters (pH, Temperature, electrical conductivity and moisture). Additionally, the soil macronutrients concentrations (N, P, K) are also provided.

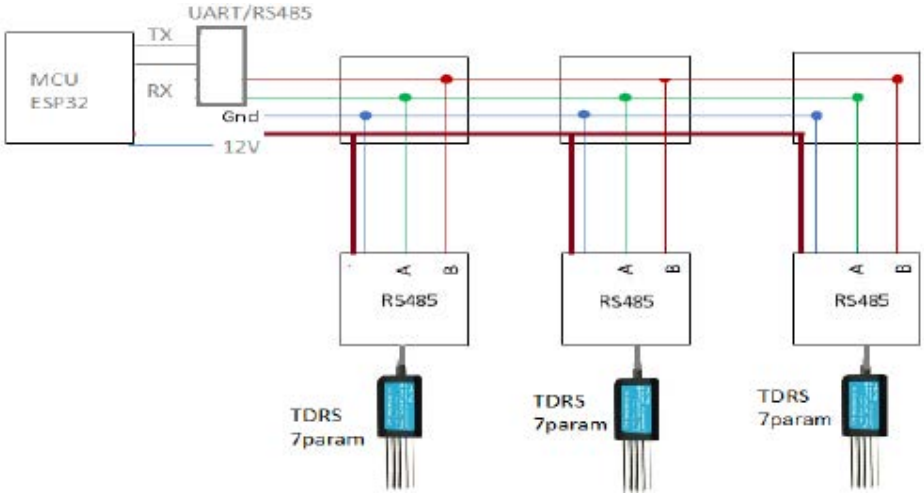
The usage of long cables associated with RS485 multidrop configuration on the field involve wire distribution difficulties and higher costs. Combining the wired and wireless communication protocols as part of smart sensing node IoT compatible was considered for real-time monitoring of soil conditions. The block diagram of the implemented smart sensing node is presented in Fig.1. bottom.

Figure 1. *Smart sensor for soil characteristics measurement: a) JCTX seven parameters sensing unit; b) smart sensor block diagram.*



The used TDR probe is characterized by five Anti-rust, non-electrolytic, salt and alkaline resistant spikes characterized by 3 mm diameter and 70 mm length. It is compatible with RS485, however the interface with the computation platform expressed by ESP32 requires the usage of RS485 to UART converter that is also included in the system (Figure 2). A 5V/10000mAh power bank is used to supply the system, particularly the TDR probe through 5V to 12V step-up converter. Considering the field operating condition, the autonomy of the system is assured using a solar panel (27.5 x 19 cm size 13.2 W) that is charging the power bank. An ESP32 embedded platform (MCU) is used as part of implemented network (master side) to control the TDRs probes.

Figure 2. *Smart Sensing Node for in situ soil characteristics monitoring*



The microcontroller interrogates the TDR sensors retrieving the data that characterize the soil in the considered agricultural field. The TDR measurement capabilities as wells as the metrological characteristics of the TDR multichannel sensor (JXCT, 2022) are presented in Table 1.

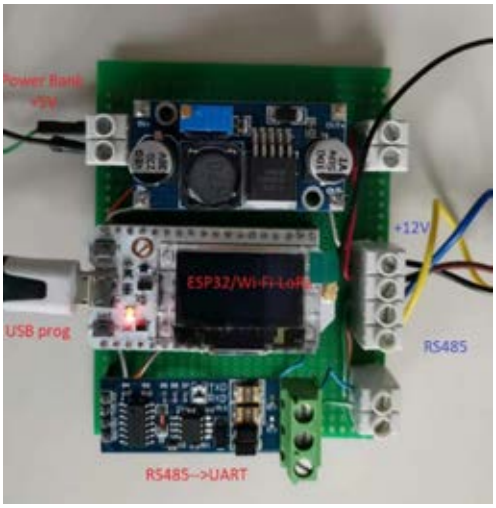
The data coming from the TDR sensors after primary processing is wireless transmitted to the edge and cloud computation platform (a Digital Ocean Virtual Private Server (VPS) in this case).

Table 1. *JXCT time delay reflectometry sensor metrological characteristics.*

Soil Parameters	Meas. Range	Meas. Accuracy
Temperature.	-40ºC÷80ºC	±0.5ºC
Electric Conductivity	0÷20mS/cm	±2% of FS
Moisture	0÷100%	±2% of FS (0÷50%) ±3% of FS (50%÷100%)
pH	3-9	±0.3
N conc	1÷1999 mg/Kg	±2% FS
P conc	1÷1999 mg/Kg	±2% FS
K conc	1÷1999 mg/Kg	±2% FS

The implemented smart sensor node prototype is presented in Figure 3.

Figure 3. *Smart Sensing Node Prototype*



The used ESP32 embedded platform is compatible with Wi-Fi wireless communication protocol (short range wireless communication up to 100m) and LoRa wireless communication (long range wireless communication protocol up to 10km). For the validation of the system and considering the direct Internet connectivity based on Wi-Fi the current tests were caried out using Wi-Fi. The flexibility of wireless communication of the smart sensor nodes assure the integration of this node in heterogenous networks namely Wi-Fi and LoRa, and can be present together other types of solutions associated with IoT such Sigfox (Osman et. Al, 2018) or NB-IoT (Vallece, 2020).

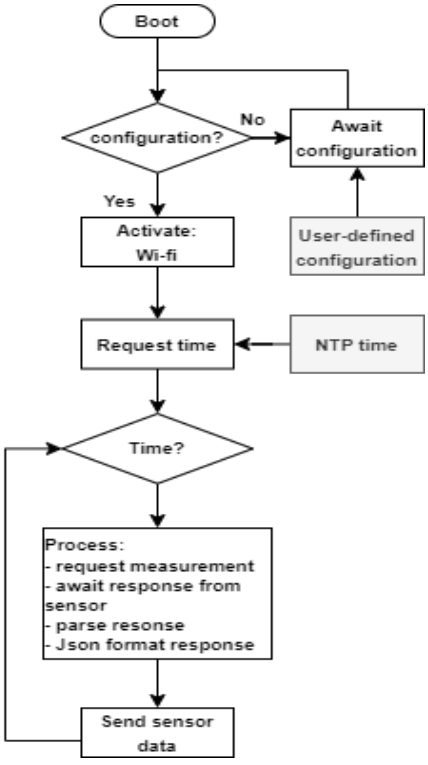
To extract relations between the soil and air conditions mainly the soil temperature and soil moisture versus air temperature and relative humidity the DHT22 air temperature and humidity sensor was considered in the system.

Regarding to the ESP32 firmware for the considered soil and air characteristics the Micro Python was selected considering the time constant of the monitored processes. Thus, the programming of smart sensor nodes for soil and air characteristics monitoring was carried out using Micropython libraries (e.g. UART communication lib, DHT lib). The sensor data is delivered to a remote database wirelessly through Wi-Fi, for which a *network* library was used. To clearly underline the main components of the developed Micropython software modules a flowchart is presented in Figure 4.

Once the ESP32 microcontroller boots, it first checks if it has any cashed configuration, which should be provided by the user when installing the sensor. In this configuration stage the communication credentials (e.g. Wi-Fi credentials in this particular case), the identifier assigned to the micro-controller and the identifiers and types of the sensors and measurement channels from the cloud and measurement intervals, as well as a web token for secure communication with the cloud are passed to the microcontroller. Next, the microcontroller, connects to the Wi-Fi using the received credentials in the configuration stage and updates its clock using Network Time Protocol (NTP). Finally, the microcontroller starts reading data from the sensors attached to it and sending them to the cloud for centralized storage.

The primary processed data on the smart sensor nodes is delivered through Wi-Fi Internet connectivity to a PostgreSQL database that is one of the most advanced open-source relational databases. The database offers reliability, feature robustness, and performance (Obe et.al, 2012). A preliminary analysis and discussion is the data stored is presented next.

Figure 4. *Flowchart of ESP32 main firmware associated with smart sensing node*

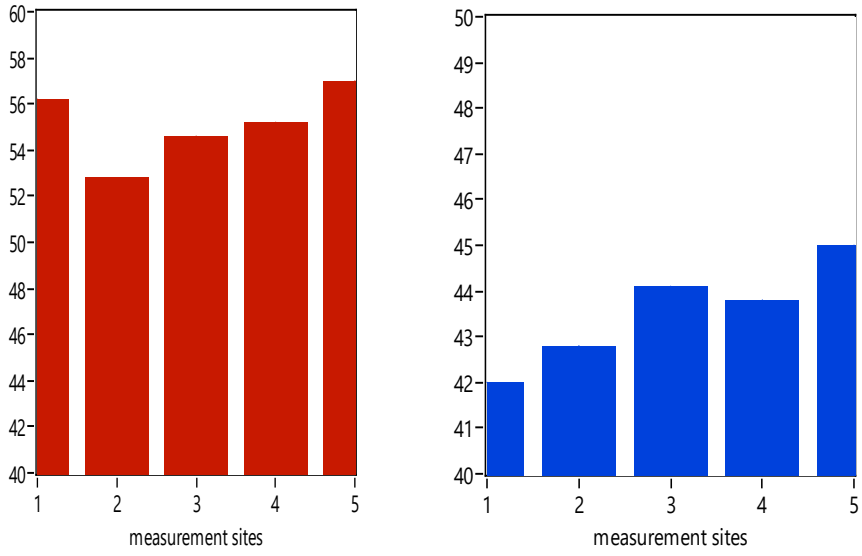


Results and Discussion

Using the smart sensor network and the implemented software the measurements were carried out on different sites of the vineyard to extract the information on distribution of different physical or concentration of macronutrients in the considered field.

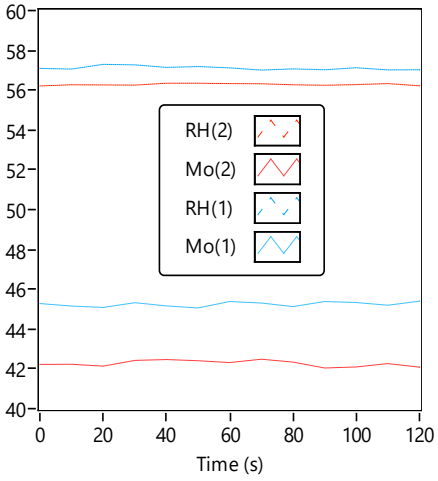
One of the important environment characteristics that affect the vine production is the water content in soil. The relation between soil moisture but also air relative humidity were measured at the level of measured sites. For each vineyard chosen site continuous measurement were performed. The time interval between measurements was 10s. The data was stored in the database for data analysis and representation. The average values of soil moisture and relative humidity for different measurements of vineyard are presented in Figure 5.

Figure 5. *The distribution of soil moisture and relative humidity in a vineyard for five measurement sites*



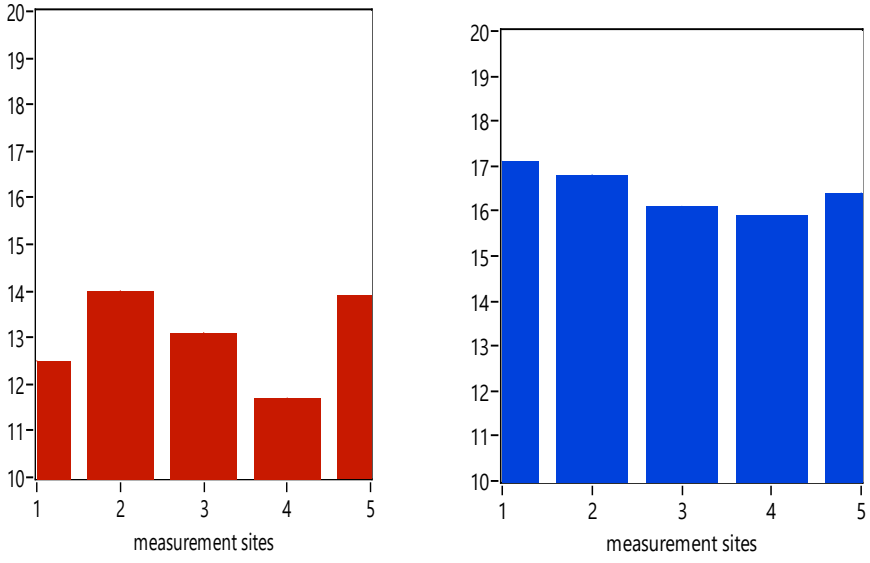
The graphs above show small differences between different measurement sites that are related with topography of the considered vineyard. The presented values were obtained as average values for measurement sessions for one day with no occurrence of rain. The measured values of soil moisture and relative humidity for two considered sites are presented Figure 6.

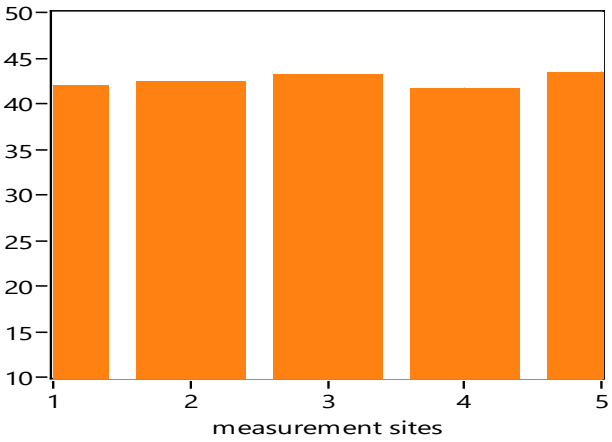
Figure 6. *The soil moisture and air relative humidity evolution for a measurement session for two established vineyard sites*



Regarding the macronutrients the TDR based smart sensing node were used to measure the concentration of N, P, and K macronutrients for one day and the obtained average values are presented in Figure 7

Figure 7. *The distribution of macronutrients for considered five measurement sites of vineyard (N-nitrogen, P-phosphorus. K- Potasium in mg/kg).*





Analyzing the macronutrients distribution can be underlined the higher level of potassium (K) comparing with N and P which underline a unbalance of the macronutrients. According to the vine needs this situation sems not very critical and cannot trigger the nutrients stress status on vine.

Conclusion

Portugal has long boasted one of the oldest and best wine traditions in Europe and worldwide. Each Portuguese region produces a broad range of high-quality wines from the world-renowned Alentejo and Douro Valley to the Lisbon area. To optimize the vineyard production precision agriculture implementations are being successfully implemented. In the present approach a solution of smart sensor network for in situ measurement of soil and air condition in Ribatejo vineyard was presented including also IoT elements. Experimental validation was carried out highlighting the proposed system robustness. The data associated with different measurement sites is analysed to extract information for agricultural field conditions that may be used for future decision regarding the watering and/or nutrients distribution.

In Future developments the data from smart sensors associated with in-situ measurement can be calibrated with data acquired from Unmanned Arial Vehicles (UAVs) images associated with remote monitoring of the vineyards but also to create new models that can be successfully used for operation and production management under the Smart Farm Colab project.

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Literature

1. A. Tal, "Rethinking the sustainability of Israel's irrigation practices in the Drylands," Water Res., vol. 90, pp. 387–394, Mar. 2016, doi: 10.1016/j.watres.2015.12.016.
2. S. Grashey-Jansen, "Optimizing irrigation efficiency through the consideration of soil hydrological properties – examples and simulation approaches," Erdkunde, vol. 68, no. 1, pp. 33–48, Mar. 2014, doi: 10.3112/erdkunde.2014.01.04.
3. J. L. Hatfield and J. H. Prueger, "Temperature extremes: Effect on plant growth and development," Weather Clim. Extrem., vol. 10, pp. 4–10, Dec. 2015, doi: 10.1016/j.wace.2015.08.001
4. X. Wu, M. Liu, In-situ soil moisture sensing: Measurement scheduling and estimation using compressive sensing, Proceedings 2012 ACM/IEEE 11th International Conference on Information Processing in Sensor Networks, pp:1-6, 2912
5. Kafarski M., Wilczek A., Szypłowska A., Lewandowski A., Szerement J., Novel TDR Probe for Monitoring Moisture Distribution in Soil Profile - Electromagnetic Simulations, Proceedings of 12th International Conference on Electromagnetic Wave Interaction with Water and Moist Substances (ISEMA), pp.1-6, 2018.
6. JXCT,"7 in 1 Soil Sensor EC PH NPK Moisture Temperature Integrated Meter" , on-line at: https://jxdziot.com/product/soil-sensor-ec-ph-npk-moisture-temperature%EF%BC%887-in-1%EF%BC%89tester, visualized in November 2022.
7. Osman N., Abbas E., Simulation and Modelling of LoRa and Sigfox Low Power Wide Area Network Technologies, International Conference on Computer, Control, Electrical, and Electronics Engineering (ICCCEEE). Pp. 1-5, 2018.

8. Valecce G., Petruzzi, P., Strazzella S., Grieco L.A., NB-IoT for Smart Agriculture: Experiments from the Field, 2020 7th International Conference on Control, Decision and Information Technologies (CoDIT), pp. 1-6, 2020.

9. R. Obe, L. Hsu, ", PostgreSQL: Up and Running",O'Reilly Cambridge, 2012.

10. Tollervey N., Programming with Micropython: Embedded Programming with Microcontrollers and Python, Publisher: O'Reilly Media, Inc, USA, 2020.

11. L. Feng, S. Chen, C. Zhang, Y. Zhang, and Y. He, "A comprehensive review on recent applications of unmanned aerial vehicle remote sensing with various sensors for high-throughput plant phenotyping," *Computers and Electronics in Agriculture*, vol. 182, p. 106033, Mar. 2021, doi: 10.1016/J.COMPAG.2021.106033.

12. B. B. Bohlool, J. K. Ladha, D. P. Garrity, and T. George, "Biological nitrogen fixation for sustainable agriculture: A perspective," *Plant and Soil*, vol. 141, no. 1, pp. 1–11, Mar. 1992, doi: 10.1007/BF00011307.

RURAL REVITALIZATION: CHINA'S APPROACH TO SUSTAINING RURAL DEVELOPMENT

Vasilii Erokhin[1]

Abstract

The rural revitalization policy is one of the critical components of systematic economic and administrative reforms that have been carried in China in recent years. It aims at putting forward the prosperous industry, livable ecological villages, civilized governance, and an influential and affluent life for residents with a commitment to consolidating and enhancing the achievements of new rural construction. A specific feature of China's approach to sustaining rural development is the considerable involvement of the state and public organizations in the regulation of various aspects of rural life. Although not directly and entirely applicable to many market economies, China's impressive experience in achieving sustainable development goals in the sphere of rural development and lifting millions of rural people out of poverty definitely deserves a vigorous study. Employing the comparative review of publications on sustainable rural development indexed in the China National Knowledge Infrastructure platform, the study summarizes the specifics of China's approach to rural development across research themes and sustainable development goals.

Key words: *sustainable development goals, China, new rural economy, countryside, rural poverty*

Introduction

In the context of increasingly rapid urbanization, many countries face the problem of maintaining sustainable economic and social development of rural areas (Gao et al., 2018). Since in agriculture, neither labor nor land can be fully replaced by capital (Panait et al., 2020; Constantin et al., 2021), the sustainability of rural development is facilitated by the management and preservation of land and the retention of labor in rural areas. Rational use of natural, demographic, and economic resources of rural areas can potentially provide

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diversified development, full employment, and a high standard of living for the rural population. However, many studies show that countries with a high proportion of rural population in the total population and a significant contribution of the agricultural complex to GDP face the most complex problems from the point of view of sustainable rural development (Li et al., 2019; Liu et al., 2021). One of these countries is China, the majority of whose population has traditionally been locating in rural areas.

Today, about 40% of China's population lives in rural areas. For a significant part of them, agriculture is the main source of livelihood (Gao et al., 2018). Economic reforms in China and the skyrocketing growth of the industry and cities have ignited the outflow of labor from less developed inland provinces to rapidly industrializing coastal areas (Zhang & Song, 2003; Kleinwechter, 2012). The level of interprovincial migration has increased significantly in the course of the economic development (Fan et al., 2018). During the previous three decades, urbanization stimulated rural migration (Hao, 2012), while migrants moving to urban areas provided flexible and cheap labor for the industrialization of the country (Mohabir et al., 2017). Against the background of such an outflow of labor and the degradation of local sectors of the economy, low incomes of the population with a significant income gap have become a critical issue of sustainable economic development of rural areas (Gao et al., 2018). In 2021, China announced the eradication of extreme poverty in the country. Nevertheless, in general, the problem of low income in rural areas still exists. It is exacerbated by the income gap between rural and urban areas, as well as between the industrialized coastal provinces and the inner areas.

China's government is implementing numerous complementary programs aimed at ensuring sustainable rural development, including spending, loans, and public works designed to eradicate rural poverty and improve employment and income opportunities in rural areas. The umbrella approach to promoting sustainable rural development is the rural revitalization strategy, designed to improve the quality of agricultural development, promote green development in rural areas, and enhance rural culture (Liu et al., 2019; Wang, 2019; Shi & Yang, 2022). By 2035, China aims for reaching the decisive progress in the fundamental modernization of the agricultural sector and rural areas. By 2050, the latter should see stable and strong agriculture, a beautiful countryside, and well-off farmers. Protection of natural, land, and water resources, combating air, soil, and water pollution, protection of the environment and ecology in rural areas, as well as the development of low-carbon agricultural chains are identified as priorities for

long-term sustainable development of rural areas (Wang & Dong, 2018; Shu et al., 2019; Tan, 2019).

The specifics of land use and availability of water resources in China largely limit the possibilities of expanding agricultural production. Of the total territory of the country, the share of agricultural land accounts for no more than 15%. Pressure from growing cities prevents the expansion of arable land. Competition for land between agricultural producers, as well as between agricultural, industrial, and residential uses is high. There are only about 0.08 hectares per capita in China, which is significantly lower than the global average of 0.22 hectares (Nath et al., 2015). Gross agricultural output is mainly provided by small households (over 200 million households, 0.66 ha average size). The demand for land is especially high in ecologically vulnerable areas, because the income of most local residents depends on agriculture, while labor productivity and soil quality lag behind national average levels (Liu et al., 2016). Environmental problems are expressed in the deterioration of ecosystems, irrational use of land, and overgrazing. The area of polluted soil in China is growing, while environmental restoration practices have not yet matured enough to ensure the revitalization of rural areas by 2035. The dilemma is that intensive use of land is critical for improving the livelihood of small rural households, but the public request for sustainable use of land and other resources in agriculture is rising (Wang et al., 2019).

The evolution of the above dilemma can be traced as part of the analysis of the prevailing narratives on sustainable rural development in general and the rural revitalization policy in particular in Chinese academic literature. This paper attempts to track the evolution of academic and practical approaches to dealing with the sustainable rural development agenda in China through decades, summarize the key parameters of China's current vision of sustainable rural development, and identify China's peculiar sustainable development measures that can be potentially adopted in EU countries, with a particular focus on Serbia.

Materials and Methods

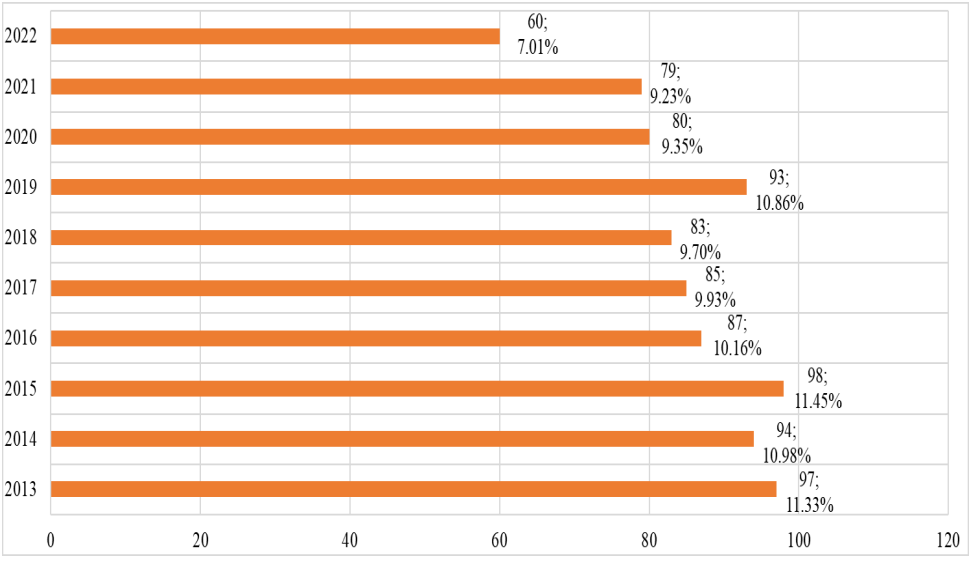
The study was conducted on the basis of a sample of publications from the CNKI database of scientific publications (China National Knowledge Infrastructure platform) for the previous decade 2013-2022. The sample was made among publications in Chinese and international scientific journals in Chinese and English by keywords "sustainable rural development" and "rural re-

vitalization". The array included review papers and original articles, excluding books, monographies, chapters in books and monographies, and papers in conferences proceedings. For the purpose of comparative analysis of the results, the identified 856 publications were grouped into seven thematic categories (economy, environment, institutions and participation, society, systemic properties, transversal issues, technology) and 17 sustainable development goals, according to the United Nations. For each of the seven categories, the most common keywords specific to the Chinese academic discourse are highlighted (by publication titles and keywords).

Results and Discussion

The number of publications is relatively evenly distributed by year (2013-2022). However, there is a slight decrease in the number of publications in the second half of the period (especially in 2020-2022) compared to the earlier years (Figure 1).

Figure 1. *Publications by year*



Source: author's development

About one-third of all publications fall in the "Economy" category, but its share in the total decreases after 2018 against the background of a rise in the number of publications in the "Society" and "Systemic Properties" categories. The number of publications addressing nature-related and environmental aspects of sustainable rural development declines steadily (Table 1).

Table 1. *Publications by categories, % of the total by year*

Category	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average in 2013-2022
1	24.74	34.04	33.67	33.33	30.59	40.96	34.41	35.00	29.11	26.67	32.25
2	17.53	24.47	11.22	10.34	11.76	9.64	8.60	12.50	6.33	6.67	11.91
3	12.37	5.32	9.18	10.34	7.06	9.64	9.68	3.75	10.13	15.00	9.25
4	15.46	8.51	11.22	6.90	11.76	9.64	18.28	21.25	16.46	16.67	13.61
5	11.34	7.45	11.22	12.64	8.24	9.64	7.53	1.25	11.39	11.67	9.24
6	6.19	6.38	5.10	9.20	8.24	6.02	10.75	12.50	8.86	8.33	8.16
7	7.22	6.38	5.10	11.49	10.59	13.25	9.68	12.50	12.66	11.67	10.05

*Source***:** author's development

Note: categories: 1 = Economy, 2 = Environment, 3 = Institutions, 4 = Society, 5 = Systemic Properties, 6 = Transversal Issues, 7 = Technology

A similar trend in the reorientation of sustainable development agenda from economic to social and institutional aspects is evident in the distribution of publications on sustainable development goals. Taken together, the "Economic Growth" and "Industry and Infrastructure" categories account for more than 40% of all publications, but their contributions to the total have been decreasing since 2016. By contrast, the portion of the "Sustainable Cities and Communities" goal expands (there is a particularly significant growth in 2021-2022 as a result of the need for post-pandemic restoration of economic activities in rural areas) (Table 2).

In recent years, in the context of the fight against rural poverty, there increases the number of publications related to "No Poverty" and "Reduce Inequalities" SDGs. Such keywords as "poverty", "migration", and "social security" in the "Social" category reflect the growing focus on society-related challenges in rural areas. The fight against poverty is carried out within the framework of an overall strategy for the economic and social revival of rural areas (for example, see "revitalization" in the "Economy" category and "new rural economy" in the "Systemic Properties" category) and comprehensive development of economic opportunities to raise living standards in rural areas (such keywords as "circular economy", "organic agriculture", "rural finance", and "tourism").

Table 2. *Publications by SDGs, % of the total by year*

SDG	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Average in 2013-2022
1	5.15	2.13	0.00	0.00	4.71	3.61	8.60	12.50	7.59	6.67	5.10
2	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00	0.00	0.00	0.11
3	1.03	4.26	7.14	3.45	1.18	1.20	0.00	0.00	0.00	1.67	1.99
4	2.06	2.13	4.08	1.15	1.18	2.41	4.30	0.00	2.53	3.33	2.32
5	0.00	1.06	0.00	1.15	0.00	0.00	0.00	0.00	0.00	1.67	0.39
6	4.12	7.45	1.02	5.75	1.18	1.20	1.08	0.00	0.00	1.67	2.35
7	4.12	6.38	5.10	4.60	5.88	4.82	1.08	0.00	1.27	3.33	3.66
8	25.77	27.66	27.55	32.18	29.41	27.71	24.73	22.50	24.05	18.33	25.99
9	9.28	5.32	15.31	21.84	10.59	16.87	15.05	22.50	18.99	16.67	15.24
10	6.19	4.26	8.16	3.45	4.71	6.02	4.30	5.00	7.59	8.33	5.80
11	15.46	9.57	12.24	10.34	20.00	10.84	16.13	17.50	24.05	18.33	15.45
12	8.25	3.19	5.10	2.30	8.24	4.82	5.38	6.25	2.53	5.00	5.11
13	0.00	1.06	0.00	0.00	1.18	0.00	0.00	0.00	0.00	0.00	0.22
14	0.00	0.00	0.00	0.00	0.00	0.00	1.08	0.00	0.00	0.00	0.11
15	3.09	14.89	6.12	5.75	9.41	8.43	9.68	10.00	6.33	6.67	8.04
16s	14.43	9.57	6.12	8.05	2.35	12.05	6.45	2.50	5.06	6.67	7.32
17	1.03	1.06	2.04	0.00	0.00	0.00	1.08	1.25	0.00	1.67	0.81

Source: author's development

The China-specific issues related to the rural revitalization agenda are increasingly addressed in the literature. This finding is also evidenced by Liu et al. (2021), Chen and Wen (2018), and Li (2018), among others. In recent years, contemporary rural revitalization agenda has been focusing on the improvement of well-being or rural dwellers, reorganization and restructuring of rural services and activities (Qu et al., 2021), healthcare services and public health systems in rural areas, particularly, in remote settlements (Mao, 2014), and cultural and environmental heritage (Du & Shi, 2020; Xu & Liu, 2019; Xue, 2019). Increasingly, Chinese scholars discuss the need to go beyond local rural communities and develop inter-territorial networks of cooperation based on the promotion of local competitive advantages (Zhou, 2018; Yin et al., 2019). The latter issue is particularly relevant for promoting sustainable rural development practices in diverse rural communities (potentially applied to Serbia and other countries in Eastern Europe).

Conclusion

Summing up, it should be said that sustainable rural development in China is seen not so much in terms of ecology, climate change, or sustainable land use

as in terms of economic development, the creation of economic opportunities in rural areas, the elimination of poverty and social inequalities, and the preservation of the cultural heritage of diverse rural communities. Ensuring sustainable rural development implies a significant role of the state and society through various public institutions. Such a policy can be called society-supported sustainable rural development. Therefore, sustainable development of rural areas is seen as an integral element of the public policy of rural revitalization and building a new socialist countryside.

Evidently, in its pure form, China's rural revitalization policy could be hardly implemented directly in other social and economic patterns. Nevertheless, China's experience in alleviating poverty in rural areas and creating opportunities for gaining income for rural people is definitely applicable. Especially, the rural revitalization agenda could be used in promoting sustainable development of small-scale agricultural production, diversifying economic advantages, and preserving the unique features of rural localities in scattered settlements across Western Europe. Particularly, for rural areas in Serbia, differences on economic, social, cultural, ethnic, and other grounds should considered as conditions for improving the overall stability of the system of rural communities on the basis of localization of competitive advantages and cross-localization of diversities. Attention should be paid to education in rural areas and the development of culture, sports, leisure, and tourism.

Literature

1. Chen, L., & Wen, C. (2018). Rural Green Development and Rural Revitalization: Internal Mechanism and Empirical Analysis. *Technology Economics, 10*, 98-106.
2. Constantin, M., Radulescu, I.D., Andrei, J.V., Chivu, L., Erokhin, V., & Gao, T. (2021). A Perspective on Agricultural Labor Productivity and Greenhouse Gas Emissions in Context of the Common Agricultural Policy Exigencies. *Economics of Agriculture, 68*(1), 53-67. https://doi.org/10.5937/ekoPolj2101053C.
3. Du, X., & Shi, D. (2020). Rural Heritage: Value, Conservation and Revitalisation – From the Perspective of the Human-Land Relationship. *Built Heritage, 3*(1), 1-6. https://doi.org/10.1186/BF03545723.

4. Fan, X., Liu, H., Zhang, Z., & Zhang, J. (2018). The Spatio-Temporal Characteristics and Modeling Research of Inter-Provincial Migration in China. *Sustainability, 10*, 618. https://doi.org/10.3390/su10030618.

5. Gao, T., Ivolga, A., & Erokhin, V. (2018). Sustainable Rural Development in Northern China: Caught in a Vice between Poverty, Urban Attractions, and Migration. *Sustainability*, *10*, 1467. https://doi.org/10.3390/su10051467.

6. Hao, L. (2012). Cumulative Causation of Rural Migration and Initial Peri-Urbanization in China. *Chinese Sociological Review, 44*(3), 6-33. https://doi.org/10.2753/CSA2162-0555440301.

7. Kleinwechter, U. (2012). Rural-Urban Migration in China: An Analytical Framework of Migrants' Contributions to Rural Development. *Journal of Alternative Perspectives in the Social Sciences, 4*, 757-789.

8. Li, N. (2018). Exploration on Sustainable Development of Ecological Landscape with Rural Revitalization: A Case Study of Chongqing National Mining Park. *Eco-city and Green Building, 4*, 56-61.

9. Li, Y., Yan, J., & Song, C. (2019). Rural Revitalization and Sustainable Development: Typical Case Analysis and Its Enlightenments. *Geographical Research, 3*, 595-604.

10. Liu, H., Ji, F., & Zhu, R. (2019). Study on the Agricultural Sustainable Development in Kalaqin County Under the Strategy of Rural Revitalization. *Journal of Northern Agriculture, 1*, 1130-1134.

11. Liu, M., Heijman, W., Zhu, X., Dries, L., & Huang, J. (2016). Individual and Social Optima of Rural Land Allocation by Stakeholders: A Case Study on Eco-Fragile Areas of Northern China. *The Rangeland Journal, 38*, 57-72. https://doi.org/10.1071/RJ15069.

12. Liu, X., Zhang, Y., Zhao, X., & Rui, Y. (2021). Research Progress and Enlightenment of Sustainable Agriculture and Rural Development: Bibliometric Analysis Based on 1990-2020 Web of Science Core Collection Literatures. *Human Geography, 36*(2), 91-101. https://doi.org/10.13959/j.issn.1003-2398.2021.02.012.

13. Mao, Z. (2014). An Overview of the Sustainable Development of the New Rural Cooperative Medical System. *Journal of Anhui Agricultural Sciences, 33*, 11936-11938. https://doi.org/10.13989/j.cnki.0517-6611.2014.33.117.

14. Mohabir, N., Jiang, Y., & Ma, R. (2017). Chinese Floating Migrants: Rural-Urban Migrant Labourers' Intentions to Stay or Return. *Habitat International, 60*, 101-110. https://doi.org/10.1016/j.habitatint.2016.12.008.

15. Nath, R., Luan, Y., Yang, W., Yang, C., Chen, W., Li, Q., & Cui, X. (2015). Changes in Arable Land Demand for Food in India and China: A Potential Threat to Food Security. *Sustainability, 7*, 5371-5397. https://doi.org/10.3390/su7055371.

16. Panait, M., Erokhin, V., Andrei, J.V., & Gao, T. (2020). Implication of TNCs in Agri-Food Sector – Challenges, Constraints and Limits – Profit or CSR? *Strategic Management, 20*(4), 33-43. https://doi.org/10.5937/StraMan2004033P.

17. Qu, Y., Jiang, G., Ma, W., & Li, Z. (2021). How Does the Rural Settlement Transition Contribute to Shaping Sustainable Rural Development? Evidence from Shandong, China. *Journal of Rural Studies, 82*, 279-293. https://doi.org/10.1016/j.jrurstud.2021.01.027.

18. Shi, J., & Yang, X. (2022). Sustainable Development Levels and Influence Factors in Rural China Based on Rural Revitalization Strategy. *Sustainability, 14*, 8908. https://doi.org/10.3390/su14148908.

19. Shu, H., Guan, Z., & Xu, Y. (2019). Studies of Sustainable Development of Tourism Resorts Based on the Strategy of Rural Revitalization, Taking Tianmu Lake Tourist Resort as an Example. *Journal of Northeast Agricultural Sciences, 44*(4), 81-84. https://doi.org/10.16423/j.cnki.1003-8701.2019.04.017.

20. Tan, T. (2019). A Probe into the Logic and Path of Rural Tourism's Sustainable Development under the Background of Rural Revitalization – Based on the Investigation of Villagers' Perception in Jitousi Village, Sichuan Province. *Journal of Leshan Normal University, 34*(7), 33-41. https://doi.org/10.16069/j.cnki.51-1610/g4.2019.07.006/.

21. Wang, C., & Dong, W. (2018). Studies on the Path to Improve Agricultural Sustainable Development under the Strategy of Rural Revitalization – Taking Shandong Province as an Example. *Journal of Northeast Agricultural Sciences, 4*, 48-52. https://doi.org/10.16423/j.cnki.1003-8701.2018.04.012.

22. Wang, C., Dong, W., & Wang, X. (2019). A Study on the Coupling and Adjustment of Agricultural Sustainable Development Strategy and Rural Revitalization Strategy. *Journal of Anyang Normal University, 4*, 31-35. https://doi.org/10.16140/j.cnki.1671-5330.2019.04.008/.

23. Wang, J. (2019). Study on Sustainable Development Path of Traditional Villages in Taizhou Under the Vision of Rural Revitalization. *Journal of Zhejiang Agricultural Sciences, 5*, 840-843. https://doi.org/10.16178/j.issn.0528-9017.20190552/.

24. Xu, W., & Liu, C. (2019). On the Sustainable Development of Rural Bookstore in the Perspective of Rural Revitalization Strategy. *Journal of Luoyang Normal University, 3*, 12-17. https://doi.org/10.16594/j.cnki.41-1302/g4.2019.03.004.

25. Xue, F. (2019). SWOT Analysis of Rural Tourism Development in Henan Province under the Background of Rural Revitalization Strategy. *Social Values and Society, 4*(1), 15-17. https://doi.org/10.26480/svs.04.2019.15.17.

26. Yin, X., Chen, J., & Li, J. (2019). Rural Innovation System: Revitalize the Countryside for a Sustainable Development. *Journal of Rural Studies, 93*, 471-478. https://doi.org/10.1016/j.jrurstud.2019.10.014.

27. Zhang, K., & Song, S. (2003). Rural-Urban Migration and Urbanization in China: Evidence from Time-Series and Cross-Section Analyses. *China Economic Review, 14*(4), 386-400. https://doi.org/10.1016/j.chieco.2003.09.018.

28. Zhou, H. (2018). Theme Forum: “Green Industries and Rural Vitalization” Rural Revitalization Guided by Green Development. *The New Era of Ecological Civilization, 3*, 65-68.

THE VARIABILITY OF MICROCLIMATE PARAMETERS IN DAIRY CATTLE FARM FACILITY

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Abstract

Since the change in climate is unquestionable if we plan to have sustainable milk production we need to implement a long-term mitigation method. A precondition for the genetic evaluation and selection of genetically heat-resistant animals is the measurement and analysis of the variability of microclimate parameters. Therefore, this research aimed to show the variability of microclimate parameters in a selected dairy cattle farm. The records of ambient temperature and relative humidity in the selected farm were measured using a Datalogger. The conducted research and data analysis indicate noticeable variability of observed microclimate parameters (ambient temperature, relative humidity and temperature-humidity index) in regard to the measurement days. Determined daily THI values indicate a high probability of the occurrence of heat stress in the observed period. Furthermore, daily monitoring of microclimate parameters enables timely reaction and prevention of more serious consequences of heat stress on dairy cows.

Key words: *dairy cattle, microclimate, heat stress*

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Introduction

The changes in climate, worldwide, become one of the most pronounced problems in agricultural production, especially in livestock production. Climate change threatens the global food supply since many crops have lower yields due to the occurrence of extreme weather events; droughts, floods, higher temperatures etc. (Popović et al., 2015, 2020). Furthermore, Gauly et al. (2013) pointed out that in Europe heat stress becomes a growing problem in total livestock production and especially in dairy cattle breeding. Accordingly, to the report of IPCC (2007) changes in climate will result in increasingly adverse climatic conditions for all sectors of food production (plant and animal). Based on their research, Reiczigel et al. (2009) in Hungary, and Dunn et al. (2014) in the UK determined the increase in the occurrence of heat stress days per year. Almeida et al. (2011) emphasized that the optimal temperature of the environment in dairy production depends on the selected species, the animal's breed, the amount and quality of consumed feed, age (parity), individual capability of acclimatization, animal's productivity, the characteristics of coat and fur and also on individual animal tolerance to environmental conditions (high or low temperatures). Furthermore, Santos Daltro et al. (2017) concluded that high-producing dairy cows are more susceptible to heat stress. They explained that with the increase in milk production, also the production of animals' metabolic heat is increased. Vasconcelos and Demetrio (2011) pointed out that the selection for high milk production decreases the capability of the cow to resist the heat stress caused. The same authors concluded that therefore in dairy cows during the months with higher temperatures, susceptibility to heat stress increases while the milk production and reproductive efficiency decreases. Likewise, Hansen (2013) noted that the elevated milk production causes dairy cows to be more sensitive to heat stress conditions suggesting that heat stress will become a huge problem in intensive dairy farming regardless the climate changes. Furthermore, Bohmanova (2006) and Collier et al. (2006) indicated that animal productivity considerably modifies the animal reaction to heat stress causing high-production animals are more susceptible to heat stress than animals with lower milk production. Different studies (Bouraoui et al., 2002; West, 2003; Spiers et al., 2004; Upadhyay et al., 2009; Wheelock et al., 2010; Gantner et al. 2011, 2017) pint out that the environment characterized by heat stress adversely affects the quantity and quality of milk in dairy animals, particularly in animals of high breeding value. Moreover, accordingly, to NRC (2007) dairy animals in heat-stress conditions also have increased energy requirements for maintenance for 30%. Fur-

thermore, Das et al. (2016) determined that heat stress also affects animals' health due to changes in physiology, metabolism, hormonal and immunity system. Based on all stated, heat stress generates a substantial loss of profit for dairy farms (St-Pierre et al., 2003).

Heat stress represents a combination of ambient temperature and humidity that overreach the animal's comfort zone. The standard measure of heat stress in dairy farming is the temperature-humidity index (THI) which incorporates data regarding the ambient temperature and relative humidity (Kibler, 1964). The value of the THI at which heat stress impacts milk production and feed intake range from 68 to 72 (Du Preez et al., 1990a, b; Bouraoui et al., 2002; Bernabucci et al., 2010; Gantner et al., 2011; Collier end Hall, 2012). There are various methods for the reduction of the heat stress effect in dairy farming. Short-term methods refer to feeding management and the usage of diverse cooling systems in farm facilities, while long-term methods mean the selection of animals resistant to heat stress. Since the change in climate are no longer questionable if we plan to have sustainable milk production we need to implement a long-term reduction method. A precondition for the genetic evaluation and selection of genetically heat-resistant animals is the measurement and analysis of the variability of microclimate parameters. Therefore, this research aimed to show the variability of microclimate parameters in selected dairy cattle farm.

Material and Methods

The records of ambient temperature and relative humidity in selected production facility of the dairy cattle farm were measured on daily basis every 5 minutes using a Datalogger. Furthermore, the data was stored on a weekly basis in a central server for further analytical processing. For the analysis of the variability of microclimate parameters (ambient temperature, relative humidity and temperature-humidity index), records of microclimate parameters measured in the period from 15.05.2022 until 30.08.2022 were used. Based on measured microclimate parameters, the temperature-humidity index (THI) was calculated using the following equation by Kibler (1964):

$$THI = 1.8 * Ta - (1 - RH) (Ta – 14.3) + 32$$

Where:

Ta - the average temperature in degrees Celsius,

RH - the relative humidity as a fraction of the unit.

The basic variability of analysed traits is presented in Table 1.

Table 1. *Basic statistical parameters of the analysed traits*

Measuring month	Temperature, °C			Relative humidity, %			THI		
	Mean	SD	CV	Mean	SD	CV	Mean	SD	CV
5	21.5	4.00	18.550	63.4	15.17	23.930	67.8	5.00	7.380
6	25.1	3.64	14.494	65.5	14.49	22.131	73.1	4.10	5.615
7	25.9	4.18	16.123	52.2	14.08	26.964	72.7	4.44	6.112
8	25.0	3.99	15.938	67.5	20.57	30.472	72.9	3.86	5.303
Total	24.8	4.19	16.898	61.9	17.64	28.475	72.1	4.64	6.437

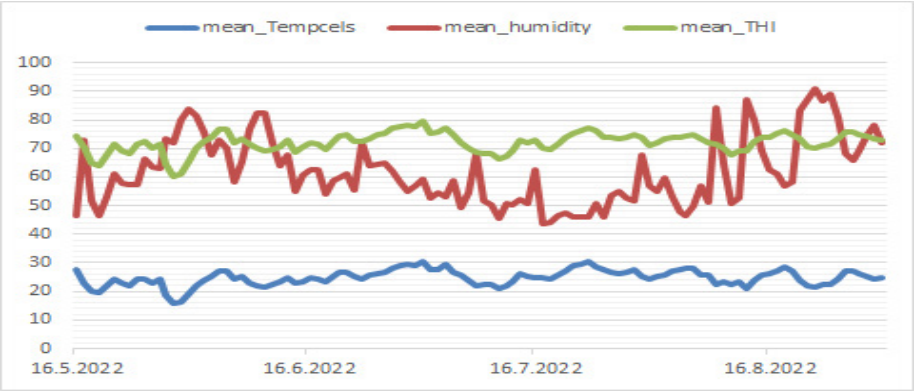
The variability of microclimate parameters in the selected production facility is shown as an average, minimum and maximum value per day separately for each month and measurement day.

Logical control of data base and statistical analysis was carried out in the statistical program SAS/STAT (SAS Institute Inc., 2000). Furthermore, MS Excel was used for the graphic presentation of the data.

Results and discussion

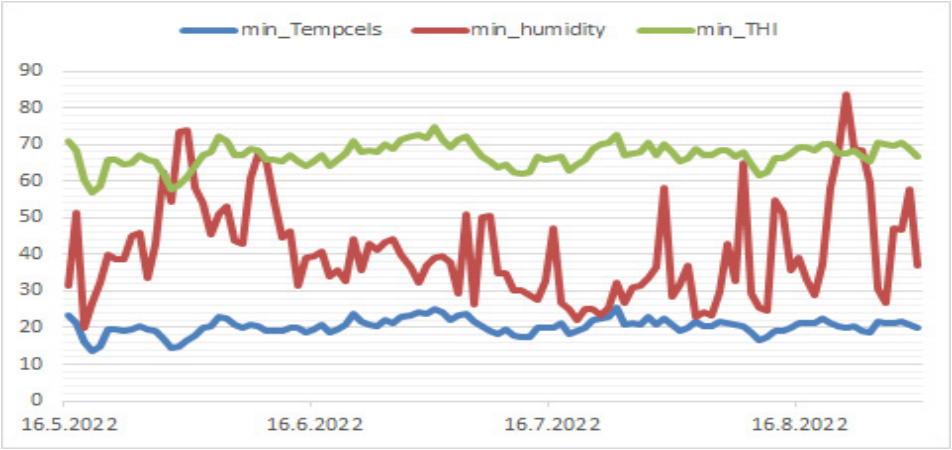
The variability of average daily values of microclimate parameters in the selected facility is shown in Figure 1. Mean values of daily ambient temperatures ranged from 15.84 to 30.42°C. The mean values of daily relative humidity ranged from 43.52 to 91.10, while the mean values of the daily temperature-humidity index ranged from 60.04 to 79.72. The determined mean values of daily ambient temperatures and the daily temperature-humidity index indicate the occurrence of heat stress in the animals in the selected facility. Since highly productive dairy cows lose thermoregulation ability at temperatures higher than 25°C, a decrease in daily milk production on this farm is expected.

Figure 1. *Variability of average daily values of microclimate parameters (Tempcels – ambient temperature in °C; humidity – relative humidity; THI – temperature-humidity index)*



The variability of minimal daily values of microclimate parameters in the selected facility is shown in Figure 2. Minimal values of daily ambient temperatures ranged from 13.84 to 25.50°C. The minimal values of daily relative humidity ranged from 19.80 to 83.80, while the minimal values of the daily temperature-humidity index ranged from 50.03 to 74.72. Given that THI values above 68 Collier et al. (2012) cause heat stress in dairy cows, even determined minimum values of the daily temperature-humidity index indicate the occurrence of heat stress.

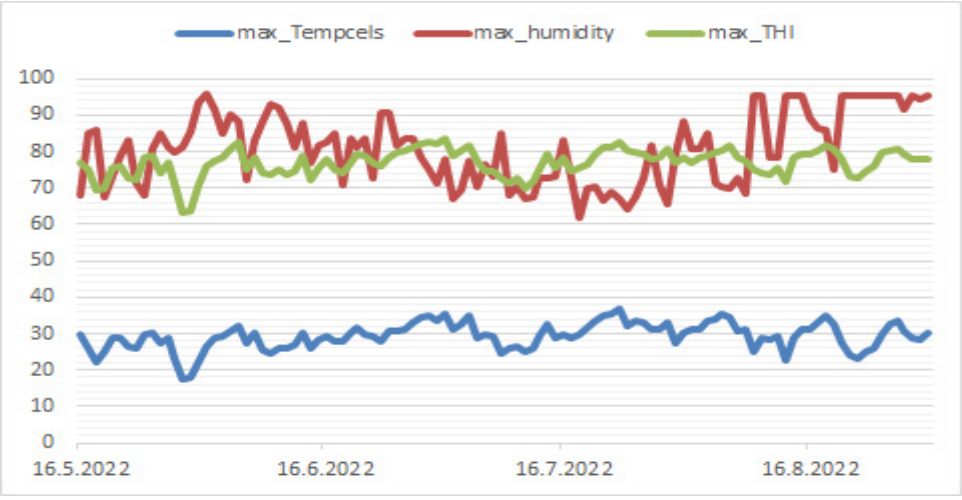
Figure 2. *Variability of minimal daily values of microclimate parameters (Tempcels – ambient temperature in °C; humidity – relative humidity; THI – temperature-humidity index).*



The changes in maximal daily values of microclimate parameters in the selected facility are shown in Figure 2. Maximal values of daily ambient temperatures vary in the interval from 17.70 to 36.90°C, while the maximal values of daily relative humidity vary from 61.90 to 96.00. The maximal values of the daily temperature-humidity index vary from 63.13 to 83.66.

If we analyse the maximum values of the observed parameters, it is evident that the cows in the selected facility were under heat stress for most of the observed period. Accordingly, to other research, heat stress is manifested when the THI of the environment exceed 68 (Collier et al., 2012; Bernabucci et al., 2010; Bouraoui et al., 2002; Du Preez et al., 1990a, b). Vitali et al. (2009) concluded that dairy cows are at increased risk of death in facilities where THI reaches 80.

Figure 3. *Variability of maximal daily values of microclimate parameters (Tempcels – ambient temperature in °C; humidity – relative humidity; THI – temperature-humidity index).*



In the following research, it is important to determine which factor has the most pronounced effect, the maximum temperature and the temperature-humidity index or the cumulative sum of individual measurements of those two parameters.

Conclusion

The conducted research and data analysis indicate noticeable variability of observed microclimate parameters (ambient temperature, relative humidity

and temperature-humidity index) in regard to the measurement days. Average daily THI values ranged from 60 to 70, maximum daily THI values ranged from 63 to 84, and minimum daily THI values ranged from 57 to 75. Determined daily THI values indicate a high probability of the occurrence of heat stress in the observed period. Furthermore, daily monitoring of microclimate parameters enables timely reaction and prevention of more serious consequences of heat stress on dairy cows.

In the subsequent research, it is necessary to determine which factor has the most pronounced effect, the maximum temperature and the temperature-humidity index or the accumulation of individual measurements of those two parameters.

Literature

1. Almeida G.L.P., Pandorfi H., Guiselini C. (2011), *Uso do Sistema de resfriamento adiabático evaporativo no conforto térmico de vacas da raça Girolando*. Revista Brasileira de Engenharia Agrícola e Ambiental 15:754-760.
2. Bernabucci U., Lacetera N., Baumgard L. H., Rhoads R.P., Ronchi B., Nardone A. (2010), *Metabolic and hormonal acclimation to heat stress in domestic ruminants*. Animal, 4, 1167-1183.
3. Bohmanova J. (2006), *Studies on genetics of heat stress in US Holsteins*. PhD thesis. Athens: University of Georgia.
4. Bouraoui R., Lahmar M., Majdoub A., Djemali M., Belyea R. (2002): *The relationship of temperature humidity-index with milk production of dairy cows in a Mediterranean climate*. Animal Research, 51, 479-491.
5. Collier R.J., Dahl G. E., Van Baale M. J. (2006): *Major advances associated with environmental effects on dairy cattle*. Journal of Dairy Science, 89, 1244-1253.
6. Collier R. J., Hall L.W. (2012): *Quantifying heat stress and its imp act on metabolism and performance*. Tucson, Arizona: Department of Animal Sciences, University of Arizona.
7. Das R., Sailo L., Verma N., Bharti P., Saikia J., Imtiwati, Kumar R. (2016): *Impact of heat stress on health and performance of dairy animals: A review*. Veterinary World, 9(3): 260-268.

8. Du Preez J.H., Giesecke W. H., Hattingh P. J. (1990a): *Heat stress in dairy cattle and other livestock under Southern African conditions. I. Temperature-humidity index mean values during the four main seasons*. Onderstepoort Journal of Veterinary Research, 57, 77-86.

9. Du Preez J. H., Hatting P. J., Giesecke W. H., Eisenberg B.E. (1990b): *Heat stress in dairy cattle and other livestock under Southern African conditions. III. Monthly temperature-humidity index mean values and their significance in the performance of dairy cattle*. Onderstepoort Journal of Veterinary Research, 57, 243-248.

10. Dunn R. J. H., Mead N.E., Willett K.M., Parker D. E. (2014): *Analysis of heat stress in UK dairy cattle and impact on milk yields*. Environmental Research Letters 9, 064006.

11. Gantner V., Bobić T., Gantner R., Gregić M., Kuterovac K., Novaković J., Potočnik K. (2017): *Differences in response to heat stress due to production level and breed of dairy cows*. International Journal of Biometeorology 61, 9, 1675- 1685.

12. Gantner V., Mijić P., Kuterovac K., Solić D., Gantner R. (2011). *Temperature-humidity index values and their significance on the daily production of dairy cattle*. Mljekarstvo, 61(1), 56- 63.

13. Gauly M., Bollwein H., Breves G., Brügemann K., Dänicke S., Das, Demeler J.G., Hansen H., Isselstein J., König S., Lohölter M., Martinsohn M., Meyer U., Potthoff M., Sanker C., Schröder B., Wrage N., Meibaum B., Von Samson-Himmelstjerna G., Stinshoff H., Wrenzycki C. (2013*): Future consequences and challenges for dairy cow production systems arising from climate change in Central Europe—A review*. Animal, 7, 843-859.

14. Hansen P.J. (2013): *Genetic control of heat stress in dairy cattle*. In: Proceedings 49th Florida Dairy Production Conference, Gainesville, April 10, 2013.

15. Intergovernmental panel on climate change – IPCC (2007): Climate change 2007: *The physical science basis*. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge: Cambridge University Press.

16. Kibler H.H. (1964): *Environmental physiology and shelter engineering*. LXVII. Thermal effects of various temperature-humidity combinations on Holstein cattle as measured by eight physiological responses. Research Bulletin, University of Missouri, College of Agriculture, Agricultural Experiment Station, 862.

17. NRC. (2007): *Nutrient Requirements of Small Ruminants, Sheep, Goats, Cervids, and New World Camelids*. National Academy Press, Washington, DC.

18. Popović V. (2015). *The concept, classification and importance of biological resources in agriculture.* (Ed) Milovanovic J., Đorđević S.: Conservation and enhancement of biological resources in the service of ecoremediation. Monograph. Belgrade. ISBN 978-86-86859-41-9; 29-51; 1-407.

19. Popović V., Jovović Z., Marjanović-Jeromela A., Sikora V., Mikić S., Bojovic R., Lj. Šarčević Todosijević (2020): *Climatic change and agricultural production*. GEA (Geo Eco-Eco Agro) Inter. Conference, Podgorica; 27-31.05.2020, p. 160-166.

20. Reiczigel J., Solymosi N., Könyves L., Maróti-Agóts A., Kern A., Bartyik J. (2009): *Examination of heat stress caused milk production loss by the use of temperature-humidity indices*. Magy Allatorv, 131: 137-144.

21. Santos Daltro D., Fischer V., München Alfonzo E.P., Calderaro Dalcin V., Tempel Stumpf M., Kolling G. J., Marcos Vinícius Gualberto Barbosa Da Silva, Mcmanus C. (2017): *Infrared thermography as a method for evaluating the heat tolerance in dairy cows*. Revista Brasileira de Zootecnia / Brazilian Journal of Animal Science, 46(5), 374-383.

22. SAS Institute Inc. (2000). SAS User's Guide, version 8.2 ed. Cary, NC: SAS Institute Inc.

23. Spiers D. E., Spain J. N., Sampson J. D., Rhoads R.P. (2004), *Use of physiological parameters to predict milk yield and feed intake in heat-stressed dairy cows*. Journal of Thermal Biology, 29(7-8): 759-764.

24. St-Pierre N.R., Cobanov B., Schnitkey G. (2003): *Economic loses from heat stress by US livestock industries*. Journal of Dairy Science, 86, 52–77.

25. Upadhyay R.C., Ashutosh, Singh S.V. (2009): *Impact of climate change on reproductive functions of cattle and buffalo*. In: Aggarwal, P.K., editor. Global Climate Change and Indian Agriculture. ICAR, New Delhi. 107-110.

26. Vasconcelos J. L. M., Demetrio D. G. B. (2011), *Manejo reprodutivo de vacas sob estresse calórico*. Revista Brasileira de Zootecnia 40:396-401.

27. Vitali A., Sagnalini M., Bertocchi L., Bernabucci U., Nardone A., Lacetera N. (2009): Seasonal pattern of mortality and relationships between mortality and temperature humidity index in dairy cows. Journal of Dairy Science, 92, 3781-3790.

28. West J. W. (2003): *Effects of heat-stress on production in dairy cattle*. Journal of Dairy Science, 86(6): 2131-2144.

29. Wheelock J. B., Rhoads R. P., Van Baale M. J., Sanders S.R., Baumgard L.H. (2010): *Effect of heat stress on energetic metabolism in lactating Holstein cows*. Journal of Dairy Science, 93(2): 644-655.

ADDING VALUE TO WINTER WHEAT CROP BY ORGANIC SEED PRODUCTION – SOCIO-ECONOMIC CASE STUDY

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Abstract

Chemical fertilizers costs intensified worldwide from 2019 to 2022 due to the gas price crisis. Also the climate change affects crops susceptibility and response to applied synthetic inputs in conventional agriculture. Farmers are returning to agroecological measures and shifting to organic agriculture. In both agricultural systems seed producing is adding value to the final product. This study case aims to analyze the production cost and income on winter wheat (Glosa variety – used by over 60% of Romanian farmers), for certified seed in organic agriculture system. The used data are from applied technology in experimental and seed production fields of National Agricultural Research and Development Institute Fundulea, Calarasi County, Romania. The production costs are influenced by manual operations and fuel price. Seed production in organic agriculture, even if generated an income of 476.05 €/ha, for this study case in 2022, is not economical viable without organic farming subsidies in all situations.

Key words: *organic, seed production, wheat, Romania, costs, income*

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Introduction

CoVid-19 Crisis (Nicolae *et al.*, 2021) and the conflict in Ukraine (Schnitkey *et al.*, 2022) is threatening the energy costs and the market of two main basic agricultural inputs that are necessary for agricultural production: diesel and fertilizers. Last years showed that energy plays an undisputed place for the breakdown of costs. Energy crisis experienced since the conflict between Russia Ukraine started increased the food system vulnerability and shifted some of the old paradigms. This added to the volatility of natural gas prices going all the way back to the pandemic start, which has an impact on the fertilizer market since natural gas is a key component in fertilizer manufacturing (Mottaleb, Kruseman and Snapp, 2022).

Nevertheless, in Europe there are different farm types and socio-economic contexts. For most of Central and Eastern European countries like Czech Republic, Hungary, Slovakia, Poland, Bulgaria, Estonia, Latvia, Lithuania, Romania, Serbia, Slovenia the business environment is more susceptible, with a lower level of security (Andrei *et al.*, 2021). In the strategies for green energy, it is also important the secondary production of agricultural crops, that could be used as biomass, although it is needed also the industrial development to use multiple sources of energy (Ciornei *et al.*, 2022). To be able to adapt to societal needs and keep up with the rapid rate of development and population growth, agriculture has experienced countless mutations over time. Traditional agriculture dominated a long span of time, from the beginning of civilization until the Industrial Revolution. It was defined by the involvement of many people and the use of basic tools; low yields and a minimum level of competence were required for the production methods (Popescu, 2017).

With the industrial revolution, industrial agriculture was developed. On this occasion, the metropolitan areas that are required to fill the employment gaps left by the mechanization of production processes in the agriculture sector are in the spotlight. The transition is being made to big farms that can use this type of system. The gene pool and biodiversity of cultivars had been seriously reduced, by extending only a few top variety or hybrid with performant yield, although for different plant diseases there it is needed heterogeneity (Cristina, Turcu and Ciuca, 2015).

After side-effects of intensive agricultural systems promoted by green revolution, agroecological principles and organic agriculture are brought into focus (Pingali, 2012). This is associated with movements for the protection of the

environment and supports the need to approach this branch through the prism of activities that contribute to the protection and support of biodiversity.

As highlighted above industrial agriculture and organic agriculture are in contrast but there is also a similarity namely both require a large consumption of inputs and agricultural works on the soil, which demands high investments.

Material and Methods

The data of this study case was collected from technology journal of winter wheat organic produced at the Center for Research of Organic Agriculture and from Development Department of National Agricultural Research and Development Institute from 3 agricultural years: 2018-2019, 2019-2020 and 2020-2021. Both production systems on organic and conventional are on the same soil type: cambic chernozem in non-irrigated conditions. Also it was used the same winter wheat variety: Glosa, that in conventional agriculture on fertilized and non-fertilized, grain protein content, Zeleny sedimentation and rheological parameters qualifies it's as a product for baking quality wheat (Marinciu *et al.*, 2019). The sowing period of each year was in the optimal period (1-20 October) for winter wheat for South-East Romania continental temperate area. The previous crops were field grain legumes: soybean/field peas. The typical crop rotation used was: Soybean – Wheat – Maize – Sunflower. For conventional agriculture the quantity per surface of active compounds of used fertilizers were 75 N kg/ha + 50 kg P_2O_5/ha ($N_{70}P_{50}$).

The costs of fuel and materials are given on different agricultural years as their acquisition costs. The number of working hours varies from specific field conditions. On calculation it was considered the number of maximum working hours estimated. The labor costs have been considered at 5€/hour on simply operations and at 7 €/hour on mechanized operations.

Subsidies for wheat are according to measure 11.2 for Sustaining Organic Agriculture Program by Agency for Payments and Interventions in Agriculture (APIA, 2014).

For this study case, indirect costs are at 20% from working hours costs.

The price for organic and conventional bread quality wheat also is considered at the real market selling price, even if the value on international market was different (Gimbășanu and Tudor, 2019).

Results and discussions

This study case, could suffer radical changes regarding costs if it will be applied to different farms and technologies. First of all, ”chernozem” soils are the most suitable for cereals. Soil type is an important variable, that will determine the further steps for soil tillage mechanization works and the quantity of applied fertilizers.

Materials (quantity) used, their costs, as well as labor expenses and labor hours, were considered to give an overview of the agricultural operation costs for winter wheat.

The first table displays the processes used in both types of agriculture, while the following ones shows the particular processes used in conventional agriculture (second table), organic farming (third table), and the last table displays the specific operations for seed production.

Table 1. *Agriculture operations with their working hours and costs.*

Winter Wheat					
Agricultural operations	**Machinery and Materials used**	**Quantity used (kg/ l)/(ha/ t)**	**Materials costs**	**Working hours (h)**	**Working hours costs**
Disk harrow	Tractor+Disk harrow 3.8/Diesel	8.5	15.3	0.9	6.3
Total cultivation	Tractor+ Cultivator/ Diesel	29	52.2	2	14
S-tine cultivator	Tractor+S-tine cultivator/Diesel	5.3	9.54	0.6	4.2
Seeding	Tractor+Seeder/Diesel	5.3	9.54	1	7
	Wheat Seed – Base Category	210	63		
Harvesting	Combine harvester	20	36		
	Wheat - C1 – brute quantity	3700			
Straw return + weeds chopping	Tractor+Straw return/ Diesel	5	9	0.8	5.6

Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Table 2. *Conventional agriculture operations with their working hours and costs.*

Agricultural operations	Machinery and Materials used	Quantity used (kg/ l)/ (ha/ t)	Materials costs	Working hours (h)	Working hours costs
Chemical fertilizer	Tractor+Ferilizer machine/Diesel	4	7.2	0.5	3.5
	Fertilizer N16P16	300	300		
Chemical fertilizer	Tractor+Ferilizer machine/Diesel	4	7.2	0.5	3.5
	Fertilizer Urea	50	100		
Chemical fertilizer	Tractor+Spray machine/Diesel	4	7.2	1	7
	Herbicide	2	50		

Source: National Agriculture Research and Development Institute, Fundulea, Călărași

The chemical fertilizer doze it was not chosen for this case at the maximum yield potential of the variety. Due to the various factors. First of all, the fields are non-irrigated, in an area, where the average precipitation quantity does not overcome 275 mm/m^2, from October to April, the most important vegetation period for wheat (Petcu *et al.*, 2022).

Except of seed treatment, there is no treatment with chemical fungicide or insecticide at the target yield of 6000 kg/ha. But this varies with annual conditions. A sustainable principle is to not include the treatments in the crop production technology. The treatments to diseases or pests are applied just in case of emergency. In this particular study the seed treatment cost for conventional agriculture is neglected.

The chemical weeding by herbicides treatments differs by the product needed, that is relative to weed spectrum in different areas. It is recommended to perform periodically assessment of weed species, and to keep records of the field history from the previous years, in order to chose the suitable products, for Monocotyledon or Dicotyledon species.

To increase the sustainability also organic fertilizers or more friendly plant protection products could be used.

Table 3. *Organic agriculture operations with their working hours and costs*

Agricultural operations	Machinery and Materials used	Quantity used (kg/ l)/ (ha/ t)	Materials costs	Working hours (h)	Working hours costs
Tine-flex weeding	Tractor+Tine flex weeder/Diesel	3	5.4	0.2	1.4
Tine-flex weeding	Tractor+Tine flex weeder/Diesel	3	5.4	0.2	1.4
Weeding (Manual)				72	360
Organic foliar fertilizer	Tractor+Spray machine/Diesel	4	7.2	0.5	3.5
	Organic fertilizer	2	50		
	Water	200	34		

Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Wheat is a crop that could be manageable without manual working hours. In practice, in autumn and early spring, there are performed mechanical weeding operations with a tine-flex weeding tool. In different organic farms, manual weeding is performed with stand up weeder tools. There are on the market other simple mechanical tools, or very expensive, that request high digitalization of the farms. Large organic farms in Romania, already adopted a digital profile and for small farms, the investment is not profitable.

In our particular case, it was not used solid organic fertilizer, compost or other type of fertilizer accepted by organic agriculture norms. The use of organic agriculture manure is conditioned by the fact that, it should to origin from an organic certified animal growing farm.

In Romania the animal husbandry sector is at a low level. Organic livestock in 2021 dropped at 14.807 dairy cows, 13.837 of live sheeps and 171.391 live poultry (EUROSTAT, 2021). At this level, the output of it is not well correlated with organic country's surface.

In low input organic agriculture system, if no organic fertilizer are applied the protein content will decrease to a level that will no longer meet the demands for bred wheat quality.

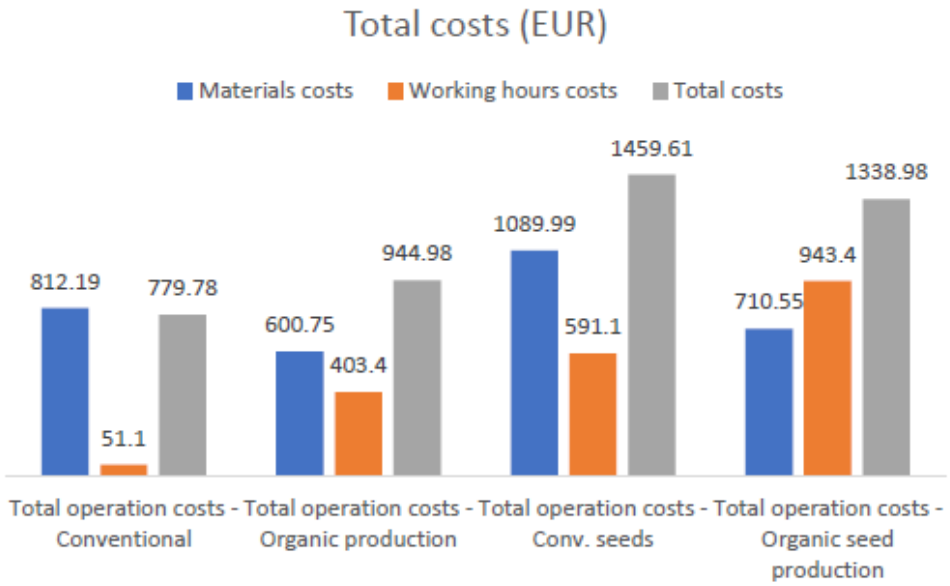
Table 4. *Seeds operation*

Agricultural operations	Machinery and Materials used	Quantity used (kg/ l)/(ha/ t)	Materials costs	Working hours (h)	Working hours costs
Seed conditioning	Seed conditioner/ KW	50	90	16	96
Seed bagging and labeling	Seed bags. labels	5	9	4	24
Seed certification					20
Roguing (Manual)				80	400

Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Compared with vegetables or other field crops, autumn wheat is not a difficult plant species for seed production. The crop technology is merely the same with wheat crop production for bread quality. The seed production and especially organic seed production raise a set of challenges for the farmers. First of all, they need to be certified by state (Petcu, 2020). Also, there are other resources that a farmer needs to buy or to use it in frame of a cooperative. These key resources for a simple farmer to became a seed producer are: a facility for conditioning and storing seeds. Seed conditioning equipment. The demands and quality requested for seed production, often requires more plant protection products. In organic agriculture, fungicides and pesticides approved are not very efficient. But with a good management this task is not a bottleneck for the process. The main actor that is missing in Romania are functional cooperatives, in which a seed producer should have his plan for the next following two years with the clear demand for the future requested quantity. Therefore, Romanian farmer that is producing seed for marketing it, is missing the most important block from the business: a sure customer.

Figure 1. *Total costs*



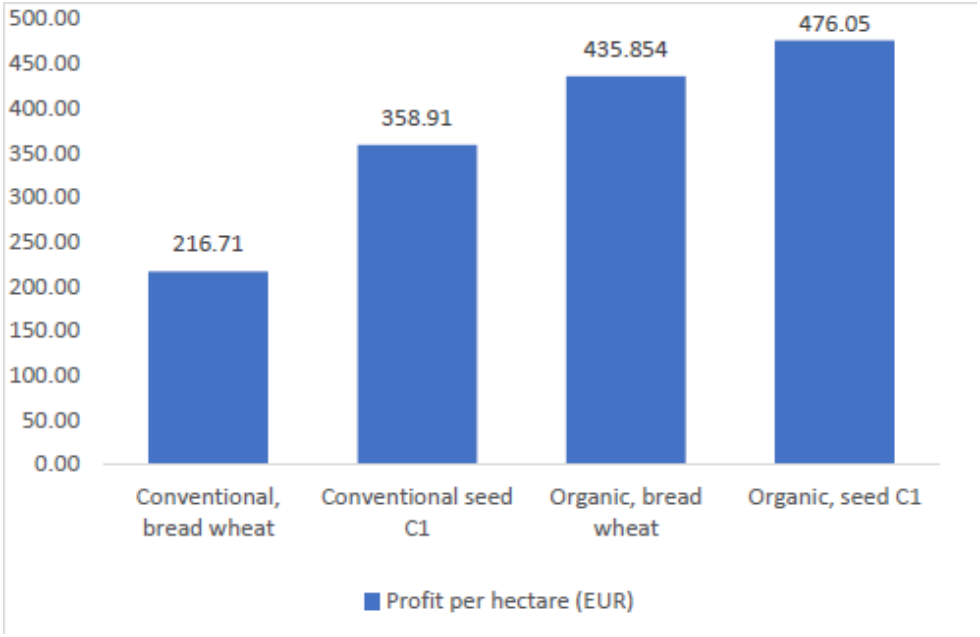
Source: National Agriculture Research and Development Institute, Fundulea, Călărași

When considering the conventional and organic farming it was observed that material costs are similar (Figure 1). While working hours for conventional agriculture are 7.3, the organic agriculture requires more effort (78.2 hours) making the costs for organic farming eight times higher. The main factor for this is the manual operation (weeding) required for organic agriculture.

For seeds, it was noted that material costs for conventional type are double comparing to organic seeds production. While the working hours can be considered similar, the total working hour costs are higher for organic type due to manual operations. The average labor costs per hour is 5 EUR for conventional seeds production and 9.6 for organic seed production.

The economic value per hectare without calculating the subsidies for good agricultural practice or organic farming has a linear growth starting with Conventional bread wheat (216,71€/ha), Conventional seed C1 (358,91€/ha), Organic bread wheat (435,85€/ha), Organic seed C1 (476,05€/ha).

Figure 2. *Profit per hectare without any farming subsidies*



Source: National Agriculture Research and Development Institute, Fundulea, Călărași

Conclusions

Seed producing is an option to add value to their final product for conventional and organic farmers. In this study case, the seed production, for conventional agriculture added a value of 120,20€/ha and for organic agriculture 40,20€/ha.

The highest added value was by organic agriculture, compared with conventional bread wheat, the profit difference was at 219,15€/ha.

On different soil, whether and farm and market conditions, the data could change and also the depicted order of profit per hectare from conventional bread wheat to organic certified seeds.

The production process of organic bread wheat and organic seed production is a challenge to farmers in Romania, due to key resources: workforce in the rural area, equipment and functional cooperatives to plan and sell the final products.

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Literature

1. Andrei, J.V. *et al.* (2021) ‘Small and Medium-Sized Enterprises, Business Demography and European Socio-Economic Model: Does the Paradigm Really Converge?’, *Journal of Risk and Financial Management*, 14(2). Available at: https://doi.org/10.3390/jrfm14020064.
2. APIA (2014) *Măsura 11 – agricultură ecologică din Programul Naţional de Dezvoltare Rurală (PNDR) 2014 – 2020*. Available at: https://apia.org.ro/directia-masuri-de-sprijin-i-iasc/masuri-delegate-din-pndr/masuri-de-mediu-si-clima-finantate-prin-pndr-2014-2020/masura-11-agricultura-ecologica/.
3. Ciornei, L. *et al.* (2022) ‘Public policies and the business environment, factors that condition Romania’s transition to green energy. Case study: cogeneration plants.’, *Proceedings of the International Conference on Business Excellence*, 16(1), pp. 1133–1144. Available at: https://doi.org/doi:10.2478/picbe-2022-0104.
4. Cristina, D., Turcu, A.-G. and Ciuca, M. (2015) ‘Molecular Detection of Resistance Genes to Leaf Rust Lr34 And Lr37 in Wheat Germplasm’, *Agriculture and Agricultural Science Procedia*, 6, pp. 533–537. Available at: https://doi.org/https://doi.org/10.1016/j.aaspro.2015.08.080.
5. EUROSTAT (2021) ‘Agriculture, forestry and fisheries > Agriculture > Organic farming’.
6. Gimbășanu, G. and Tudor, V. (2019) ‘The evolution of average prices for agricultural products in Romania during 2007-2017.’, *Scientific Papers: Management, Economic Engineering in Agriculture & Rural Development*, 19(2).
7. Marinciu, C.-M. *et al.* (2019) ‘Quality parameters of several Winter Wheat varieties tested at NARDI Fundulea’, *Analele INCDA Fundulea*, LXXXVII.

8. Mottaleb, K.A., Kruseman, G. and Snapp, S. (2022) 'Potential impacts of Ukraine-Russia armed conflict on global wheat food security: A quantitative exploration', *Global Food Security*, 35, p. 100659. Available at: https://doi.org/https://doi.org/10.1016/j.gfs.2022.100659.

9. Nicolae, I. *et al.* (2021) 'The Impact of COVID-19 Crisis on the Romanian Agricultural Sector BT - Economic Recovery After COVID-19', in A.M. Dima, I. Anghel, and R.C. Dobrea (eds). Cham: Springer International Publishing, pp. 17–35.

10. Petcu, V. (2020) 'How to become a producer of certified organic seed in Romania'. ÖMKi Hungarian Research Institute of Organic Agriculture. Available at: https://www.liveseed.eu/wp-content/uploads/2020/11/PA48_How-to-become-a-producer-of-certified-organic-seed-in-Romania.pdf.

11. Petcu, V. *et al.* (2022) 'Cover crops from Winter Wheat, Triticale and Peas cultivated in pure stands and mixtures – soil and weed suppression benefits', *Romanian Agriculture Research*, 39. Available at: https://www.incda-fundulea.ro/rar/nr39/rar39.31.pdf.

12. Pingali, P.L. (2012) 'Green revolution: impacts, limits, and the path ahead', *Proceedings of the National Academy of Sciences*, 109(31), pp. 12302–12308.

13. Popescu, G. (2017) *Agricultura pe scara timpului*. Bucharest: Editura Academiei Române.

14. Schnitkey, G. *et al.* (2022) 'Nitrogen Fertilizer Prices and Supply in Light of the Ukraine-Russia Conflict', *farmdoc daily*, 12(45).

IMPACTS AND ADOPTION OF ROMANIAN AGRICULTURE SECTOR TO CLIMATE CHANGE: A BIBLIOMETRIC STUDY

Vili Dragomir[1]

Abstract

Climate change affects agriculture at multiple levels, including changes in agriculture. Average temperatures, extreme precipitation and high temperatures, changes in the variety of pests and diseases, modifications of atmospheric carbon dioxide and methane concentrations, ground-level ozone concentrations. All of these trigger variations in the quantity and quality of crop production, leading to alterations of nutritional quality of food and threatening food security. While agriculture is both affected and affecting the variations of climate change and needs to reconsider several adaptation measures, it is at the same time an important factor in mitigation of the foreseen effects and plays a key role in climate neutrality action plans. The research involves carrying out a bibliographic study on the subject of „climate changes in agriculture" carried out at the level of Romania. According to the research directions that have been identified, the adoption of sustainable agricultural practices such as precision agriculture, crop rotation, and temperature monitoring should be priorities for the Romanian agricultural sector.

Key words: *climate change, agriculture sector, Romania*

Introduction

Agriculture is most affected by climate compared to other economic sectors, through changes in annual temperature, heavy rainfall, drought, and extreme events. Temperature, changes in diseases, changes in atmospheric CO2, changes in the ocean affect the level of coastal areas, thus reducing the agricultural area (Tudor et al., 2022; Butu et al., 2020).

In Romania, climate change has a major impact on the agricultural sector. They can affect crop production through changes in temperature and precipitation, as well as by increasing the frequency and intensity of extreme events such as drought, floods, or hail (Dumitru et al., 2022). This can negatively

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affect the agricultural economy and the food security of the population. It is important that the agricultural sector adapts to these changes by adopting more sustainable technologies and practices and developing climate-resilient crops (Istudor et al., 2019).

Climate changes in Romania have a negative impact on agriculture. Rising temperatures, drought leading to soil aridity and desertification, floods, and extreme weather events affect productivity and lead to the disappearance of crops (Tudor et al., 2022). All these phenomena have an impact on the quality of the soil, the water for irrigation, and also the distribution of plants and animals (Micu et al., 2022; Rodino et al., 2019).

Environmental education is key to providing people with the necessary information about climate change and its impact on the agricultural sector. The first step in an education development strategy is to assess the economic dimensions of the multiple effects of climate change. The observed increase in average temperatures, especially in recent decades, is one of the most important and visible signals of global climate change (Dumitru et al., 2021; Iancu et al., 2022).

Methodology

The term „bibliometrics" has been used since 1969 by Alan Pritchaed, being considered a mathematical research method, applied to various scientific materials such as books and publications.

In recent times, bibliometric analysis has been increasingly used involving a quantitative method that involves an analysis and organization on a much larger scale of a given topic.

With the help of the Web of Science database, a database on the subject of „climate changes in agriculture" is exported, these results being filtered according to the country, namely Romania. Using the VosViewer software, certain maps are generated that show us the interconnection of our topic with other terms, but also the coauthor countries that are of interest to the researched topic.

The purpose of the work is to identify the related research directions of the studied subject, the impact and adaptation of the agricultural sector to climate change, but also the countries with which Romania is closely related in research.

Results and Discussions

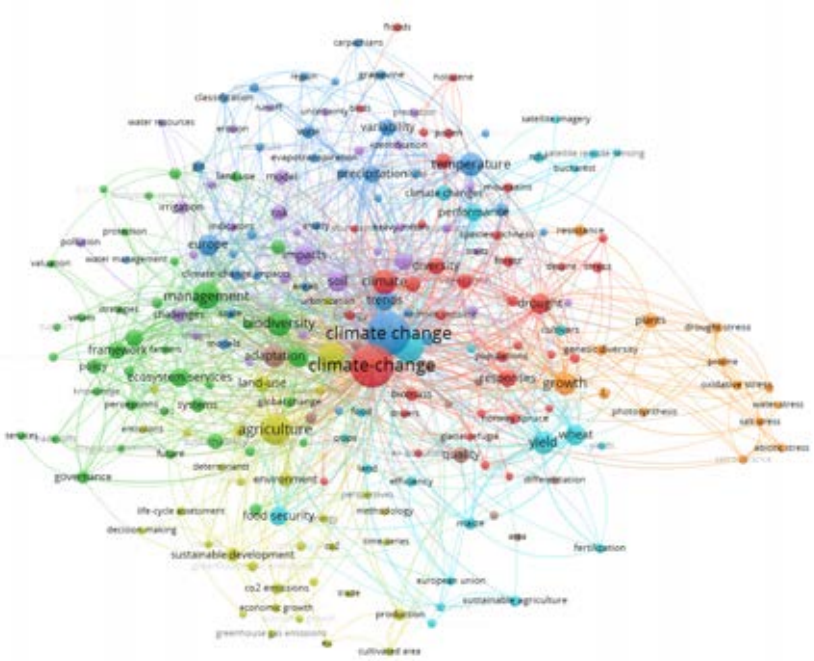
According to the WOS database, on the subject of „climate change in agriculture", Romania presents the most scientific papers in the number of 836, followed by Germany with 182 papers,, Italy with 162 papers and Spain with 159 papers.

Figure 1. *The fields of interest in which the researches from Romania were include*

Source: own processing based on WoS data

Also, the first 10 fields in which Romanian scientific work was included are: environmental science (199 works), agronomy (90 works), environmental studies (76 works), agricultural economic policy (75 works), ecology (65 papers), plant sciences (65 papers), geosciences multidisciplinary (55 papers), green sustainable science technology (55 papers), economics (50 papers), forestry (48 papers) (Figure 1).

Figure 2. *The link between „climate changes in agriculture" and other related terms at the level of Romania*



Source: own processing based on WoS data

The main terms related to the studied subject are impact, sustainable development, production, precipitation, temperature, food security, fertilization, food, land use, water resources.

The first red cluster called „climate change" includes the following terms: impact, management, agriculture, politics, sustainable development, challenge, knowledge, education, determinants, floods, quality, wine, grapevine.

The second green cluster called „biodiversity" includes drought, productivity, resistance, forests, drought stress, tree rings, global change, carbon, diversity, change in land use, co2.

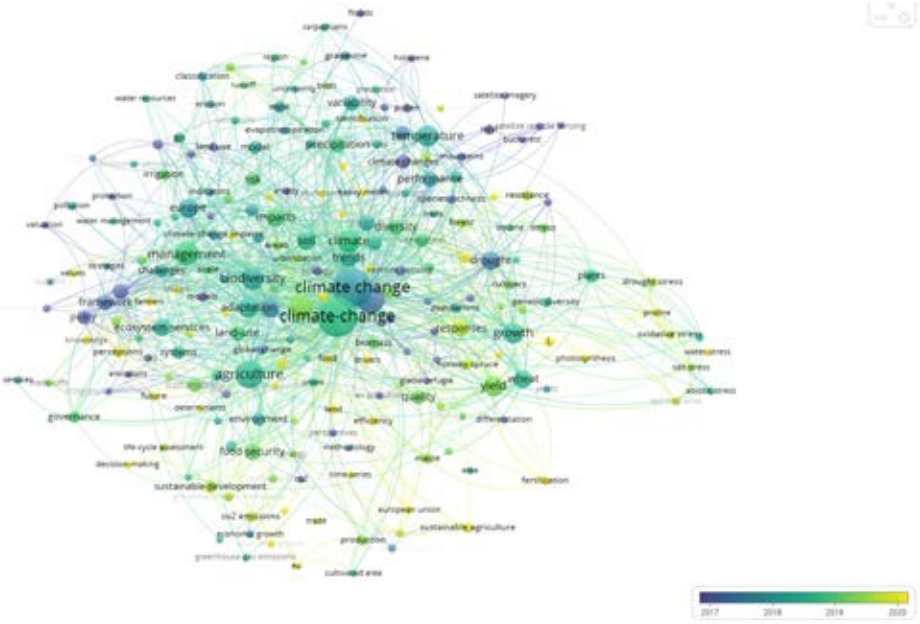
The third dark blue cluster named „temperature" includes Europe, perception, variability, wine, classification, region, precipitation, and climate-change impact.

The fourth yellow cluster named „agriculture" includes rainfall, decision-making, determination, environment, trend, economic growth, production, cultivated area, time, series, and technology.

The fifth turquoise cluster „food security" includes yield, wheat, fertilization, efficiency, land, crops, food, maize, European Union, sustainable agriculture, performance, climate-change.

The sixth purple cluster „impact" includes risk, impact, soil, irrigation, pollution, runoff, erosion, water resources, river, carbon, risk assignment (Figure 2).

Figure 3. *The link between „climate changes in agriculture" and other related terms at the level of Romania, according to years*



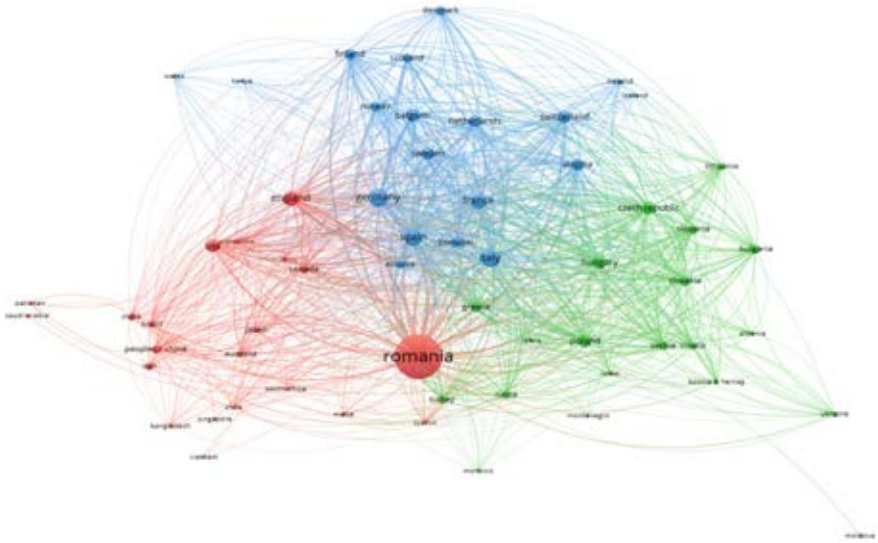
Source: own processing based on WoS data

In the figure above, the terms related to our topic used in the research are presented by year. Thus, in 2017, researchers were concerned with drought, policy, framework, protection, valuation, land use, climate change, floods, Bucharest.

Later, in 2018 and 2019, researchers focused on climate chance, agriculture, soil, growth, plants, wheat, management, environment, system, ecosystem services, biomass, quality, genetic diversity, forest, resistance, food security, governance, production, cultivated giving.

In 2020, researchers were concerned about trade, farmers, values, design, perception, responses, European Union, sustainable agriculture, co2 emission, perception, knowledge, identification, susceptibility, exposure (Figure 3).

Figure 4. *Link between co-author countries*



Source: own processing based on WoS data

Through the analysis of the frequency of co-authors carried out according to the country, the degree of relationship between the countries that give interest to the studied subject is identified. Thus, the nodes show the countries that were interested in the subject, and the distance between them represents the degree of relationship between them.

On the other hand, Romania registers an important interest in the subject studied, indicating collaborations with Cyprus, Turkey, Malta, and Russia as a result of the financing granted through companies operating in Romania.

Also, the research direction is identified according to the color present on the map, being present 3 research directions complementary to the colors on the map, in an attempt to discover and limit the effects of climate change. Romania together with Cyprus, Malta, Canada, England, the United States of America, Italy, Brazil (Figure 4).

Conclusion

The research directions that Romanian researchers approach are multiple. The negative impact of climate change on agriculture at the level of Romania is felt by their concerns regarding the changes occurring in the agricultural system.

Some of the researchers' concerns are: drought, emissions, pollution, irrigation, biodiversity, biomass, degradation, global changes. In addition, the focus is on CO2 emissions, water resources, precipitation, air pollution, fertilization, and sustainability. A direction of research that has been addressed since 2019 is represented by food security, which together with terms such as quality, food, cultivated areas, population which, through these extreme phenomena, lead to reductions in production, and implicitly increases in food prices . A concern of the population is access to food in areas that are poorly developed from an economic point of view.

It is important to adopt sustainable agricultural practices and technologies adapted to climate change to reduce the negative impact on the sector and ensure food security for the population.

In Romania, in order for agriculture to adapt to climate change, certain practices must be adopted, such as efficient irrigation, precision agriculture, the cultivation of crops that are resistant to these extreme phenomena, the use of soil conservation practices such as crop rotation. In addition, climate monitoring can represent an important step for Romania to be able to make famous decisions regarding agricultural practices.

Literature

1. Butu, A., Rodino, S., Butu, M., & Ion, R. (2020). Bioeconomy related perspectives for boosting agriculture development in Romania. In Proceedings of the International Conference on Business Excellence (Vol. 14, No. 1, pp. 548-558).
2. Dumitru, E. A., Micu, M. M., & Sterie, C. M. (2022). The key to the development of agricultural cooperatives in Romania from the perspective of those who run them. Outlook on Agriculture, https://doi.org/10.1177/00307270221138118.
3. Dumitru, E.A., Ursu, A., Tudor, V.C., Micu, M.M. (2021). Sustainable Development of the Rural Areas from Romania: Development of a Digital Tool to Generate Adapted Solutions at Local Level. Sustainability, 13, 11921. https://doi.org/10.3390/su132111921.
4. Iancu, T., Tudor, V. C., Dumitru, E. A., Sterie, C. M., Micu, M. M., Smedescu, D., ... & Costuleanu, L. C. (2022). A Scientometric Analysis of Climate Change Adaptation Studies. Sustainability, 14(19), 12945. https://doi.org/10.3390/su141912945.

5. Istudor, N., Ion, R. A., Petrescu, I. E., & Hrebenciuc, A. (2019). Agriculture and the twofold relationship between food security and climate change. Evidence from Romania. Amfiteatru Economic, 21(51), 285-293.

6. Micu, M. M., Dinu, T. A., Fintineru, G., Tudor, V. C., Stoian, E., Dumitru, E. A., ... & Iorga, A. (2022). Climate change—between "myth and truth" in Romanian Farmers' perception. Sustainability, 14(14), 8689.

7. Rodino, S., Butu, A., Dragomir, V., & Butu, M. (2019). An analysis regarding the biomass production sector in Romania-a bioeconomy point of view. Scientific Papers Series Management, Economic Engineering in Agriculture and Rural Development, 19(1), 497-502.

8. Tudor, V. C., Dinu, T. A., Vladu, M., Smedescu, D., Vlad, I. M., Dumitru, E. A., ... & Costuleanu, C. L. (2022). Labour implications on agricultural production in Romania. Sustainability, 14(14), 8549.

9. Tudor, V.C., Dinu, T.A., Vladu, M., Smedescu, D., Vlad, I.M., Dumitru, E.A., Sterie, C.M., Costuleanu, C.L. (2022). Labour implications on agricultural production in Romania. Sustainability, 14, 8549. https://doi.org/10.3390/su14148549.

10. https://clarivate.com/

PLENARY SECTION

***Second day*, 16th December 2022**

THE IMPACT OF EMPOWERMENT ON MARRIED WOMEN THROUGH SELF-EMPLOYMENT IN RURAL TOURISM

Aleksandra Vujko[1], *Olgica Zečević Stanojević*[2], *Leposava Zečević*[3]

Abstract

Previous research has shown that women feel empowered if they are a part of some associations. However, it has also been shown that rural women are particularly sensitive category. There are a largest number of these women, so they represent very fascinating interest group. The aim of the paper is to show how tourism directly or indirectly influences the empowerment of married rural women, and that they thus become more independent and more equal members of community. The research is conducted on a sample of 513 rural women, and the results showed that the participants in most cases are married women with children, that the main motive for starting a business is "caring for others", that the problem they face when starting a business is "the lack of initial capital", and that from all tourism jobs they choose making traditional products and souvenirs, as well as engaging in rural tourism (providing food and beverage services).

Key words: *women's empowerment, self-employment, women's entrepreneurship, rural tourism*

Introduction

Serbian society has been described as a patriarchal one. This particularly refers to rural areas. Women feel inferior in such an environment.(Seguino,

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2000), and are often victims of domestic violence, whether physical or verbal abuse. With feelings of inferiority, dissatisfaction also grows, so it often happens that a woman withdraws into herself and spends her life as a silent observer (Agarwal, 1997). In such an environment, a woman is "doomed" to a repressed position and a complete dependence on a man.

The concept of women's entrepreneurship in Serbia became relevant in the second half of the 1990s. (Anderson, Eswaran, 2009). In that sense, workshops and education of women were organized, with the aim of raising women's awareness that they can take "their lives into their own hands". In the last 15-20 years, things have gradually changed. The number of women enterprises has increased (Rao, 2011), and the structure has changed so apart from traditional "female" activities, women's enterprises have appeared in the areas of business which are less labor intensive, mostly in the area of services, such as ICT, bookkeeping, intellectual services (financial consulting, human resource management, education), etc. Changes continue, and lately, women's education has been "moving" from cities to villages (Reddy et al., 2003). Research has shown that rural women are particularly sensitive category and that they need more help than women in cities (Vujko et al., 2019; Maksimović et al., 2019).

The problem was how and in which way to approach women in the villages and how to gain their trust. It has been systematically done; so as the bases of the development, many women's organizations and other associations appeared (Suja, 2012) in which rural women could finally find the most valuable resource of the 21st century i.e. information. Rural women needed some time to realize that they also have the possibility to change things and to contribute. Women's organizations started empowering women and soon things got visibly better. An empowered woman is more independent, stronger and self-sufficient i.e. more satisfied with her.

Economic independence of a woman gives a number of positive effects, most importantly, such a woman is more productive and thus, a more effective and efficient member of society. Women's associations for women's empowerment have shown that tourism is one of the most effective ways to empower women in rural areas. In this regard, tourism aims primarily at economic women's empowerment, and also at developing and promoting of entrepreneurial spirit, encouraging entrepreneurship among unemployed women, as well as improving efficiency and institutional support of business and women's entrepreneurship development.

Literature review

What is women's empowerment?

In recent days, there has been a growing debate about what represents *women's empowerment,* and opinions are moving in different directions, form economic to sociological (Kabeer, 2005, Narayan, 2002). Kabeer qualifies her argument by suggesting there are three interrelated dimensions required for women to be empowered to make decisions in their lives: (1) access to resources, including preconditions; (2) agency, including process; and (3) achievements, including outcomes (p. 437). As a theoretical construct, "women's empowerment" often has a certain amount of justification in its construction, representing a bases in search for answers why it is needed at all (Bhatt-Datta & Gailey, 2012).

Moser (1991) defines women empowerment as: "giving women the right to determine choices in life and to influence the direction of change through the ability to gain control over crucial material and non-material resources". Osirim (2001) suggests that it is a complex structure that consists of social emotions "be good for the society" and economic independence. When a psychological dimension is added to it, it is clear that it is a feeling that has a driving force within. (Soroushmehr et al., 2012). Certain scientists consider it to be a transformation that enables greater control to women over their lives (Batliwala, 1994; Harriet & Sen, 2003).

According to Mosedale (2005), empowerment is a process which primarily refers to those who are visibly vulnerable and who need empowerment (particularly rural women). According to Hashemi and Schuler (1993), the dimensions of women's empowerment include: sense of self and vision of future, mobility and visibility, economic security, decision making in household, ability to interact effectively in public sphere, and participation in non-family groups. In view of this, it can be concluded that it is a process which manifests itself multidimensionally (Ramanathan, 2004).

Basically, it is women's absolute wellbeing, where empowerment is seen as a process which visibly and significantly improves women's lifestyle and is indicated by outcomes that measure current status with respect to literacy and schooling, health and nutrition, labour force participation, contraceptive use, mobility, and ownership of clothing and assets, but also their social status indicated by women's involvement in intra-household processes such as decision-making, control over household income and assets, and control over loans taken (Ali & Hatta, 2012).

What is women's entrepreneurship and self-employment?

Women entrepreneurship is a multidimensional phenomenon which can be referred to from different points of view, and thus scientists approached it (Ateljevic, 2009). From the point of view of women's activism and feminism, women entrepreneurship is perceived as the way women resources are activated to woman's own advantage (de Bruin et al., 2006; 2007; Calás et al., 2009). A second approach is from the view of economic development, when women's entrepreneurship is considered as a way to activate women's resources, especially in tourism (Heilman, Chen, 2003; Hania et al., 2012). A third approach is from the view of social politics, when by empowering women's entrepreneurship, women's unemployment rates are to be decreased, especially of middle-aged women who at risk of losing a job(Godwyn, 2009).

A fourth approach is from the view of securing sustainable growth when women's entrepreneurship is seen as a way to harmonize economic development with ecological and social development by doing socially responsible business (Tassel, 2004; Markantoni & van Hoven, 2012). Women's entrepreneurship was perceived most often from the view of social welfare (Heilman, Chen, 2003), although it is essentially "par excellence" individual strategy of women's emancipation. Namely, every woman who decides to be an entrepreneur, or is already one, is at the same time a woman who is achieving, awakened and empowered by herself.

Methodology

Fruška Gora Mountain covers an area of 21,500 km^2.This Mountain is located between 45° 00' and 45° 15' north latitude and between 16° 37' and 18° 01' east longitude. It is a mountain in the northern part of Srem District (South-western part of Vojvodina Province in Northern Serbia), i.e. south-eastern periphery of the vast Pannonian Plain (Đurđev et al., 2010). In its west-east direction it has the length of about 80 km. This low island type mountain, with the peaks Crveni čot (539 m), Orlovac (512 m), and Iriški venac (490 m), represents a mountain with a special benefit for the development of rural tourism (Bukurov, 1978; Jovičić, 1962; Milić, 1973). The survey was conducted on a sample of 513 women in 25 rural settlements on Fruška Gora Mountain in which there are 32 women's associations. The associations are formed mainly in the period from 2014 to 2016, in order to empower women within the association in both economic and social terms.

The associations usually number about 30 members of different age and education. They are involved in humanitarian work and activities in the field of culture and handicrafts (making of handicrafts and food products, souvenirs, rural tourism). The rural settlements involved in this research are: Čerević, Banoštor, Lug, Irig, Rakovac, Susek, Jazak, Neradin, Vrdnik, Adaševci, Bačinci, Berkasovo, Bikić Do, Erdevik, Gibarac, Ilinci, Jamena, Kukujevci, Ljuba, Molovin, Morović, Privina Glava, Sot, Vašica and Višnjićevo. All the interested female respondents in the observed villages participated in the survey. The only condition was that their domicile address was in the researched villages. The examination of the target groups was done with the technique "face to face".

In order to test the hypothesis H that self-employment is an ultimate goal of women's empowerment, three sub-hypotheses are set: h1 – on women's empowerment to starting their own business largely influenced "care for others" motive; h2 – on women's empowerment to starting their own business is mostly affected the lack of initial capital as part of the business environment and h3 –women are empowered to start their own business in the field of handicraft souvenir production and rural tourism.

Number of 513 women was interviewed for this study, and their qualitative responses provide the basis on which we deduce our research findings. For the data analysis we used a factor analysis which normally uses correlations between variables, so before starting the procedure it is necessary to check whether the variables are correlated and for that purpose we use Bartlett's Test of Sphericity (it tests null hypothesis that the matrix of intercorrelated variables in identity correlation matrix procedure i.e. that all correlations between variables are zero). If Bartlett's test is not statistically significant, there is no use to conduct a factor analysis (without a strong theoretical justification).

Results and discussion

The data analysis showed that the largest percentage of female respondents is married with children. The study showed that the (396) 77, 2% women are in marriage status, (58) 11, 3% women are not in communion, (48) 9, 4% are divorced and (11) 2, 1% are widows. Thus, the study showed that the (430) 83, 8% of women are parents, and (83) 16, 2% of women has no children.

Since Bartlett's Test (Table 1) showed significance, a factor analysis is conducted. The results showed the justification of using the analysis, so it

was approached to the further analysis and comparison of responses based on marital women status.

Table 1. *KMO and Bartlett's Test*

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		,529
Bartlett's Test of Sphericity	Approx. Chi-Square	468,947
	df	15
	Sig.	,000

Source: Own calculations

Table 2. *Factor analysis*

	Initial	**Extraction**
What was your motivation to found your own enterprise?	1,000	,792
How do you see the business environment in Serbia?	1,000	,668
Do you feel empowered as members of self-help groups?	1,000	,545
In which areas is the strongest empowerment?	1,000	,825
Would you have started your own business and what would you do?	1,000	,799
What is the essence role of the Self Help Groups?	1,000	,637

Source: Own calculations

About the motives (Table 3), data analysis showed that one motive is dominant in the responses, and that is "Care about others". "Care about others" is a specific motive, and appears as a driving category of motive. In this case, it is about mothers who take care of their children. Children caring is a sublime job, and need to provide everything necessary to the child gives the parent the feeling that nothing is difficult for them. This is the key motive in the case of rural women and their need to try out as entrepreneurs. This confirmed h1: – on women's empowerment to starting their own business largely influenced "care for others" motive.

Table 3. *Motives for starting a women's business*

		N	Mean	Std. Dev.	Std. Error	95% Confidence Interval for Mean		Min	Max	Between Comp. Var.
						Low. Bound	Upper Bound			
Care about others.		269	1,42	,818	,050	1,32	1,51	1	4	
The pursuit for achievement.		50	1,28	,607	,086	1,11	1,45	1	3	
Higher degree of freedom and independence		98	1,33	,670	,068	1,19	1,46	1	3	
Dissatisfaction with previous work (working location, co-workers, working conditions).		83	1,16	,366	,040	1,08	1,24	1	2	
Something else		13	2,23	1,092	,303	1,57	2,89	1	4	
Total		513	1,36	,741	,033	1,30	1,43	1	4	
Model	Fixed Effects			,724	,032	1,30	1,43			
	Random Effects				,118	1,04	1,69			,037

Source: Own calculations

When it comes to women's empowerment, women (especially women in rural areas) need systemic support in developing their entrepreneurial spirit (Tebela 4). But, often the economic moment is one of the insurmountable obstacles. Therefore, in order to achieve their goal, women need, among other things, economic empowerment, ie support of the environment.

The economic empowerment of women is the process of achieving equal access to and control over economic resources, and also ensuring that they can use those resources in a way that will give them greater control over other areas of their own lives. After deciding to start their own business, women face financial problems, which can be seen in Table 4, according to which 393 respondents say that lack of start-up capital was one of the most difficult obstacles.

In addition to the lack of capital, ie financial support, the main obstacle to starting an entrepreneurship is the lack of support in legal and consulting terms, for finding subsidies and startup loans, and for understanding all procedures. This confirmed h2 – on women's empowerment to starting their own business is mostly affected the lack of initial capital as part of the business environment.

Table 4. *Influences of the environment on starting a business for women*

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum	Between-Compon. Variance
						Lower Bound	Upper Bound			
Women have greater responsibilities in the family and in the upbringing of children.		43	1,28	,591	,090	1,10	1,46	1	3	
The problem is the lack of initial capital.		393	1,40	,780	,039	1,32	1,48	1	4	
Unfavourable attitude of the social environment for the woman who enters into business.		33	1,33	,777	,135	1,06	1,61	1	4	
The problem of the marginalization, humiliation of women and sexual harassment.		26	1,19	,402	,079	1,03	1,35	1	2	
Disadvantages come from high levels of corruption and strong male network.		18	1,06	,236	,056	,94	1,17	1	2	
Total		513	1,36	,741	,033	1,30	1,43	1	4	
Model	Fixed Effects			,739	,033	1,30	1,43			
	Random Effects				,068	1,18	1,55			,006

Source: Own calculations

In addition to the lack of capital, the difficulty of meeting potential business partners and adequate legal assistance in the realization of ideas has been recognized as an obstacle. The lack of ideas was not noticed in the conversation with the respondents, but only the means for their realization. After managing to provide the necessary

funds to start a business, women in rural areas who start their own business often find themselves in the field of services. Tourism has established itself here as the dominant industry.

Women in the villages decide to sell their handicrafts (Swanson, Timothy, 2012), whether it is food or clothing, decorations etc. (Dimitrovski et al., 2012). As many as 334 respondents (Table 5) responded that handicrafts are sold as souvenirs, which are the main source of income and the basis of their empowerment. Another important indicator of the impact of tourism on women's empowerment is that 95 respondents answered that they decided to engage in rural tourism. This confirmed h3 –women are empowered to start their own business in the field of handicraft souvenir production and rural tourism.

Table 5. *Types of businesses run by married women in the countryside*

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Min.	Max.
					Lower Bound	Upper Bound		
Humanitarian work and care for the local community.	18	1,56	,984	,232	1,07	2,04	1	4
The food preparing.	17	1,59	1,004	,243	1,07	2,10	1	4
Cultivation of traditional crafts and make handicrafts.	334	1,34	,713	,039	1,27	1,42	1	4
Dealing with ecology and environmental improvements.	28	1,86	1,008	,190	1,47	2,25	1	3
The focus on rural tourism.	95	1,27	,643	,066	1,14	1,40	1	3
Agricultural activities: products are made from herbs, dried herbs for tea, make brandy, produced tinctures.	11	1,18	,405	,122	,91	1,45	1	2
I do not feel the support.	10	1,00	,000	,000	1,00	1,00	1	1
Total	513	1,36	,741	,033	1,30	1,43	1	4

Source: Own calculations

Conclusion

The economic empowerment of women has a strong impact on the economy as a whole (Orser et al., 2006) - gender parity is estimated to have the potential to increase global gross domestic product (GDP) between $ 12 trillion and $ 28 trillion by 2025. National economies lose finances when a significant part of the population cannot compete equally for projects or realize their full potential in the economic sphere. So, economic empowerment of women is one of the special measures in the National Strategy for Gender Equality 2016 - 2020. The research showed what are the biggest challenges that women in the countryside face. These are the lack of finances for successfully starting one's own business, insufficient tax relief, weak business contacts and lack of information. Women are burdened with household chores, and various forms of discrimination and gender prejudice are important factors influencing the poor position of women's entrepreneurship. Women's entry into entrepreneurship is often conditioned by the existence of stereotypes as well as difficulties in reconciling family and business obligations.

It can be concluded that the gender perspective is not sufficiently included in regulations directly aimed at regulating and developing entrepreneurship, and that these policies and regulations do not recognize specific problems of women in entrepreneurship, nor do they provide specific forms of support. That is why a special set of questions was aimed at talking to respondents who have previous experience in the field of entrepreneurship about the obstacles and challenges they faced, as well as the forms of support needed to overcome these obstacles. On the other hand, an economically empowered woman is satisfied, happy and fulfilled. Such a woman is more independent in decisions making and has more confidence to take her life into her own hands. Tourism has proven to be the perfect link between women and entrepreneurship. Whether it is rural tourism, ie the provision of food and beverage services in rural households, or the sale of souvenirs and all kinds of handicrafts, tourism is an ideal economic activity for women.

The research confirmed that the economic empowerment of women contributes not only to women but also to their families and society as a whole. This confirmed the starting hypothesis H that self-employment is an ultimate goal of women's empowerment.

Literature

1. Ali, I., Hatta, A.Z. (2012). Women's Empowerment or Disempowerment through Microfinance: Evidence from Bangladesh. *Asian Social Work and Policy Review* 6, 111-121.
2. Anderson, S., & Eswaran, M. (2009). What determines female autonomy? Evidence from Bangladesh. *Journal of Development Economics*, 90, 179–191.
3. Agarwal, B. (1997) Bargaining and gender relations: within and beyond the household. *Feminist Economics*, 3(1), 1–51.
4. Ateljevic J. (2009): Tourism entrepreneurship and regional development: Example from New Zealand. *International Journal of Entrepreneurial Behaviour and Research*, 15(3), 282–308.
5. Bukurov, B. 1978: *Bačka, Banat, Srem*. Novi Sad: Matica Srpska (in Serbian).
6. Batliwala, S. (1994). *The meaning of women's empowerment: New concepts from action*, In G. Sen, A. Germain & L. Chen (Eds.), Population policies reconsidered: Health, empowerment and rights. Cambridge MA: Harvard University Press.
7. Bhatt-Datta, P., & Gailey, R. (2012). Empowering Women Through Social Entrepreneurship: Case Study of a Women's Cooperative in India. *Entrepreneurship theory and practic*e, *36*(3), 569-587.
8. Calás, M., Smircich, L., & Bourne, K. (2009). Extending the boundaries: Reframing "entrepreneurship as social change" through feminist perspectives. *Academy of Management Review*, *34*(3), 552–569.
9. Dimitrovski D. D., Todorović A.T., Valjarević A.D. (2012): Rural tourism and regional development: Case study of development of rural tourism in the region of Gruza, Serbia. *Procedia Environmental Sciences*, 14, 288–297.
10. De Bruin, A., Brush, C., & Welter, F. (2006). Towards building cumulative knowledge on women's entrepreneurship. *Entrepreneurship Theory and Practice*, *30*(5), 585–594.
11. De Bruin, A., Brush, C., & Welter, F. (2007). Advancing a framework for coherent research on women's entrepreneurship. *Entrepreneurship Theory and Practice*, *31*(3), 323–339.

12. Đurđev, S.B., Arsenović, D., Dragin, A. 2010: Contemporary problems in studying population of Vojvodina Province. *Acta geographica Slovenica,* 50-1, 115-129.

13. Godwyn, M. (2009). This Place Makes Me Proud to be a Woman": Theoretical explanations for success in entrepreneurship education for low-income women. *Research in Social Stratification and Mobility, 27*, 50–64.

14. Heilman, E.M., & Chen, J.J. (2003). Entrepreneurship as a solution: the allure of self-employment for women and minorities. *Human Resource Management Review, 13(2)*, 347-364.

15. Harriet, B., & Sen, G. (2003). Women's empowerment and demographic processes: Moving beyond Cairo. New York, NY: Oxford University Press.

16. Hania, U., Rachmaniaa, I.N., Setyaningsiha, S., & Putria, R.C. (2012). Patterns of Indonesian Women Entrepreneurship. *Procedia Economics and Finance 4*, 274 – 285.

17. Hashemi, S.M., Schuler, S.R., & Riley, A.P., (1996). Rural credit programs and women's empowerment in Bangladesh. *World Development,* 24(4), 635– 653.

18. Heilman, E.M., & Chen, J.J. (2003). Entrepreneurship as a solution: the allure of self-employment for women and minorities. *Human Resource Management Review, 13*, 347–364.

19. Jovičić, Ž. 1962: *Geografske osnove za razvoj turizma na Fruškoj gori*. Novi Sad: Matica srpska, (in Serbian).

20. Kabeer, N. (2005). Is Microfinance a 'Magic Bullet' for. Women's Empowerment: Analysis of Findings from. South Asia. *Economic and Political Weekly*, 40(44): 4709-4718.

21. Milić, Č. (1973). *Fruška Gora - geomorfološka proučavanja*. Novi Sad: Matica Srpska (in Serbian).

22. Markantoni, M., & van Hoven, B. (2012). Bringing 'invisible' side activities to light. A case study of rural female entrepreneurs in the Veenkoloniën, the Netherlands. *Journal of Rural Studies, 28,* 507–516.

23. Maksimović, G., Ivanović, T., Vujko, A. (2019): Self-employment of women through associations in the rural areas of Sirinicka zupa. *Economic of Agriculture*, 66(1), 251-263.

24. Mosedale, S. (2005). Assessing women's empowerment: towards a conceptual framework. *Journal of International Development*, 17, 243–257.

25. Moser, C. (1991). Gender planning in the Third World: Meeting practical and strategic gender needs. In T. Wallace, C. March (eds.) Changing Perspectives: Writings on Gender and Development, Oxford: Oxfam.

26. Narayan, D., (Ed.) (2002). *Empowerment and Poverty Reduction: A Sourcebook.* Washington, DC: World Bank.

27. Orser, J.B., Riding, L.A. & Manley, K. (2006). Women Entrepreneurs and Financial Capital. *Entrepreneurship Theory and Practice*, *30*(5), 643-655.

28. Osirim, J.M. (2001). Making good on commitments to Grassroots Women: NGO's And Empowerment for women In Contemporary Zimbabwe. *Women's Studies International Forum, 24*(2), 167-180.

29. Ramanathan, M. (2004). Women and empowerment: Shri Mahila Griha Udyog Lijjat Papad. *Economic and Political Weekly*, *39*(17), 1689–1697.

30. Rao, S. (2011). Work and Empowerment: Women and Agriculture in South India. *Journal of Development Studies*, Vol. 47, No. 2, 294–315.

31. Reddy, S., Galab, S. & Rao, P. (2003) Trends and determinants of poverty: 1973 to 1999–2000. *Economic and Political Weekly*, 38(12–13), 1262–1274.

32. Swanson, K.K., & Timothy, J.D. (2012). Souvenirs: Icons of meaning, commercialization and commoditization. *Tourism Management, 33(3),* 489-499.

33. Seguino, S. (2000) Gender inequality and economic growth: a cross-country analysis. World Development, 28(7), 1211–1230.

34. Soroushmehr, H.,Kalantari, K., Fami, H.S. & Sarani, V. (2012). Investigation of Self-help Groups (SHGs) Effect on Rural Women Empowerment (Hamedan County, Iran). *Journal of Agricultural Science*, 4(1), 1–13.

35. Suja, S. (2012). Women empowerment through self-help group – an evaluative study. *Global Management Review*, 6(3), 68–82.

36. Tassel, E.V. (2004). Household bargaining and microfinance. *Journal of Development Economics*, 74, 449–468.

37. Vujko, A., Tretiakova, N.T., Petrović, M., Radovanović, M., Gajić, T., Vuković, D. (2019): Women's empowerment through self-employment in tourism. *Annals of tourism research*, 76, 328-330 https://doi.org/10.1016/j.annals.2018.09.004

ALTERNATIVE CROPS KNOWLEDGE MANAGEMENT FROM THE STANDPOINT OF SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT[1]

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Abstract

The main goal of sustainable agriculture and rural development is to increase food production and food security in a sustainable way. The increasing demand for food and feed initiated cultivation of new or less cultivated plant species, especially in regions where the staple crops cultivation is difficult. The diverse requirements of agricultural producers, processing industries and consumers, in terms of cultivation, processing and the quality of primary raw materials and products, as well as the economic and ecological benefits of growing alternative crops, impose the need for inter- and multidisciplinary research and the use of twenty-first-century tools for the transfer and application of acquired knowledge. The paper aims to illustrate how agricultural practice and grower demands drive scientific research. Through an overview of knowledge creators and providers, organizations and associations, dedicated events and publications, the work maps new research paths for more advanced applications of these crops.

Key words: *alternative crops, knowledge creators, knowledge providers, knowledge beneficiaries*

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Introduction

We are witnessing a dramatic change in agriculture after the Second World War. Due to new technologies, mechanization, increased use of chemicals, and government policies, the productivity of food and fiber in the world has increased dramatically making possible to produce more food and fiber at lower prices.

While these developments have reduced the risks of farming, they also come with significant costs - soil depletion, air and groundwater pollution, the spread of new pathogens, the decline of family farms and the disintegration of rural communities.

The basic principle of agricultural sustainability is that meeting the current needs of society must not jeopardize the needs of future generations. The scientific understanding of what constitutes sustainability in ecological, economic and social terms is constantly evolving and is influenced by contemporary chalanges, perspectives and values. The details of what makes an agricultural system sustainable are fluid and vary from one cultural and ideological perspective to another. Therefore, agricultural systems move along a continuum from unsustainable to highly sustainable.

With the development of modern agriculture and intensification of crop production, technological development has promoted the cultivation of several high-yielding types of major commodity crops (Kim, 2016). Such practices have made farmers more vulnerable to environmental and market changes, which reflects negatively on farm incomes. By limiting the food and nutrients availability for human consumption, the loss of agricultural biodiversity poses a risk not only to ecological, but also to human health (Díaz et al., 2006).

Such concerns and the increasing demand for food and feed initiated cultivation of new or less cultivated plant species, especially in regions where the staple crops cultivation is difficult. Farmers' interest in alternative crops has grown in recent decades due to the simple inclusion in crop rotations and the positive effect on the environment (reduction in the use of pesticides, positive effect on the soil, increase in biodiversity), but also due to the possibility of placing these products on new markets.

„Knowledge and information play a key role in the contemporary society and business. Relevant information allows to make right decisions operatively both at individual and business level“ (Zecca & Rastorgueva, 2017).

Commercial agricultural production is a complex enterprise that involves both scientific research and the experiences and practices of farmers. Due to economic pressure, many local farms are going out of business. Economic development policies and tax structures that would encourage more diverse agricultural production on family farms are the foundation of a healthier rural economy (Brodt et al., 2011). Moreover, the agricultural economy and the environment are connected through many complex relationships (Zecca & Rastorgueva, 2017). Tharefore, farmers should keep this interdependence in mind when adapting their enterprises to environmental, social, market and political changes to achieve long-term sustainability. Through their purchases, consumers can also send strong messages to producers, retailers and others in the value chain about what they think is important, including environmental quality and social equality.

The paper aims to illustrate how agricultural practice and grower demands drive scientific research. Through an overview of knowledge creators, providers and beneficiaries, dedicated events and publications, the work maps new research paths for more advanced applications of these crops.

Alternative crops

The term alternative crops could be used to refer to plant species that are atypical for a certain geographical area, though there are agroecological possibilities for their cultivation. These can be plant species that were once grown in the regions (buckwheat, spelled), but were suppressed by intensification of agricultural cultivation, so that the species production ceased, and were replaced by other similar species. Another group of alternative crops are major commodity crops in some geographical regions, while for other regions are alternative crops.

Kim (2016) highlights some advantages of alternative crops, as well as barriers to their successful commercialization (Table 1):

Table 1. *Main opportunities and challanges to commercialization of alternative crops according to Kim (2016).*

OPPORTUNITIES	Promotion of biodiversity and human health	• ecological health • use of underused natural plant resources • health benefits due to high plant content of bioactive compounds
	Economic benefits	• diversification of farm income • adding values to the existing crops • spreading out risks • less affected by price fluctuations
	New market opportunities	• access to regional, domestic, and global markets with new products • well suited for conventional, organic, upscale and ethnic markets
	Environmental protection	• low inputs • perform well under water- and nutrient-limited conditions • could be grown in marginal and degraded lands
CHALANGES	Lack of cultivars.	• imported germplasm not adapted to local production conditions
	Limited information on cultural practices	• specific growing requirements
	Marketing and handling issues	• limited knowledge of market demands • the high risks inherent in establishing a viable supply chain for a new crop product • a long period before profits are measured
	Policy and research issues	• little public funding for research • minor attention from the decision-makers and institutions

Energy – crops

Alternative crops are considered as energy crops if the purpose of the cultivation is not human or animal consumption, but production of plant raw materials for conversion into biofuels and bioenergy. Compared to major field crops, energy - crops produce more biomass throughout the annual production cycle. Energy- crops are grasses (miscanthus, reed, prairie millet, tall sedge, elephant grass, Sudan grass, sorghum), legumes (lupins, soybeans) and daisy family (jerusalem artichoke, safflower). Species of the cabbage family, *Euphorbiaceae* (castor and jatropha) and *Cannabaceae* (industrial hemp) have a high grain oil content, important for obtaining biodiesel. Some species from the *Malvaceae* family have excellent bioenergetic value (kenaf, abutilon and Virginian mallow).

Some of the alternative plant crops have a long production tradition (hemp, sorghum, broomcorn), while others are not well known to Serbian farmers. For some there are certified varieties, while for others the breeding process has just started (gene pool import, collection of autochthonous genetic resources) using different methods of hybridization and selection.

The agropedological conditions of Serbia favor the production of energy - crops. In order to mitigate the effect of the limiting factors of cultivation, the correct choice of the species, agricultural form and assortment of energy-crop is of extreme importance. Each of these alternative plant species has specific advantages that can make it suitable for a specific growing region. The fondation of high and stable yields of energy crops is a system of good - agricultural - practice. Proper crop rotation and compliance with integral crop management measures, could ensure proper development of energy crops even in unfavorable weather conditions. Energy - crops are a chance for profit for farms with soils of less favorable physical and chemical properties.

In the time of global warming, stable yields of the most high-yielding types of major commodity crops are threatened and insufficient to ensure the farms' sustainability. There are no realistic possibilities for a significant increase in irrigated production areas; therefore the imperative of agricultural science and practice must be finding solutions to the curent issues of arid agriculture. Some of the solutions are to breed staple crops varieties adapted to unfeverable growing conditions (Marjanović Jeromela et al., 2019; Rajković et al., 2022), maximal utilization of genetic resources (Varotto et al., 2022), and the application of the up-to-date biotechnology methods (Miladinović et al., 2021).

Alternative crops knowledge management

The diverse requirements of agricultural producers, processing industries and consumers, in terms of cultivation, processing and the quality of primary raw materials and products, as well as the economic and ecological benefits of growing alternative crops, impose the need for inter- and multidisciplinary research and the use of twenty-first-century tools for the transfer and application of acquired knowledge.

The knowledge-based economy is a framework for the generation, transfer and effective use of collected knowledge by all participants of the circular chain (industry, research centers, policy makers and the general public) in order to strengthen economic growth and employment (Skrodzka, 2016). The formation of knowledge bases can help overcome key technological bottlenecks (Ge & Liu, 2021).

An appropriate means of the sector's progress through the creation, exchange and application of knowledge are different types of projects: (i) research and innovation (ii) demonstration, and (iii) coordination and support projects. Research-innovation projects are focused on researching the potential for increasing yields, production of products with added value and finding alternative applications, etc. The funding of the projects is crucial for the development of production technologies of the minor cultivated crops.

Considered to be leaders in one or more areas of science and technology, Centers of Excellence (CoE) are established with intent to conduct research and support innovation activities (Yakovlev et al., 2015), often characterized with unique technical, intellectual and human resources. In September 2021, The National Council for Scientific and Technological Development of the Republic of Serbia granted the status of the CoE – 'Centre of Excellence for Innovations in Breeding of Climate-Resilient Crops', Institute of Fields and Vegetable Crops in Novi Sad. Among other activities, CoE is directed towards conducting research of many alternative crops. The solutions developed in the CoE should serve the production systems affected by current climate change. The Center's activities include: (i) exploiting existing and creating new genetic variability, (ii) breeding superior genotypes, and (iii) knowledge and know-how-technology transfer and implementation.

Attitudes on agricultural innovations and promotion of rural development is highly dependent on extension trainings (Kassem et al., 2021). Agricultural-ex-

tension services are "the entire set of organizations that facilitate and support people engaged in agricultural activities to solve problems and to obtain information, skills, and technologies to improve their livelihoods and well-being" (Davis et al., 2020). According to a survey conducted in the United States, questionable social attitude of the community and (inadequate) industrial hemp knowledge were directly related to respondents' openness to hemp cultivation (Dingha et al., 2019). In the Unated States, by 2000 The Kansas Center for Sustainable Agriculture and Alternative Crops (KCSAAC) was established and 'works with state and federal agencies, nonprofit organizations, environmental groups, and producer organizations to assist family farmers and ranchers to boost farm profitability, protect natural resources, and enhance rural communities' (Kansas State University, 2023). KCSAAS administrative home is the Kansas-State Research and Extension Programs Unit in the College of Agriculture.

Government bodies and agencies are also important actors in the alternative crops knowledge creation and management.

Common interest to contribute to the alternative-crops-related industries, has led farmers, medical experts, researchers and other stakeholders to geather around multiple organizations and associations. Dedicated events are organized nationally and globally that provide networking and educational opportunities for researchers, innovators and industry experts. Connecting the economy with science and investors is the primary goal of such events.

Conclusions

Growing alternative crops is an opportunity for economic and environmental sustainability. However, numerous obstacles to the successful commercialization of these crops could be attributed to the lack of reliable information regarding the adequate choice of plant species and assortment, cultivation technology and market conditions. The process of developing and introducing an alternative crop into agricultural production systems is long and challenging and requires consistent public and private funding and a close partnership between legislators, research institutions, industry and the general public. Given overall multipurpose potential of alternative crops, a top priority should be set to the promotion of the currently underutilized plant species. In order to manage knowledge about alternative crops efficiently, it is necessary to develop protocols for harmonizing the interaction of all participants in the chain - creators, providers and end beneficiaries of the knowledge at the global level.

Literature

1. Davis, K. E., Babu, S. C., & Ragasa, C. (2020). *Agricultural extension: Global status and performance in selected countries*. Washington, D. C.: International Food Policy Research Institute.
2. Díaz, S., Fargione, J., Chapin, F.S.I.I.I. & Tilman, D. (2006): Biodiversity loss threatens human well-being. *PLoS Biol*. 4(8):E277.
3. Dingha, B., Sandler, L., Bhowmik, A., Akotsen-Mensah, C., Jackai, L., Gibson, K., & Turco, R. (2019): Industrial hemp knowledge and interest among North Carolina organic farmers in the United States. *Sustainability*, 11(9), 2691. https://doi.org/10.3390/su11092691
4. Brodt, S., Six, J., Feenstra, G., Ingels, C. & Campbell, D. (2011): Sustainable Agriculture. *Nature Education Knowledge* 3(10):1.
5. Ge, S., & Liu, X. (2021): The role of knowledge creation, absorption and acquisition in determining national competitive advantage. *Technovation*, 102396. https://doi.org/10.1016/j.technovation.2021.102396.
6. Kansas State University (2023): Kansas Center for Sustainable Agriculture and Alternative Crops. Retrieved from http://kansassustainableag.org/about (2/1/2023).
7. Kassem, H. S, Alotaibi, B. A, Muddassir, M., & Herab, A. (2021): Factors influencing farmers' satisfaction with the quality of agricultural extension services. *Evaluation and Program Planning*, 85, 101912. https://doi.org/10.1016/j.evalprogplan.2021.101912.
8. Kim, HJ. (2016): Opportunities and challenges of alternative specialty crops: the global picture. *Horticultural Science*, 51(11): 1316–1319.
9. Marjanović-Jeromela, A., Terzić, S., Jankulovska, M., Zorić, M., Kondić-Špika, A., Jocković, M., Hristov, N., Crnobarac, J. & Nagl, N. (2019): Dissection of Year Related Climatic Variables and Their Effect on Winter Rapeseed (Brassica Napus L.) Development and Yield. *Agronomy*, 9, 517. https://doi.org/10.3390/agronomy9090517
10. Miladinović, D., Antunes, D., Yildirim, K., Bakhsh, A., Cvejić, S., Kondić-Špika, A., Marjanovic Jeromela, A., Opsahl-Sorteberg, H. G., A Zambounis, A. & Hilioti, Z. (2021): Targeted plant improvement through genome editing: from laboratory to field. *Plant cell reports*, 40(6):935-951.

11. Rajković, D., Marjanović Jeromela, A., Pezo, L., Lončar, B., Zanetti, F., Monti, A., & Kondić Špika, A. (2022): Yield and Quality Prediction of Winter Rapeseed—Artificial Neural Network and Random Forest Models. *Agronomy*, 12(1): 58. https://doi.org/10.3390/agronomy12010058

12. Skrodzka, I. (2016): Knowledge-based economy in the European Union – cross-country analysis. *Statistics in Transition*, 17(2), 281-294.

13. Varotto, S., Krugman, T., Aiese, C., Kashkush, K. R., Kondic-Spika, A., Aravanopoulos, F., Pradillo, M., Consiglio, F., Riccardo, A., Ales, P. & Miladinovic, D. (2022):Exploitation of epigenetic variation of crop wild relatives for crop improvement and agrobiodiversity preservation. *Theoretical and Applied Genetics*, 135:3987–4003.

14. Yakovlev, N. A., Kostikov, S. K., Kozyreva, N. I. & Martyushev, V. N. (2015): From high technologies to the technological superiority. *Procedia - Social and Behavioral Sciences*, 166:232-234. https://doi.org/10.1016/j.sbspro.2014.12.516.

15. Zecca, F. & Rastorgueva, N. (2017): Knowledge management and sustainable agriculture: the Italian case. *Food safety management*, 18(159):97–104.

AGRICULTURAL INSURANCE: CURRENT DEVELOPMENT IN SERBIA AND MONTENEGRO

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Abstract

Plant production is exposed to numerous risks from unfavorable weather conditions, especially in the current period, which is characterized by increasingly pronounced climate changes. Livestock production is also exposed to risks and they primarily relate to animal diseases and accidents. Insurance is the most common system for risk management in agricultural production. The aim of the paper is to analyze the current development of agricultural insurance in the Republic of Serbia and the Republic of Montenegro. The authors analyze the offer on the agricultural insurance market as well as the support of the state, through regressing the premium, as significant prerequisites for the development of agricultural insurance. On the basis of the research carried out, the authors give recommendations for the development perspectives of agricultural insurance, and thus agriculture, as a significant economic activity for both of the countries.

Key words: *risks of agricultural production, agricultural insurance, development, Serbia, Montenegro*

Introduction

The importance of agricultural insurance is that it provides economic protection to the insured - agricultural producers from harmful effects and disruptions caused by the occurrence of the insured event, that is, the realization of the risk covered by the insurance. Agricultural insurance "plays a significant role in measures for the protection and improvement of agricultural production" (Sredojević et al, 2010, p. 207). According to

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(Mishra, 1995) "agricultural insurance, particularly crop insurance, exists in many countries as an institutional response to the current risks accompanying agricultural production" (Mishra, 1995, p. 86). The authors (Chambers & Quiggin) state that there are several types of risk management in agriculture available to agricultural subjects, and one of them will almost inevitably be the purchase of an insurance policy in every risk management program (Chambers & Quiggin, 2004, p. 203).

Agricultural insurance is most often highlighted as the most widespread way to manage risks. In this sense, Roberts defines agricultural insurance as "a segment of risk management, and its development depends on the cost-benefit ratio at the level of agricultural holdings or agricultural enterprises, as well as on the potential offer on the insurance market" (Roberts, 2005, p. 93). Different classifications of risks associated with agricultural production are present in the literature. According to (Hardaker et al.) risks can be divided into: production or yield risks, financial, institutional, human and property risks (Hardaker et al, 1997, p. 33). Clasification of three groups of risks that threaten agricultural production is preveiling in literature. These are: natural, social and economic risks (Ray, 2013, p. 10).

Agricultural production in modern conditions is increasingly threatened by extreme natural conditions, which are characterized by high temperatures or heavy rainfall, and their cause is increasingly pronounced climate changes. Intensive agricultural production is one of the causes of current climate changes, as well as uncontrolled exploitation of other natural resources (Njegomir et al, 2017). With the intensification of production, greenhouse gas emissions related to agriculture, have doubled in the last 50 years, and projections predict a further increase (Hohl, 2019). According to the opinion of the Food and Agriculture Organization (FAO), a more sustainable approach to agriculture is needed, in order to use land, water and resources more efficiently, and at the same time increase farmers' incomes, as well as food security (FAO, 2016). In particular, agricultural production faces more demanding tasks, given that, according to FAO projections, agriculture will have to produce almost 50% more food, feed and biofuels by 2050 compared to 2012 (FAO, 2016). The United Nations, recognizing the complexity and importance of the problem of climate change, adopted the document "Sustainable Development Goals", where under goal number 13, they called on countries to take urgent measures to combat climate change (FAO, 2017). Climate change and future economic development are the main factors affecting supply and demand for agricultural products, as well as food security (Hohl, 2019).

Methodology

The aim of the paper is to analyze the current development of agricultural insurance in the Republic of Serbia and the Republic of Montenegro. For this purpose, the representation of economic protection of agricultural production among agricultural farms is analyzed, bearing in mind that they are the most numerous in the structure of agricultural entities in both countries. Also, the offer on the agricultural insurance market is analyzed, as well as the state's support for the development of agricultural insurance, which is realized through regression of the agricultural insurance premium. The paper uses descriptive, statistical, as well as the method of analysis and synthesis. The sources of data used in the research are legislative regulations, data from the Ministry of agriculture, as well as conditions for agricultural insurance of insurance companies that operate on the agricultural insurance market in the Republic of Serbia and in the Republic of Montenegro.

Research results

The research analyzes the offer of insurance companies that operate on the territory of the Republic of Serbia, that is, the Republic of Montenegro, in terms of coverage of the most significant risks that endanger plant and livestock production. Also, the amount allocated from the agricultural budget, for agricultural insurance premium regressions in the entire period since these incentives were introduced, is analyzed, as well as the number of agricultural farms that have realized the right to them in the last five years.

Current situation in Serbia

There is a satisfactory offer on the agricultural insurance market in terms of coverage of basic and supplementary risks of crop and livestock production (Radović, 2018a). For the purpose of "the development of agricultural insurance in the Republic of Serbia, it is necessary to have a greater offer of insurance against the risk of drought and loss of income on the market" (Radović, 2016, p. 181). Livestock insurance policies can provide coverage for basic risks, namely: death due to disease and accident, as well as slaughter out of necessity. However, for the development of this type of insurance an increase in the livestock fund is required (Radović, 2018b).

The participation of the agricultural insurance premium recourse in the agricultural budget, in the entire period of existence of this measure, is shown in table number 1. Based on the data presented, it can be stated that the specified participation was above 1% only in a few years, the largest was 1.25 % in 2020, and that the average participation was only 0.65%.

Table 1. *Participation of agricultural insurance premium recourse in the agricultural budget in the period 2006-2021.*

Year	Agrarian budget (in millions of RSD)	Funds for agricultural insurance premium recourses (in millions of RSD)	Share of funds for agricultural insurance premium recourses in the agricultural budget (in %)
2006	27,543.9	12	0.04
2007	26,095.8	35	0.13
2008	32,895.4	120	0.36
2009	26,690.4	62	0.23
2010	31,577.9	77	0.24
2011	33,676.0	171	0.51
2012	40,876.7	267	0.65
2013	44,699.5	335	0.75
2014	45,427.2	455	1.00
2015	45,308.2	476	1.05
2016	40,465.7	450	1.11
2017	43,787.6	450	1.03
2018	44,109.2	150	0.34
2019	54,614.7	600	1.10
2020	56,067.9	700	1.25
2021	60,271.3	327	0.54
Average share of agricultural insurance premium recourse in the agricultural budget:			0.65

Source: RS Budget Law 2006-2021; Regulations 2006-2021. Author's calculation.

In Serbia, agricultural insurance premiums have been paid from the agricultural budget since 2006. In the current period, recourses amount to 40% of the value of the insurance premium, and up to 45% for agricultural holdings located in areas that are considered to have difficult conditions for agricultural production. Agricultural farms located in the area of five administrative districts (Moravički, Kolubarski, Podunavski, Šumadijski and Zlatiborski), for which it is considered that in their area agricultural production is the most threatened by bad weather, have the right to recourses in the value of up to

70% of the agricultural insurance premium. Agricultural insurance premiums paid from the budget of local governments can be cumulatively added to the stated percentages of recourse, so that in some municipalities the recourses fully cover the premium - the price of agricultural insurance. Agricultural entities, in accordance with current regulations, can collect a maximum of 2.5 million dinars per year based on recourse to the agricultural insurance premium. The number of registered agricultural farms, which in the period 2016-2020 used the right to recourse to agricultural insurance premiums is shown in table number 2.

Table 2. *The number of agricultural farms that exercised the right to recourse in the period 2016-2020.*

Year	Number of agricultural farms
2016	20,112
2017	22,171
2018	22,475
2019	16,303
2020	28,100

Source: Directorate for Agrarian Payments of the Ministry of Agriculture, Forestry and Water Management of the RS

There are a total of 301,028 registered agricultural farms in Serbia, according to the last published statistical data (Group of authors, 2019). On the basis of the above, it can be concluded that in 2020, only 9.3% of the total number of agricultural farms exercised the right to recourse to agricultural insurance premiums, i.e. insured their production.

Current situation in Montenegro

By analyzing the agricultural insurance conditions available on the websites of companies operating on the insurance market in Montenegro, it can be concluded that the current offer includes coverage against basic as well as some additional risks.

Table 3. *Participation of agricultural insurance premium recourse in the agricultural budget in the period 2008-2021.*

Year	Agrarian budget (in thousands of euros)	Funds for agricultural insurance premium recourses (in thousands of euros)	Share of funds for agricultural insurance premium recourses in the agricultural budget (in %)
2008	14,750	100	0.7
2009	19,750	100	0.5
2010	18,671	20	0.1
2011	15,736	10	0.1
2012	14,580	360	2.5
2013	14,143	300	2.1
2014	14,030	200	1.4
2015	14,975	202	1.3
2016	16,219	200	1.2
2017	16,900	80	0.5
2018	18,788	80	0.4
2019	22,318	150	0.7
2020	24,405	200	0.8
2021	27,162	200	0.7
Average share of agricultural insurance premium recourse in the agricultural budget:			0.9

Source: Budget Law of the Republic of Montenegro, 2008-2021. Author's calculation.

Economic protection of agricultural production with financial incentives from the state can be realized in Montenegro since 2008. In the initial year, the subsidies amounted to 30% of the total value of the paid insurance premium. Since 2009, these subsidies have been increased and since then they are paid in the amount of up to 50% of the value of the insurance policy (https://wapi.gov.me). Based on the data shown in table number 3, it can be stated that the average share of funds for agricultural insurance premium recourses, in the entire period of their existence so far, was less than 1%.

Crop production insurance provides coverage against basic risks, namely: risk of hail, fire, excessive precipitation, and lightning. Crops and fruits can be insured against additional risks, namely: from spring and autumn frost, storm and flood. In the case of crop and fruit insurance, it is necessary that the agricultural holding fulfills all agro-technical measures and principles of good agricultural practice during production, as well as that it is a registered

agricultural producer. Also, there is a possibility to insure against basic, as well as some additional risks in livestock production. These risks are: death, forced slaughter, diseases and animal accidents. In the case of animal insurance, it is necessary for the agricultural farm to undertake all necessary veterinary, sanitary (hygienic) and zootechnical measures, that is, to organize regular veterinary examinations and to fulfill all prescribed measures, for the keeping and use of animals.

In addition to subsidies of the state, some local governments allocate funds from their budgets for the purpose of developing agricultural insurance. For example, the Municipality of Pljevlja approves subsidies in the amount of up to 25% of the value of the insurance policy (https://pljevlja.me). Despite the financial support of the state, a small number of agricultural producers insure their production. In 2012, only two, and in 2013 nine agricultural insurance policies were concluded. According to the data of the Ministry of Agriculture, Forestry and Water Management, in 2017, 74 agricultural farms insured their production, in 2018 there were 262, in 2019 the number of insured agricultural farms increased to 313, and in 2020 there were fewer of them, 297 of agricultural producers ensured its production (https://mina.news). According to the latest available data, there are a total of 14,831 registered agricultural farms in Montenegro (https://www.gov.me). This means that in 2019, when the largest number of insured agricultural farms was recorded, they accounted for only 2.1% of the total number of registered agricultural farms in this country.

Conclusion

Agricultural insurance, although in the current conditions of increasingly pronounced climate changes can be considered a necessary agrotechnical measure, it is insufficiently represented in both Serbia and Montenegro. Based on the results of the realized research, it can be concluded that there are subsidies in both countries for the purpose of developing agricultural insurance. Also, insurance companies' offers on the market cover basic and supplementary risks of crop and livestock production. The reason for insufficient application of the available economic protection of agricultural production is the lack of interest and lack of information among agricultural producers. Often the reason is the insured's lack of trust in the objectivity of the insurer, that is, negative experiences in working with them. In order to develop agricultural insurance, continuous cooperation of all three relevant

subjects (insurance companies, agricultural producers and the relevant ministry) is necessary, in order to overcome current problems.

In order to develop agricultural insurance both in the Republic of Serbia and in the Republic of Montenegro, it is necessary to draw up a Strategy for the Protection against Climate Change in Agriculture, which developed countries have adopted a long time ago. An important element of this strategy is the economy of climate change, in which insurance in agriculture plays an important role.

Literature

1. Chambers R. G, Quiggin J. (2004): *Technological and financial approaches to risk management in agriculture: an integrated approach,* Australian Journal of Agricultural and Resource Economics, Vol. 48, pp. 199-223.
2. FAO (2016): *Managing Climate Risk Using Climate-Smart Agriculture*, Rome, Italy, FAO Publication.
3. FAO (2017): *The Future of Food and Agriculture – Trends and Challenges*, Rome, Italy, FAO Publication.
4. Grupa autora (2019): *Anketa o strukturi poljoprivrednih gazdinstava, 2018: Struktura, ekonomska snaga i marketing proizvoda poljoprivrednih gazdinstava*, Republički zavod za statistiku, Beograd.
5. Hardaker J. B, Huirne R. B. M, Anderson J. R. (1997): *Coping with Risk in Agriculture*, CAB International, Wallingford, USA; USDA.
6. Hohl R. M. (2019): *Agricultural Risk Transfer, From Insurance to Reinsurance to Capital Markets,* John Wiley & Sons Ltd, The Atrium, Southern Gate, Chichester, West Sussex.
7. Mishra P. K. (1995): *Is Rainfall Insurance a New Idea? Pioneering Work Revisited*, Published by: Economic and Political Weekly, Vol. 30, No. 25, pp. A84-A88.
8. Njegomir V, Marović B, Pejanović R, Kuzmanović B. (2017): *Klimatske promene i osiguranje poljoprivrede,* Monografije, Prezent press, Beograd.
9. Opštine Pljevlja https://pljevlja.me/wp-content/uploads/2021/04/agrobudzet-stampa-1.pdf?x55136 (12. 10. 2022.)

10. Program podsticaja osiguranja u poljoprivredi, https://wapi.gov.me/download/9830346f-7e15-4620-a797-e9e228d4756b?version=1.0. (17. 10. 2022.)
11. Radović G. (2016): *Poljoprivredno osiguranje kao moguća vrsta obaveznog osiguranja u Republici Srbiji*, Doktorska disertacija, Fakultet za poslovne studije, Univerzitet „Džon Nezbit“, Beograd.
12. Radović G. (2018): *Komparativna analiza posebnih uslova za osiguranje biljne proizvodnje na tržištu poljoprivrednog osiguranja u Srbiji,* Tokovi osiguranja, Br. 1/2018, str. 75-94.
13. Radović G. (2018): *Uporedna analiza posebnih uslova za osiguranje životinja na tržištu poljoprivrednog osiguranja u Srbiji*, Tokovi osiguranja, Br. 3/2018, str. 81-98.
14. Ray P. K. (2013): *Agricultural Insurance: Principles and Organization and Application to Developing Countries*. Elsevier, The Food and Agriculture Organisation of the United Nations, Rome, Italy.
15. Registrovana poljoprivredna gazdinstva u Crnoj Gori https://www.gov.me/dokumenta/bb20e217-c9b4-454b-8db5-e96f03c25164 (15. 10. 2022.)
16. Roberts R. A. J. (2005): *Insurance of crops in developing countries*, (Vol. 159) Food and Agriculture Organisation of the United Nations, Rome, Italy.
17. Sredojević Z, Jeločnik M, Subić J. (2010): *Insurance as Possibility of Business Risk Reducing in Agriculture,* Scientific Papers Series Management „Economic Engineering in Agriculture and Rural Development“, Vol.10 (2), pp. 207-211.
18. U prošloj godini osigurano samo 297 poljoprivrednika, https://mina.news/mina-business-ekonomske-vijesti-iz-crne-gore/u-prosloj-godini-sigurano-samo-297-poljoprivrednika/, (4. 10. 2022.).
19. World Meteorological Organization (2018): *Understanding the IPCC special report on 1.5*℃ (2018): Geneva, Switzerland, Nairobi, Kenya, United Nations Environment Programme.

COOPERATIVE SOCIETY IN FUNCTION OF SUSTAINABLE RURAL DEVELOPMENT

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Abstract

The cooperative system of organization in the world is very efficient and developed in all areas of life and work, and in the function of economic and regional development. Cooperatives in Serbia have a tradition and a significant role in the development of agriculture and villages. As active participants in many positive processes, cooperatives were developing in different socio-economic conditions and took on the characteristics of the periods they were passing through, which directly affected their work and business. Bearing in mind the importance of agriculture and the countryside and in this sense the role of cooperatives in sustainable rural development, significant financial resources are invested in the development of the cooperative system. Looking at and analyzing natural and socio-economic factors, the goal is to point out the importance of mutual connection of cooperatives and their cooperation with scientific institutions, in order to apply the latest scientific and technical achievements in practice, with the aim of more rational use of available natural resources and human potential, and in the function sustainable rural development.

Key words: *cooperatives, agriculture, village, sustainable development, rural development.*

Introduction

The cooperative sector in Serbia is the subject of increasing interest of the scientific and professional public. The state has undertaken a series of measures aimed at the restoration of cooperatives and the revival of the Serbian countryside. Based on the importance of agricultural development and cooperatives for balanced rural development, significant financial resources are invested in the development of the cooperative system, so that young people in the villages can create a more favorable environment for the production and

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marketing of products and improve the development of rural areas. Serbian cooperatives went through numerous transformations, and cooperatives took on the characteristics of certain socio-economic systems. After several years of almost complete neglect of cooperatives by state authorities, the Law on Cooperatives was adopted in 2015 ("Official Gazette of RS", no. 112/2015), and two years later, the implementation of the program called "500 cooperatives in 500 villages" begins, which involves the allocation of grants to existing and newly formed cooperatives. For the first time in the last few decades, financial resources were invested directly in the cooperative sector, and the basis for this activity is Article 12 of the Law on Cooperatives (2015), according to which "cooperatives enjoy the special protection of the Republic of Serbia, autonomous provinces and local self-government units in the performance of their predominant activities". The goal is to return to cooperatives the role of driver of village development, both economically, culturally, socially and ecologically, bearing in mind that they have always played a significant role in the development of rural areas. Association based on modern principles should enable the organization of other activities in rural areas, such as various crafts, ethnic tourism, health tourism, cultural and sports events. The future should bring the application of the experiences of the best European cooperative sectors, and above all the specialization of cooperatives and the formation of complex cooperatives, so that producers can connect with each other, but also with scientific institutions in order to apply the latest scientific solutions, knowledge and experience in practice.

Cooperatives in the function of supporting sustainable rural development

Bearing in mind that sustainable development as a modern development concept harmonizes the social, economic and ecological interests of current and future generations, cooperatives should play an important role, especially in the sustainable development of rural areas of the Republic of Serbia. The definition of the World Commission for Environment and Development, the so-called Brundtland Commission that sustainable development meets the needs of the present, without questioning the ability of future generations to meet their own needs, indicates, among other things, the need to preserve natural resources and human potential. Sustainability, or sustainable development, is an essential prerequisite, but also the ultimate goal of the efficient organization of overall human activity on our planet (Milanović, 2008). In the struc-

ture of cooperatives in Serbia, the majority are agricultural, so we are primarily talking about their role in the sustainable development of rural areas. In this sense, it is important to emphasize the long tradition of cooperatives, and in support of that, the first agricultural credit cooperative was founded in 1894 in the village of Vranovo, near Smederevo, and the founder was Mihailo Avramović, a Serbian theoretician and publicist, together with 28 Vranovo peasants. The first agricultural cooperative association in Serbia was founded on July 20, 1895 in Smederevo under the name of the Main Union of Serbian Agricultural Cooperatives. Cooperatives significantly contributed to the development of agriculture and other economic activities, and as a form of economic association of farmers, it developed very quickly. The first credit cooperatives expanded their activities, which led to the emergence of new, specialized forms of cooperatives, such as producer-processing cooperatives, procurement-consumer cooperatives, cooperatives for joint procurement and use of agricultural machinery, and others. With the adoption of the Law on Agricultural Cooperatives in 1898, cooperatives developed faster, so that in Serbia until the First World War, an average of 56 agricultural cooperatives were founded per year.

Table 1. *Credit Cooperatives in Serbia from 1894 to 1913.*

Year	Number of cooperatives	Year	Number of cooperatives
1894	5	1904	429
1895	12	1905	525
1896	17	1906	573
1897	50	1907	629
1898	109	1908	654
1899	167	1909	683
1900	244	1910	694

Source: Monograph '100 years of agricultural cooperatives in Serbia', 1994.

The development of cooperatives was determined by numerous specificities, depending on the policy of economic development and the economic position of farmers. There were periods when Serbian cooperatives suffered huge damages and many cooperatives lost their property and disappeared. Despite the problems they faced, there were some that survived. The modern cooperative system of organization and economy in all developed countries of the European Union is an important segment of the economy. Cooperatives are recognized as the best form of rapid employment and development of less at-

tractive economic areas, and the experiences of good regulation and practice of EU member states were also used during the preparation of the current Law on Cooperatives (2015). The International Cooperative Federation consists of 105 countries with more than a billion cooperative members and about 3 million cooperatives, employing over 280 million people and achieving a total annual income of 2.1 trillion US dollars. One of the most important issues of cooperatives is the horizontal and vertical association of our farmers in cooperatives, joint stock companies, business associations and other types of association. The importance of agricultural cooperatives for the development of rural areas is best illustrated by data on the structure and size of holdings of agricultural holdings. According to the agricultural census from 2012, the average size of the property is about 4 hectares, and the concentration is made at slightly more than 5,500 farms, which on average cultivate over 96 hectares and participate in the structure of the total cultivated agricultural areas with 18.7%. According to the data of the Cooperative Union of Serbia, every fifth resident of a village in Serbia is over 65 years old, while in the region of Southern and Eastern Serbia it is every fourth. The question is how to rationally organize 623,000 farms with small and medium-sized property, if the revival of cooperatives is not realized. In response to this, but also to many other questions, since 2012, the restoration of the place and role of Serbian cooperatives began, and after many years, agricultural cooperatives were for the first time enabled to be beneficiaries of current and development incentives, provided for by the measures of the economic and agrarian policy of the Government of the Republic Serbia. The most significant systemic measure is the adoption of the Law on Cooperatives in December 2015, which simplified the procedure for establishing and starting activities, defined the relationship of state authorities in the function of developing cooperatives, and simplified the procedure for proving and registering cooperative property. For the first time since the Second World War, in 2017, the budget of the Republic of Serbia provided grants for improving the work of agricultural cooperatives, which are used primarily for the purchase of equipment, which creates conditions for the production of competitive cooperative products, but also a more favorable environment for the development of rural areas.

The current state and possibilities of improvement of cooperatives

Cooperatives of Serbia today are in a relatively specific position and are faced with numerous challenges. The cooperative sector in the Republic of Serbia

is best illustrated by the following data: out of a total of 5,246 cooperatives of all types (agricultural, housing, consumer, craft, worker, student-youth, social, health, as well as other types of cooperatives for production, trade of goods, provision of services and other activities in accordance with the Law on Cooperatives), 2,909 cooperatives, or 55%, are active. Of the total number of active cooperatives, 75% are agricultural cooperatives. Business income is generated by 1,454 cooperatives or 50%, which is a far better average than the rest of the economy. According to the data of the Cooperative Federation of Serbia, the business income of agricultural cooperatives is 685 million euros per year. These cooperatives represent a direct link between small and medium producers and the market for reproduction materials and agricultural products. Current accounts of 664 cooperatives are blocked, 180 cooperatives are in the process of liquidation, 57 are in the process of bankruptcy, while 1908 cooperatives have been deleted from the Register. When it comes to newly formed cooperatives, 37% of the total number of cooperatives have business income and this data can be considered European. In cooperatives 5605 workers are employed. In the period of 2015 and 2016, an average of 50 new agricultural cooperatives were formed annually in Serbia. Before the adoption of the Law on Cooperatives in December 2015, in the period from 2010 to 2015, the most newly formed cooperatives were recorded in 2012 and 2013. In the period from 2016 to 2021, the number of newly founded cooperatives exceeded 1,000.

Table 2. *Establishment of cooperatives before and after the adoption of the Law on Cooperatives (December 2015), 2010-2015. year and 2016-2021. years.*

Year	Number of cooperatives	Year	Number of cooperatives
2010	65	2016	52
2011	68	2017	185
2012	74	2018	145
2013	74	2019	304
2014	56	2020	153
2015	46	2021	194

Source: Cooperative Union of Serbia

Adoption of the Program of the Government of the Republic of Serbia for the placement of grants for newly formed and existing cooperatives influenced a significant increase in the number of newly formed agricultural cooperatives in 2017. The number of newly formed cooperatives in 2017 was 3.5 times higher, and in 2019 it was 5.8 times higher than in 2016. Due to the pandemic caused by the Covid-19 virus, a decrease in the number of newly formed cooperatives was recorded in 2020. According to the data of the Cooperative Union of Serbia, in 2015 and 2016, agricultural cooperatives were formed evenly on the territory of Vojvodina and in the central part of Serbia. However, in 2017, twice as many new agricultural cooperatives were formed in the central part of the Republic of Serbia compared to the Vojvodina area, which is the result of the adopted program that gave priority to the districts of Niški, Toplički, Jablanički and Pčinjski. As for the number of cooperative members, there are on average 1.5 more cooperative members per newly formed cooperative compared to the minimum number stipulated by the Law. Looking at the average age of cooperative members per cooperative, it is characteristic that it continuously increases by age, so the average age of cooperative members is 46 years old. The above data can serve as a basis for the creation of economic and agrarian policy measures in this area, with the aim of sustainable rural development.

Development directions of cooperatives in the context of rural development

The Law on Cooperatives regulates this area in a modern way, and was prepared at the initiative of cooperatives and cooperative associations, in order to regulate the operations of cooperatives in Serbia, define the property of cooperatives, increase their competitiveness and access to credit, increase the number of cooperative members and enable inclusion in cooperatives and social threatened. The establishment of social cooperatives of socially disadvantaged groups is foreseen, while Article 11 of this Law defines the existence of consumer cooperatives, which provide joint procurement of services and goods for their cooperatives. Also, the Law on Cooperatives establishes the cooperative audit. Observing the current situation in the villages and agriculture of Serbia, one of the most important issues is the horizontal and vertical association of our agricultural producers (in cooperatives, joint stock companies, business associations and other types of association). The category of rural areas at the local level includes those areas with a population density be-

low 150 inhabitants per km2. When forming new cooperatives or training the existing ones, more importance should be given to the development of animal husbandry, as a key factor in the economic development of villages. Special emphasis is placed on the opening and development of family and cooperative processing capacities, in order to improve the standard of the rural population through traditional final products with geographical origin and organic production. For sustainable rural development, it is important that cooperatives have a great potential for safer and sustainable businesses, because through cooperatives it is possible to offer services to the community, which the private corporate sector does not provide due to low profits. However, cooperatives are limited by the unresolved issue of property, so they have difficult access to the capital market because they practically have nothing to guarantee. The lack of credit is a limiting factor for the performance of current activities and especially the provision of investment funds for capital investment in facilities and equipment in the processing industry. Agricultural cooperatives were not included in the incentives system of the ministries of agriculture and economy from 2004 to 2012, and only with the adoption of the Law on Incentives in 2013 were they equalized with the rights of registered farms. Bearing in mind that cooperatives are becoming an important factor for overcoming social and economic limitations in the development of rural areas, it is necessary to improve their work by hiring professional staff. The lack of credit is a limiting factor for the performance of current activities and especially the provision of investment funds for capital investment in facilities and equipment in the processing industry. Agricultural cooperatives were not included in the incentives system of the ministries of agriculture and economy from 2004 to 2012, and only with the adoption of the Law on Incentives in 2013 were they equalized with the rights of registered farms. Bearing in mind that cooperatives are becoming an important factor for overcoming social and economic limitations in the development of rural areas, it is necessary to improve their work by hiring professional staff. In the analysis of the cooperative sector, it was observed that there is insufficient employment of professional personnel, with difficult access to the capital market, despite the fact that in the past few years, the state has successfully supported beginners in business, especially in the sector of small and medium-sized enterprises, where cooperatives have remained unnoticed. It is necessary that, for the first time, the Fund for the Development of the Republic of Serbia and Komercijalna Bank, as the bearer of these activities, are included in the lending of cooperatives for business beginners, as the bearer of these activities, by creating specific measures aimed

directly at cooperatives, which would significantly expand the availability of support. This program offers a solution for cooperatives with a good business idea that could not meet the requirements for project financing. Starting from the implementation of Article 12 of the Law on Cooperatives, and taking into account that agricultural cooperatives operate within smaller communities in rural areas, local communities are recognized as a potential source of accumulation of funds needed for the construction and functioning of the Cooperative Development Fund. All forms of cooperatives should be encouraged, in accordance with appropriate criteria, especially in rural areas. The goal is the rational use of available natural resources and human resources, and through the application of standardization, new business programs and marketing, the competitiveness of cooperative products on the market.

Conclusion

Cooperatives have an exceptional potential for revitalizing rural areas, so in order to improve their business, it is necessary to carry out: registration of cooperative property, rezoning of agricultural production and modeling an economically sustainable agricultural farm for each region, as a basis for the use of incentives and the backbone of agricultural development. As important factors of sustainable rural development, cooperatives must not be excluded from the competition for the allocation of funds for the improvement of agricultural production or the implementation of projects in the field of rural development. With the help of the state, it is necessary to improve the personnel potential of cooperatives and cooperative unions, so that they can adequately represent the interests of cooperative members and define the directions and methods of solving all issues. Cooperatives can be engaged as active partners for performing certain tasks of importance for the local community, and it is necessary to enable them to be included in the implementation of action plans for increasing employment in the territory of their operation. Agricultural cooperatives should be connected according to the reputation of European ones, which have a leadership position in the market, which would mean mutual connection of producers, but also with scientific institutions, all with the aim of including cooperatives as much as possible in the modern concept of sustainable rural development.

Literature

1. Milanović M. (2008): *Natural resources-economy, ecology, management.* Institute for Agricultural Economics, Belgrade.
2. Mijajlović, Jasmina (2013): *Indicators of sustainable development of cattle production in the Rasin district*. Doctoral dissertation, Faculty of Biofarming, Bačka Topola.
3. Ranđelović, V. (1999): *Basics of cooperatives and agricultural cooperatives*. Faculty of Agriculture and Cooperative Union of Serbia, Belgrade.
4. Simić, J., Bošković Jelena, Ivanc, A., Komazec Gordana, (2003): *Economic and ecological aspects of the sustainable development of the agricultural sector and the possibility of producing biologically quality food*. Megatrend University of Applied Sciences, Belgrade.
5. Vitez, M., (1988): *Agricultural cooperative*, Scientific book, Belgrade.
6. Cooperative Union of Serbia (1994): *Monograph "100 years of Serbian agricultural cooperatives*", Belgrade.
7. Cooperative Union of Serbia (2002): *Resolution on the development of agricultural cooperatives,* Belgrade.
8. Cooperative Union of Yugoslavia (1995): *A century and a half of cooperatives*, Novi Sad.
9. Law on cooperatives - ZOZ (2015), Official Gazette of RS, no. 112/15.

ANALYSIS OF OPPORTUNITIES AND LIMITATIONS OF RASPBERRY COMMODITY EXCHANGE DEVELOPMENT IN SERBIA

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Abstract

The paper analyzes the opportunities and potential limitations relating to the establishment of a raspberry commodity exchange in Serbia, i.e., raspberry as a potential commodity to be traded on the commodity exchange. In this regard, in addition to the total volume of raspberry production in Serbia, the quality standardization process regarding this fruit is being considered. The research conducted in the empirical section of the paper is based on the questionnaires distributed on the territory of the municipalities of Ivanjica and Arilje with the aim of determining the capacities and readiness of raspberry producers to shift to this alternative way of selling and distributing this particular fruit. Based on the analysis conducted in the paper, it is determined that the inclusion of raspberries in the process of commodity exchange trading in Serbia is possible; however, numerous existing and potential limitations need to be eliminated.

Key words: *community exchange, raspberry, quality standardization.*

Introduction

In practice, there are numerous commodity exchanges through which various agricultural products are being very successfully traded, for example: corn, wheat, soybeans, palm oil, cotton, black pepper, sugar, apples, rapeseed, raisins and etc. Therefore, in terms of Serbia, considering raspberry as a potential commodity exchange product is of great theoretical and practical importance. Raspberries are a very much sought-after commodity on the world market. In addition to being a delicious fruit which can be consumed fresh, i.e., without any further processing, raspberries are an input in the

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production of juices, jams, extracts and the like. They are also very popular due to their proven medicinal properties. Numerous empirical studies confirm that raspberries can help control blood glucose levels in people who are at high risk of developing diabetes (Schell et al., 2019; Di Xiao et al., 2019; Moreno, 2019). This medicinal property of raspberry is of great importance considering that worldwide a growing number of adults are facing this problem. For example, in the US approximately 96 million US residents aged 18 years or older have prediabetes, which is approximately 38% of the total adult population (*National Diabetes Statistics Report*, 2017). In addition, certain raspberry extracts have been proven to protect the skin from damage caused by UVB rays due to their antioxidant and anti-inflammatory properties (Pei-Wen Wang et al, 2019). The antioxidant and cancer-preventing effects of raspberry leaf and fruit extracts have been proven on the example of the Serbian wild raspberry (Veljković et al, 2018). The mentioned benefits of consuming raspberries undoubtedly contribute to the increase in demand for this fruit on a global level. Given the fact that Serbia is one of the world's largest raspberry producers, it is vitaly important to examine the possibilities and potential limitations of the raspberry commodity market development.

Raspberry as a potential commodity exchange product was analyzed in several recent studies. Namely, the research conducted by Šapić et al. (2020) identified the dissatisfaction of raspberry producers with the services provided by the purchasers (the owners of the cold storage warehouses). In other words, the respondents (raspberry producers) gave a lower rating to the quality of cold storage services compared to the rating of the perceived value[4] of selling through the commodity exchange. In addition, it was determined that the perceived value of selling through the commodity exchange had a negative effect on satisfaction with the services provided by the owners of the cold storage warehouses, and therefore on loyalty towards the owners of the cold storage warehouses. Accordingly, the statement included in the mentioned research reading that the raspberry producers would continue to sell their produce through the owners of the cold storage warehouses even in the event that the commodity exchange opened received low ratings from the respondents. Stojković et al. (2020) tested a possible model of raspberry trading through the commodity exchange similar to the one that had been already implemented on the commodity exchange Produktna Berza JSC in Novi Sad. Similar to the findings of the research conducted by

4 For the purpose of commodity exchange services evaluation, the research used the perceived value rated by the respondents based on their knowledge on functioning of commodity exchanges.

Šapić et al., the research carried out by Stojković et al. identified a number of advantages that supported the idea that the inclusion of raspberries in the process of commodity exchange trading in Serbia would be possible. The identified advantages referred to the following: a large volume of production and export of raspberries, long-established and continued production, raspberry fruits were subject to quality standardization, established efficient product storage system and etc. However, in both cases, numerous limitations to the development of the raspberry commodity exchange were identified, the most significant of which included: lack of knowledge concerning the functioning of the commodity exchange, fragmentation of production, raspberry production as a predominantly secondary activity (rather than the main source of income), producers were not members of cooperatives, the existing purchase system offered the possibility of credit funding (borrowing from buyers to fund different agricultural inputs, taking advance payments during the harvest, etc.) and the like.

The aim of this paper is to conduct furter analysis of raspberry as a prospective commodity exchange product. With this in mind, a research aimed at determining additional advantages and limitations of the development of the raspberry commodity exchange in Serbia has been carried out. The first section of the paper looks at the importance of the development of commodity exchanges and the regulatory framework pertaining to their development, while the second section of the paper analyzes the basic characteristics of raspberry production in Serbia. The empirical research is conducted in the third section of the paper.

The importance of commodity exchanges and the regulatory framework pertaining to their commercial activities

The most often cited key functions of commodity exchanges in the relevant literature are as follows: market risk management, reducing counterparty risk, increasing price transparency, reducing risks related to collateral value, certifying quality of commodities and providing direct access to the capital market (Belozertsev, Rutten & Hollinger, 2011, 7). In the past, these market institutions used to be a staple of developed countries. However, owing to the development and availability of computers, the Internet and information technologies, commodity exchanges are also emerging in developing countries nowadays (Rashid, Winter-Nelson & Garcia, 2010). Belozertsev, Rutten & Hollinger (2011) studied commodity exchanges in Europe and Central Asia and determined that the basic conditions for their development include the following:

- Supply and demand for particular commodity need to be sufficiently large;
- The commodity traded must be subject to standardization;
- Commodity pricing should be left to the market;
- The commodity exchange should support major commercial interests;
- Efficient and reliable clearing system has to be established;
- The commodity exchange services have to be well-functioning and accessible and supported by necessary infrastructure facilities;
- The government support is required, including development of adequate regulations and implementation of the appropriate monitoring of the exchange trading.

However, the following elements were observed as the most significant limitations to the development of commodity exchanges in the observed area: poor understanding of commodity exchange functioning and trading activities and insufficient knowledge of risk management system, a low level of agricultural production, underdeveloped agricultural and financial sectors and inadequate agricultural policy (Belozertsev, Rutten & Hollinger, 2011)

The agricultural producers especially benefit from the functioning of the commodity exchange, given that their earnings are conditioned by the product prices, as well as the fact that they are largely exposed to the risk of price changes. In this regard, the volatility of commodity prices and high transaction costs provide a strong theoretical basis for the establishment of commodity exchanges in all parts of the world (Nicholas & Jayne, 2012). Additionally, buyers of agricultural products also benefit from the commodity exchange. The trade through the commodity exchange implies certification of the quality and the quantity of the traded commodities, as well as a well-established system of guarantees for the execution of concluded transactions.

In most cases, commodity exchanges receive significant government support and are regulated by the precisely defined regulations, since they ensure sound trading of the strategically important products. However, in Europe, the field of commodity exchanges' functioning is not regulated by any special EU directives, therefore, the regulatory frameworks pertaining to their functioning differ from country to country. In some cases, the commodity exchange and the capital market are regulated by the same laws. In Serbia, the

Law on the Capital Market provides opportunities for developing a modern commodity futures exchange. In addition, the Law on Trade stipulates that the establishment and operation of the commodity exchange shall be regulated by a separate law. Thus, the Law on Commodity Exchanges was adopted in Serbia in mid-2019, which should contribute to the significant development of the commodity market in the analyzed area. The main goal of this law is the regulation and organization of a fair, transparent and efficient market of certified commodity products and the protection of market integrity (the Law on Commodity Exchanges, Article 3).

The fundamental characteristics of the raspberry production in Serbia

The total production of raspberries at the global level will be analyzed based on the data published by *the Food and Agriculture Organization* - FAO (Table 1).

Table 1. *World raspberry production from 2010-2020, thousand tons*

2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
599.5	569.4	588.1	628.2	676.4	841.9	812.7	850.4	822.5	895.8

Source: FAO, 2022a

Based on the data presented in Table 1, it can be concluded that the period beginning in 2011 and ending in 2020 saw a significant increase in raspberry production. In the observed ten-year period, there was an increase in raspberry production by about 50% at the global level. Observed by the Continent area, Europe is by far the largest producer of this fruit (Table 2).

Table 2. *World raspberry production based on Continent area in 2020.*

Europe	68%
America	30%
Other Continents	2%

Source: FAO, 2022b

In 2020, 610 thousand tons of raspberries were produced in Europe, which represents 68% of the total world production. America comes second with the share in raspberry production of about 30%, while the share of other parts of the world is only about 2% (The Science Agriculture, 2022). The largest producer of raspberries in the world is the Russian Federation, which

produced 182,000 tons of raspberries in 2020, which is about 20% of the total global production of this fruit (Table 3).

Table 3. World's largest raspberry producers in 2019 and 2020.

	2019	**2020**
Russian Federation	174,000	182,000
Mexico	128,848	146,350
Poland	75,660	121,700
Serbia	120,058	118,674
USA	102,510	100,698

Source: Atlas Big (2022); The Science Agriculture, (2022) and Based on data published by FAO.

Serbia ranks fourth in terms of the world raspberry production with a total production of 118,674 tons in 2020. However, in 2019, Serbia held the third place, due to a diminished crop yield of raspberry in Poland. Mexico comes second in terms of raspberry production and this is a country that is becoming increasingly engaged in the production of this fruit. According to the available data, in 2015, raspberries were grown in this country on an area of 3,673 hectares, while in 2020 raspberry growing area increased to 7,767 hectares (Producepay, 2022). With this in mind, based on the data relating to the period between 2008 and 2017, it should be noted that in the mentioned period Mexico was not ranked among the 4 largest raspberry producers in the world (Šapić et al, 2020). On the other hand, raspberry production in Serbia has been a common agricultural activity for many years, which is confirmed by the average annual production of 97,500 tons of this fruit in the period from 2011 to 2020. The total production of raspberries in Serbia is presented in Table 4.

Table 4. *Raspberry production and export in the period 2011-2020, tons*

	Production	**Export**
2011	89,602	73,548
2012	70,320	64,268
2013	68,458	61,417
2014	61,715	73,253
2015	97,165	93,732
2016	113,172	85,957
2017	109,742	94,000
2018	127,010	103,276
2019	120,058	114,354
2020	118,674	107,745

Source: Kljaić et al, 2022 and Statistical Office of the RS, 2022.

Based on Table 4, it can be concluded that the largest part of raspberry production is intended for export, while only a small portion is sold on the domestic market. In 2020 The share of raspberry exports in total fruit exports from Serbia was 40.6% (Kljaić et al, 2022). At the global level, the export of frozen raspberries from Serbia accounts for about 30% of the total world export of frozen raspberries (Development Agency of Serbia). The largest buyers of raspberries grown in Serbia are the EU countries, while the largest amount of this fruit is exported to Germany (more than 40%). Other buyers are France, the Netherlands, Belgium, Great Britain, Russia, and in recent years new markets have emerged, such as the USA, Argentina and Saudi Arabia (PKS, 2022). However, during 2022, there was a significant drop in demand for raspberries on foreign markets. During the first eight months of 2022, 43,000 tons of raspberries were exported, while in the same period in 2021, the export volume amounted to 65,000 tons, thus, the export volume of raspberries fell by about 30% (the Chamber of Commerce and Industry of Serbia, 2022). Some of the reasons for the lower demand are lower sales in supermarkets and lower demand from the processing industry, i.e., generally the spending has been rationed to staple foods. Also, one of the more significant reasons for the drop in demand for raspberries is the increase in warehousing costs and the uncertainty regarding the regular supply of electricity in the future. The decline in demand for raspberries is particularly pronounced among the largest buyers, for example exports to Germany have dropped by about 40%.

Raspberry producers in Serbia are incrisingly opting for the Global G.A.P. Certification to ensure the quality of this fruit. Global G.A.P. rests on the principles of safe and sustainable agriculture and strong partnerships between agricultural producers and buyers. This quality assurance standard refers to the production of primary agricultural products, but also to the follow-up activities. In this respect, fruit harvesting plays a very important role in the raspberry production process, therefore, it is of great importance that it is carried out in the right way. Also, the post-harvest crop activities are of great importance, namely: grading, transport and storage of fruits. All these activities aim to ensure that the end product retains its quality and meets market requirements. Raspberries are frozen after harvesting, and the frozen fruits can be stored for a long time. First, the raspberries are chilled by being stored at a temperatures of up to 0 °C, and then they are deep frozen at temperatures between -35 °C and -45 °C. Deep-frozen fruits are then stored at a temperatures between -18 °C and -20 °C (Agrotv, 2021). After freezing, raspberries are sorted into four categories: “roland quality” (A-grade), “bruh

quality" (whole and broken), "griz quality" (crumble) and "blok quality" (pressed). Deep-frozen raspberries graded as *"Roland quality"* raspberries are of uniform color and ripeness, that is, they are high-quality, individual frozen berries. *"Bruh quality"* means a mixture of frozen whole berries, broken berries and crumble. *"Griz quality"* is crushed raspberry, and *"Blok quality"* is the fourth category of raspberries and is intended for processing (jams, juices, etc.).

Empirical research

Methodology. A survey method was used to collect primary data. The survey was conducted on the basis of personal contact with the raspberry producers. The raspberry producers were contacted mainly at the point of purchase where they were asked to participate in a survey that is to be used for research purposes only. Also, the respondents were informed that the survey was anonymous. The survey questionnaire contained a total of 17 statements divided into four groups. The first group of statements was formulated with the aim of determining the basic characteristics of the individual raspberry producers, while the second group of statements refers to determining the safety and security of raspberry production. The third group of statements is aimed at analyzing the profitability of raspberry production, while the fourth group of questions is aimed at examining the ability and readiness of raspberry producers to switch to an alternative way of selling (i.e., selling through the commodity exchange). The research was conducted in 2022 on the territory of the municipalities of Ivanjica and Arilje. A total of 200 valid survey questionnaires were collected and processed. The results of the research are shown in Table 5.

Table 5. *Research results*

Basic characteristics of raspberry production			
I have been producing raspberries	< 5 years	from 5 to 15 years	> 15 years
	10%	38%	52%
I produce raspberries every year.	YES	NO	
	91%	9%	
The raspberry plantation area is:	up to 50 ares	from 50 ares to 1 hectare	over 1 hectare
	69%	28%	3%
The average annual raspberry crop is:	up to 5 tons	from 5 tons to 1 wagon	over 1 wagon
	30%	53%	17%
Raspberry production is my main source of income.	YES	NO	
	29%	71%	
Safety and security of raspberry production			
I use irrigation system on the raspberry plantation.	YES	NO	
	12%	88%	
I use hail netting to protect my raspberry crops against hail.	YES	NO	
	7%	93%	
I insure my raspberry crops every year.	YES	NO	
	9%	91%	
Profitability of raspberry production			
Raspberry production requires large investments.	YES	NO	Not sure
	49%	19%	32%
The share of harvesting costs in total revenue is	up to 20%	20-40%	over 40 %
	18%	68%	14%
The price of raspberries is realistic (it is determined based on the supply/demand ratio).	YES	NO	Not sure
	15%	46%	39%
The payments for sold raspberries are paid within the agreed period.	YES	NO	Not sure
	51%	35%	14%
Grading of raspberries is implemented in the right way.	YES	NO	Not sure
	39%	43%	18%
The producer's ability and willingness to switch to an alternative way of selling			
Do you have a registered agricultural holding?	YES	NO	
	81%	19%	
Are you a member of an agricultural cooperative?	YES	NO	
	3%	97%	
Would you switch to some alternative way of selling raspberries, e.g., through the commodity exchange?	YES	NO	Maybe
	43%	11%	46%
Would you apply quality standards more effectively in order to achieve a higher purchase price for raspberries?	YES	NO	Maybe
	77%	8%	15%

Source: Authors' research

Based on the conducted research, the following conclusions can be drawn:

- Raspberry production is long-established and continued;
- Raspberry production is generally not the main source of income;
- Raspberry production is mostly carried out without usage of an irrigation system;
- In the great majority of cases, raspberry plantations are not protected against hail damage by anti-hail netting;
- Raspberry crop yield is generally not insured;
- Raspberry production requires increasingly large investments, while the share of harvesting costs is high;
- The majority of respondents believe that the price of raspberries is not realistic and objective, while according to them the sold raspberries are generally paid within the agreed period;
- A smaller number of the respondents believes that the grading of raspberries is implemented in the right way;
- A significant number of respondents does not have a registered agricultural holding, while a negligible percentage of them are members of a cooperative;
- The vast majority of respondents would switch to some alternative way of selling raspberries, in addition, they would be ready to raise the quality of production due to higher earnings.

Conclusion

The large scale of raspberry production and the relatively simple quality grading of this fruit imply the economic justification of including raspberries in the process of commodity exchange trading. In addition, the continuous and long-established production of raspberries in Serbia are additional arguments in favor of the prospective development of the raspberry commodity exchange. However, raspberry plantations are mostly planted on small land areas, while raspberry production is still a secondary economic activity for the great number of producers and does not represent the main source of income. In this regard, greater commitment to raspberry production is needed, as well as greater investment in the production process, primarily concerning the irrigation and hail protection

systems. Furthermore, only a small percentage of respondents regularly insure their production. Nonetheless, there is a willingness and interest among the respondents for some alternative system of sale and distribution of raspberries, which may indicate a real need for the establishment of a raspberry commodity exchange.

Literature

1. Belozertsev, A., Rutten, L. & Hollinger, F. (2011). Commodity exchanges in Europe and Central Asia: A means for management of price risk, *Food and Agriculture Organization/World Bank Cooperative Programme*, Working Paper;
2. Di Xiao, Lanjun Zhu, Indika Edirisinghe, Jawed Fareed, Yevgeniy Brailovsky & Britt Burton-Freeman (2019). Attenuation of Postmeal Metabolic Indices with Red Raspberries in Individuals at Risk for Diabetes: A Randomized Controlled Trial, *Obesity*;
3. Kljaić N., Vuković P., Arsić S., (2022). Raspberry production, trade and market in the Republic of Serbia, *Economics of Sustainable Development*, Vol 67, No. 3;
4. Kljaić, N., Subić, J. & Sredojević, Z. (2017). Profitability Of Raspberry Production On Holdings In The Territory Of Arilje, *Economics of Agriculture,* 57-68;
5. Moreno Ucles, R. (2019). "Effects of Red Raspberry Polyphenols and Metabolites on Biomarkers of Inflammation and Insulin Resistance in Prediabetes and Type 2 Diabetes" (2019). *LSU Doctoral Dissertations*. 4802;
6. Nicholas J. S. & Jayne T.S. (2012). *Why are African commodity exchanges languishing? A case study of the Zambian Agricultural Commodity Exchange, Food Policy*, Volume 37, Issue 3, p. 275-282;
7. Pei-Wen Wang, Yu-Chen Cheng, Yu-Chiang Hung, Chih-Hung Lee, Jia-You Fang,4 Wen-Tai Li, Yun-Ru Wu, & Tai-Long Pan (2019). Red Raspberry Extract Protects the Skin against UVB-Induced Damage with Antioxidative and Anti-inflammatory Properties, *Oxidative Medicine and Cellular Longevity*;
8. Rashid, S. Winter-Nelson, A. & Garcia, Ph. (2010). Purpose and Potential for Commodity Exchanges in African Economies, *The International Food Policy Research Institute,* Discussion Paper;

9. Šapić S., Jakšić M., Stojković D. (2020). The Raspberry Commodity Exchange in Serbia: An Exploratory Research of Producers' Attitudes, *Ekonomika preduzeća*, Journal of Serbian Association of Economists, No. 3-4, p.215-228;

10. Schell J., Betts N.M., Lyons T.J. & Basu A. (2019) Raspberries Improve Postprandial Glucose and Acute and Chronic Inflammation in Adults with Type 2 Diabetes, *Ann Nutr Metab*;74:165–174;

11. Stojkovic D., Živić F., Štimac M., Borisavljević K., Grujović N. (2020). Raspberry as a Potential Commodity Exchange Material in the Republic of Serbia, *Ekonomika poljoprivrede*, No. 3, 2020;

12. Veljkovic B., Djordjevic N., Dolicanin Z., Licina B., Topuzovic M., Stankovic M., Zlatic, N. & Dajic-Stevanovic Z. (2018). Antioxidant And Anticancer Properties of Leaf And Fruit Extracts of the Wild Raspberry (Rubus Idaeus L.). *Notulae Botanicae Horti Agrobotanici Cluj-Napoca*, 47(2), 359-367;

13. Zakon o robnim berzama, „*Službeni glasnik RS"*, br. 52/2019.

14. Zakon o trgovini, Službeni glasnik RS, 52/2019;

15. Zakon o tržištu kapitala, „*Službeni glasnik RS"*, br. 31/11;

Internet sources:

1. Agrotv, 2021. Retrieved November 28, 2022, from http://www.agrotv.net/berba-cuvanje-klasiranje-plodova-maline/;

2. Atlas Big (2022). *World Raspberry Production by Country.* Retrieved November 17, 2022, from https://www.atlasbig.com/en-us/countries-raspberry-production;

3. Development Agency of Serbia, *Serbia Food Industry.* Retrieved October 25, 2022, from https://ras.gov.rs/uploads/2018/10/food-1.pdf;

4. FAO, 2022a. Retrieved November 25, 2022, from https://www.fao.org/faostat/en/#data/QCL;

5. FAO, 2022b. Retrieved November 25, 2022, from https://www.fao.org/faostat/en/#compare;

6. IRO, 2022. Retrieved November 15, 2022, from https://www.internationalraspberry.net/ ;

7. National Diabetes Statistics Report 2017. Retrieved from https://www.cdc.gov/diabetes/data/statistics/statistics-report.html ;
8. PKS (2022). *Smanjen izvoz maline.* Retrieved from https://pks.rs/vesti/izvoz-zamrznute-maline-opao-ali-prihodi-povecani-7104;
9. Producepay (2022). *Exploring Raspberry Production in Mexico.* Retrieved November 23, 2022, from https://producepay.com/exploring-raspberry-production-mexico/ ;
10. The Science Agriculture (2022). *10 World's Biggest Raspberries Producers.* Retrieved November 20, 2022, from https://scienceagri.com/10-worlds-biggest-raspberries-producers/ ;
11. Zavod za statistiku RS. Retrieved November 29, 2022, from https://data.stat.gov.rs/Home/Result/170402?languageCode=sr-Cyrl&displayMode=table&guid=f02d0669-c305-452e-9c06-9fd3153345b8 .

IMPORTANCE OF THE AGRO-FOOD SYSTEM FOR ECONOMIC DEVELOPMENT IN SELECTED LMICs

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Abstract

Primary agricultural production and the food industry jointly represent the agro-food system of one country. This system has an important role in the economic development of the Republic of Serbia, which according to the World Bank classification, belongs to the group of LMICs. The aim of this paper is to validate the strategic role of the agro-food system in the economic structure of low- and middle-income countries and its contribution to overall economic development. Applied criteria for selecting the countries for the analysis were: gross national income per capita, territorial affiliation (geographical position), and CEFTA agreement. Based on such criteria, the sample countries include Serbia, Albania, Bosnia & Herzegovina, and North Macedonia. Indicators of the contribution to economic development are created using secondary data and divided into four categories: employment indicators, activity indicators, population indicators, and economic indicators. The period covered by this analysis is from 2013 to 2018.

Key words: *agro-food system, LMICs, economic development, qualitative indicators, Serbia*

Introduction

The socioeconomic characteristics of the developing countries together with geographical position determine the intensity and progress of economic development (Jovanović, 2021). When the economic growth rates of low- and middle-income countries are analyzed, special attention is dedicated to agriculture and its contribution to economic development. Besides primary agriculture, the research includes the processing industry (separately or as a part of the agro-food sector).

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Various indicators can be used to estimate the contribution of the agro-food system to the economic development of low- and middle-income countries. Numerous studies worldwide analyzed indicators of primary agricultural production and the food industry individually, to determine how these two sectors behaved over years. Especially, in years close to important moments in the country's economic development. Nevertheless, for the improvement of current agricultural policy, it is important to observe not only national indicators for Serbia but also to go beyond borders.

Methodology

Since the contributions of the agro-food system can be measured through various indicators, we selected only those identified according to Mitrović et al., 2017. The contributions of the primary agricultural production (*i.e. sector A from the Classification of Activities*), were mostly presented in the literature (Meijernik, Roza, 2007; Vaško, Mirjanić, 2013). The contributions of the food industry were often researched as part of the processing industry *(i.e. sector C according to the Classification of Activities*). In addition, the least represented in the literature are studies about the contributions of the agro-food system.

For comparison, countries that have common characteristics and similarities with the Serbian economy were chosen. Three criteria were applied to decide which countries will be included in the analysis. The first applied criterion is *the gross national income per capita*. According to the World Bank, countries can be divided into three groups based on the GNI per capita – with low, middle, or high income. Low- and middle-income countries are often considered developing countries in the literature. Based on this criterion, all countries that, like Serbia, have a middle-income level and consequently belong to the LMIC group are suitable for analysis. As the second criterion, we include *territorial affiliation* (geographical position). The scope of the analysis is narrowed to the countries of the Western Balkan, so the indicators of the agro-food system of Serbia are compared with the countries that geographically belong to this region. As a third criterion, *membership in international trade agreements* is included. Thus, the fact that the selected countries, together with Serbia, are signatories to the CEFTA agreement determined the final sample.

Taking into account the above, the selected indicators for Serbia were compared with Albania, Montenegro, Bosnia and Herzegovina, and North Mace-

donia. Although Moldova and Kosovo* are also signatories to the CEFTA agreement, they were not taken into consideration. Moldova is excluded due to the low volume of international trade in agricultural and food products with other countries of the Western Balkans. Kosovo* is excluded due to the lack of reliable data for comparative analysis.

The indicators are divided into the following four categories: a) Employment indicators, b) Activity indicators, c) Population indicators, and d) Economic indicators.

Indicators were obtained using secondary data or publicly available databases. The reliability of databases was the main criterion for selecting relevant sources. Additionally, comparability between countries and consistency over the years were considered. Accordingly, the following databases were used: (a) the World Bank database; (b) the UN FAO database; (v) the SEE Rural database (SEE RURAL); (g) the national database of the Republic Institute for Statistics of the Republic of Serbia.

The research covers the period 2013-2018. At the time of the research, there were no comparative indicators for 2019, so it was not taken into consideration. Also, countries or years were excluded from the analysis for several indicators due to data reliability.

Results

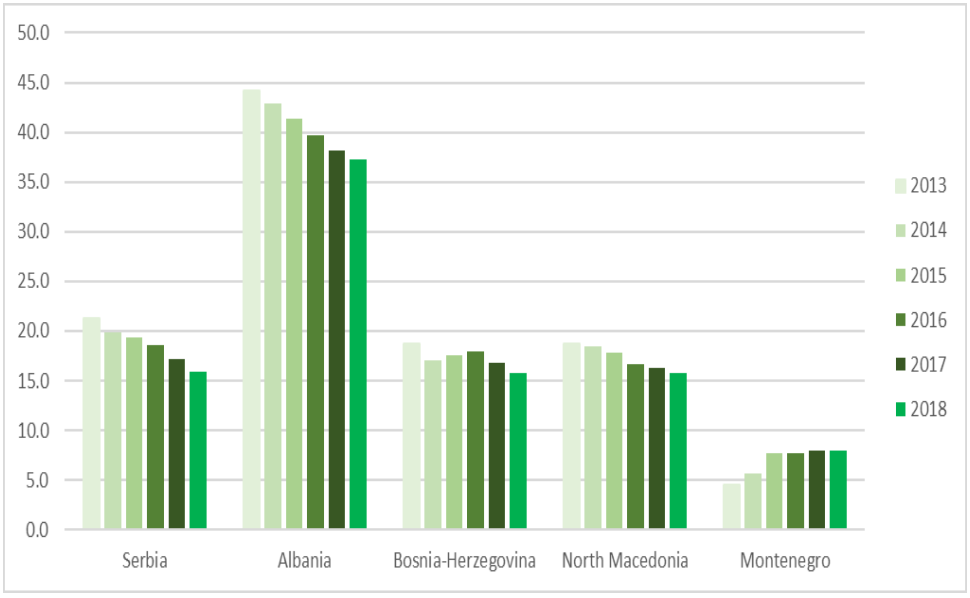
The first employment indicator is the ratio of employees in agriculture to total employment. According to the FAO UN definition, this relative indicator represents the ratio of the number employed in agriculture to the total employed population. It includes all people aged 15 to 64 working for an employer or self-employed during a short period of time (a week or even a day) (FAO UN database, 2020).

There are no missing data for this indicator, so the results are shown in Figure 1. First of all, a significantly higher share of employees in agriculture in the total employment in Albania, compared to other countries can be noticed. However, it is not surprising, bearing in mind that agriculture participated with 23 percent in the creation of the gross value added in this country in 2017 (Volk et al., 2019). The average share of agriculture to the gross value added in other observed countries was between 7 percent and 12 percent in 2017. However, the participation of employees in agriculture in the total employment of Albania decreased by

almost 7 percentage points (from 44.2 percent in 2013 to 37.3. percent in 2018). At the same time, the value of this indicator decreased by 5.4 percentage points in Serbia (from 21.3 percent in 2013 to 15.9 percent in 2018).

This is not surprising and is completely in line with the conclusions presented by the authors Zakić and Stojanović (Zakić, Stojanović, 2008). It is consistent with the fact that transfers of capital and labor from agriculture to other sectors are considered a significant sign of economic empowerment in developing countries. The growing need for labor in industry causes a decrease in the number of employees in agriculture (as well as other sectors of the economy). This does not indicate that agriculture is less important for economic growth. On the contrary, the reduced value of this indicator indicates the existence of a factor contributing to economic development. It can be concluded that primary agriculture (along with the food industry) takes a strategic role in low- and middle-income countries.

Figure 1. *The ratio of employees in agriculture to total employment (in %)*



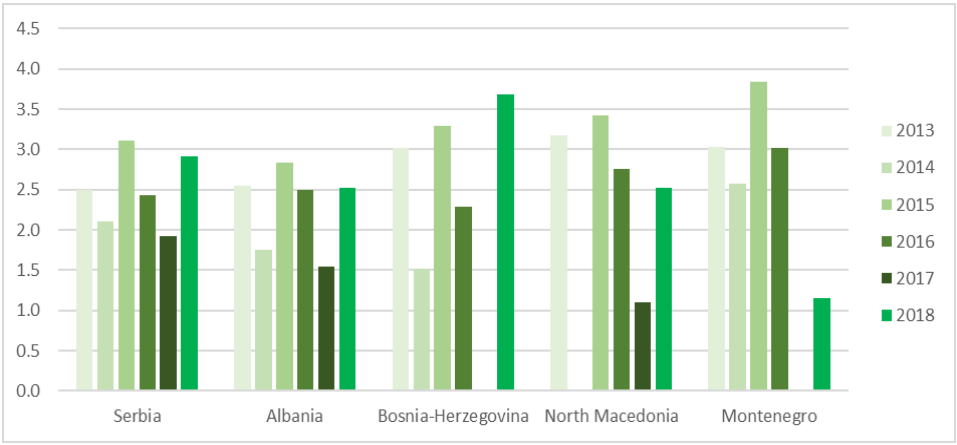
Source: World Bank database, November 2020.

The second employment indicator is the ratio of people employed by employers in agriculture to the overall number of people employed by employers. According to the FAO UN definition, this indicator refers to employed persons who have concluded an employment contract with the company or farm

where they work; who receive a monthly salary, and where earnings are independent of the company or farm gains.

The results are shown in Figure 2. The value did not exceed 4 percent in the observed period. The shares varied during the observed period, so the value in 2013 was lower compared to 2018 only in Serbia and Bosnia and Herzegovina. In all other countries, this value was higher. The unstable movements are in accordance with the nature of the agricultural activity, which does not require the long-term engagement of the labor force based on employment contracts. There is a greater need for seasonal workers. Also, fluctuations in the number of paid employees can be justified primarily due to the adaptation of agricultural production to market requirements and growing needs for food, as well as the process of industrialization.

Figure 2. *The ratio of people that were employed by employers in agriculture in the overall number of people employed by employers (in %).*



Source: FAOSTAT database, November 2020.

The first activity indicator is the ratio of the active rural population to the total rural population. More than half of the population in rural areas in Serbia belongs to the active population (aged 15 to 64). The active rural population growth may mean that the younger ones remain in rural areas due to better living and working conditions. Due to a lack of reliable data, the results are considered only for Serbia and Bosnia and Herzegovina. The percentage of the active population in rural areas in Bosnia and Herzegovina is lower compared to Serbia (40 percent). Also, the increasing number of inactive population (housewives, pensioners) indicates that farming is a way of life in developing

countries, with noticeably older households. Results for Serbia suggest that significant labor force potential exists in rural areas, and it can be used to achieve economic development goals. On the other hand, it is necessary to improve the rural development policy in Bosnia and Herzegovina in order to increase the usage of rural areas and improve the living standards of agricultural workers.

The second activity indicator is the ratio of the employed population in rural areas to the working-age population. In order to have a more detailed analysis, the active population is divided into employed and unemployed persons. In Serbia, growing employment in rural areas is noticeable. Almost 50% of the active population of the rural areas were employed, with a tendency for further growth. Although employment in the rural areas in Bosnia and Herzegovina is lower than in Serbia, in the observed six-years period it increased by about 3 percentage points. The increase in the number of employees leads to social benefits such as improvement of living conditions in rural areas, rural empowerment, development of rural infrastructure, and others.

The ratio of the rural population to the total population is one of the two population indicators. Bosnia and Herzegovina has the largest share of the rural population in the total, more than 50 percent during the observed period. Although the indicator recorded a slight decline over time, the percentage is still the highest in the region. At the beginning of the observed period, Serbia and Albania had similar values of the indicator with a share of the rural population of almost 45 percent. A higher decline in the number of people in rural areas was recorded in Albania compared to Serbia – the value of the indicator in 2018 was lower by 0.6 percentage points in Serbia and 4.9 percentage points in Albania. Because the lowest decline in the share of the rural population to the total was recorded in Serbia, it can be concluded that the rural development policy measures and activities stimulate the development of rural areas, and improve the infrastructure and telecommunication network, in order to create a surrounding for a longer stay and permanent residence. The data for North Macedonia were not included in the analysis due to inconsistent and missing data.

The total rural population in the selected Western Balkan Countries is another population indicator. This indicator in absolute numbers is also important because its use can lead to indicators of activity and employment expressed in absolute rather than relative terms. The total number of the rural population in the selected LMICs decreased by 476,085 inhabitants in 2018. The values of the indicator are presented in Table 1.

Table 1. *The total rural population in the selected Western Balkan countries.*

Country	2013	2014	2015	2016	2017	2018
Serbia	3,190,260	3,167,188	3,143,538	3,119,072	3,093,250	3,065,922
Albania	1,291,587	1,258,985	1,226,200	1,195,854	1,167,112	1,137,407
Bosnia and Herzegovina	1,894,621	1,851,086	1,811,629	1,777,181	1,746,950	1,720,299
North Macedonia	888,785	887,542	885,627	883,006	879,685	875,613
Montenegro	216,571	214,705	212,741	210,706	208,638	206,498

Source: World Bank database, November 2020.

One of the most important economic indicators is the share of the agri-food system in GDP. In Serbia, the agri-food system contributes to GDP by 8.9 percent in 2018. It is lower than in 2013 when it was 10.4 percent. Almost a tenth of the GDP is generated in the agri-food system, which means significant participation in national economic empowerment. Observed by activities within the agri-food system, Albania has the largest share of the Agriculture, forestry, and fishing sector in GDP (18.4 percent in 2018). On the contrary, the lowest share was recorded in Bosnia and Herzegovina (5.9 percent in 2018). The average value of this indicator for all observed countries in the analysis was 9.2 percent in 2018.

The second economic indicator relevant to the topic is the share of the agri-food system in foreign trade exchange. Since the data were not available for all countries, the analysis covered the period from 2013 to 2017. Serbia had the largest export of agricultural and food products among the countries of the Western Balkans in the observed period. In 2017 Serbia recorded a 35 percent higher export value than in 2013. Nevertheless, in all countries in the sample, the export of agricultural and food products grew. On the other hand, the value of the import is also considered an important factor for the rural empowerment of developing countries. The average import value of agricultural and food products was 1,363 million euros. The highest import values were achieved by Bosnia and Herzegovina, while the lowest import values had Montenegro.

Serbia is the only one among the observed countries that had a positive value of net exports. In other words, the export of agricultural and food products is greater than the import. Consequently, the agro-food system plays a key role in the economic development of Serbia. In other countries, however, net exports recorded a negative value. The average values of negative net exports in the observed period were as follows: Albania: 554 million euros, Bosnia and

Herzegovina: 1,044 million euros, North Macedonia: 188 million euros, and Montenegro: 419 million euros. The average value of the surplus of agricultural and food products in Serbia was 1,164 million euros.

Conclusions

When analyzing the strategic role of the agro-food system in low- and middle-income countries, it is especially important to emphasize the opinion that supports the importance of this economic branch for overall economic and social development. First of all, in countries that have lower values of disposable income per capita (and consequently are considered poorer), primary agriculture production represents the backbone of the development of other (non)agrarian activities. Therefore, the connection between economic sectors is becoming more intense and stronger.

The criteria that were applied to evaluate indicators are: a) improving the quality of life of the rural population (positive effect), b) labor transfer from agriculture (positive effect), c) improving the rural development, d) the lower contribution of agriculture in GDP indicate economic empowerment, e) increase the value of export, f) decrease in the import of agriculture products.

Indicators used in this paper have been developed to evaluate the contribution of the agri-food system over a six-year period to the economic development of selected Western Balkans. They can also be used for future evaluations of the economic effects. In addition to the indicators used in this research, more indicators could be created depending on the data availability.

Following the criteria, and based on analysis of each indicator separately, with a reasonable level of reliability, we can conclude: the agri-food system, as part of the agricultural sector, has a significant role in the economic development of low- and middle-income countries.

Literature

1. Jovanović, Olivera. (2021). Uloga subvencija u razvoju malih i srednjih preduzeća u agro-prehrambenom sistemu Srbije. Doktorska disertacija, Ekonomski fakultet Univerzitet u Beogradu.
2. Meijernik, Gerdien, Roza, Pim. (2007). *The role of agriculture in economic development*. Markets, Chains and Sustainable Development Strategy & Policy paper no. 5, Stichting DLO. Wageningen.

3. Mitrovic, Slavka, Mitrović, Aleksandra, Cogoljević, Maja. (2017). Contribution of agriculture to the development of Serbia. *Economics of Agriculture,* 64(2), 805-819.

4. The classification of activities 2010, Republic Institute for Statistics of the Republic of Serbia. Available at: https://www.stat.gov.rs/media/2622/klasifikacija-delatnosti-2010.pdf

5. Vaško, Željko, Mirjanić, Stevo. (2013). Osnovni indikatori razvoja poljoprivrede u Bosni i Hercegovini – retrospektiva od 1950. do 2010. godine. *Agroznanje,* 14(4), 575-589.

6. Volk, Tina, Rednak. Miroslav, Erjavec, Emil, Rac, Ilona, Zhllima, Edvin, Gjeci, Grigor, Bajramović, Sabahudin, Vaško, Željko, Kerolli-Mustafa, Mihone, Gjokaj, Ekrem, Hoxha, Bekim, Dimitrievski, Dragi, Kotevska, Ana, Stamenkovska, Ivana Janeska, Konjević, Darko, Spahić, Mirsad, Bogdanov, Natalija, Stevović. (2019). Agricultural Policy Developments and EU Approximation Process in the Western Balkan Countries. EUR 29475. Luxemburg: Publication Office of the European Union. Available at: https://op.europa.eu/en/publication-detail/-/publication/5921b0c3-408c-11e9-8d04-01aa75ed71a1/language-en

7. Zakić, Zorka, Stojanović, Žaklina. (2008). Ekonomika agrara. Beograd: Ekonomski fakultet Univerziteta u Beogradu.

RURAL TOURISM AND WELL-BEING OF VILLAGE RESIDENTS IN SERBIA

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Abstract

Every form of tourism contributes to the social and economic development of the destination. The current study aimed to assess the impact of the development of rural tourism on the perception of the villagers about its positive impact on a better quality of life (S&S- Satisfaction and Support). The findings revealed that the quality of rural services is at a satisfactory level, creating satisfaction among local residents who believe that they should support and invest in the development of this type of tourist product. The importance of the research can be reflected in the awareness of the local population about the future development and the importance of rural tourism in terms of its implications on the quality of life in the countryside, but also as a basis for further theoretical and professional research on the given issue.

Key words: *village, quality, local development, Serbia, tourism.*

Introduction

Tourism is considered an economic activity that for centuries has contributed directly or indirectly to the development of destinations and social development, as well as contributing to the quality of life of the local population, especially in rural areas. Rural tourism appears as a potential driver of rural development, which would affect the reduction of the existing gap in the degree of development of rural and urban areas. If we look at the facts about the development of villages in Serbia, it is generally known that agricultural production is the most significant in influencing the survival of the economy and social sectors in villages. However, in recent decades, rural tourism has become increasingly important, or at least there is a growing awareness

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among people that the development of this form of tourism can contribute to a better life for the rural population. Serbia is still very far from the concept of developed rural tourism, but the goal is certainly to investigate the development market and the attitude of local residents on the extent to which it can contribute to a better quality of life for people who are left to live in the countryside. Statistics show that in the last 10 years in Serbia, the number of inhabitants in Serbian villages decreased by more than 350,000 people, while about 1,200 villages are in the process of disappearing. In the period when the world was hit by an unforeseen crisis in the form of the COVID-19 pandemic, people became more aware of the importance of villages and life in a naturally untouched environment, which offers a better quality and healthier way of life. Apart from agriculture, which is one of the main activities that provide a better standard of living and the opportunity for self-employment, the rural population is increasingly opening the doors of their households to tourists, in the hope that the Serbian countryside will be placed on a higher market level. According to the current issue and the available literature, the authors of the manuscript aimed to try, through a pilot study, to determine the attitude of the local population on the impact of the development of rural tourism on the quality of their life in the countryside. They used a modified model to examine the satisfaction factors of local residents, established by Pham et al. (2019). They used exploratory factor analysis to reduce the number of factors, as well as multiple regression analysis in order to confirm whether some of the factors have a significant impact on the satisfaction of local residents and their support for the development of rural tourism. Two research questions were set:

R.Q.1- Does the population think that the development of rural tourism will contribute to the quality of life in the countryside?

R.Q.2-Should we work on increasing the promotion of rural tourism in accordance with sustainable development?

Pilot research can find its importance in social, scientific and economic terms. Although the number of respondents is not large, the results of the research can contribute to the theoretical part in terms of the impact on the better development of tourism in the villages of Serbia, and be a starting point for further research of wider significance. Also, the results of this research can make all stakeholders aware of the importance of rural tourism development, as a great opportunity in Serbia. The research has theoretical and applied limitations, which will be listed

in a separate part of the manuscript, but they certainly do not diminish the importance of the research.

Literature Review

Rural tourism is a realistic path to the revitalization of numerous smaller and larger rural spatial units. As a country with a rural character, Serbia is one of the most agrarian countries in Europe. There are about 328,000 agricultural farms in Serbia, which is 56% of the total number of rural households in the villages of Serbia, many of which are engaged in rural tourism (Cvijanović et al., 2021). In Serbia today, more than 900 rural households are registered to work with tourists. Among them there are almost a hundred that host up to 1,300 people annually (Cvijanović et al., 2022). The development of rural tourism, which includes a high-quality and diverse offer of local food, requires a number of economic and social preconditions, as well as human potential, which the average Serbian village does not have. Due to decades of labor migration to cities, there are no active farmers on more than half of the rural estates, and most of the household owners are over 60 years old (Gajić et al., 2021a,2021b). Among the population older than 15 years, 28% have completed only primary school, as many as 29% are illiterate and have no formal education, and only 4% have higher education (Cvijanović et al., 2021). It is estimated that there are about 32,000 registered and unregistered beds in rural areas, of which only 10,000 are in the villages themselves, and the number of overnight stays is about 27% of the total number of overnight stays in domestic tourism. The average daily consumption is lower than in other countries and amounts to 1,900 dinars per person, and rural tourism accounts for about 16% of the total GDP of the travel and tourism sector (Cvijanović et al., 2021). Many studies in the world point to the importance of the increasing development of rural tourism on the quality of the local population (Gnanapola, 2015), however, there are those who claim that the local population is unaware of its importance (Jalani, 2012; Barkauskas et al., 2015). Raising the awareness of the local population can be a step towards a better understanding of the ways of rural survival, retaining the youth in the countryside, as well as greater support for the community (Andereck et al., 2005). Kumar et al. (2013), in their research found that the awareness and participation of the local population are key factors in the perception of the importance of rural tourism. However, many point out that not only the local population is an actor in the development of rural tourism, but the involvement of all stakeholders in a region (Su et al., 2017). Research in Cyprus conducted by Nikolaos Boukas (2019) indicates that rural tourism is recognized as a viable niche, but that its fragmented nature, inadequate management, lack of knowledge

and micro-interests hinder its appreciation. Many residents are not aware of the importance of rural tourism (Ap, 1992; Gao and Wu, 2017), and do not show much interest in its development (Liang and Hui, 2016). Tourism in the natural environment and rural areas is of vital importance for different societies, clusters and individuals depending on their morals, attitudes and resources that exist for the development of tourism (Henandez, 2016; Pham et al., 2019). Increasing the development of tourism in villages can bring many problems. Therefore, the tourist experience is essential for the image and development of the destination (Gnanapala, 2019). Rural tourism can stop migration to cities (Cawley and Gillmor, 2008; Kim et al., 2013), and contribute to the economic development of rural areas (Paresishvili et al., 2017). Many believe that rural tourism with its development can contribute to a quality way of life (Barkauskas et al., 2015; Ridderstaat et al., 2014), and that with the help of connecting all spheres of interest and local opinion, it can contribute to economic development and standards (Salvatore et al., 2018; Yunikawati et al., 2021). According to the existing literature, the research hypotheses were set:

H1: The quality of rural service is at a satisfactory level

H2: Quality factors predict the satisfaction of the local population and support for the development of rural tourism

Methodology

Sample and Procedure

The research was conducted in the villages of Vojvodina, Eastern and Western Serbia, on a total sample of 508 respondents, residents of the villages. An interview survey was conducted in the period from June to November 2021, and the survey is considered a volunteer pilot survey. The sample could be much larger in relation to the number of villages and the number of inhabitants in rural areas of Serbia, but due to the existing limiting circumstances, the answers received can be considered representative, as it is a pilot study. The survey was conducted with the help of 35 students of the Faculty of Hotel Management and Tourism from Vrnjacka Banja. Of the total number of research participants, 44.8% belonged to the over 60 age category, followed by 32.6% from 30 to 59 years of age, and only 22.6% from 20 to 29 years of age. A total of 69.4% are engaged in agriculture, while 30.6% are engaged in work in nearby city municipalities. The participation of men in the research was 58.2%, while the participation of women was 41.8%. Other parameters will not be discussed in this manuscript.

Measures and data analysis

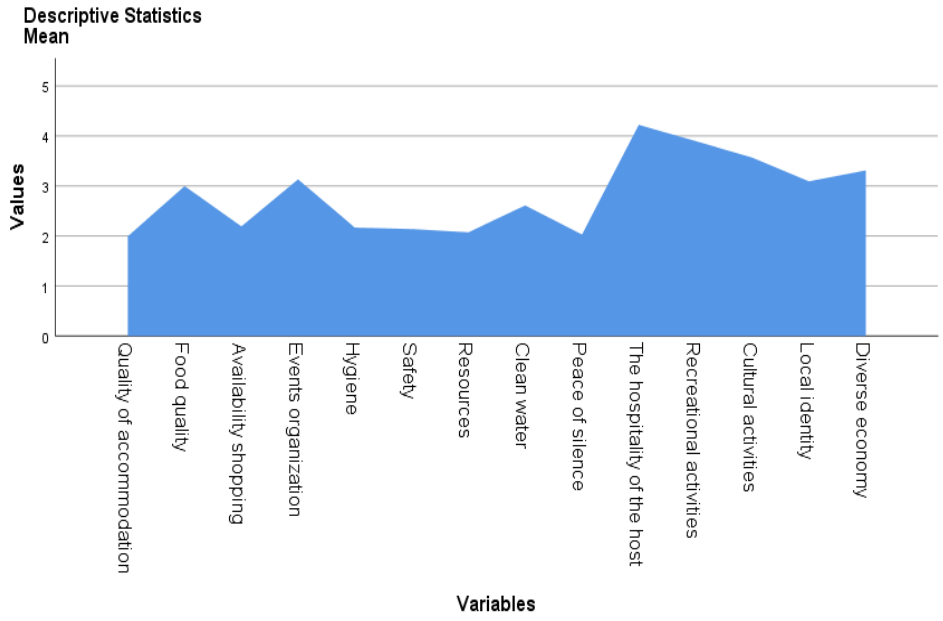
The authors used a modified model established by Pham et al. (2019), in his work entitled Local residents' perceptions about tourism development. Three factors with a total number of 14 questions and a very good Cronbach Alpha value were determined: Satisfaction with tourism infrastructure and services (ST: 4 items- Quality of accommodation, Food quality, Availability shopping, Events organization; $\alpha = 0.725$), Satisfaction with environment (SE: 5 items – Hygiene, Safety, Resources, Clean water, Peace of silence; $\alpha = 0.899$) and Satisfaction with socioeconomic elements (SE: 5 items – The hospitality of the host, Recreational activities, Cultural activities, Local identity, Diverse economy; $\alpha = 0.799$). The literature states that the appropriate power of the test is 0.8 or higher (it should not be lower by any means) and the generally accepted rule is "eighty-five", which means that the probability of a type 1 error is 5%, and a type 2 error is 20% (Tabacnick and Fidell, 2013). SPSS software, version 26.00, was used for data analysis. A five-point Likert value scale was used. Then, in order to perform a valid revision of the group of satisfaction indicators into a smaller number of factors, an exploratory factor analysis was used, which investigates the relationships between the set of observed variables and the construct. Also, the values of the Kaiser-Meier-Olkin test, which shows the measure of the value and adequacy of sampling, are at 0.89 and $p < 0.001$, showing that the data are suitable for continuing the factor analysis. After determining the percentage of explained variance for each factor, multiple regression analysis was performed in order to determine the influence of factors (predictors) on the satisfaction of local residents and their support for the development of tourism.

Results and discussion

At the very beginning of the examination, key research questions were asked, independently of the other items, to which the respondents answered. Affirmative answers were received to both questions, namely that the local population believes that the development of rural tourism will contribute to the quality of life in the countryside (79.2% yes, 20.8% no), and that promotional activities and investments in the development of rural tourism should be increased (69.4% yes, 30.6% no). There is a small percentage of respondents who believe that rural tourism does not contribute to the well-being of the quality of life in the countryside. Chart 1 shows the arithmetic values of all 14 items that are classified into three quality factors. The highest average score was the item hospitality of the host m= 4.22. Then, all items from the SES factor group (Satisfaction with socioeconomic elements) have an average rat-

ing of over 3. The questions that belonged to the SE factor (Satisfaction with environment) carry an average rating of over 2, while the questions related to factor 1 ST (Satisfaction with tourism infrastructure and services) are rated lower, and refers to the quality of services. In this case, the quality of accommodation has an average rating of m=1.9, which is seen to be the worst rated compared to other items.

Graph 1. *Average ratings for given items of rural service quality*



Source: authors' research

Table 1 provides insight into the results of the exploratory factor analysis I and the loadings of all factors, where it can be seen that the total percentage of explained variance is 62.34%. All 14 items are grouped into exactly three factors. The first factor explains the largest percentage of the variance 41%, then all the following factors explain less percentages.

Table 1. *Results of exploratory factor analysis*

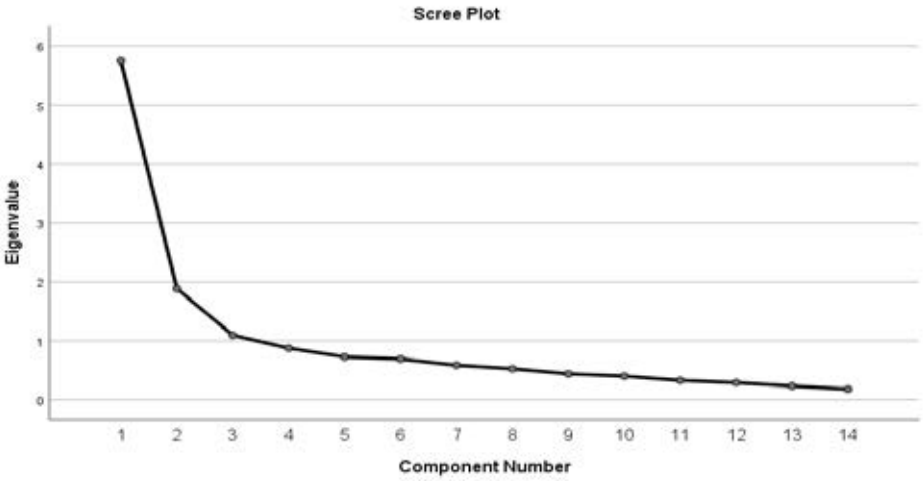
		Initial Eigenvalues		Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings[a]
Items	**Total**	**% of Variance**	**Cumulative %**	**Total**	**% of Variance**	**Cumulative %**	**Total**
1.	5.748	41.055	41.055	5.748	41.055	41.055	4.356
2.	1.885	13.468	54.522	1.885	13.468	54.522	4.419
3.	1.095	7.823	62.346	1.095	7.823	62.346	3.389
4.	.873	6.237	68.583				
5.	.726	5.188	73.771				
6.	.692	4.946	78.717				
7.	.587	4.193	82.911				
8.	.526	3.755	86.666				
9.	.439	3.135	89.801				
10.	.400	2.854	92.655				
11.	.328	2.342	94.997				
12.	.289	2.065	97.062				
13.	.232	1.658	98.720				
14.	.179	1.280	100.000				

Source: authors research Extraction Method: Principal Component Analysis.

[a]. *When components are correlated, sums of squared loadings cannot be added to obtain a total variance.*

Also, the same values are observed on the Scree Plot, where the breaking point is shown, which indicates the obtained number of factors, which coincides with the analysis values from table 1.

Graph 2. *Scree plot display of grouping of items into factors*



Source: author's research

Table 2 shows the results of the multiple regression analysis. The factors were key predictors, and the goal was to determine the strength of their influence on the satisfaction of local residents and their support for the development of rural tourism (criterion code: S&S - Satisfaction and Support). The R^2 coefficient shows what percentage of the variance is explained, and its value was 77.1%, with the values of the other parameters indicating that the model corresponds or fits the data: F= 571.472, df = 3, p=0.00. The contribution of all three predictors in predicting the criteria S&S is significant. Table 2 shows the data on the partial contribution for each of the risks (b), as well as the correlation of how much they are related to the predictor (ß). The third factor SES (Satisfaction with socioeconomic elements) had the largest partial contribution with values b=0.800 and correlation with predictor ß=0.809. Then, the factor SE (Satisfaction with environment) had the following contribution values to the prediction of S&S: b= 0.135, ß= 0.037. The factor ST (Satisfaction with tourism infrastructure and services) had the least partial contribution, but statistical significance can also be observed in it (b=0.700, ß=0.040).

Table 2. *Multiple regression analysis of predicting the influence of factors on the predictor S&S.*

Factor	B (b)	Sd. deviation	Beta (ß)	t	Sig.
Constant	0.178	0.093		1.910	0.05
ST	0.070	0.040	0.051	1.720	0.03
SE	0.135	0.037	0.101	3.621	0.00
SES	0.800	0.024	0.809	33.248	0.00
R^2 = 77.1%; F= 571.472; df = 3; p=0.00					
H1: Confirmed *H2: Confirmed*					
R.Q.1 Affirmative answer: 79.2% *R.Q.2 A ffirmative answer: 69.4%*					

a. Dependent Variable: S&S 8Satisfaction and Support)

Conclusion, future implications and research limitations

For many years, rural tourism has been the leading trend in the world when looking at tourist products. In the last two years, since the sudden development of the pandemic, people have become more aware of the importance of a healthy environment and life in the countryside. In Serbia, the village gains more value, in the sense that people turned to domestic tourism in such conditions, and that the local population began to open their households to tourists. Serbia is an agrarian country, where there are certainly all the natural resources for the development of rural and agritourism that would be available for larger visits, but also where more significant infrastructural content for visitors could be built. In accordance with the current issue of acceptance of rural tourism as an implicator of a better quality of life by the local population, the authors conducted a pilot study. The goal was to answer two key questions concerning the satisfaction of the local population with the development of rural tourism, as well as the question of greater promotional activity and investment in rural content available to visitors. Initial hypotheses about the level of quality of rural services and hypotheses about the influence of quality factors on the satisfaction of the local population and their support for the stronger development of tourism in the villages of Serbia were set. A volunteer survey, which is considered a pilot survey, was conducted on a total sample of 508 survey participants in the villages of Vojvodina, Western and Eastern Serbia. All parameters of the suitability of the questionnaire were within the allowed limit values, so the analysis of the results was performed using parametric statistics in the SPSS 26.00 program. The reliability of the

questionnaire was shown to be very good for all factors. Descriptive statistical analysis showed that all the items that made up the three groups of quality factors have relatively high average scores or arithmetic mean values over 3. At the very beginning of the survey, key research questions were specifically asked of the respondents and received a positive response. Namely, the local population believes that the development of rural tourism will contribute to the quality of life in the countryside (79.2% yes, 20.8% no), and that promotional activities and investments in the development of rural tourism should be increased (69.4% yes, 30.6% no). Then, by factor analysis, all items were reduced and classified into three factors: SES (Satisfaction with socioeconomic elements), SE (Satisfaction with environment) and ST (Satisfaction with tourism infrastructure and services). The percentage of explained variance was 62.34%, with the first factor having the highest saturation with a value of 41%. It must be noted that Cronbach Alpha values for all three factors were very high and representative for further research. After an exploratory factor analysis, the authors set out to determine the impact of all three factors on the satisfaction of the local population and support for the development of rural tourism (S&S - satisfaction and support). Each of the factors had statistical significance in predicting satisfaction as a criterion variable, with a high value of partial contribution. Plazen hypotheses were confirmed: that the quality of rural services is at a satisfactory level (H1), and that quality factors predict the satisfaction of the local population and support for the development of rural tourism (S&S) (H2).

Research can have great social, economic and scientific significance in the future development of rural tourism in Serbia. Primarily, it can contribute to the development of theory that is less accessible, but also to greater research problems when the same topic is in question. Also, this research can provide insight to the readers and the local population about the importance of rural tourism, and in some way influence their awareness for further support for its development. During the research, there were theoretical and applied limitations. A large number of respondents refused to give an answer, but a large part of them had difficulties in understanding the question, because it is an older group of respondents and a rather uneducated category of people. Disturbances also occurred in cooperation with the respondents due to fear of infection with the current pandemic, and they did not want to come into contact with the researchers. Also, available literature with specific results and with a large sample is lacking.

Literature

1. Andereck, K. L., Valentine, K. M., Knopf, R. C., & Vogt, C. A. (2005). Residents' perceptions of community tourism impacts. Annals of Tourism Research, 32, 1056-1076.
2. Ap, J. (1992). Residents' perceptions on tourism impacts', Annals of Tourism Research, 19, 4, 665-690.
3. Barkauskas, V., Barkauskienė, K., & Jasinskas, E. (2015). Analysis of Macro Environmental Factors Influencing the Development of Rural Tourism: Lithuanian Case. Procedia - Social and Behavioral Sciences, 213, 167- 172.
4. Boukas, N. (2019). Rural tourism and residents' well-being in Cyprus: Towards a conceptualised framework of the appreciation of rural tourism for islands' sustainable development and competitiveness. International Journal of Tourism Anthropology 7(1):60.
5. Cawley, M. and Gillmor, D.A. (2008). Integrated Rural Tourism: concepts and practice. Annals of tourism research, 35, 2, 316-337.
6. Cvijanović, D., Gajić, T., & Vukolić, D. (2022). Stronger Involvment of Women in the Development of Serbian Rural Tourism. International Scientific Conference Sustainable Agriculture and Rural Development. Thematic Proceeding, Belgrade, Serbia, ppp. 223-234.
7. Cvijanović, D., Gajić, T., & Cvijanović, D. (2021). Achieving the Complete Quality of the Rural Gastronomy in Vojvodina. International Yearbook, Faculty of Security, Skoplje, pp. 43-53.
8. Gajić, T., Petrović, D., Radovanović, M., Darko Vuković, D., Yakovenko, N.V. (2021a). Women's Role in Organizational Commitment and Job Satisfaction in the Travel Industry – An Evidence From the Urban Setting. Sustainability, 13, 2-15, 8395.
9. Gajić, T., Raljić Popov, J., Aleksić, M., Blešić , I., Vukolić, D., Petrović, M.D., Yakovenko, N.V., Sikimić, V. (2021b). Creating Opportunities for the Development of Craft Beer Tourism in Serbia as a New Form of Sustainable Tourism. Sustainability, 13(16), 1-22, 8730.
10. Gao, J. and Wu, B. (2017). Revitalizing traditional villages through rural tourism: a case study of Yuanjia Village, Shaanxi Province, China', Tourism Management, 63, 223-233.
11. Gnanapala, W.K.A. (2015). Tourist perception and satisfaction: Implications for destination management. American Journal of Marketing Research 1(1), 7-19.

12. Hernández, J. M., Suárez-Vega, R. and Santana-Jiménez, Y. (2016). The interrelationship between rural and mass tourism: the case of Catalonia, Spain. Tourism Management, 54, 43-57.

13. Jalani, J.O. (2012). Local People's Perception on the Impacts and Importance of Ecotourism in Sabang, Palawan, Philippines. Procedia-Soc. Behav. Sci. 2012, 57, 247–254.

14. Kim, K., Uysal, M., & Sirgy, M. J. (2013). How does tourism in a community impact the QOL of community residents? Tourism Management, 36, 527-540.

15. Kumar, C., Sakthivel, R., & Ramanathan, H. (2013). Local residents perception and attitude towards model tourism village Kumbalangy Kerala. Journal of Contemporary Research in Management, 8(1), 59-67.

16. Liang, Z. X., & Hui, T. K. (2016). Residents' quality of life and attitudes toward tourism development in China. Tourism Management, 57, 56-67.

17. Paresishvili, O., Kvaratskhelia, L., & Mirzaeva, V. (2017). Rural tourism as a promising trend of small business in Georgia: Topicality, capabilities, peculiarities. Annals of Agrarian Science, 15(3), 344-348.

18. Pham K., Andereck K.L., Vogt C.A. (2019). Local residents' perceptions about tourism development; Proceedings of the 2019 International Conference—Navigating Shifting Sands: Research in Changing Times; Melbourne, VIC, Australia. 25–27 June 2019.

19. Ridderstaat, J., Croes, R. and Nijkamp, P. (2014). The tourism development–quality of life nexus in a small island destination', Journal of Travel Research, 16, 5, 472-487.

20. Salvatore, R., Chiodo, E., & Fantini, A. (2018). Tourism transition in peripheral rural areas: Theories, issues and strategies. Annals of Tourism Research, 68, 45-51.

21. Su, M.M., Wall, G., & Wang, S. (2017). Yujiale fishing tourism and island development in Changshan Archipelago, Changdao, China. Island Studies Journal 12(2): 127-142.

22. Yunikawati, N.A., Istiqomah, N., Priambodo, M.P., Puspasari, E.Y., Sidi, F., Marzanah, A.J. (2021). Community Based Rural Tourism (CBRT): The Impact on Local Residents Quality of Life in Indonesia; EDP Sciences: Les Ulis, France, p. 02012

VALUES OF ECOSYSTEM SERVICES: OXYGEN PRODUCTION IN THE FORESTS OF BELGRADE

Tatjana Dimitrijević[1], *Mihailo Ratknić*[2]

Abstract

Forests produce oxygen, which is necessary for human existence, and bind CO_2, thus contributing to the reduction of global warming. Precisely forest biomass is the basic parameter in evaluating the amount of produced oxygen and bound carbon. In the past 50 years, more oxygen has been used, expressed in percentage, than in the entire Anthropocene. The reduction of oxygen, in the late 21st century, may become one of the dominant problems for the survival of life on Earth. With the annual oxygen consumption of only 10 billion tonnes, the human race would face danger in 100,000 years, with high concentrations of carbon dioxide at the same time. With an increase in oxygen consumption by 1.1%, this kind of danger would appear in 700 years. Different methods were used in identifying the cost of human life (use of resources, statistical methods, methods of determining human capital, questionnaires, etc.). The cost of a human life in the UK is estimated at EUR 3.1 million, in Latvia - EUR 320,000, in Luxembourg – USD 5.0 million, in Sweden - EUR 2.6 million and in Portugal - EUR 2.3 million. The cost of human life is determined based on age, sex, educational level, acquired qualification and social status. By using the known statistical data and adopting relevant methodologies, we have assessed that a human life in Serbia is worth EUR 368,000 (based on data for the second quarter of 2021). The total value of oxygen produced in the forests of Belgrade amounts to EUR 703,223 million and provides life for 1,910,954 inhabitants. According to the data of the Statistical Office of the Republic of Serbia, Belgrade had 1,694,056 inhabitants in 2019, which means that the existing forest ecosystems meet the current needs of the population. However, if we include other "consumers" of oxygen (cars, industry, etc.), we can conclude that the amount of oxygen produced in the forests of Belgrade is insufficient.

Key words: *ecosystem services, forest, oxygen production, value of human life*

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Introduction

Forests are exposed to a large number of negative effects that are reflected in the deterioration of their health condition, changes in the natural structure of stands, reduced area and the creation of conditions of ecosystem instability, incorrect management system and natural conditions in the form of climate change, acid rains, fires, etc. Climate change resulting from the increase in the concentration of greenhouse gases (CO_2, methane, chlorofluorocarbon, nitrous oxide and ozone) has an impact on the increase in air temperature, on a global level, by 2°C during the next 100 years (Bateman et Lovett, 2000).

Projections from the EURO-CORDEX initiative suggest that European land areas will warm faster on average than global land areas in the range of 1 to 4.5 °C for the RCP4. 5 scenario and in the range of 2.5 to 5.5 °C for RCP8.5 by the end of the century (Jacob et al., 2014), while the number of heat waves will be increasing by the end of the century (and as often as every two years in the second half of the 21st century) for the RCP8.5 scenario (EEA, 2016). In line with the increase in average annual temperature, precipitation is expected to increase by up to 25% in central and northern Europe, while a significant decrease is expected in southern Europe. By the end of the century, extreme daily precipitation will decrease by up to 25% in some parts of southern Europe, while it will increase by the same percentage in central and eastern Europe (Jacob et al., 2014).

Current climate change projections for Serbia foresee a trend of temperature increase for the A1B and A2 scenarios, for the three observed periods (2011-2040, 2041-2070 and 2071-2100) (MAFWM, 2015). The following temperature changes are expected for the observed periods:

1. 2011-2040 - 0.5-0.9°C temperature increase for the A1B scenario and 0.3-0,7°C for the A2 scenario;
2. 2041-2070 – 1.8-2.2°C temperature increase for the A1B and 1.6-2.0°C for the A2 scenario;
3. 2071-2100 – 3.6-4.0°C temperature increase for the A1B and 3.2-3.6°C for the A2 scenario.

The highest warming levels, exceeding 4.0°C by the end of the century, are expected to happen in the summer and autumn seasons (MAFWM, 2015).

Summer warming in the Balkans and western Turkey will be 5-6°C for the period 2071-2100 and the A2 scenario (Gao & Giorgi, 2008). Applying the ICTP-RegCM3 model for the period 2071-2100 and the A2 scenario, an increase of 7.0°C is predicted over the Balkan countries, including Serbia (Önol & Semazzi, 2009).

The amount of oxygen in the air decreases as a result of the increased concentration of CO_2 due to the increase in the use of fossil fuels, but also the use of wood from the forest ecosystems as an energy source. Population growth (today there are already 8,000,000,000 people) indicates an increasing need of the population for oxygen and clean air (Novak et al., 2002), which can only be provided from forest areas, especially urban forests around large city centres. For this reason, oxygen production is included in the ecosystem service in *Section*: Maintenance, *Sector*: Maintenance of Physical, Chemical and Biological Conditions.

Methodology

For the purpose of this paper, we used the data from the management plans of all the managing entities in the Belgrade area, as well as the areas under privately-owned forests.

The research area has been divided into 11 types based on the Typology of Belgrade Landscapes for the needs of the implementation of the European Landscape Convention (Cvejić i sar., 2008):

- Type 1: Alluvial plains of Pančevački Rit (divided into two sub-types: 1/1 - forests in the unprotected part (foreland) and 1/2 - forests in the protected part
- Type 2: Loess and loess plain of South Srem
- Type 3: Alluvial plain of South Srem
- Type 4: Alluvial landscapes
- Tip 5: Alluvial plain in the zone of Posavo-Tamnava and the lower reaches of the Kolubara river
- Type 6: Alluvial plain of the middle reaches of the Kolubara river and the Ljig river valley

- Type 7: Upland and plains in the immediate basin of the Sava river
- Type 8: Neogene upland in the Kolubara river basin
- Type 9: Hilly and hilly-mountainous landscape of northern Šumadija
- Type 10: Upland and plains in the immediate basin of the Danube river and in the basins of Ralja and Lug rivers
- Type 11: The Danube coast - sloping part of the right bank of the Danube;

The state of the growing stock was analysed by landscape type based on the data of forest estates. In the forest estate that included two or more types of landscape, adequate recalculation (transferring) of data into the corresponding type was performed.

The spatial database included the information on surface, tree varieties, canopy, mixture, life cycle, age classes, volume and volume increment.

The geographic information system (GIS), which allows a spatial analysis and a spatial presentation of biomass, was used to estimate the amount of bound carbon and produced oxygen in the area.

The results of oxygen production for the years 2030, 2050 and 2100 are presented for three scenarios: if there is no forest increment, if there is a 10% forest increment and if there is a 30% forest increment. For the year 2100, we show only data for the scenario where there is no increment due to the increased concentration of carbon dioxide resulting from the concept of civilization development aimed at achieving carbon neutral development by 2050.

The value of the amount of oxygen produced in the forests in the Belgrade area was estimated based on the estimation of the cost of human life, bearing in mind that oxygen is the basis of a healthy life and life in general.

Research findings

The industrial revolution brought a lot of air pollution. In the last 100 years, 245 billion tonnes of oxygen were destroyed and the atmosphere was polluted with 360 billion tonnes of carbon dioxide. Oxygen starvation is expected to occur if the current rate of oxygen consumption continues.

In the past 50 years, more oxygen has been used, expressed in percentage, than in the entire Anthropocene. The reduction of oxygen, in the late 21st century,

may become one of the dominant problems for the survival of life on Earth. With the annual oxygen consumption of only 10 billion tonnes, the human race would face danger in 100,000 years, with high concentrations of carbon dioxide at the same time. With an increase in oxygen consumption by 1.1%, this kind of danger would appear in 700 years. This upward trend has already been reached, and industry uses 10% of oxygen produced by plants (Zahar, D.,1984, according to Velašević, V., 1998).

In the process of photosynthesis, plants bind carbon dioxide and release oxygen, and forest ecosystems are the most important for oxygen production. As much as 60% of the oxygen on Earth is produced by plants, while the rest comes from phytoplankton and water vapour that is created in the upper layers of the atmosphere. To create 1 tonne of primary organic production, the forest releases from 1.2 to 1.38 tonnes of oxygen. Plant life from an area larger than one hectare consumes 8 kg of CO_2 from the air in one hour, which is the amount exhaled into the atmosphere by 200 people (Bunuševac, T., 1973).

The balance between the amount of carbon dioxide and oxygen is of crucial importance for the living world on Earth. Although there is no reliable proof, we can still conclude that a small increase in the carbon dioxide content of plants increases the assimilation processes and leads to stabilisation. A small increase in the CO_2 content has influenced a volume increment of 10-30% in forests, while the impact, which would arise from a larger disturbance of the ratio, is unknown.

In the rebalancing of oxygen and carbon dioxide, there is usually a local deviation from the optimal ratio in the atmosphere. These differences are equalised from the resources of other areas by air currents. However, the reduction of oxygen is evident on a global level. For example, plants in the USA replace only 60% of the oxygen that is consumed annually by burning oil, coal and natural gas (Velašević, V. i sar., 1998).

Trees release oxygen when they use the energy of sunlight to make glucose from carbon dioxide and water. Oxygen is also used in the breakdown of glucose to release energy for the metabolic process. More oxygen is produced for these processes on average, during 24 hours, than the consumed amount. It takes six molecules of CO_2 to produce one molecule of glucose in photosynthesis. A molecule of glucose contains six carbon atoms, and a tree gets a net addition of one molecule of oxygen for each carbon atom. A tree about 15 meters high and weighing two tonnes (including roots and leaves) annu-

ally produces about 100 kilograms of wood, which includes 38 kilograms of carbon. In relation to the relative molecular masses of carbon and oxygen, it amounts to 100 kilograms per tree per year. A person inhales about 9.5 tonnes of air, but oxygen is only 23% of that air, and with each breath we separate slightly more than a third of oxygen, which amounts to 740 kilograms per year. That is approximately seven to eight trees. Oxygen production in total biomass (t ha^{-1}) is shown in Table 1.

Table 1. *Oxygen production in total biomass (t ha^{-1})*

Type of land-scape	2020	2030			2050			2100
		Scenario			Scenario			
		0%	+10%	+30%	0%	+10%	+30%	0%
Type 1/11/1	462042	496664	534749	541673	790954	829039	835963	1137178
Type 1/2	185921	194014	202917	204536	262808	271711	273330	343742
Type 2	268589	277914	288173	290038	357184	367443	369308	450443
Type 3	331197	341943	353765	355914	433289	445110	447260	540755
Type 4	70635	72897	75384	75837	92119	94606	95059	114733
Type 5	170296	178884	188331	190049	251885	261332	263049	337768
Type 6	128605	133988	139909	140986	179743	185665	186741	233574
Type 7	490786	513532	538553	543103	706877	731899	736448	934342
Type 8	195738	206256	217825	219929	295658	307228	309331	400837
Type 9	1902822	1988564	2082881	2100030	2717375	2811691	2828840	3574799
Type 10	623826	655683	690727	697098	926474	961517	967888	1245050
Type 11	103136	107275	111829	112656	142460	147014	147841	183854
Total	4933591	5167616	5425043	5471848	7156827	7414254	7461059	9497074

Source: Original

We have valued the production of oxygen through the value of human life. Valuing life is a very difficult issue, often considered unethical, because human life is considered priceless. In the economic sense, the value of human life is always finite, because any rational decision-making mechanism must be able to weigh the probability of profit in relation to the probability of saving life (Vrijling and Galder, 2000).

“If, despite ethical problems, the cost of human life must be calculated, the objective number is the present value of the net product per capita of the country under study (Net National Product - Depreciation). For the Netherlands area, and a human lifespan of 70 years, the value is from USD 450,000 to 800,000, depending on the interest rate. The consequence of this approach is that the value of human life in developing countries is lower. This question

seems strange and unethical, but highlights the advantages in the context of the national economy" (Vrijling and Galder, 2000). In ancient Egypt the price of slaves was about USD 32,000; in the Roman Empire a gladiator (slave) was worth USD 2,080, in America a boy (slave) was worth USD 8,100.

Different methods were used in identifying the cost of human life (use of resources, statistical methods, methods of determining human capital, questionnaires, etc.). The cost of a human life in the UK is estimated at EUR 3.1 million, in Latvia - EUR 320,000, in Luxembourg – USD 5.0 million, in Sweden - EUR 2.6 million and in Portugal - EUR 2.3 million. The cost of human life is determined based on age, sex, educational level, acquired qualification and social status.

The US Environmental Protection Agency, in 2011, put the value of a human life at USD 9.1 million, while the Food and Drug Administration estimated it to be worth USD 7.9 million. By using the known statistical data and adopting relevant methodologies, we have assessed that a human life in Serbia is worth EUR 367,996 (based on data for the second quarter of 2021).

We are aware of the fact that these data can help in recognising the importance of the forest for sustaining life, but also raise a number of other questions. If one human life is valuable, how much would one have to pay to prevent an event that in 100 or 500 years would result in the loss of tens of billions of human lives? If we use a 7% discount rate, the value is extremely small (USD 162.63), while at lower discount rates it is "so large that there are too many zeros to fit on this side" (Partnoy, 2012). The total value of oxygen produced in the forests of Belgrade amounts to EUR 703,223 million (RSD 82,628,752.81 million) and provides life for 1,910,954 inhabitants (Table 2).

According to the data of the Statistical Office of the Republic of Serbia, Belgrade had 1,694,056 inhabitants in 2019, which means that the existing forest ecosystems meet the current needs of the population. However, if we include other "consumers" of oxygen (cars, industry, etc.), we can conclude that the amount of oxygen produced in the forests of Belgrade is insufficient.

The Strategy of the Belgrade area afforestation (Ratknić, M. et al., 2009) foresees the afforestation of new 50,000 hectares (Option 1) to 100,342 hectares (Option 2), which should enable an increase in the bound carbon and the amount of oxygen produced. The increase in oxygen would be 100% under Option 1 to 200% under Option 2, based on urban forest oxygen production in

2021. Tables 3 and 4 show the expected risk foreseen for oxygen production under the climate scenarios A1B and A2.

Table 2. *Value of forest ecosystems expressed in the cost of human life*

Type of landscape	Total number of trees	Number of trees needed for life	Number of inhabitants provided with oxygen	Cost of a human life	Total value of produced oxygen (in million RSD)
Type 1/1	493486	8	61686	43,239,530.00	2,667,273.65
Type 1/2	412006	8	51501	43,239,530.00	2,226,879.03
Type 2	311713	8	38964	43,239,530.00	1,684,785.05
Type 3	360595	8	45074	43,239,530.00	1,948,978.58
Type 4	73718	8	9215	43,239,530.00	398,452.27
Type 5	185885	8	23236	43,239,530.00	1,004,713.72
Type 6	95671	8	11959	43,239,530.00	517,101.54
Type 7	1799480	8	224935	43,239,530.00	9,726,083.68
Type 8	3591959	8	448995	43,239,530.00	19,414,332.77
Type 9	7334608	8	916826	43,239,530.00	39,643,125.33
Type 10	49771	8	6221	43,239,530.00	268,993.12
Type 11	578738	8	72342	43,239,530.00	3,128,034.08
Total	15287630	8	1910954	43,239,530.00	82,628,752.81

Source: Original

Table 3. *Expected risk for ES - production of oxygen caused by climate change by applying the A1B Model*

Risk	Spring	Summer	Autumn	Winter
Heat wave	**Very high**	**Very high**	High	
Extreme cold	High			*Medium*
Drought	**Very high**	**Very high**	**Very high**	
Heavy precipitation / flooding	High	High	*Medium*	
Storms	High	High	High	High

Source: Original

Table 4. *Expected risk for ES - production of oxygen caused by climate change by applying the A2 Model*

Risk	Spring	Summer	Autumn	Winter
Heat wave	**Very high**	**Very high**	**Very high**	
Extreme cold	High			High
Drought	**Very high**	**Very high**	**Very high**	
Heavy precipitation / flooding	**Very high**	**Very high**	High	
Storms	**Very high**	**Very high**	**Very high**	**Very high**

Source: Original

The following risks have the greatest impact on forest ecosystems: heat wave, extreme cold, drought, heavy precipitation/floods and storms. Each of these risks has a different frequency in the analysed scenarios and is given by season.

Conclusions

Forests play a decisive role in the production of oxygen, which is necessary for human life, and by accumulating carbon, they influence the reduction of the effect of global warming. By absorbing CO_2 from the air, they turn it into biomass, and release oxygen into the atmosphere, which means that these processes are an important segment of the ecosystem services that forests provide in terms of improving air quality.

The existing urban forest ecosystems in the area of Belgrade meet the current needs of the population, but if we include other "consumers" of oxygen (cars, industry, etc.), we can conclude that the amount of oxygen produced in the forests of Belgrade is insufficient. This indicates the need to plant new forests in the future to compensate for this shortage of oxygen.

Literature

1. Bunuševac, T. (1973): Uloga zelenih površina u melioraciji nepovoljnih uslova sredine naselja Srbije, Zbornik radova „Čovek i životna sredina u SR Srbiji", Glas, Beograd
2. Cvejić, J., Vasiljević, N., Tutundžić, A. (2008): Tipologija predela Beograda za potrebe Evropske konvencije o predelima. Univerzitet u Beogradu Šumarski fakultet, Grad Beograd-Gradska uprava, Sekretarijat za zaštitu životne sredine

3. Jacob, D., Petersen, J., Eggert, B., Alias, A., Christensen, O. B., Bouwer, L. M., Yiou, P. (2014): EURO-CORDEX: new high-resolution climate change projections for European impact research. Regional Environmental Change, 14(2), 563–578.

4. Nowak, DJ., Stevens, JC., Sisinni, SM., Luley, CJ. (2002). Effects of urban tree management and species selection on atmospheric carbon dioxide. J. Arboricult. 28: 113-122.

5. Önol, B., Semazzi, F. (2009): Regionalization of climate change simulations over the eastern Mediterranean. J Clim 22: 1944–1961.

6. Partnoy, F. (2012): Corporation and Human Life. https://digitalcommons.law.seattleu.edu/cgi/viewcontent.cgi?article=2394&context=sulr

7. Ratknić, M., Braunović, S., Bilibajkić, S., (2009): Ecological ethics in the global ecological changes**.** International Conference "LAND CONSERVATION" - LANDCON 0905 GLOBAL CHANGE – CHALLENGES FOR SOIL MANAGEMENT. 26-30. maj 2009. Tara Mountain. CD ROM Conference Poceedings.

8. Velašević, V., Đorović, M. (1998): Uticaj šumskih ekosistema na životnu sredinu, Šumarski fakultet Univerziteta u Beogradu, str. 1-450.

9. Vrijling, J., Galder, P. (2000): An analysis of the valuation of a human life, https://www.researchgate.net/publication/239387302_An_analysis_of_the_valuation_of_a_human_life

WORKING SECTION

SUPPORTING RURAL TOURISM IN ROMANIA THROUGH THE NATIONAL RURAL DEVELOPMENT PROGRAMME 2014-2020

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Abstract

For balanced rural development, in addition to supporting agriculture, particular attention must be paid to the non-agricultural economic sector. Even if the main activity of rural residents is agriculture, the diversification of economic activity towards the non-agricultural sector provides additional incomes for entrepreneurs and stable jobs that can be achieved throughout a year, as opposed to seasonal incomes and employment opportunities in agriculture. The rural environment in Romania creates the appropriated framework for tourism development, through the natural and cultural resources that can be exploited by local entrepreneurs. Both Romanian and foreign tourists are increasingly attracted by the opportunities of visiting and spending their leisure time, which the Romanian countryside offers. The National Rural Development Programme 2014-2020 transposes in Romania the priorities of the Common Agricultural Policy and the objectives of the European Fund for Agriculture and Rural Development. Through this program, the socio-economic development of the Romanian rural area is supported, including by granting non-reimbursable financing to the rural non-agricultural sector. Tourism is one of the important sectors that needs to be supported and exploited for the benefit of rural communities.

The purpose of this article is to carry out an analysis of the use of the funds for agriculture and rural development made available by the EU in the period 2014-2020, in order to make investments in the establishment and development of tourist activities in the Romanian rural area. The results of the analysis reveal

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that non-reimbursable funding has created opportunities for the socio-economic development of local communities by increasing the number of businesses active in the tourism sector and by creating jobs, especially for women.

Key words: *rural tourism, CAP, European funds, rural development.*

Introduction

Between the regions of Romania there are significant differences in the economic development caused by the specific geographical, demographic, social and economic characteristics. In order to reduce disparities between the country's territories, it is necessary to adopt policies to ensure economic, social development and environmental protection. (Mocanu, I., Grigorescu, I., Mitrică, B., Popovici, E.-A., & Dumitrașcu, M., 2018).

In rural areas, the business environment is poorly represented, with the rural economy relying mainly on the agricultural sector, with the non-agricultural sector being less represented. The rural market is characterised by approaches and behaviours differentiated by area that are based on traditional rural values, but also those stemming from a continuous process of adaptation and evolution. (National Strategy for Sustainable Development of Romania 2030)

National budget investments and european funding support the development of a region, while the lack of them increases the differences between regions and especially between rural and urban areas. Rural areas often face the impossibility of supporting co-financing of the process of absorption of EU funds, so private entrepreneurial intervention could be a solution for local development and the elements constituting rural tourism can constitute a market segment with development potential. According to the Romanian National Strategy for Tourism Development 2019-2030, authenticity, rural and ecological character are some of the most important characteristics that tourists associate with Romania. (Romania's Tourist Development Strategy, 2019)

An important contribution to the development of the entrepreneurial sector in rural areas has had funding for non-agricultural investments supported by the 2014-2020 NRDP, through sub-measures 6.2 "Support for the establishment of non-agricultural activities in rural areas" and 6.4 "Investments in the creation and development of non-agricultural activities". (Ministry of Agriculture and Rural Development, 2021). The article proposes an analysis of the financing granted by the NRDP until the end of 2021, for the establishment and development of non-

agricultural activities in rural areas. In making this article were used information from the official platform of the Ministry of Agriculture and Rural Development, data available at the level of the Agency for Financing Rural Investments regarding the number of contracts, their value, the type of activities supported and categories of beneficiaries, as well as public information on the tourist structures in Romania, available on the official website of the National Institute of Statistics. A series of national and European articles and regulations aimed at the development of the rural tourism sector have been covered.

Literature review

Tourism is an important element in the development of a country, both economically and socio-culturally. Through the opportunities it creates in terms of job creation, income growth and the development of complementary services, the tourism sector has a positive effect on the degree of development of a country or region. (Egbali, N.; Nosrat, A.B.; Alipour, S.K.S., 2011) (Shariff, N.M.; Abidin, A.Z., 2013)

The development of the rural area in Romania is one of the priorities of the state policies that must be based on a strategy that identifies appropriate solutions, taking into account the existing dysfunctions, both in the economic and social sectors. (Popescu, G., 2014).

The natural, ecological and traditional nature of rural areas provides the optimal framework for the development of tourist activities, both for the satisfaction of tourists and for the benefit of local communities. (Scientific, S. 2012)

The geographical coverage of 91 % and the population of 59 % of rural areas in the EU represent the potential to be exploited in tourism development. (Giannakis, E., 2014)

The process of revitalising tourism must be carried out responsibly, with the protection of both natural and anthropogenic resources, ensuring sustainable development. The sustainable approach of this sector should be based mainly on environmentally friendly practices, but only partially achieved in practice. (Mihalic, T. 2014) The local community and the entrepreneurial environment must understand that the development of a business must take into account the protection of resources, otherwise the destruction or consumption of resources will lead to business failure in the long-term.

The allocation of funds from national or European sources and for the development of access infrastructure, the restoration of heritage objectives and the improvement of quality of life contribute to reducing inter-regional disparities and increasing the potential of rural tourism, agro-touristic affairs in particular. (Love, M.; Iamandi, I.; Munteanu, S.; Ciobanu, R.; Tsarţavulea R.; Lădaru, R. (2017) In most rural areas of the European Union, lack of employment opportunities, low skills in the population, low digital connectivity, aging stable population, poor social services are identified. Funding made available through European policies and programmes in various fields leads to economic growth in rural areas, supports social inclusion and the development of "smart villages". (European Union, 2022)

Material and methods

The article aims to carry out an analysis of the impact of the European funds for agriculture and rural development on the development of the tourism sector.

In this respect, quantitative and qualitative research was used, based on various observations, analyses and data processing. Information was processed from the official platform of the Ministry of Agriculture and Rural Development, available at the level of the Agency for Rural Investment Financing and on the website of the National Institute of Statistics. A review of specific literature such as scientific articles, books, tourism and rural development studies, as well as applicable European and national legislation has also been carried out.

The objectives pursued by the research concern the impact of granting non-reimbursable support for tourism activities established and developed in rural areas in Romania. It also highlights the number of jobs, specified by gender, created by projects funded in the field of tourism.

Research and results

For the period 2014-2020, with a view to the sustainable development of rural areas, the European Union has made available to the Member States the European Agricultural Fund for Rural Development (EAFRD), which is used to pursue the objectives of the Common Agricultural Policy. The EU Regulation 1305/2013 sets out the general rules for regulating this support, as well as the relevant objectives, priorities and measures of the Union in the field of rural development. In addition to prioritising farm development, non-reimbursable support is also intended to support the non-agricultural sector in rural areas. This creates the right framework

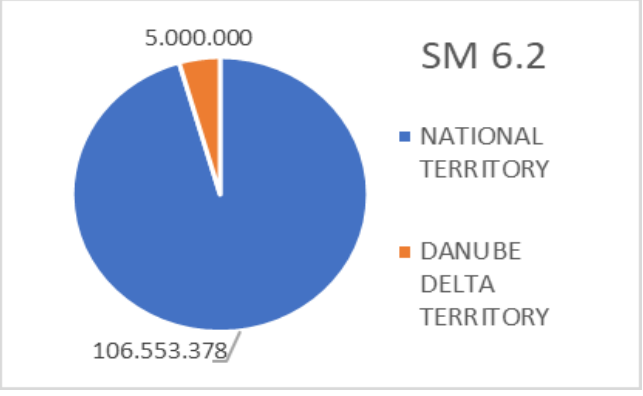
for employment, diversification of agricultural income of the rural population and the creation of cross-sectoral links at local level. Initiatives that integrate agriculture and rural tourism with a focus on sustainable development, natural and cultural heritage and the use of renewable energy are encouraged. (EurLex, 2022)

Financing opportunities for non-agricultural activities through the 2014-2020 NRDP

At Romanian level, the EAFRD implementation framework was created through the 2014-2020 National Rural Development Programme. This programme provides support for the development of agriculture and rural areas, while respecting environmental conditionalities. The programme provides local entrepreneurs with support for both the establishment of non-agricultural businesses and the development and modernisation of existing ones, through Sub-measure 6.2 "Support for the establishment of non-agricultural activities in rural areas" on and sub-measure 6.4 "Investments in the creation and development of non-agricultural activities". These sub-measures target production, service and tourism activities. (NRDP,2022)

In the 2014-2020 NRDP, according to version 12, EUR 106.553.378 was allocated for sub-measure 6.2. This allocation was distributed during three project submission sessions in 2015, 2016 and 2017. For the Danube Delta area, a separate allocation was established in the NRDP for sub-measure 6.2, amounting to EUR 5.000.000, which was distributed to beneficiaries in two sessions in 2017 and 2018. (Paying Agency for Rural Investments, 2022)

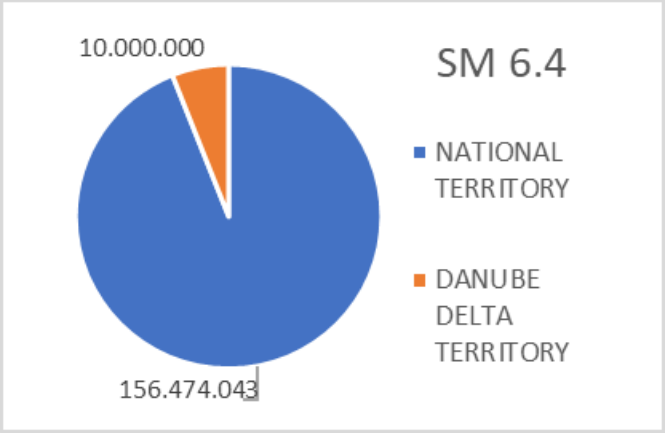
Figure 1. *Distribution of sub-measure funds 6.2.*



Source: https://madr.ro/docs/dezvoltare-rurala/2021/Program-National-de-Dezvoltare-Rurala-2014-2020-v12.pdf

For sub-measure 6.4 in the 2014-2020 NRDP, version 12, EUR 156.474.043 million was allocated. This allocation was distributed during three project submission sessions in 2015, 2016 and 2017. For the Danube Delta area, a separate allocation was established in the NRDP for sub-measure 6.4, amounting to EUR 10.000.000, which was distributed to the beneficiary in two sessions in 2017 and 2018.

Figure 2. *Distribution of sub-measure funds 6.4*



Source: https://madr.ro/docs/dezvoltare-rurala/2021/Program-National-de-Dezvoltare-Rurala-2014-2020-v12.pdf

Tourist activities set up by sub-measure 6.2 — NRDP

During the three project submission sessions dedicated to the rural area in Romania (with the exception of the Danube Delta area), 435 projects were contracted for tourism services, with a public value of approximately EUR 30 million, out of 1860 total contracted projects.

Of these, 428 projects with a value of EUR 29.218.000 aim at setting up rural quest houses and 7 projects with a value of EUR 350.000 aimed at recreational and fun activities.

For the Danube Delta 2 submission sessions were held, following which a total of 71 projects with a value of EUR 4.790.000 were contracted, of which 58 projects, with a value of EUR 3.850.000 for the establishment of rural quest houses.

Following the implementation of the projects, 423 jobs were created, of which 255 were occupied by women. (Paying Agency for Rural Investments, 2022)

The distribution of jobs created by tourism enterprises financed by sub-measure 6.2, according to gender and activity, is shown in Table 1.

Table 1. *Jobs created by sub-measure 6.2*

Activity Tipe	National Territory		Danube Delta Territory	
	Men	Women	Men	Women
Rural guest house	152	239	8	4
Recreational and fun activities	0	0	8	12

Source: http://opendata.afir.info/

Tourism activities developed through sub-measure 6.4 — PNDR

For sub-measure 6.4, three project submission sessions were opened for the entire rural area in Romania, with the exception of the Danube Delta area. During these sessions, 841 projects with a public value of EUR 139.008.051 were contracted, creating 1471 total jobs, of which 879 were occupied by men and 592 women. Out of the total projects that received funding, 408 projects targeted tourism activities, with a contracted public value of EUR 76.617.849. Of these projects, 350 targeted tourist accommodation services and 433 jobs were created, of which 174 were occupied by men and 259 women. Through 58 projects targeting fun and agreement activities, 125 jobs were created, of which 74 were occupied by men and 51 women.

Two sessions were opened for the Danube Delta area. They contracted a total of 47 projects with a public value of EUR 8.565.548 and 62 jobs were created, of which 27 men and 35 women. Of the total projects, 44 projects targeted tourist accommodation services with a value of EUR 7.977.940, creating 56 total jobs, of which 23 men and 33 women (Paying Agency for Rural Investments, 2022)

The distribution of jobs created by tourism enterprises funded by sub-measure 6.4, by gender and activity, is shown in Table 2.

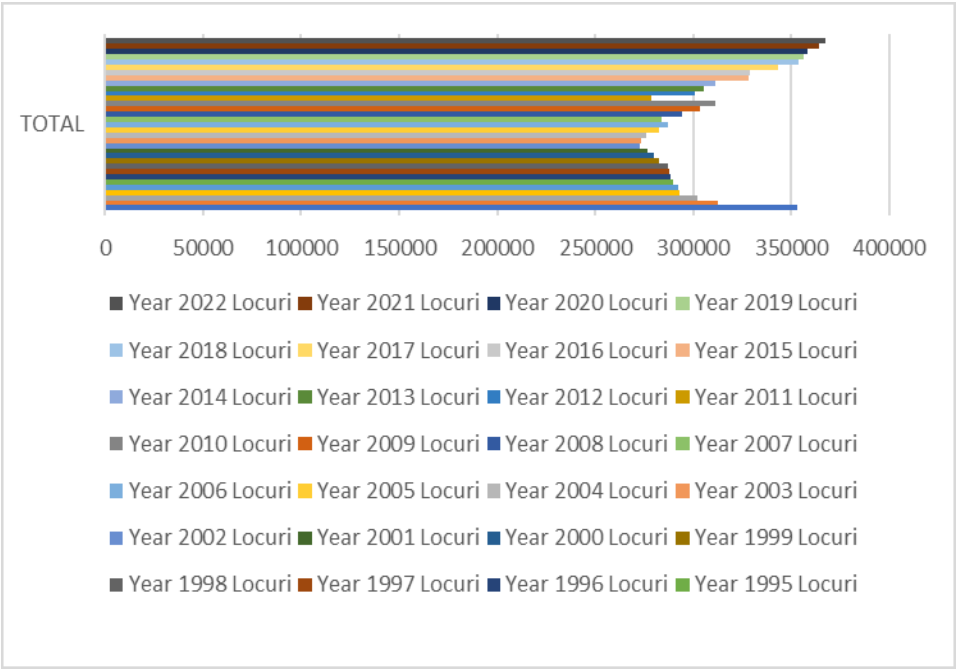
Table 2. *Jobs created by sub-measure 6.4.*

Activity Tipe	National Territory		Danube Delta Territory	
	Men	Women	Men	Women
Rural guest house	174	259	23	33
Recreational and fun activities	74	51	0	0

Source: http://opendata.afir.info/

Studying the official data published by National Institute of Statistical regarding "The existing tourist accommodation capacity by types of tourist reception structures, macro-regions, development regions and counties" there is a considerable difference between the places available before 2016, when the implementation of the National Rural Development Programme for 2014-2020 and the period after this year began. Thus, if in 2016 we had 328 888 beds, in 2021 we had 364 507 seats and in 2022 367 386 accommodation places were reached.

Figure 3. *Tourist accommodation capacity by types of tourist reception structures, macro-regions, development regions and counties*

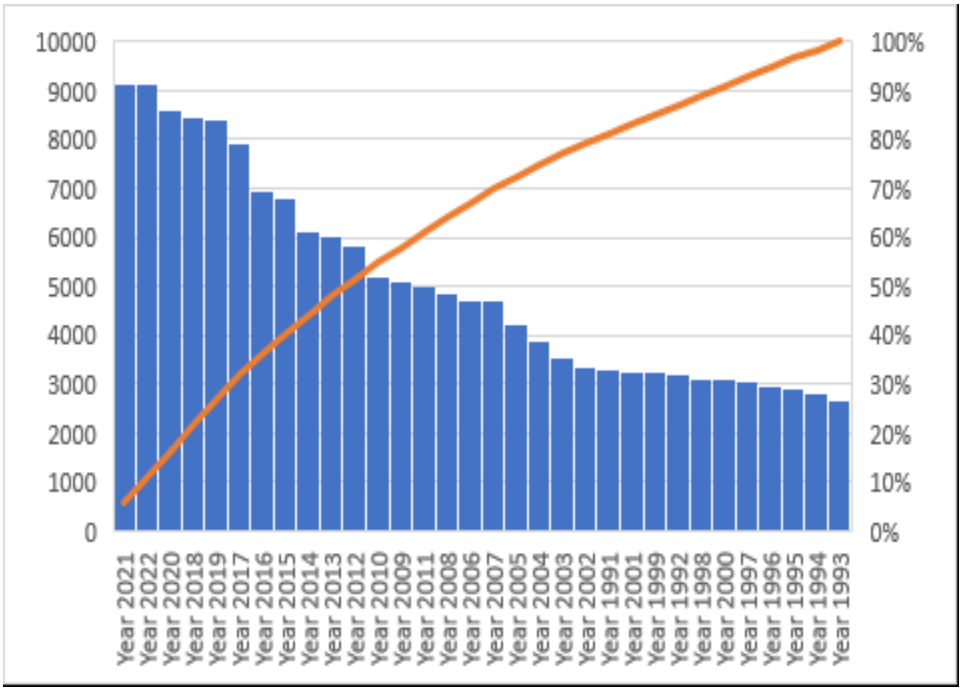


Source: http://statistici.insse.ro/tempo-online

In the analysis of these data we can find that in the post-communism years, the accommodation capacity was 14.150 places lower compared to 2022, but the added value brought by the non-reimbursable financing consists of the quality of the accommodationplaces, their originality and authenticity. If in the post-communist years most of the accommodation places were in hotels, after the appearance of non-reimbursable funds, the capacity of accommodation in rural quest houses was developed, these offering more comfort, quality and above all "originality", increasingly sought by the current consumer.

If in the 1990s there were 3213 villas/pension accommodation structures, in 2016 there were 6946 units and in 2022 there were 9120 such structures.

Figure 3. *Tourist accommodation structures by types and forms of ownership*



Source: http://statistici.insse.ro/tempo-online

Conclusion

Rural areas provide important resources for sustainable development. The basic activity of the rural population is agriculture, but the technological development and execution of the production and processing of agricultural products in an automated manner and with the application of precision agriculture, makes this activity to reduce the labour force needs. Thus, rural residents need to find other sources of income in order to improve their lives and have the safety of tomorrow.

The rural environment offers many and various natural and anthropogenic resources that can be exploited and transformed into a source of income for the local community and at the same time a point of interest for both those who want to invest and those who want to spend their free time. The natural environment of Romania, with a diversified flora and fauna, as well as the elements of tradition and cultural heritage material and intangible create the optimal context for the development of

touristic activities. The use of European funds for rural development represents an important support for the rural environment in Romania, being an important financial impute that supports the economic development of local areas. The use of non-reimbursable resources is carried out in a rigorous manner, following the strategic lines drawn through the NRDP and respecting the environmental and public health conditionalities.

As is apparent from the analysis carried out in this paper, the measures in the NRDP dedicated to non-agricultural activities in rural areas are very successful, being highly accessed, and the allocated funds exhausted from the first years of implementation of the program. The high share of requests for support for tourism activities, especially for rural quest houses, shows us the increased interest of the rural population in the diversification of agricultural activities in non-agricultural ones or complementary to agriculture. At the same time, data analysis shows that the development of tourism services creates the opportunity for employment, especially for women, which solves many rural social problems.

The results of this research can be a starting point for further analysis on how future sources of funding and policies to support strategic priorities for the development of rural tourism in Romania.

Acknowledgements

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Literature

1. Drăgoi, M.; Iamandi, I.; Munteanu, S.; Ciobanu, R.; Tsarţavulea R.; Lădaru, R. (2017) *Incentives for Developing Resilient Agritourism Entrepreneurship in Rural Communities in Romania in a European Context.* Sustainability 2017,9(12), 2205;
2. European Union (2022) https://single-market-economy.ec.europa.eu/sectors/tourism/funding-guide/european-agricultural-fund-rural-development_en (accessed on 17.11.2022)
3. EurLex (2022) https://eur-lex.europa.eu/legal-content/RO/TXT/PDF/?uri=CELEX:32013R1305&from=es (accessed on 28.10.2022)
4. Egbali, N.; Nosrat, A.B.; Alipour, S.K.S. (2011) *Effects of positive and*

negative rural tourism (Case study: Rural Semnan Province) J. Geogr. Reg. The plan. 2011, 4, 63-76.

5. Giannakis, E., 2014 *The role of rural tourism on the development of rural areas: The Case of Cyprus Elias*. Romanian J. Reg. SCI. 2014, 8, 38-53.
6. Mihalic, T. (2014) *Sustainable-responsible tourism discourse e towards 'responsustable' tourism sustainability.* J. Clean. Prod. 2014.
7. Ministry of Agriculture and Rural Development, (2022), https://madr.ro/pndr-2014-2020/implementare-pndr-2014-2020/documente-aprobate.html (accessed on 20.11.2022)
8. Mocanu, I., Grigorescu, I., Mitrică, B., Popovici, E.-A., & Dumitrașcu, M., (2018). *Regional disparities related to socio-economic determinants of agriculture in the romanian plain*. Journal of Urban and Regional Analysis.
9. Paying Agency for Rural Investments (2022), www.afir.info/Reports and Lists/Selection Reports (accessed on 10.11.2022)
10. Paying Agency for Rural Investments (2022), www.afir.info /Date Open AFIR (accessed on 30.10.2022)
11. J. G. (2014). *Proposals regarding the focal points of a future strategy for the development of rural space and of agriculture in Romania*. Competitiveness of Agro-Food and Environmental Economy, 26.
12. Shariff, N.M.; Abidin, A.Z. (2013) *Community attitude towards tourism impacts: Developing a standard tool in the Malaysian context.* E-J. Soc. SCI. It's RES. 2013, 1, 386-396.
13. Stetic, S. (2012) *Specific features of rural tourism destinations management.* J. Settl. Spat. The plan. 2012, 1, 131-137.
14. *Tourism Development Strategy of Romania*, 2019 http://sgg.gov.ro/1/wp-content/uploads/2020/09/Strategia-de-Dezvoltare-Turistic%C4%83-a-Rom%C3%A2niei-volum-2-Strategia-%C8%99i-Planul-de-Ac%C8%9Biune.pdf.
15. *National Strategy for Sustainable Development of Romania 2030* https://sgg.gov.ro/1/wp-content/uploads/2018/10/SNDD-2030-_-varianta-dup%C4%83-Comitet-interministerial-4-octombrie-2018.pdf.
16. Tempo Online, INSSE: http://statistici.insse.ro:8077/tempo-online/#/pages/tables/insse-table

TOURISM IN THE SUSTAINABLE DEVELOPMENT SYSTEM: THE CASE OF IZOBILNENSKY DISTRICT

Anastasia Morozova [1], *Irina Pavlenko* [2]

Abstract

There are two processes are being carried out simultaneously in Russia: the process of sustainable development and the process of developing domestic tourism. Intensive development of tourism can lead to violations of the principles of sustainability. This is particularly relevant for rural areas where tourism development can be unorganized. In view of this, it is necessary to determine the role of tourism in the system of sustainable development and identify possible ways to stimulate it through the tools of the tourism industry. In this article, the experience of SSAU researchers with Izobilnensky district that is located in the Stavropol region is demonstrated. This experience involves the preparation of an exclusive tourism development programme for the rural district, in line with the principles of sustainable development.

Key words: *sustainable development, sustainable rural development, tourism, sustainable tourism, domestic tourism.*

Introduction

Nowadays, an overwhelming number of countries, including the Russian Federation, are aware of the need to incorporate sustainable development principles and goals into their national strategies. In Russia, work on sustainable development goals is primarily presented in the form of federal and regional programmes, as well as National projects.

A sustainable development approach involves the integrated improvement of the socio-economic and environmental spheres and their individual elements. In turn, one of these elements is tourism. In the current circumstances, the

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Russian Federation is working actively to develop the domestic tourism industry. Hence, there are two parallel processes are being carried out in Russia: the process of sustainable development and the process of developing domestic tourism.

The central idea of the article: defining the role of tourism in the sustainable development system and identifying possible tourism industry tools that can be used to stimulate it. The tourism project developed by researches of SSAU for Izobilnensky district is demonstrated as one of such tools.

A strong tourism industry can have a positive impact on travellers by improving the quality of their recreation, as well as on the socio-economic condition of the country, its individual regions and tourist destinations.

However, there are a range of negative impacts of tourism activities, among which are the emergence of intercultural conflicts, higher crime rates, an increasing proportion of unskilled and seasonal unstable labour, increasing consumption of water and other natural resources, environmental pollution, etc. Thus, the organisation of tourism can be counterproductive to the implementation of sustainable development programmes, which means that it is necessary to apply the principles of sustainable tourism in its planning. According to the UNWTO, such principles include: an optimal approach to resource management; assisting in the conservation of the natural and biological complexes of the host regions; preserving and protecting the cultural authenticity of the populations in tourism destinations; ensuring a fair distribution of economic goods; providing stable and equal employment and additional income opportunities; contributing to poverty reduction work [7].

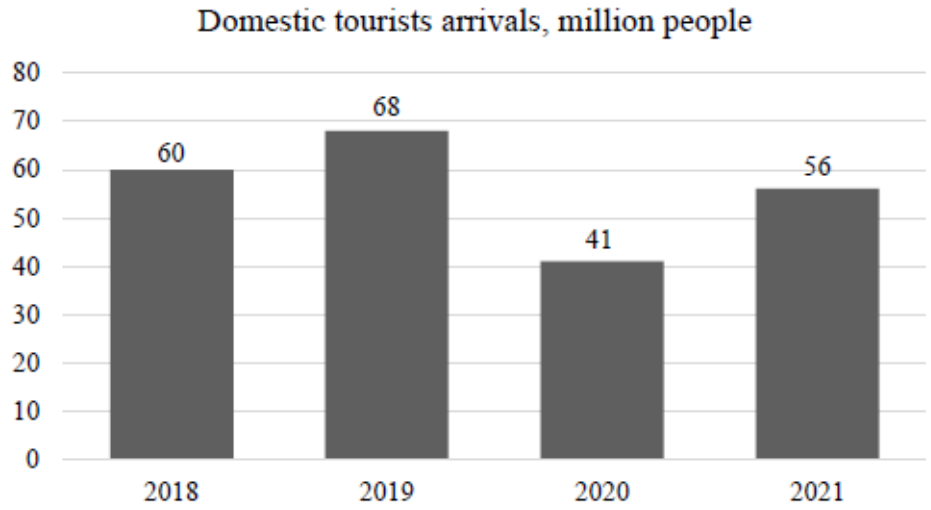
Methods of the research

The empirical basis of the study was constituted by official statistical information taken from open sources of the Federal Agency for Tourism (abolished on the 20th of October 2022) and the Federal Statistical Service, scientific works on the economy of tourism and the impact of tourism activities on sustainable development. In addition, the experience of the project work of SSAU researchers with Izobilnensky District of the Stavropol region is demonstrated as an example of a tourism tool that may cause a supportive impact on sustainable development processes. The researchers used the analytical method (in terms of examining and processing statistical data) and the abstract-logical method.

Results

The Picture shows the dynamics of domestic tourism flows in the Russian Federation from 2018 to 2021 [6]. According to this chart, the most successful year for domestic tourism and tourism in general is 2019, during which 68 million people traveled within Russia. From 2020 onwards, the tourism industry faces a period of limiting external factors, including the impact of the worsening sanitary and epidemiological situation worldwide and the emergence of political conflicts. Thus, 2020 was the most crisis year for tourism with a record low of 41 million domestic tourist arrivals in this timeframe.

Figure 1. *Statistics on domestic tourism flows in Russia, 2018-2021.*



In 2021, the government has launched the rehabilitation of the domestic tourism industry. For this purpose, federal and regional programmes have been developed and implemented, one of which and the most popular is the "Tourist Cashback" programme, aimed at popularising new tourist destinations within the country and stimulating consumer demand. The tourism industry has thus been rehabilitated by 82.4%, almost reaching the figures for 2019.

In 2022, the development of domestic tourism continues due to the influence of exogenous factors and the resulting metamorphosis of the international tourism sector. The number of domestic tourists is expected to rise to 61 million by the end of the year. As of August 2022, a number of 34 million tourists have already been recorded [3].

It is also necessary to note that there is a flow of unorganised tourists, complete and reliable information about which could not be captured in official statistics.

Thus, the trend towards domestic tourism continues, its development is one of the priority processes at the state level. The development of Russian system of domestic tourism will make the industry more independent of external circumstances and will certainly bring a number of positive effects for the socio-economic complex of the country. However, as the popularity of domestic tourism and consumer demand for domestic tourism products and services increase, so does the potential for negative influences on the sustainable development system. Domestic tourism destinations may undergo heavy human pressure, and unorganised tourism may lead to spontaneous and uncontrolled development of the industry, which in turn may have a devastating effect on the identity of the host regions of the country and their ecological complex.

According to the Voluntary National Review of the 2020 Sustainable Development Goals, Russia has incorporated principles of responsible tourism as a part to the National Ecology Project [8]. This mainly takes the form of the promotion of ecotourism, which is used as a tool to create awareness of the natural and ecological complex of the country.

Meanwhile, the domestic tourism system is increasingly developing. In view of this, it is necessary to revise the existing approach to the organisation of domestic tourism, taking into account current development trends and introduce into its system other tools of the tourism industry that allow achieving sustainability [2].

As an example of such tools the concept of sustainable tourism development in the territory of Izobilnensky district of the Stavropol region is demonstrated below. This concept was created by researches of SSAU.

Izobilnensky district is one of the most perspective in terms of tourism development within the region. It is based on significant and diverse resource potential, including the tourism aspect. There are prerequisites for the development of recreational, cultural, religious, ecological, active and event tourism. The area is also a transit zone and has a favourable location relative to the regional centre (Stavropol) as well as the Krasnodar region, which is one of the most attractive tourist destinations in Russia. There are also a number of catering and accommodation facilities in the area that form a potential foundation of the organised tourism system. The population of the district also supports the

preservation and maintenance of the cultural traditions and customs of the Cossacks (one of the local cultures). It is also important to note that despite the presence of urban settlements, the area is predominantly rural.

However, there are a range of challenges in the district and regional tourism sector:

- the prevalence of amateur and unorganised tourism;
- lack of detailed statistical data on the flow of tourists in the area, which complicates the formation, promotion and sale of local tourism products and services;
- lack of a unified marketing component of the district;
- the local infrastructure is not ready to receive organised mass flows of tourists;
- lack of qualified tourism professionals and the general trend of outflow of able-bodied young people from the district's territories [4].

Thus, not all the processes of tourism organisation in Izobilnensky district comply with the principles of sustainable development: tourism and work in this sphere have a strongly seasonal character; the industry is developing out of a systematic approach; there is an outflow of working-age population from the administrative unit; unorganised tourism prevails, which leads to spontaneous development of the industry and uncontrolled anthropogenic impact on tourist destinations; anthropogenic load is unequally distributed in the territory [4].

In order to eliminate the noted disadvantages, researchers of SSAU have created a tourism development programme that takes into account the special characteristics of the area and current trends of the industry.

This programme included proposals for the implementation of an audio guided tour of the murals in Solnechnodolsk (the village) and a territorial brand of the district. Recommendations were also developed on how to organise project teams and work on the implementation of the measures of the tourism development programme.

The implementation of the audio guided tour of the murals in Solnechnodolsk may promote the area as an attractive tourist destination and with the help of the special function of the integration platform provide the first detailed consumer information that can be used for further product formation and pro-

motion. Thus, managing the consumer demand, it will be possible to initiate the transition to organised tourism from non-organised one.

The concept of the product: tourists walk along the route and learn about the murals and the message of their authors by listening to the audio accompaniment. In the framework of this idea, the product has been named "The artist's view". The night tour route includes 39 murals and 1 point of panoramic view of the urban settlement and the reservoir. The tour route is suggestive – tourists will have the opportunity to visit the sites in the order of their choice in walking mode.

The audio guide is integrated into the specialised platform. Access to the product is free, provided by a QR code, tourists listen to the audio guide through their own headphones and walk through the murals.

Target audience for the excursion product: young people aged 18 and over; mainly students of local universities and colleges; travellers coming to tourist bases of Solnechnodolsk and staying overnight; residents of the Stavropol Region; transit tourists.

The implementation of the proposals for a territorial brand would solve the problem of the lack of a unified marketing component of the area. Three versions of the brand were developed, with examples of their placement in the urban environment (on banners, bus stops, vehicles, etc.) that directly engage tourists and other visitors, as well as on souvenirs and other products whose purchase is an integral part of a tourist trip, and which also allows for promotion outside the territory.

Territorial branding is a key factor in forming the image of an area, as it is fixated in the minds of people visually, suggests positive images and associative reactions in various audiences. In addition, the branded territory becomes more competitive, becomes attractive for potential investors as well as for the local population, which may reduce the outflow.

Thus, it should be noted that the exclusive tourism development programme aims not only to develop tourism, but also to improve the socio-economic standard of living in Izobilnensky district as an administrative unit of the Stavropol region.

Its implementation will achieve the following key effects, in particular those related to the sustainable development of the area:

- there will be a real opportunity to start the process of transition to organised tourism from unorganised one, which prevails in the territory of Izobilnensky district at the moment. The development of organised tourism will make it possible to collect statistical data on tourist flows and thus to approach the organisation of tourism activities in a scientific and rational way, as well as to manage the resources and to form tourism products and their promotion with a view to targeting consumers;

- the development of the tourism industry in the district will provide an opportunity to generate additional income for its residents, as well as for the municipality and the Stavropol region as a whole. Also, the emergence of a stable tourist flow in the area will create an incentive for local entrepreneurs and producers to improve the quality of services and open new elements of infrastructure;

- the positive image of the area will be formed, which will create additional favourable conditions for positioning the territory as a brand in the external market and promoting local products;

- also, the positive image of the area, as well as the processes of improving the local infrastructure and the socio-economic environment, will decrease the outflow of the population, and may promote an external inflow of personnel into the tourism industry and other sectors.

Obviously, this will not eliminate all the disadvantages of the current tourism management, but it will create prerequisites for a more vivid manifestation of the above-mentioned key effects, as well as prerequisites for setting new strategic plans for next tourism development programmes, taking into account the actual capabilities of the municipality.

However, for the initial stage, it is necessary to form a consumer portrait of tourists of Izobilnensky district, to form an image of the territory for promotion in the external market (both in terms of tourism and other areas), to determine the volume of existing tourist flow and monitor the number of future tourists in order to assess the effectiveness of the implementation of the proposed measures in this tourism development programme and the effectiveness of the implementation of the subsequent development and improvement of the sphere.

Conclusion

This approach to preparing such tourism development programmes, based on unique characteristics of an area and capabilities of its municipality, can be used as a tool to maintain sustainable development. It could be expanded in terms of working with other constituent entities of the Russian Federation and administrative units, which would allow the approach to be scaled up. The application of such development programmes will allow an organised and scientific shaping of the tourism systems of the individual regions and their constituent territories, and will make the process of tourism development sustainable. In the long term, it is possible to talk about expanding the area of influence of the main key effects of implementation to the national level.

In conclusion, a tourism industry based on sustainability principles will certainly not solve all the current global problems, but responsible tourism can contribute significantly to the process of achieving the sustainable development goals [1]. Thus, it is important to perceive tourism and its particular instruments as an integral part of the modern sustainable development system.

Literature

1. Ivolga A., Erokhin V. (2013): *Tourism as an approach to sustainable rural development: case of Southern Russia*, Economics of Agriculture scientific journal of BSAAE. No. 4. 2013. pp. 789-800.
2. Polukhina A. N. (2020): *Strategic tourism development programs as a way to achieve sustainable development of Russian regions,* Sustainable development of the socio-economic system of the Russian Federation : collection of articles of the XXII All-Russian Scientific and Practical Conference (Simferopol, November 19-20, 2020) / CFU. Simferopol, 2020. pp. 94-98.
3. Report of the meeting on the development of the tourism and hospitality industry: *The Russian Government,* URL: http://government.ru/news/46227/ (30.10.2022)
4. Romanchenko E. A., Filandysheva L. B. (2021): *The impact of unorganised tourism on the ecological state of the Nature Monument "Talovsky Bowls",* Nature management and conservation: protection of natural monuments, biological and landscape diversity of the Tomsk Oblast and other regions of Russia: materials of the All-Russian Conference with

international participation (Tomsk, April 21-23, 2020) / TSU. Tomsk, 2021. pp. 175-178.

5. Statistical bulletin “Migration of the population of the Stavropol Region 2020”: *Federal Statistical Service,* URL: https://stavstat.gks.ru/ofstatistics_stav (01.11.2022)
6. Statistical indicators characterising the tourism industry: *Federal Agency for Tourism,* URL: https://tourism.gov.ru/other/statistika/statisticheskie-pokazateli-kharakterizuyushchie-razvitie-turistskoy-otrasli-v-rossiyskoy-federatsii/ (01.11.2022)
7. Sustainable development: *UNWTO*, URL: https://www.unwto.org/sustainable-development (29.10.2022)
8. Voluntary National Reviews: *Sustainable Development Knowledge Platform,* URL: https://sustainabledevelopment.un.org/vnrs/#VNRDatabase (02.11.2022)

COMMERCIAL BANKS AS SUPPORT FOR RURAL DEVELOPMENT OF SERBIA[1]

Biljana Grujić Vučkovski[2], *Zoran Simonović*[3], *Irina Marina*[4]

Abstract

The subject of the analysis is the determination of changes in the structure of bank claims from public companies and companies in agriculture, forestry, and fishing, as well as from registered agricultural producers by purpose period from 2010 to 2020. The obtained results show that the claims of banks from public companies increased by 15.6% on average per year and from business companies by 5.4%. Bank claims from registered agricultural producers recorded the highest average annual growth rate in loans for liquidity and working capital at 21.8%. The purpose of the research is to look at the involvement of commercial banks to determine whether the share of implemented agro loans in the total disbursed bank loans is changing in their credit portfolio. The paper presents the results of the banks' operations period from 2017 to 2020 and analyses: commercial bank, Banca Intesa, and ProCredit bank. The achieved results show a constant increase in the share of realized agricultural loans in the total disbursed loan funds.

Key words: *rural development, commercial banks, agricultural loans*

Introduction

Serbian agriculture has been neglected, unstimulating and uncompetitive for exports for decades. Regardless of the mentioned shortcomings, this activity realizes a surplus in the balance of payments and contributes to a better result in the foreign trade balance. For this sector to continue to be the bearer of economic stability, additional investments in the agricultural sector are needed, which can be realized through the role of commercial banks (Joksimović et al., 2020).

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The Ministry of Agriculture, Forestry and Water Management (MAFW) of the Republic of Serbia since 2004. subsidizes agricultural loans approved by commercial banks with a favorable interest rate (Popović et al., 2018). The mentioned authors point out the essential fact that in the previous period, agricultural loans by assigned with a high-interest rate and a short repayment period without the approval of a grace period. At the same time, they state that the situation is different today.

On the one hand, the low demand for agricultural loans is a consequence of the high representation of predominantly elderly households in Serbia, and the age limit of the loan applicant is the first condition encountered. On the one hand, the low demand for agricultural loans is a consequence of the high representation of predominantly elderly households in Serbia, and the age limit of the loan applicant is the first condition encountered. Besides, problems are made by the level of their education, knowledge, and interest in credit borrowing. On the other hand, commercial banks are not ready to significantly support the development of agriculture due to their technical and technological backwardness (Lukić and Cvetković, 2012).

Although there is a great need for agricultural loans, agricultural producers are not ready to take credit, because they are afraid of whether they will be able to repay the debt on time (Tasić, 2017).

Methodology

The research in the paper consists of two parts. *In the first part of the analysis,* which considers changes in the total claims of banks based on agricultural loans, the mains source of data is the electronic database of the National Bank of Serbia (NBS). Based on these values, changes in the average and average annual interest rates of banks' receivables from public companies, commercial companies, and registered agricultural producers for 2010-2020. by calculated. *The second part of the analysis* considered changes in the structure of paid-out agricultural loans in the total values of realized loans from 2017 to 2020. In addition, were considered, and the business results of the operations of the following banks by given: Komercijalna bank, Banca Intesa, and ProCredit bank. For this part of the research, the data sources are the annual reports on business for the analyzed years. The data were processed using the methods of descriptive statistics. Based on the obtained results, adequate and appropriate comments and conclusions by given.

Claims of commercial banks in the sector of agriculture, forestry, and fisheries of the Republic of Serbia

Commercial banks have assumed an important role when it comes down to it to financing agricultural production through lending. Their role is reflected in the financing of rural development, cross-the approval of loans with favorable interest rates, reduction of loan processing costs, long-term repayment terms, and a grace period.

In the continuation of the work, overviews of banks' receivables for different purposes by giving.

Table 1. *The structure of banks' receivables from public companies and companies in domestic currency in the agriculture, forestry, and fishing sector from 2010 to 2020 (in %).*

Year	Participation (in %)	
	Public companies	Average for the period
2010	0.4	5.9
2011	0.3	5.9
2012	0.3	5.7
2013	0.3	5.5
2014	2.3	6.9
2015	2.3	7.4
2016	2.3	7.4
2017	2.8	7.6
2018	0.4	7.9
2019	0.5	8.0
2020	0.7	7.5
Average for the period 2010-2020. (in %)	*1.2*	*6.9*
Average annual rate of change (in %)	*15.6*	*5.4*

Source: National Bank of Serbia, Bank dinar and FX-indexed claims on corporates by sector (https://nbs.rs/en/drugi-nivo-navigacije/statistika/detaljni_potrazivanja/index.html#)

Table 1 shows that the average annual participation of banks' claims in domestic currency in the agriculture, forestry, and fishing sector from public companies was 1.2%, and 6.9% from business companies. In the observed period, the bank's total receivables in domestic currency from public companies increased by 15.6% on average per year and from commercial companies by 5.4%.

The following is a tabular overview of the structure of bank claims in domestic currency from registered agricultural producers by purpose (in %) from 2010 to 2020. (Table 2).

Table 2. *Structure of bank claims in local currency from registered agricultural producers by purpose from 2010 to 2020 (in %)*

Year	Participation (in %)					
	By transaction accounts	Gashi[1]	For liquidity and working capital	Investment	For export	The others
2010	0.0	0.0	20.1	63.5	0.0	16.3
2011	0.0	0.0	26.0	59.9	0.0	14.1
2012	0.0	0.0	21.1	64.9	0.0	13.9
2013	0.0	0.0	20.9	68.0	0.0	11.1
2014	0.2	0.4	23.2	67.6	0.0	8.5
2015	0.2	0.2	22.0	68.8	0.0	8.8
2016	0.2	0.2	23.5	68.1	0.0	7.9
2017	0.1	0.2	24.7	68.5	0.0	6.4
2018	0.1	0.3	25.4	69.1	0.0	5.2
2019	0.1	0.2	24.4	70.7	0.0	4.6
2020	0.1	0.3	31.3	64.9	0.0	3.4
Average for the period 2010-2020. (in %)	*0.1*	*0.2*	*23.9*	*66.7*	*0.0*	*9.1*
Average annual rate of change (in %)	*14.8*	*5.4*	*21.8*	*12.9*	*0.0*	*-7.9*

Source: National Bank of Serbia, Bank claims on registered agricultural producers by purpose (https://nbs.rs/en/drugi-nivo-navigacije/statistika/detaljni_potrazivanja/index.html#)

[1] Since December 2014, the "Cash loans" category has been displayed separately and excluded from the "Other loans" category.

Note: Only credit claims were analyzed (without other claims).

In April 2019. the data for the period December 2016 - February 2019 by revised to the reclassification of loans at one bank was a decrease in the balance of loans for liquidity and working capital and other loans and an increase in the investment loans balance (NBS, Bank Claims on Registered Agricultural Producers by Purpose). Table 2 shows that the average annual share of bank claims from registered agricultural producers is the highest for investment loans at 66.7%,

followed by liquidity and working capital at 23.9%, and the lowest for claims on transaction accounts at 0.1%. In the same period, the average annual growth rate was the highest in loans for liquidity and working capital with 21.8% and based on transaction accounts at 14.8%. However, other receivables from agricultural producers decreased by an average of 7.9% per year. In this period, no claims of banks based on loans for export by recorded.

We conclude that there is an interest of agricultural producers in agro loans, while the increase in realized loans is gradual, slow, and insufficient to achieve results in the long term.

Contributions of commercial banks to rural development from 2017 to 2020

The activities of ***Commercial bank*** carries out through a business network of business centers. At the end of 2020, NLB bank from the Republic of Slovenia took over the acquisition of the commercial bank. (Commercial Bank, Annual report on operations of Commercial bank for 2020).

Indicators of credit activity and market share of the banks in the agricultural sector from 2017 to 2020 are given below (Annual reports on the Commercial bank's operations for the analyzed years):

- *During 2017* the bank operated in a favorable macroeconomic environment in agriculture. Although they tried to shorten the time for the population sector to decide on a credit request, agricultural producers by not included in this decision, which is why a long-term period is needed for the bank to decide. This year, the bank increased approved agricultural loans by 26% compared to the previous year, and in the structures of total approved loans, agricultural loans accounted for 14%. Action and fair loans, as well as approved loans in cooperation with the Ministry of Agriculture, Forestry, and Water Management of the Republic of Serbia, contributed to this success.
- *During 2018* Realized loans to the agricultural sector increased by 13% compared to 2017, while in the totals structure of approved loans, 13% of the participation by made up of loans paid to farmers. This result by achieved thanks to an agreement with the Ministry of Education and Culture, which together participated in the financing of projects from IPARD funds. The bank can boast of the fact that in 2018. made an early repayment of the credit line with KfW bank (German development bank).

- *In 2019* the bank continued to grow its market share in the structure of approved loans, so realized agricultural loans accounted for 14%, and the placement of loans increased by 6% compared to the previous year. The bank conducted cooperation with the Ministry of Internal Affairs and Communications, machinery dealers, and local governments. This year the bank enabled the purchase of land through an agricultural loan with a repayment term of up to 15 years.
- *During 2020* the bank operated alongside the COVID-19 virus pandemic. During this period, the bank managed to increase the placement of loans because it used the lending programs of the Guarantee Scheme of the Government of the Republic of Serbia and subsidized agricultural loans from the Ministry of Agriculture and Forestry. At the end of the analyzed year, the bank's participation in the structure of approved loans amounted to 37% of the total number of approved loans and 24% of approved loans in the agricultural sector.

Below is a tabular presentation (table 3) of the basic indicators of the market share of Commercial banks' agricultural loans from 2017 to 2020 with the balance on 31.12. (in %).

Table 3. *Indicators of implemented agricultural loans of Commercial banks' from 2017 to 2020 on 31.12. (in %)*

Indicators	2017	2018	2019	2020
The share of the net balance of placements of agricultural loans in total placements	8.7	9	9	11
Share of approved agricultural loans in total loans	14	13	14	37

Source: Commercial banks, Annual reports on operations of Commercial bank for the analyzed years.

The bank adopts a development plan on an annual level to preserve its leadership position, and the following have by selecting:

- the creation of credit lines for the purchase of agricultural equipment;
- cooperation with state bodies and programs to further increase the placement of agricultural loans;
- promoting the placement of agricultural loans at relevant fairs and events throughout Serbia.

Banca Intesa has been operating in the agricultural sector since 2008. All these years, she tried to improve the quality of services to retain existing and attract new clients.

In the continuation of the work, indicators of credit activity and market share of the bank in the agricultural sector from 2017 to 2020 by giving. (Annual reports of the bank for the analyzed years):

- *During 2017* the bank increased the market share of agricultural loans by 3.5 p.p. and placement by 47%. This year, the loan portfolio in the sector grew by 53%. The bank also stands out for its cooperation with the German Development Bank and the Ministry of Finance, which is why it participated with 18% in the total amount and 28% in the total number of approved agricultural loans. The bank continued cooperation with the APV Guarantee Fund for financing loans. This year, loans accounted for 5% of the total loan portfolio.

- *In 2018* the bank founded the Intesa Farmer Center, which started operating at the end of 2018. to justify the role of the leading bank in the market of loans. One 2018 bank increased the market share of these loans by 18% and the number of clients by 8% compared to the previous year. The bank continued its cooperation with KfW Bank and the Ministry of Finance, which helped it achieve 20% in the total amount and 30% in the total number of approved loans. As a result of the cooperation with the Guarantee Fund, APV bank achieved a 26% increase in total disbursed loans.

- *In 2019* the bank managed to maintain its leading position in the market with a market share of 12% in the agricultural sector, while the credit portfolio in the agricultural sector decreased by 7%. Cooperation with the MAFW bank contributed to achieving a share of 17% in the total amount of subsidized loans and 23% in the total number of approved loans. Looking at the loan portfolio by activity, agriculture accounted for only 7%.

- *In 2020* the bank achieved a market share of 12% in business with agriculture, and the loan portfolio in agriculture was 18%. Although exposed to the effects of the COVID-19 pandemic, this year bank managed to introduce a new loan product EaSI (Farmer Invest loan). These are investment loans that should improve the structure of the agricultural portfolio. The bank continued its cooperation with the Ministry of Finance, thanks by participated with 19% of total disbursed loans and 23% of total approved loans. The bank also

paid out 58 agro-protect loans, which include an insurance policy for crops exposed to bad weather conditions. This year, the participation of the bank's loan products in agriculture was 5% of the bank's total loan portfolio

In the coming years, the bank plans to cooperate with sellers of agricultural machinery to participate in fairs and education. It continues to organize the "Intesa Farmer" contest, where it selects the most successful agricultural producers in the categories of arable farming, vegetable farming, fruit growing, and animal husbandry.

Below is a table overview of the Bank's loan portfolio in the agricultural sector from 2017 to 2020 (Table 4).

Table 4. *The share of Bank Intesa's loan portfolio in agriculture in the total loan portfolio from 2017 to 2020. (in %).*

Indicator	2017	2018	2019	2020
The Bank's loan portfolio in agriculture	5	12	7	5

Source: Bank Intesa, Annual reports for the analyzed years.

After a long period of economic crisis, the bank's most important goals were to preserve its leading market position and increase lending activity and the number of loan clients. The bank plans to increase the offer of agricultural loans and credit products in the coming years.

ProCredit Group has a developed loan offer for companies, agricultural holdings, and citizens. The bank supports the so-called green financing, which means providing support for the development of energy efficiency projects, renewable energy sources, and other similar measures (Consolidated financial report with auditor›s report for 2020).

The bank has adopted a strict credit policy whereby it lends to legal entities, entrepreneurs, registered agricultural enterprises, and other natural persons on the territory of Serbia. The credit risk committee assesses the branches of the economy or areas that may be risky for the credit portfolio and determines the limits of permitted credit borrowing.

The following table shows the structure bank's loan portfolio from activity. Based on the data shown in table 5, we can see that one-third of the bank's loan portfolio. However, the share of these loans in the bank's total portfolio is decreasing, so in 2020 it was 4.5 p.p. fewer agricultural loans than in 2017.

Table 5. *Structure of ProCredit Bank's loan portfolio by activity as of December 31. from 2017 to 2020 (in %)*

Activity	2017	2018	2019	2020
Trade	24,8	22,97	20,2	21,5
Tourism	1,68	2,01	3,3	3,2
Transportation	5,15	5,1	4,7	4,1
Other services	4,03	4,91	4,0	5,0
Industry and other production	21,24	25,2	25,3	26,5
Agriculture	***32,74***	***30,07***	***29,4***	***28,2***
Construction	2,94	4,45	8,3	5,7
Other	7,41	5,29	0,2	1,1
Individuals	0,01	0,01	4,8	4,6

Source: ProCredit Bank, Consolidated financial statements with the auditor's report for the analyzed years.

After agricultural loans, the most represented are loans intended for the industry share of 24.6% on average per year, followed by the trade sector share of 22.4% on average per year. The remaining activities (tourism, transport, construction, other services, and loans to individuals) in the total loan portfolio achieved 23.7% at the end of 2020.

Below is a presentation of claims from farmers based on loans (table 6).

Table 6. *Structure of ProCredit Bank's receivables from farmers based on loans as of December 31. from 2017 to 2020 (in %)*

Category	2017	2018	2019	2020
Share of agro loans in the bank's total receivables (in %)	22.1	18.6	18.0	17.1

Source: ProCredit Bank, Consolidated financial statements with auditor's report for the analyzed years.

The table data show that in the four years the Bank's claim on loans from farmers has decreased significantly, so in 2020 this claim is 5 p.p. less compared to 2017, and the average annual participation was 19%. However, if we analyze the value of claims based on agro-loans, we see that they grow more slowly than total claims (claims based on agro-loans in the observed period are higher by 15.3% and total claims by 49.5%). From the above. it can be concluded that the participation of other clients in total loan claims has increased.

In the coming years. the bank plans to grow its loan portfolio with support for energy solutions. It comes to natural persons. the bank to be more involved in determining the conditions for approving investment and housing loans (Consolidated financial report with auditor's report for 2020).

Conclusion

The line ministry partly assumed the role of the financier of agrarians by participating in subsidizing part of the interest rate on loans granted by commercial banks to registered agricultural producers. Considering that it did not give adequate results. There is a need to form one agricultural bank that would deal exclusively with the development sector and whose credit portfolio would be determined only for agricultural producers.

The current conditions surrounding the realization of agricultural loans approved by commercial banks lead us to the following conclusions:

- *Lending by not adapted to the seasonal nature of production;*
- *Strict requirements for securing loans;*
- *High costs of loan insurance.*

These are the reasons why there are no agricultural loans in the loan portfolio of banks. From the point of view of farmers. their non-involvement in the implementation of loans is a consequence of distrust in the banking sector due to the uncertainty of the placement of agricultural products.

Literature

1. Banca Intesa (2018). *Annual report 2017.* Belgrade
2. Banca Intesa (2019). *Annual report 2018.* Belgrade
3. Banca Intesa (2020). *Annual report 2019.* Belgrade
4. Banca Intesa (2021). *Annual report 2020.* Belgrade
5. Joksimović, M., Joksimović, D., & Grujić Vučkovski, B. (2020). *A test of international Fisher effect: researching from Serbia and the European Union.* Journal Economica, Vol. 66. No. 2/2020, Society of Economists "Ekonomika", Nis, Serbia, pp. 49-61.
6. Komercijalna banka (2018). *Godišnji izveštaj o poslovanju Komercijalne banke a.d. za 2017. godinu (Annual report on operations of Commercial bank for 2017),* Beograd.

7. Komercijalna banka (2019). *Godišnji izveštaj o poslovanju Komercijalne banke a.d. za 2018. godinu (Annual report on operations of Commercial bank for 2018),* Beograd.

8. Komercijalna banka (2020). *Godišnji izveštaj o poslovanju Komercijalne banke a.d. za 2019. godinu (Annual report on operations of Commercial bank for 2019),* Beograd.

9. Komercijalna banka – NLB grupa (2021). *Godišnji izveštaj o poslovanju za 2020. godinu (Annual report on operations of Commercial bank for 2020),* Beograd.

10. Lukić, S. & Cvetković, S. (2012). *Development banks as a mainstay in agriculture lending*. Journal CIVITAS. No. 4/2012. p. 80-88.

11. National Bank of Serbia. *Bank dinar and FX-indexed claims on corporates by sector* (https://nbs.rs/en/drugi-nivo-navigacije/statistika/detaljni_potrazivanja/index.html#)

12. National Bank of Serbia. *Bank claims on registered agricultural producers by purpose* (https://nbs.rs/en/drugi-nivo-navigacije/statistika/detaljni_potrazivanja/index.html#)

13. Popović, S., Janković, I., & Stojanović, Ž. (2018). *The importance of bank credits for agricultural financing in Serbia. Economic of agriculture*. *65*(1). 65-80.

14. ProCredit banka (2018). *Konsolidovani finansijski izveštaj sa izveštajem revizora za 2017. god. (Consolidated financial report with auditor's report for 2017),* Beograd

15. ProCredit banka (2019). *Konsolidovani finansijski izveštaj sa izveštajem revizora za 2018. god. (Consolidated financial report with auditor's report for 2018),* Beograd

16. ProCredit banka (2020). *Konsolidovani finansijski izveštaj sa izveštajem revizora za 2019. god. (Consolidated financial report with auditor's report for 2019),* Beograd

17. ProCredit Bank (2021). *Consolidated financial statements for the year ended 31 december 2020.* Belgrade

18. Tasić V. T.. & Milošević I. (2017). *The impact of macroeconomic changes on the business decisions of managers in agriculture.* International Journal of Economic Practice and Policy. 1/2017. 117-133.

ENVIRONMENTAL CONDITIONS OF RURAL AREAS OF SERBIA AND PERSPECTIVES FOR RURAL DEVELOPMENT

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Abstract

Serbia is a predominantly rural country. Rural areas cover 85% of the total territory, and the rural population accounts for 43.9 percent of the total population of the country. In accordance to definition of rural development, it is important to improve the quality of life and economic well-being of people living in these areas. To achieve these goals, environmental conditions are very important. Healthy environment is important for quality of life, provision of agricultural activity, as well as attracting people to visit rural areas, especially for rural tourism development. Despite this, rural areas in Serbia face significant environmental challenges. This paper analyses environmental conditions of rural areas in Serbia, which are important for rural development and rural tourism, in order to present state of current conditions and to give some recommendations for future activities, with the goal to provide environmental sustainability which will contribute to overall rural development.

Key words: *environment, Serbia, rural development*

Introduction

Serbia is a predominantly rural country. Rural areas cover 85% of the total territory, and the rural population accounts for 43.9 percent of the total population of the country (FAOSTAT, n.d.). Majority of inhabitants of rural areas are employed in agriculture, as agriculture accounted for 15 percent of Serbia's employment (World Bank, 2021). Based on these data, it is notable that healthy environment is essential for inhabitants of rural areas in Serbia, as for their own health and living conditions, as well as for future possibilities of agricultural production, and also for further development of rural tourism activities and overall rural development.

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Agenda 2030 relies on 17 sustainable development goals supported by the United Nations as a global effort to manage current challenges related to poverty, climate, environmental pollution, geographical inequalities, prosperity, peace, and justice (UN, 2015; Mihai, F.C., Iatu, C.,2020). Agenda 2030 is an international initiative which address major concerns related to future economic development perspectives combined with social and environmental sustainability issues. Sustainable rural development is vital to the economic, social and environmental viability of nations (UN, n.d.). Agenda 2030 is associated with rural development especially through Goal 2. End hunger, achieve food security and improved nutrition and promote sustainable agriculture, and Goal 11: Make cities and human settlements inclusive, safe, resilient and sustainable (UN, n.d.). Rural areas comprise geographical regions where a significant population still lives and faces emerging threats associated with climate change, poverty, and lack of critical infrastructure. On the other hand, rural areas are base and source for urban areas with raw materials, energy sources, food. Besides, rural areas are full with biodiversity, and they also contribute to the cultural heritage of each region and country. Rural communities depend on local geographical conditions (climate, natural resources, landscape, and geographical barriers, socioeconomic conditions, demographic features) to develop agricultural, industrial, or tourism activities as economic development pathways (Mihai, F.C., Iatu, C., 2020). Therefore, sustainable rural development is a complex issue which is very important to every country, thus also for Serbia. The success of sustainable rural development depends on ensuring environmental sustainability in rural areas, with developing and implementing comprehensive strategies for dealing with climate change, drought, desertification and natural disasters.

In European Union (EU), Rural development is the "second pillar" of the common agricultural policy (CAP), with the main goal of strengthening the social, environmental and economic sustainability of rural areas (EC, n.d.). Environmental sustainability is considered an important component of rural development is also given a significant amount of attention (Ristić, 2013). Financial sources and budget from European Agricultural Fund for Rural Development from 2014-2020 used for Environmental protection and resources efficiency and climate change, adaptation and risk prevention are significant. As Serbia is candidate country for entering into EU, it is important to underline and harmonize Serbian laws and measures with principles and measures of CAP. So, in Strategy of Agriculture and Rural Development of Serbia, it is underlined that it is important to manage natural resources, environment

and cultural heritage of rural areas in accordance with the principles of sustainable development, in order to make rural environments attractive a place for young people and other residents of rural areas to live and work. Among strategic development goals, sustainable use of natural resources and environmental protection, and enhancement of life quality in rural areas have important place (MAFWM, 2014).

Rural tourism development can contribute to the social and economic regeneration of rural areas. Rural tourism is becoming the driver of economic development and standard improvement of living in rural areas, as it rests on the principles of sustainable development and conservation of natural resources (Dasic et al., 2020). The main resource for the development of rural tourism is nature, and it is estimated that about three quarters of the world's tourism demand is directed towards natural values (Dasic, et al., 2020).

Poverty, marginalization, depopulation and low quality of life in rural areas causing village decay are now identified as a global problem (Vasilevska, 2010, Joldžić et al., 2018). Poverty in rural areas results in the degradation of natural environment and has negative implications in social and economic sphere (Bogdanov, 2007, Joldžić et al., 2018). On the other hand, there are many aspects of rural development that are related to environmental protection, such are rural or agro - tourism, agriculture and organic farming and food production (Joldžić et al., 2018). To be able to perform these activities healthy environment is essential, and as a benefit from them, impact on the environment will be positive.

Materials and methods

The subject of this paper is to analyze environmental conditions of rural areas in Serbia, which are important for rural development and rural tourism, in order to present state of current conditions and to give some recommendations for future activities, with the goal to provide environmental sustainability which will contribute to overall rural development. For the purposes of this article, secondary information collection has been done. Data about environmental conditions in Serbia, from various representative sources were analyzed and most relevant information were synthesized.

Environmental conditions of rural areas in Serbia

Natural resources (including agricultural lands, forests, waters, flora, fauna and cultural heritage) represent important components of rural areas in Serbia (Joldžić et al., 2018). Despite favorable country's position, moderate continental climate, diverse soil types, amounts of water, richness in genetic, species and ecosystem diversity, Serbia faces numerous problems connected to the environment in rural areas. Besides exploitation and degradation of natural resources from human activities, climate change represents additional factor that have impact on the environment.

Climate change, manifested through temperature increasement, iincreasing frequency and duration of heat waves and extreme heatwaves, as well as change in annual precipitation have significant influence on natural resources in Serbia. Compared to the 1961–1990 period, average surface air temperature increase in Serbia is 1.4°C for 2001–2020, and 1.8°C for the 2011–2020 decade. The Increase of temperature is highest during the summer season and higher during the growing season than the annual average. According to predictions, the average temperature will increase by 2.5–3.1°C in the 2041–2060 period compared to 1961–1990 (UNDP, 2022). Average annual precipitation in Serbia has an inconclusive signal of change, without a significant rate of change (UNDP, 2022). Precipitation is changing its annual distribution toward the colder period, and its distribution by intensity toward more extreme precipitation events and reduction of moderate precipitation events (UNDP, 2022). Climate Vulnerability Index ranking of Serbia is 75, which is high (UNDP, 2022).

The main threats to soil quality are: reduction of organic matter, soil acidification, soil pollution and erosion (MAFWM, 2014). Soil degradation in the Republic of Serbia is currently dominantly driven by human factors, as land conversion, abandonment of agricultural fields, overexploitation of soil in agriculture (UNDP, 2022). Climate change effects also tend to exacerbate the degradation process (UNDP, 2022). Soil erosion is a major form of soil degradation in Serbia (UNDP, 2022). Approximately 88% of the total land area in the Republic of Serbia is exposed to water erosion, while wind erosion affects about 25% of the territory of the Republic of Serbia (MAFWM, 2014). A large part of arable land is acidified (more than a quarter of the areas), as a result of the uncontrolled use of chemical agents, In Vojvodina part of the area is also salty (14%) (MAFWM, 2014). The average soil organic carbon con-

tent (indicator of soil degradation and desertification) in Serbia has decreased and reaches the low category with further tendency to decrease, and is mostly impacted by land use and climate change (UNDP, 2022).

Built irrigation systems cover an area of 250.000 ha, but currently irrigates only 40,000-70,000 ha per year, of which 90% are located in the area of Vojvodina, and for more then 47,000ha irrigation system is only partially functional (MAFWM, 2014). According to World Bank data, only 1.5% of agricultural land was irrigated in 2020.

According data, Serbia seeks to balance efficient application of nitrogen fertilizer with maximum crop yields as a measure of the environmental performance of agricultural production, and regarding it, is ranked at 8th place in the World (Environmental Performance Index, 2022).

Forest land represented 31.1% of land area in Serbia in 2020, that is slow increasement from 2006, when forest area represented 29.9% (World Bank, n.d.). Forest degradation, along with the resulting habitat loss and fragmentation, is one of the key environmental problems faced by Serbia (UN, 2020). Tree cover loss indicator is 26.2, where 100 meands that there is no tree cover loss (Environmental Performance Index, 2022). Terrestrial protected areas (% of total land area) in Serbia was reported at 7.6 % in 2021 (World Bank, n.d.). The Protected Areas Representativeness Index indicator, that measures how well terrestrial protected areas represent the ecological diversity of a country, is 31, on the scale from 0 to 100, where 100 represents the best performance (Environmental Performance Index, 2022). These data show that biodiversity protection is not strong, with a weak species base and inadequate monitoring. Natural protected areas are not sufficiently well established.

Serbia receives a significant amount of annual precipitation, and is an area rich in springs and watercourses. In spite of this, Serbia does not perform well in regard to safe drinking water. Water quality in all areas is not satisfactory, and although the water supply for people and cattle is not endangered, the percentage of people with access to safe drinking water services is slowly decreasing (WHO, 2017). Pollution from unsafe chemical use and other human activities are the main reason. Rural areas are especially exposed to this, as 64% of the rural population are exposed to possible contamination from latrines, sewers, animal breeding, cultivation, roads, industry, rubbish and other sources of pollution in their area. Water used for agriculture also poses risks in terms of quantity and quality. The risk for agricultural water quantity has

reached the highest level (4 of 4) with no improvement in recent years; the situation is the same for agricultural water quality. Annual freshwater withdrawals indicator, that refers to total water withdrawals, was 66, in 2018, with increasing trend, as it was 47 in 2007 (World Bank, n.d.).

Relatively poor sanitation and waste management, particularly in poor rural municipalities, results in environmental risks. Serbia is performing worse than comparator countries in regard to safe management of sanitation services. Only 18% of people used safely managed sanitation services in 2020, with decreasing trend (World Bank, n.d.). Only 20% of the rural population had a sewer connection in 2020 (World Bank, n.d.). Serbia performs very bad regarding wastewater treatment, measured as the proportion of wastewater that undergoes at least primary treatment in each country, multiplied by the proportion of the population connected to a wastewater collection system. Serbia is on 128th place in the world according this indicator, with score of 0.7, where score 0 indicates that no wastewater is reported as treated within a country, and maximum score is 100 (Environmental Performance Index, 2022).

Air pollution in Serbia is very high and above safe limits with consequent negative impacts on human health, but also on the environment and development. Serbia is ranked as Europe's most polluted countries. People in Serbia are exposed to five times higher concentration of fine particular matter PM2,5 than WHO's guideline (UNEP, n.d.). CO2 emissions from agriculture are decreasing. Population in rural areas is mostly affected by indoor air pollution due to burning biofuels or waste for heating and cooking (UNICEF, 2021).

Conclusions and recommendations

Sustainable rural development is dependent on environmental conditions and sustainable use of natural resources. Also, environmental conservation and sustainable use of natural resources is not possible without active enrollment of rural population and government. Rural development and natural resources sustainable practices cannot be excluded from each other, especially where climate change pressure is present. Serbia has various environmental problems that are obstacles for sustainable rural development. In order to achieve sustainable rural development different actions should be made and inclusion for all stakeholders is essential.

Although Serbia made efforts in developing a legal framework, policies, institutions, and instruments for environmental protection and climate change

action, practical implementation of the strategic and legal framework does not have environmental effectiveness, especially because it is not well coordinated among various bodies. As Serbia has been facing various climate changes resulting in extreme weather events, such as droughts, floods and high temperatures, that are affecting especially agricultural production, and rural communities, there is need for more effective mitigation and adaptation of policies. Financial support from governmental funds for rural development with accent on environmental protection and climate change risks reducement is essential. Support for irrigation systems improvement and technologicaly smart practicies for sustainable water use, as well as support for sustainable sanitation and waste management is also very important.

Education of rural population in the thematic of environmental protection and sustainable use of natural resources, as well as about the use of modern technologies is very important. Besides, promotion of environmentally friendly practices in agriculture, such as organic agriculture and quality food schemes as geographical indications, will have positive impact both on the environment as well as on economical position of agricultural producers, and overall rural development.

Rural tourism promotion and support will have positive impact on environment as well as on the position of rural areas. Only preserved natural resources and environment could provide adequate base for rural tourism, as tourists could be attracted by clean and healthy environment. Due to the importance of rural areas for rural tourism and overall rural development, active support from governmental and non-governmental bodies for the development and conservation of the environment in rural areas areas is a major goal.

Literature

1. Bogdanov, N. (2007): Mala ruralna domaćinstva u Srbiji i ruralna nepoljoprivredna ekonomija, Beograd, UNDP
2. EC (European Commission) Open Data, n.d. https://agriculture.ec.europa.eu/common-agricultural-policy/rural-development_en
3. Environmental Performance Index, Open Data, https://epi.yale.edu/epi-results/2022/country/srb
4. FAOSTAT Open Data. n.d. www.faostat.org

5. Joldzic, V., Batričević, A., Stanković, V., Paunović, N. (2018): Solving the Problems of Rural Development as Environmentally Desirable Segment of Sustainable Development, Economic Analysis, Vol 51 No 1-2, https://www.library.ien.bg.ac.rs/index.php/ea/article/view/570

6. MAFWM (Ministry of Agriculture, Forestry and Water Management) (2014) Strategy of agriculture and rural development of Serbia for the period 2014-2024. Belgrade. www.minpolj.gov.rs/wp-content/uploads/datoteke/razno/4827014.0116.30-1.pdf (In Serbian)

7. Mihai, F.C., Iatu, C. (2020): Sustainable Rural Development under Agenda 2030, Sustainability Assessment at the 21st century, DOI: 10.5772/intechopen.90161, Available from: https://www.intechopen.com/chapters/69950

8. Ristić, L. (2013): Strategijsko upravljanje održivim ruralnim razvojem u Republici Srbiji, Ekonomski horizonti, 15(3): 229-243

9. UN (United Nations) (2015) Transforming our world: The 2030 Agenda for Sustainable Development. Resolution adopted by the General Assembly. 2015. Available from: https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

10. UN (United Nations) Open Data, n.d. https://sustainabledevelopment.un.org/topics/ruraldevelopment/decisions

11. UN Country Team in Serbia (2020): Common Country Analysis, https://serbia.un.org/sites/default/files/202012/Common%20Country%20Analysis_Final%20ENG_0.pdf

12. UNDP Open Data, (2022): https://climatepromise.undp.org/what-we-do/where-we-work/serbia

13. UNEP Open Dta, n.d., https://www.unep.org/interactive/air-pollution-note/?gclid=Cj0KCQiA1ZGcBhCoARIsAGQ0kkr2KahX4msYm3g0G0jsXGzkib8w2mtjyNNr2mB9NsJy7-uMz1rSD5QaAgMsEALw_wcB

14. UNICEF (2021): Climate landscape analysis and its impacts on children in Serbia, ISBN 978-86-80902-48-7, https://www.unicef.org/serbia/media/18361/file/CLAC%20Report%20ENG.pdf

15. Vasilevska, Lj. (2010): Rural development and regional policy – conceptual framework, Facta Universitatis Series: Architecture and Civil Engineering, 8(3): 353-359.
16. WHO (World Health Organization) (2017): Improving drinking-water supply in rural areas of Serbia. Geneva. www.euro.who.int/__data/assets/pdf_file/0019/340561/Serbia_waterWeb.pdf
17. World Bank Open Data, n.d. https://data.worldbank.orghttps://data.worldbank.org
18. Životić, Lj., Vuković Vimić, A. (2022): Soil Degradation and Climate Change in Serbia, UNDP, ISBN 978-86-7728-356-8, https://www.undp.org/serbia/publications/soil-degradation-and-climate-change-serbia

HARVESTING AND PROCESSING OF PROPOLIS[1]

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Abstract

Propolis is a unique substance created by bees, which collect plant resins and process them using specific enzymes and mixing them with wax. Due to its antibacterial and antifungal properties, propolis is often used as a dietary supplement and in the treatment of certain human diseases. Propolis can be very different, both in terms of its chemical composition and its color, which mostly depend on the plant species from which the resin is collected. Official statistical data on the production of propolis in the world and by country, do not exist, but experts estimate that the world's largest producers of propolis are China and Brazil, followed by Russia, the USA, Spain, Romania, Argentina and Chile. In Serbia, propolis is the third most common bee product that is collected at apiaries, right after honey and wax. Harvested raw propolis is processed into final products, mostly into alcoholic tinctures or into mixtures with other bee products, which are sold at the local market.

Key words: *propolis, production, processing, Serbia*

Introduction

Propolis is a unique substance in nature which is created by bees that collect plant resins and mix them with enzymes and beeswax (Bankova et al., 2019). Honey bees (*Apis mellifera* L.) use this sticky substance to seal cracks in hives, repair irregularities in the internal structure of the hive, and cover frames with honeycomb. In this way, the bee colony is protected from wind, rain, the entry of undesirable organisms into the hive and the effects

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of pathogens (Wilson-Rich et al., 2009). Given that it has scientifically proven antibacterial and antifungal properties, propolis is often used as a dietary supplement and in the medical treatment of humans, mainly in dentistry and oral hygiene (Tambur et al., 2021). Also, propolis represents a very promising source of compounds with antibiotic properties, which can be used in the treatment of diseases, in combination with standard antibiotics (Benhanifia & Soltani, 2022).

Propolis can be very different, both in terms of its chemical composition and its color, which depend on the characteristics of the geographical area where it was created, i.e. most of the plant species from which the resin was collected (Simone-Finstrom & Spivak, 2010). Medicinal properties of propolis depends on its chemical composition, and the most common composition of propolis is as follows: resins (55%), wax (30%), aromatic oils (10%), pollen (5%), minerals and vitamins (Khalil, 2006). According to Okhale et al. (2021), several types of propolis have been identified in the world, of which three types are found in Europe: Birch (area of Russia), Mediterranean (area of Sicily, Greece, Crete and Malta) and Poplar type (Europe).

At the territory of Serbia, two subtypes of propolis have been registered so far, orange and blue, both of which come from the resins of plants of the genus Populus (Dimkić et al., 2016). Given that Serbia has a pronounced diversity of flora and vegetation, with the presence of autochthonous and endemic plant species, it can be expected that propolis from Serbia has a specific and unique chemical composition, with variations in relation to the region where it was harvested.

Production of propolis in the world and in Serbia

Currently, there are no official statistical data on the total production of propolis in the world, nor individually by country, but experts estimate that between 1,800 and 2,400 tons of raw propolis are produced annually in the world (Clarke, 2019). The world's largest producers of this product are China, with about 300 tons, and Brazil, with about 250 tons of raw propolis per year (Crane, 2009). Other countries with large production of propolis are Russia, USA, Spain, Romania, Argentina and Chile (Clarke, 2019). In terms of propolis consumption, countries with a developed market are China, Japan, Australia and New Zealand, which show an increasing demand trend (Miguel and Antunes, 2011). Countries such as New Zealand and Australia, in addition to domestic

production, are also large importers of raw propolis, mainly from China, which is also the main export market for their final propolis products (Clarke, 2019). Although China is the largest producer and consumer of propolis products in the world, there are major issues related to the counterfeiting of propolis products in this market. Namely, in the last decade there were cases of large-scale counterfeiting of this substance in China, which resulted in a drastic decrease in the demand for domestic propolis products on the Chinese market, and thus in a large economic loss for national production (Fung, 2016).

There are no official statistical data on the production of propolis in Serbia, but research by the authors of this paper shows that propolis is the third most common bee product, which is collected by beekeepers in apiaries, right after honey and wax. Propolis from apiaries is sold at the local market, usually in the form of alcoholic tinctures, or as part of mixtures with honey and other bee products. As far as the health safety of propolis products at the Serbian market is concerned, research has been done on the chemical composition of raw propolis from Serbia, which showed that systematic quality control of this product is necessary in order to put a health-safe product on the market (Tošić et al., 2017).

Harvesting of propolis

Propolis production is affected by seasonal conditions, as well as by harvesting methods. The harvesting method usually involves scraping this material from the body and moving parts of the hive, i.e. the frames, when it may contain broken wood particles and other mechanical impurities, or using more modern propolis harvesting techniques, introduced in practice to obtain cleaner raw material and facilitate the collection of larger quantities, by placing plastic grids on upper parts of the beehives (Okhale et al., 2021).

In order for propolis to be sold to a buyer or marketed to consumers, it needs to meet certain purity criteria. For example, in New Zealand, collected propolis handed over to buyers must not contain less than 15% raw propolis (Clarke, 2019). There is no single international standard for the quality of propolis, but there are national standards in individual countries that have requirements for the quality of propolis on the market. In the Republic of Serbia, according to the Rulebook on the quality of honey and other bee products („Službeni glasnik RS", br. 101/15), propolis that is placed at the market must not have more than 5% of mechanical impurities and more than 30% of wax, and must have a minimum of 35% alcohol-extractable substances.

In general, quality propolis should meet the following conditions (Okhale et al., 2021):

a) that it has a low content of mechanical impurities such as dead bees and wood remains,

b) that there is a minimal share or complete absence of contamination with pesticides and heavy metals (the best would be propolis from organic production),

c) that it has a high content of biologically active substances,

d) and that it has a low beeswax content.

Processing of propolis

The processing of propolis can be industrial, as is the case with e.g. New Zealand, where there are a small number of professional processors, who buy raw propolis from local beekeepers, refine it and process it into final products (Clarke, 2019). Hovewer, the processing can be directly on the farm where beekeepers themselves process the propolis collected at their apiaries into final products.

Industrial processing of propolis requires capital investments, knowledge, technology, regular quantities of raw propolis and secure access to larger markets. At developed markets, propolis is mainly sold in the form of capsules, tinctures, lozenges, toothpaste or tinctures, and the same are sold in health food stores, pharmacies, online, at airports, etc. (Clarke, 2019). Raw propolis can be used in human nutrition in different ways, in ground form, as an addition to drinks, as an addition to honey products, or most often in the form of an alcoholic tincture (Bogdanov, 2014).

In countries where processing of propolis is developed, there is investing in the branding of the final product, which gives added value to the final product. Good example is *Kangaroo Island propolis* produced in South Australia, an area rich in endemic flora which causes the unique chemical composition of this propolis (Duke et al., 2017).

Whether it is industrial or farm processing, the collected propolis needs to be purified in order to obtain propolis that can be used safely. The stages of processing raw propolis on the beekeeping farm include compacting the propolis

into larger pieces and keeping it in the freezer for a few hours, because it has a sticky consistency. Then, propolis is turned into a powder and mixed with alcohol, in order to extract flavonoids, remove wax and other impurities. The liquid propolis is then filtered, and the final product is obtained, which can then be packaged in spray bottles or mixed with pollen, honey, royal jelly and/or perga into final products for the market (Authors' research, 2022). Also, cosmetic preparations can be made, which require larger investments and knowledge. Propolis products presented at Serbian market, made at local apiaries, include both cosmetic and food supplement products (Figure 1).

Figure 1. *Propolis products from National Beekeeping Fair, Serbia*

Source: Authors' archive, 2022

With every new product that is put on the market, before larger production, it is necessary to carry out a sensory analysis of the product, in order to see if the product is commercially promising and sustainable (Osés et al., 2015). This rule also applies to propolis products produced at agricultural farms, which should initially be made in smaller quantities for the local market, in order to see if the product is sensorially acceptable to potential consumers, and whether there is any demand for this product at the local market. This is especially important when it comes to e.g. alcoholic tinctures of propolis, because they can have too strong a taste, that can repel consumers.

Also, it is necessary to work on popularizing the use of propolis products in the diet, as shown by some researches. Namely, Adekayanti et al. (2022) showed that the more limited is the consumer's general knowledge about a product, the less interested they will be in purchasing that product. Furthermore, the same authors emphasize that, as the experience of the health benefits of using a given product increases, so does the consumer's interest in purchasing the same product.

Conclusion

Propolis is a product that is gaining more and more importance, and for which there is a growing trend. In Serbia, comprehensive research is needed to describe and standardize propolis, taking into account the specifics of the area where beekeeping takes place, and with the aim of ensuring the quality and health safety of this product at the market.

Also, it is necessary to work on educating and informing the population about the health benefits of using propolis products in the diet. Regarding the production of propolis products at beekeeping farms, before starting a larger production, the beekeeper should conduct a research of the local market, in terms of demand for a given or similar products, and make a quality and sensory-pleasing product.

Industrial processing of propolis requires capital investments, technological knowledge, regular quantities of raw propolis and safe access to larger markets. However, processing of propolis at beekeeping farms does not require large investments, and can be done in addition to other activities at the apiary, which would make beekeeping more profitable activity.

Literature

1. Adekayanti, A A., Athar, H. S., Furkan, L. M. (2022): *The Effect of Subjective Knowledge, Objective Knowledge, and Experience Knowledge on Interest in Buying British Propolis Products*, International Journal of Multicultural and Multireligious Understanding, Vol. 9, No. 2, pp. 166-176, https://ijmmu.com/index.php/ijmmu/article/view/3368
2. Bankova, V., Bertelli, D., Borba, R., Conti, B. J., da Silva Cunha, I. B., Danert, C., ... & Zampini, C. (2019): *Standard methods for Apis mellifera propolis research*, Journal of Apicultural Research, Vol. 58, No. 2, pp. 1-49, https://doi.org/10.1080/00218839.2016.1222661
3. Benhanifia, M., Soltani A. (2022): *Biological Activity of Propolis: An Update*, Preprints 2022, 2022030009, doi: 10.20944/preprints202203.0009.v1
4. Bogdanov, S. (2014): *Propolis. Composition, Health, Medicine*: *A Review*, Bee Product Science. pp.1-40.

5. Clarke M. (2019): *Australian propolis market and production potential*, Report, 23 January 2019, AgriFutures Australia No 19-022, AgriFutures Australia Project No PRJ-010777, https://agrifutures.com.au/wp-content/uploads/2019/04/19-022.pdf)

6. Crane, E. (2009): *Encyclopaedia of insects* (second edition), Chapter 20 bee products, pp. 71-75. Academic Press, https://www.sciencedirect.com/science/article/pii/B9780123741448000205

7. Dimkić, I., Ristivojević, P., Janakiev, T., Berić, T., Trifković, J., Milojković-Opsenica, D., Stanković, S. (2016): *Phenolic profiles and antimicrobial activity of various plant resins as potential botanical sources of Serbian propolis*, Industrial Crops and Products, Vol. 94, pp. 856-871, https://doi.org/10.1016/j.indcrop.2016.09.065

8. Duke, C. C., Tran, V. H., Duke, R. K., Abu-Mellal, A., Plunkett, G. T., King, D. I., ... & Bruhl, J. J. (2017): *A sedge plant as the source of Kangaroo Island propolis rich in prenylated p-coumarate ester and stilbenes*, Phytochemistry, Vol. 134, pp. 87-97, https://doi.org/10.1016/j.phytochem.2016.11.005

9. Khalil M. L. (2006): *Biological activity of bee propolis in health and disease*, Asian Pacific Journal of Cancer Prevention, Vol. 7, no. 1, pp. 22-31, http://journal.waocp.org/article_24421_e27f12cfb64e899d4a0ee2f315f-985bf.pdf

10. Miguel, M.G., Antunes, M.D. (2011): *Is propolis safe as an alternative medicine?,* J. Pharm Bioallied Sci., Vol. 3, no. 4, pp.16, https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3249695/

11. Okhale, S. E., Nkwegu, C., Ugbabe, G. E., Ibrahim, J. A., Egharevba, H. O., Kunle, O. F., Igoli, J. O. (2021): *Bee propolis: Production optimization and applications in Nigeria*, Journal of Pharmacognosy and Phytotherapy, Vol. 13, No. 1, pp. 33-45, https://doi.org/10.5897/JPP2019.0561

12. Osés, S. M., Melgosa, L., Pascual-Maté, A., Fernández-Muiño, M. A., Sancho, M. T. (2015): *Design of a food product composed of honey and propolis*, Journal of Apicultural Research, Vol. 54, No. 5, pp. 461-467, https://doi.org/10.1080/00218839.2016.1183934

13. Simone-Finstrom M., Spivak M. (2010): *Propolis and bee health: the natural history and significance of resin use by honey bees*, Apidologie, Vol. 41, no. 3, pp. 295-311, https://doi.org/10.1051/apido/2010016

14. Tambur, Z., Miljković-Selimović, B., Opačić, D., Vuković, B., Malešević, A., Ivančajić, L., Aleksić, E. (2021): *Inhibitory effects of propolis and essential oils on oral bacteria*, The Journal of Infection in Developing Countries, Vol. 15, No. 7, pp. 1027-1031, https://doi.org/10.3855/jidc.14312

15. Tošić, S., Stojanović, G., Mitić, S., Pavlović, A., Alagić, S. (2017): *Mineral composition of selected Serbian propolis samples,* Journal of apicultural science, Vol. 61, No. 1, pp. 5, https://sciendo.com/downloadpdf/journals/jas/61/1/article-p5.pdf

16. Wilson-Rich N., Spivak M., Fefferman N. H., Starks P. T. (2009): *Genetic, individual, and group facilitation of disease resistance in insect societies*, Annual Review of Entomology, Vol. 54, pp. 405-423, https://doi.org/10.1146/annurev.ento.53.103106.093301

17. Правилник о квалитету меда и других производа пчела („Службени гласник РС", бр. 101/15).

APPLICATION OF INNOVATIONS IN AGRICULTURE AND DIGITISATION OF SALES AS A BASIS FOR THE FUTURE

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Abstract

The aim of the research is based on the basic IT knowledge of agricultural producers and the assumptions of the application of information technology in agriculture. The main goal of the work is to determine the attitudes of young people in the South Bačka district as they see their career in the future. Based on a literature review, a survey was conducted using a questionnaire. The research was conducted in three thematic units, the attitude of young people towards agriculture, the relationship between traditional sales at the marketplaces and the digitisation of sales, and the attitude towards agriculture as an occupation of the future. Based on the results of research on a sample of 200 respondents, we determined the perspectives of agriculture in the future from the point of view of the application of innovation and digitisation as well as the attitudes of young people as future farmers. The results provide a basis for concluding concrete guidelines for future research in the field of agriculture and youth.

Key words: *innovations in agriculture, digitization of sales, attitudes, markets, marketplaces, young people.*

Introduction

Analysing the professional literature and practical projects for the application of information technologies on a global scale in the field of agricultural production, simpler solutions for application in practice are noticeable. Ex-

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change of information, improvement of knowledge and improvement of business access and distribution of agricultural products to both retail chains and green markets have a new approach. Based on the experiences of developed countries, solutions for innovative agriculture are increasingly sought in less developed and developing countries. The problem of applying innovations in less developed countries, as well as here, is the appropriate technology and equipment, but also the knowledge and skills to apply those technologies. Basic knowledge of farmers is enough for smooth operation. This means knowledge in the use of computers and operating systems, through e-communication and Internet search of competitive moves, customers, but also the process of communication with the public and state sector. Modern technologies and digital marketing through the Internet or electronic devices enable communication with users. (Prdić, 2022). Also, other research shows that farmers have positive attitudes towards the application of ICT in agriculture and believe that mobile phones and the Internet can be useful sources of agricultural information. (Aldosari et al, 2019). Application of new technologies enables farmers to communicate through social networks and position their own products. In addition, social media is a very dynamic and progressive form of marketing. (Kostić, 2022). Information literacy through communication with retail chains and marketplaces also supports the application of innovations. Active application of innovations in marketplace operations leads to changes in the marketplace portfolio and creates a competitive advantage. (Kuzman et al, 2021). Agriculture plays an important role in developed countries, especially in medium and less developed countries. However, the contribution of the gross domestic product has been declining over the years, due to population migration to urban areas, thus reducing the labour force potential. It is difficult to define why young people are not interested in agriculture, even if they are temporarily unemployed.

The goal of the research was to examine the perception and knowledge of young people about agriculture and to analyse the factors that influence the attitudes of young people about work and employment in agriculture. Individual thematic goals are related to the research of young people's attitude towards agriculture, traditional and digital sales of agricultural products, and young people's attitude towards agriculture as a profession of the future. The results aim to provide reliable data, useful information and recommendations that will enable a development strategy in agriculture and encourage youth involvement in agriculture and agriculture-related activities.

Methodology

Based on a review of professional and scientific literature and research by other authors, a survey questionnaire was compiled. The survey questionnaire is divided into 3 thematic units: the attitude of young people towards agriculture, the sale of products and agriculture as an occupation of the future. The questions are intended for young people in the South-Bačka district in order to adapt to the research problem and the environment. Empirical research methods were used for young people aged 12-15, in front of the agricultural school in Futog, on a sample of 50 respondents in the period of 15th-30th March 2022 and online surveys of 50 respondents, aged up to 30 years. Research was also conducted on a sample of 50 respondents in front of three local marketplaces, Satelitska, Detelinarska and Petrovaradinska in Novi Sad and three retail establishments in the city centre Maxi, Roda and Univerexport, on a sample of 50 respondents. All surveys were conducted at the same time. The obtained data were processed using statistical data processing methods.

Results and discussion

Agriculture, as an occupation of the future, is an important factor in the economic development of many countries, especially those that are predominantly agrarian. The share of agriculture in the domestic GDP shows its real importance and level of development, but also the level of standards of the agricultural population. The condition of individual farms can be seen in their liquidity, through the ratio of assets and short-term liabilities, that is, the ability of farmers to meet their obligations on time. All of these indicators, from national to individual, have an impact on the attitudes of young people, in terms of doing business as an occupation of the future. Namely, in our country, agriculture is mainly done by older men, with the support of household members, wives and other younger members. Although the application of information technology in agriculture (ICT) enables the rapid flow of different types of information and the application of knowledge needed in the development of agriculture, research shows that farmers are not sufficiently aware of the benefits of using these technologies in their business (Baruah, 2018). The fact is that the educational structure of the agricultural population is at a low level, and young people who are active generally do not attend school. However, with this work, we want to point out the possibility of educating young people and the option of doing agriculture as a basic job. The fact that a large number of farmers are surviving and that young people are looking for

work in urban areas only confirms that it is necessary to educate young people for work in agriculture. If we take into account the knowledge that Serbia is an agrarian country, and that it has all the prerequisites for the development of agriculture as an occupation of the future, it is necessary to educate young people to work in agriculture. The basic premise of the research is to plan a strategy for involving young people in agriculture through their recognition of a life option as a profession of the future.

The sample included 50 young people in front of the Agricultural School in Futog and 50 young people from the area of the South Bačka administrative district through an online survey in the same period of time. The selection in front of the school was such that it was seen to survey those who were first encountered. The results showed that approximately half of the persons are male and half female. Basic data from the survey show that young people understand that agriculture is an activity in which the future can be predicted, but that they would not engage in it anyway. Namely, 70% of respondents believe that agriculture is a real future and that it offers the possibility of development of local urban and rural areas. Of them, 65% believe that their school provides adequate knowledge about agriculture, as well as that they could personally engage in agriculture based on their education. It is also a fact that young people would not engage in agriculture because it is perceived as a job for poor and uneducated people. These surveys revealed the data and the way how to present a job in agriculture to young people as a good future and remove doubts and prejudices. Therefore, it is necessary to remove the dilemma that agriculture is a job for the uneducated, and that it requires very hard work, for the incomes that are generated. Nevertheless, based on the results of the survey in terms of status and income, 51% of young people believe that agriculture brings practical benefits. Namely, the overall perception of young people surveyed in front of the agricultural school is positive, but they want visible changes in the development strategy and practical benefits from agriculture. Older people, however, must realise that young people can bring modern practices and tools to modernise agricultural activities (May et al., 2019). Over eighty percent of respondents, 81%, believe that agriculture contributes to the development of rural tourism in the South Bačka District. 53% of them believe that the financial income is good in agriculture, while another 47% believe that there is no quick profit. Young people believe that in our conditions, 56% are not sure that the state will help them with the application of new means and technologies. However, 60% would continue family production if they received incentive aid. When it comes to the basic units of the research, the following answers were received. To the specific question, what are your views on agriculture on pre-defined questions, the answers were as follows:

- Agriculture is the main economic branch that contributes to the nutrition of the population - 21%
- Agriculture enables economic development in South Bačka District - 23%
- Agriculture represents our local identity in production - 25%
- Agriculture gives a real chance to young people in the future - 31%.

Which sales channel of local agricultural products is the most efficient and effective:

- Traditional green markets - 41%
- Retail facilities - 32%
- Organised e-markets - 14%
- Digital marketing - 13%.

What is your attitude towards agriculture as an occupation of the future:

- Agriculture has a future because this is an agricultural region - 21%
- It has a future if farmers are educated - 19%
- It has a future if the state actively participates in development - 18%
- Application of modern technologies and innovations is mandatory - 21%
- Stimulating and organised sales of products at green markets - 11%
- Creates interest organisations of marketplaces, sellers and consumers 3%
- Digitises sales - 7%.

Young people who attend an agricultural school have a more pronounced attitude towards agriculture. During personal interviews and conversations with young people, they have the problem of acquiring ownership of agricultural land, they realise that agriculture is an occupation in which there is no quick turnover of monetary capital, but it pays off in a strategic sense. They also think that the state must help in the process of introducing innovations and modern technologies. Farmers who use the services of the extension service adopt and implement innovations more quickly (Altalb et al, 2015). They believe that work in agriculture is intensive and less profitable, that it is less valued in society, but

if all agrotechnical measures and technologies were applied, this attitude towards work would be more acceptable according to them. They need secondary education for work, and higher education only for developed agricultural farms that have already built their position on the market.

When it comes to the online sample, out of 50 respondents, we see diversity in approach and attitudes. Young people think that the problems are the following, acquiring agricultural land – 66%, work in agriculture is insufficiently paid - 71%, and that work in agriculture is insufficiently stimulated - 72%. In addition, 74% of the respondents think that it is an "old-fashioned" profession and because of that, they do not see themselves in perspective. But 73% of them think that young people should continue the family tradition if they have land, while 63% think that they would buy local products. Out of them, 54% think that these products should be sold in marketplaces, 21% in retail chains, and 25% that online sales should also be organised. Unlike the survey conducted at the agricultural school, where only attendance is a sign of a certain affinity in the profession, and also attitudes about the future profession, in the online survey the questions were general because the sample could not be precisely defined. These issues were at the same level of importance as all the others, so 43% of them have a positive attitude about agriculture, 54% consider traditional marketplaces as a good sales channel, and 46% think it's digital marketing that is a good sales channel. When it comes to specific questions about agriculture as a future occupation, 41% had a positive answer, while 59% of them answered that they would not engage in agriculture as a future occupation.

A survey carried out at local marketplaces gave the following overall results. 51% of those surveyed confirmed that agriculture is the main economic branch that contributes to the nutrition of the population. 31% of respondents agree that agriculture enables the development of the economy in South Bačka District, 11% believe that agriculture represents local identity in production, while only 7% believe that agriculture is a real chance in the future. When it comes to sales channels, 33% of young people believe that they are traditional marketplaces, 21% - it is retail stores, 15% believe in organised e-markets, while 31% think that digital marketing is the most effective sales channel. For the third group, the answers were that agriculture has a future because this is an agrarian region - 21% of them, if farmers are educated - 15%, if the state participates in development - 13%, that the application of modern technologies is mandatory - 16%, that the organised sales at green markets should

be supported - 16%, 9% of respondents believe that interest organisation is necessary, and 10% of respondents think that success in digitalisation of sales is necessary. The results show that young people of various occupations and passions from 13 to 30 years old have a weaker perception towards agriculture. At the same time, it can be stated that they understand that agriculture is important for feeding the population (51%), that the most important sales channels are traditional markets and digital marketing. Also, they think that South Bačka District is an agricultural region and that agriculture has a future.

The survey conducted physically in front of retail stores had the following results on questions from the thematic units, that agriculture is the main economic branch that contributes to the nutrition of the population is confirmed by 41% of respondents. 31% of respondents agree that agriculture enables the development of the economy in the South Bačka district, 15% think that agriculture represents local identity in production, while only 13% believe that agriculture is a real chance in the future. When it comes to sales channels, 17% of young people believe that they are traditional marketplaces, 39% retail stores, 11% organised e-markets, while 33% think that digital marketing is the most effective sales channel. For the third group, the answers were that agriculture has a future because this is an agrarian region is supported by 19% of them, if farmers are educated - 18%, if the state participates in development - 14%, that the application of modern technologies is mandatory - 19%, organised sales at green markets supported by 12% of the young people, 7% of respondents believe that interest organisation is necessary, and 11% of respondents think that success in digitisation of sales is necessary. The results show that young people of various professions and passions from 13 to 30 years old have a weaker perception towards agriculture and when it comes to the survey in front of retail establishments.

Critical review and recommendations

Based on the parameters of the state of agriculture in the world, it is simply a clear fact about the necessity of increasing domestic agricultural production. The supply chain of agricultural products implies an integrated interest within the chain starting from agricultural producers, marketplaces, local urban community, consumers and social community (Kuzman et al, 2022). Increasing the awareness of local regions, such as the South Bačka District, regarding agriculture is a prerequisite for development. In order to achieve this, funds are necessary to finance growth and development, which is achieved by properly

selecting and investing in investment projects (Milojević et al, 2019). Assuming that the entire region is cohesive, the current state of agriculture is actually an obstacle to young people's understanding of the agriculture of the future. Increasing the awareness of local communities about the importance of agriculture for local development can develop interests among young people, but also initiate the professional and academic level for solving this problem. Innovations are the driver of economic growth and well-being in countries (French et al, 2014). It is certainly true that the current knowledge in scientific circles is sufficient for investing in local agriculture. Both the value and the financing model are in accordance with the available data on investments (Subić et al, 2021). The research recommendation is primarily related to the initiation of interest in agriculture among young people, the continuation of education at higher levels of study and a realistic perspective in the future.

Conclusion

The main task of this paper is to present the results of research on the attitudes of young people who attend agricultural school and others, up to the age of 30, whose education and expertise have not been determined. Research thematic units gave the answer that agriculture is important for the development of the district that it is important for the nutrition of the population, but also that insufficient investment is made in the development and education of farmers. Young people understand the importance of agriculture, especially those who attend agricultural school, on the basis of which further processes and procedures can be carried out. Young people who are not related to agriculture have less interest, but they are aware of the role of local agriculture and digitisation of sales as an element of development. The result we wanted to achieve serves as a decision-making parameter for all state, professional and other organisations dealing with agriculture. Also, this research is intended for the needs of further scientific research or for agricultural producers themselves and other business decision makers. The fact that can be particularly emphasised is that even in the South Bačka district, agriculture is exclusively done by the elderly population, as well as that the sales are mostly done through local marketplaces, and the share of sales is also with the elderly. Interesting communication with local decision-makers and highlighting the importance of agriculture on the one hand, and on the other hand creating conditions for youth education and stimulating investment and subsidies on the other hand, will contribute to concrete guidelines for future research in the field of agriculture and the role of youth.

Literature

1. Aldosari, F.,Shunaifi, S. AL., Ullahal, M.A., Muddassi, M.,Ali Noor, M. (2017): *Farmers perceptions regarding the use of Information and Communication Technology (*ICT) in Khyber of the Saudi Society of Agricultural Sciences, (18) 2: 211-217. https://doi:org/10.1016/j.jssas.2017.05.004.
2. Altalb, A.A.T., Filipek, T., Skowron, P. (2015): The Role of Agricultural Extension in the Transfer and Adoption of Agricultural Technologies, Asian Journal of Agriculture and Food Sciences, Vol. 3 (5): 500-507.
3. Baruah, A. (2018): The farmers view towards the use of Information and Communication Technology in agriculture: a study among farmers in the ner (north-eastern region) of India, Journal of Emerging Technologies and Innovative Research Vol. 5, (1), 17-23.
4. French, J., Montiel, K., Palmieri, V. (2014): *Innovation in Agriculture: a key process for sustainable development.* Institutional position paper. San Hose, May 2014. Inter-American Institute for Cooperation on Agriculture. Dostupno na: http://repositorio.iica.int/bitstream/11324/2607/1/BVE17038694i.pdf .
5. Kostić, S. (2022*): Istraživanje uticaja marketinga na društvenim mrežama na lojalnost potrošača brendu u Republici Srbiji*, Ekonomist, Novi Sad, 1(1), str. 55-64, ISSN 2812-9598.
6. Kuzman, B., Prdić, N., Puškarić, A. (2021): *Innovations in the function of competitive advantage of bazaars on market,* International Scientific Conference, Sustainable agriculture and rural development in terms of the Republic of Serbia, Institute of agricultural economics, Belgrade, 17-18 December 2020, pp. 103-112.
7. Kuzman, B., Prdić, N., Kostić, S. (2022): I*nterdependence of interes of sellers and consumers by selling agricultural products on marketplaces,* Economics of agriculture, 69 (3), pp. 697-711, doi:10.5937/ekoPolj2203697K.
8. May, D., Arancibia, S., Behrendt, K., Adams, J. (2019): *Preventing young farmers from leaving the farm*: Investigating the effectiveness of the young farmer payment using a behavioural approach. Land use policy, 82: 317-327.

9. Milojević, I., Mihajlović, M. (2019): Primena metoda ocene investicionih projekata u javnom sektoru, Oditor, V. 5, (1), str. 19-31.

10. Prdić, N., Prdić, I. (2022): *Mobilni uređaji u funkciji prodaje na pijaci*, Ekonomist, Novi Sad, 1 (1), str.7-15, ISSN 2812-9598.

11. Subić, J.,Jeločnik, M., Nastić, L., Andrei V.J. (2021): *Economic effects of plum plantation establishment,* International Scientific Conference, Sustainable agriculture and rural development in terms of the Republic of Serbia, Institute of agricultural economics, Belgrade, 17-18 December 2020, pp. 149-162.

DIGITIZATION: A NEW STAGE IN THE EVOLUTION OF AGRICULTURE

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Abstract

Digitisation and digitalisation, although they seem to be two common and sometimes even identical elements, is the subject of study of two areas separately. Digitalization in the field of agriculture involves the replacement or integration of technological devices in the specific activity of production of food crops. Thus, it is about using in a manner as efficient and as cost-effective as possible the machines that take over from human activity. On the other hand, digitization is the transformation of the necessary information from a physical format to a digital format. Moreover, the concept of digitization involves data processing and the formation of databases used to obtain a larger, broader and more accurate overview of the activities. This article looks at the implications that the digitization process has on the agriculture sector.

Key words: *agriculture, digitization, collection, processing, efficiency*

Introduction

Digitalization as a basic concept for studying new changes on the market, but also as a mechanism of alignment with new times refers to the collection of information of an analog nature and its presentation in a digital format. These sets of information have a specificity of their own. From a theoretical point of view, digitization is concerned with the transformation of processes, either from an administrative perspective or from a practical point of view, directly related to the company's object of activity (Ulezko et al., 2019).

From a technical perspective, in the field of agriculture, digitization is concerned with collecting data from the working ground and the environment of external

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activity (activities aimed at food production or various goods such as fertilizers used or fertilizers). The data collected can be formatted by different methods, whether it is a manual input of the data and its subsequent processing, or the implementation of a software designed to process and enter the data yourself inside a database (Bachev, 2020). The technological equipment used for this is expensive and requires high, financially large investments, but they have the ability to reduce costs in a significant manner and to amortize investments by making better decisions, more efficient management decision s.

Methods

Among the devices used to form databases and to enter or collect them, instruments such as sensors, drones or devices that have implemented surveillance cameras and that have the ability to take information from reality and enter it in the form of numerical data or different algorithms are used. Although digitization I s a relatively new concept, having been present in society for several decades, the technological approach in the field of agriculture is a relatively new concept (Ferrari et al., 2022).

The importance of the current also arises due to the fact that two diametrically opposed concepts are assimilated as a method of approach(Ulezko et al., 2019). On the one hand there is the agricultural environment that is one of the primordial factors of the economy and the main engine of the development of the economy, and on the other hand there is the concept of digitization that is considered a neo-factor of production. Although the digitization of agriculture is a new concept in the market, it offers beneficial effects that managers can use to increase the productivity and efficiency of their business object.

One of the digital software used for this aspect in the field of agriculture is Crop360 (Shen et al., 2029). This is an application used from the computer and works as a platform. The efficiency of this practice appears through the possibilit y of the beneficiaries to follow the evolution of the crops they deal with and to manage the financial-accounting data (Ehlers et al., 2022).

Moreover, this application provides real-time alerts in case problems are predicted on arable land or if one of the equipment used has been damaged (Ulezko et al., 2019). There are also a number of programs on the market dedicated to the collection and interpretation of gifts such as those that calculate the level of productivity of hybrids achieved by the producing companies and which have as their source of origin different suppliers (Kayad et al., 2022).

The need for digitalisation is being felt more and more because production has had to keep pace with the demographic explosion and the demands of the market to obtain a larger quantity of food goods, but aimed at ever lower costs (Ferrari et al., 2022). For this reason, the monitoring and management of consignments of agricultural produce should be as strict as possible, as accurate and as coherent as possible (Ciruela et al., 2020).

When we talk strictly about the digitization of agriculture, this phenomenon has now come to be seen more as a need complementary to the object of activity and not as a competitive advantage. This is because technology has been implemented in a uniform manner by most manufacturers at European level.

However, digitization procedures provide a number of several advantages, some of which are even the quick questioning of agricultural resources that a particular producer has at hand (Lioutas et al., 2020).

The digitization process is a previous one and mandatory to the digitization process. It requires mechanisms to convert data to analog format prior to the digital transformation process. From a financial point of view, the profitability of this phenomenon will be felt after an average period of two years (Kayad et al., 2022).

As a rule, the digitization target is set for a longer period of time, the interval being set for different periods, in different calendar sequences over standardized periods, staggered (Ferrari et al., 2022). With the help of information conversion models, the beneficiaries of these systems can make decisions in a shorter period of time and with a higher quality of information (Ulezko et al., 2019).

From a managerial perspective, decisions must be made on the basis of a large data set that collects significant qualitative data that must be processed in a simple manner in order to be able to explain as concisely and as accurately as possible the phenomenon that is taking place.

Importance

Digitization has the role of helping the administrative and managerial staff to prevent large losses that may occur as a result of specific agricultural activities. The first possibility is the losses in the category of deficient planning. These errors are the basis of optimizing the budget or plan that will be the basis of the company's development strategy and the involvement of the object of activity (Ciruela et al., 2020).

Following inadequately collected data, but also due to incompletely collected data, the decisions underlying the strategy may affect the quality of future activities (Ferrari et al., 2022). Thus, the budget is not optimized for the future expenses incurred, nor the purchase of raw products (the products underlying the specific object of activity) can be an adequate one, apt that will automatically affect the final profit of the company (Kayad et al., 2022).

This approach can lead to the emergence of high waste of the company's financial resources (Ciruela et al., 2020). The second negative effect that has a high chance of occurrence is poor project management. From a technical point of view, each agricultural crop needs a clear set of treatments and regular checks to ensure the quality of production and to standardize the entire production process (Ehlers et al., 2022). As a result, the data collected on the grown crop must be as clear as possible and collected as quickly as possible in order to be able to ensure the quality of the activity (Garske et al., 2019).

As a result, the establishment of a development or administration strategy is directly influenced by the quality of the data entered and its correctness (Ulezko et al., 2019). The third important element supporting the need for digitization in agriculture is related to the sale of products (Shen et al., 2029).

Currently, the legislation that coordinates the entire activity specific to the field contains a set of clear rules at European level regarding the quality of the techniques used to grow the products, but especially the quality of the seeds and the raw material used to achieve the crop they subsequently sell.

Each product sold legally, be it shops of different sizes or restaurants that contact suppliers directly, must contain a set of documents issued by an authorized institution (Bachev, 2020). These institutions shall provide for a clear methodology with regard to the techniques used, to the technological equipment which a manufacturer is permitted to use to operate and grow products, but in particular the provenance of the raw material (Bachev, 2020).

Following the confirmation of these necessary key elements, imposed by law, the manufacturer is allowed to sell its products on the free market (Lioutas et al., 2020). In the absence of these documents, the production will not be able to receive a quality certificate, and the products will not receive a quality rating, which will affect the price at which the goods will be sold.

Digitizing agricultural activities in this way can lead to the precise collection of data, timely parceling of relevant information, elements that the seller

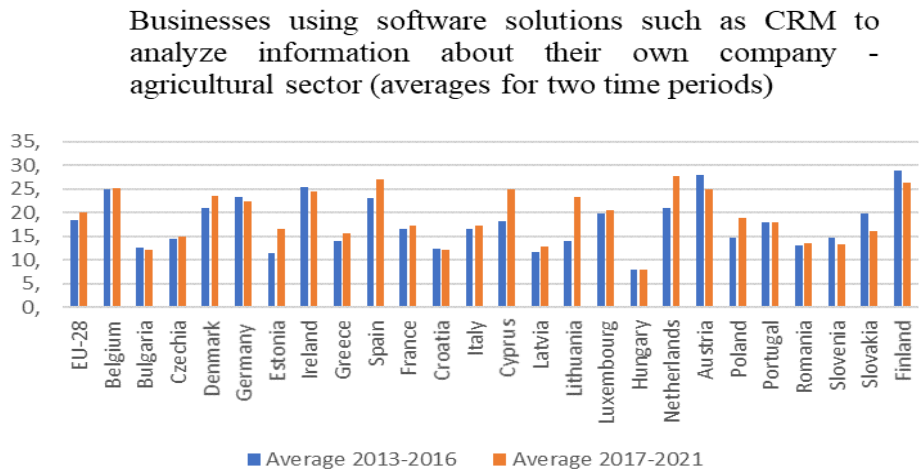
will be able to offer to those who want to purchase the stock of products. The beneficial effects are manifold (Garske et al., 2019). It can be seen that the most beneficial thing is to increase the transparency of producers and to increase competitiveness in this market.

It is certain that digitized agriculture represents a high degree of precision and also requires a higher degree of technology. As has been explained now, there are a number of high benefits that arise from these processes (Ferrari et al., 2022).

The most visible and beneficial elements are the increase in productivity, high control over costs and factors related to the protection of the environment (Kayad et al., 2022). However, once these procedures are in place, it is not enough to manage the platforms and technologies implemented. Digitization is a continuous and complementary process to the activity of modernization of production and the administrative activities underlying the activity (Lioutas et al., 2020).

Collecting data and turning it into a digital form is an auxiliary process to increasing productivity, through complex analysis and through various automated machine systems (Ehlers et al., 2022). However, all this depends on the degree of virtual technology used, on the quality of the technologies used, on the ability to monitor the developments occurring on the agricultural crop used, but most importantly on the ability to communicate between the different machines and the individuals who supervise the entire process.

Chart 1.



Source: own processing of data by authors.

More and more companies depend on the level of investment by private companies or state authorities in order to be able to develop from a technological point of view. The countries that have a geographical area with a lower agricultural capacity are those that have optimized production processes early (Kayad et al., 2022). This happens because of the need to streamline in a manner as quickly as possible the possibility of meeting the needs of one's own people with the products made at national level.

Conclusions

Reducing reaction times on the part of decision-makers is one of the most important benefits that arise from the digitization of the agricultural sector. Ensuring more flexible conditions appropriate to the sector can help reduce waste, reduce pollution through more efficient use of the equipment needed by the sector and, most importantly, reduce the costs of implementing new projects. The permanent simplification of the process provides a clearer picture of the financial situation of the profile firm, which simplifies the firm's ability to obtain financing from investors or increases the ability to attract credit from commercial banks.

Innovations are currently facing an increase in implementation requests. Relatively new concepts such as automation or excessive technology are some of the elements desired and demanded by most manufacturers. These needs, however, cannot satisfy the true desire unless the ability to process information already exists integrated.

Recommendations

One of the most used methods to solve problems related to data collection and processing is to create integrated cloud services and implement them in the specific activity uniformly. Thus, the data will be processed by the digital units implemented in the agricultural machinery and ensure the compatibility between the different electronic formats and the different necessary protocols.

Another great advantage that will result from the integration of digitization services is the logistical support it can offer. As the information collected automatically will be able to provide a larger overview of the business, the manager will be able to access information such as possibilities for cost reductions in transport, simplification of production, updating the prices of

the profile products on the agricultural market or the risks of overproduction or crop underproduction.

The creation of such integrated services, regardless of their name or quality / capacity, provides the necessary premises for significantly accelerating the digitalization of agriculture. The gradual but steady introduction of a successive generation of digital technologies is an effective way of changing these sectors of activity.

Moreover, it offers the effective premise to increase the profitability of each investment made and as a result can led to an increase in living conditions by offering better, cheaper and more qualitative products.

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Literature

1. Bachev, H. (2020). Diagnosis of the system for sharing knowledge, innovation and digitalization in agriculture (AKIS) in Bulgaria. *Journal of Integrated Marketing Communications and Digital Marketing, 1*, 1-17.
2. Ciruela-Lorenzo, A. M., Del-Aguila-Obra, A. R., Padilla-Meléndez, A., & Plaza-Angulo, J. J. (2020). Digitalization of agri-cooperatives in the smart agriculture context. proposal of a digital diagnosis tool. *Sustainability, 12*(4), 1325.
3. Ehlers, M. H., Huber, R., & Finger, R. (2021). Agricultural policy in the era of digitalisation. *Food Policy*, *100*, 102019.
4. Ferrari, A., Bacco, M., Gaber, K., Jedlitschka, A., Hess, S., Kaipainen, J., & Brunori, G. (2022). Drivers, barriers and impacts of digitalisation in rural areas from the viewpoint of experts. *Information and Software Technology*, *145*, 106816.
5. Garske, B., Bau, A., & Ekardt, F. (2021). Digitalization and AI in European Agriculture: A Strategy for Achieving Climate and Biodiversity Targets?. *Sustainability, 13*(9), 4652.

6. Kayad, A., Sozzi, M., Paraforos, D. S., Rodrigues Jr, F. A., Cohen, Y., Fountas, S., & Marinello, F. (2022). How many gigabytes per hectare are available in the digital agriculture era? A digitization footprint estimation. *Computers and Electronics in Agriculture*, *198*, 107080.

7. Lioutas, E. D., Charatsari, C., & De Rosa, M. (2021). Digitalization of agriculture: a way to solve the food problem or a trolley dilemma?. *Technology in Society*, *67*, 101744.

8. Shen, Z., Huang, M., Shi, J., Xue, X., & Huang, T. S. (2019). Towards instance-level image-to-image translation. In Proceedings of the IEEE/CVF conference on computer vision and pattern recognition (pp. 3683-3692).

9. Ulezko, A., Reimer, V., & Ulezko, O. (2019, May). Theoretical and methodological aspects of digitalization in agriculture. In *IOP conference series: earth and environmental science* (Vol. 274, No. 1, p. 012062). IOP Publishing.

TESTING RESULTS OF NEW IMI SUNFLOWER HYBRIDS IN DAI-GENERAL TOSHEVO

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Abstract

The distinctions between 18 IMI-resistant sunflower experimental hybrids were studied based on the following characteristics: seed yield, seed oil content, seed oil yield, plant height, head diameter, influence of climate conditions, and a two-factor analysis of variance. Hybrids' plasticity was established by studying their reaction to the variable climatic conditions. It was determined that hybrids 74A x 140R; 86A x 180R; 92A x 430R; 128A x 434R exceeded the mean standard on the characters seed yield and seed oil content with the highest statistical authenticity P=0,001. The studied hybrid combinations, resistant to imazamox, were affected equally by the climate conditions in terms of seed oil content. The strongest was the influence of environmental conditions related to the characters seed yield and plant height.

Key words: *sunflower, imidazolinone resistance, seed yield, ANOVA*

Introduction

Sunflower is the main oil crop in Bulgaria. The planting areas have increased in recent years because of higher profitability, low input requirements and better exporting possibilities, but higher rates of disease and pests have severely limited the sunflower production in some years. Using IMI herbicide resistant hybrids gave farmers, the opportunity to control broadleaf weeds such wide spread *Xanthium*, *Cirsium* sp. Imidazolinone herbicides control a broad spectrum of grass and broadleaf weeds in imidazolinone-tolerant sunflower, including weeds that are closely related to the crop itself and the key parasitic weed broomrape (Tan *et al*., 2005). An imidazolinone-tolerant wild sunflower population, discovered in soybean field in Kansas, USA in 1996 (Al-Khatib et al. 1998) was used as a source for insertion of imidazolinone-tolerance gene into the first imidazolinone-tolerant lines (Al-Khatib and Miller 2000). This was followed by the release of public IMISUN lines in 1998. Sala *et al.* (2008) reported for obtaining a new source of IMI resistance, CLHA-PLUS,

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developed by induced mutations (ethyl-methanesulfonate mutagenesis) and selection. This CLHA-PLUS gene has higher IMI resistance and higher oil content in sunflower hybrids. This was widely known as the Clearfield Plus System, a trademark of *BASF Co*. The development of resistant IMISUN sunflower hybrids depended on both parental lines, having IMI-resistant genes, because this resistance was controlled by two genes. With IMI resistant sunflowers, called as Clearfield® (CL) system, farmers had been able to utilize much more effective post-emergence herbicides controlling both major broad leaves and also broomrape (Demirci and Kaya, 2009). Significant results have been recently achieved in sunflower breeding in DAI-General Toshevo for tolerance to imidazolinone (IMI) herbicides (Encheva *et al*., 2015; Encheva *et al.,* 2016; Georgiev *et al.,* 2016; Georgiev *et al.*, 2018). Clearfield (CL) technology has been used successfully for ten years in Eastern Europe and has one third of market in Hungary and Turkey and increase rapidly in Bulgaria, Hungary, Romania, Russia and Ukraine (Elezovic, et al, 2012; Evci et al., 2011, Kaya et al.,2013). Dobrudzha agricultural institute has already registered four hybrids on the base of CLP Technology – Enigma CLP, Dalena CLP, Sunny IMI CLP and Camelia CLP.

The aim of this investigation was to evaluate on Clearfield Plus Technology the produced experimental IMI resistant sunflower hybrids, compare their seed yield, oil content with standards and choose those with highest exceeding.

Material and methods

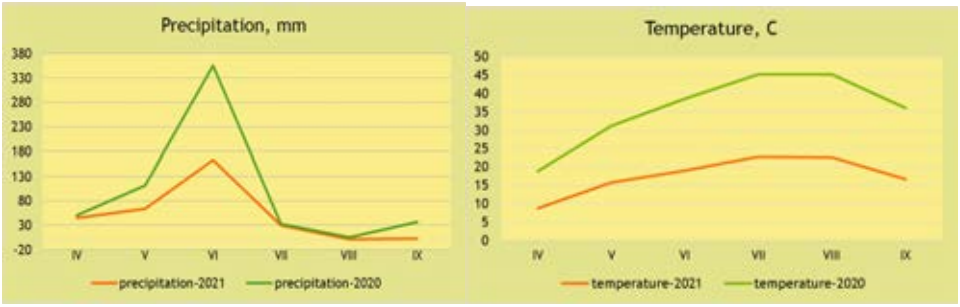
The investigation was carried out in 2020 and 2021. Three sterile mother lines and nine restorers with *CLHA-PLUS* gene were used. They were the result of implementation of long-term research program for developing herbicides resistant hybrids at DAI. The parental lines were characterized by morphological uniformity and very good combining ability. All of them were resistant to *Plasmopara helianthi*. The standards, included in this testing were P64LP140 and P64LP130. Hybrid plants were treated at phase 3-5 pair of true leaves with the herbicides - Pulsar Plus (120 ml/da) and Stomp 330 EU (230 ml/da). Hybrids were tested at the experimental breeding field of DZI-General Toshevo in a randomized block method in three replications, as the area of each repetition was 10 m2 (Barov and Shanin, 1965). Phenological and morphological characters, conformed to UPOV characteristics, were determined. The seed oil content was determined using NMR. The seed set (%) was calculated as a correlation between the number of inseminated disk florets to the total num-

ber of disk florets in one inflorescence. The obtained data were analyzed by ANOVA 3, a statistical tool, used to develop and confirm an explanation for the obtained experimental data**.** The ANOVA F-test is known to be nearly optimal in the sense of minimizing false negative errors for a fixed rate of false positive errors. The two-way analysis of variance was applied. It examines the influence of two different categorical independent variables on one continuous dependent variable. The two-way ANOVA not only aims at assessing the main effect of each independent variable, but also, if there is any interaction between them. These two factors are YEAR (Y) and HYBRID (H).

Results and discussion

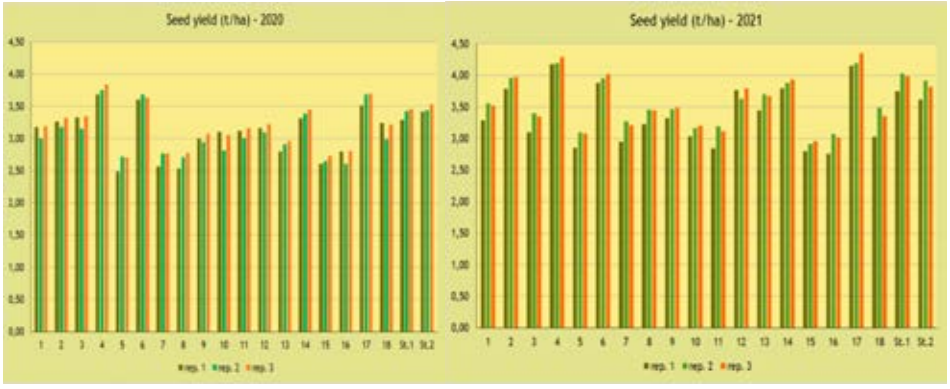
Rising temperature and altered soil moisture due to climate change is believed to decrease the yield of food crops over next 50 years. Drought is one of the environmental factors, limiting plant growth and the productivity of many crops. Sunflower is considered as comparatively drought tolerant crop. The analysis of the obtained data showed that the experimental hybrids were tolerant to both low and high temperatures, but more tolerant to the lower ones. A critical period for water stress was the period 20 days before and 20 days after flowering. The time taken for a sunflower plant to develop through the growth stages from planting to maturity is affected by planting time, temperature, day length, nutrition and moisture. Timely rains and moderate temperatures in early fall stimulated optimal planting. The time taken for germination and emergence of a sunflower seedling is variable, but usually takes between 5 and 10 days. The preferred soil temperatures for planting sunflower are 10–12ºC. Rains at the end of April and early June were appropriate for the crop. Planting into warmer soil temperature in 2020 results in faster emergence but soil moisture around the seed declined faster (fig.1). The weather conditions in 2021 were more favorable for the crop than previous year. Typically drought or moistures stress in the summer 2020 was the most commonly seen as the center seeds in the head not filling. The combination of high temperatures and moisture stress in July 2020, during flowering, reduced seed yield and oil content of experimental hybrids.

Figure 1. *Temperature and precipitation during sunflower growth 2020-2021.*



The mean standard for seed yield of replications in 2020 was 3,37 t/ha. Just three of the tested experimental hybrids exceeded it with 6,3% to 7,4%. The best results showed the hybrids 74 A x 140 R, 86 A x 180 R and 92 A x 430 R. The mean standard for seed yield of replications in 2021 was 3,81 t/ha. Just four of the tested experimental hybrids exceeded it with 2,3% to 7,1%. The best results showed four hybrid combinations: 74 A x 140 R, 86 A x 180 R, 92 A x 430 R and 128 A x 434 R. Hybrid 86A x 180R was distinguished with the highest seed yield during both years of investigation (fig. 2).The vegetation period varied 115-122 days. Debaeke *et al*. (2021) described that an ideal head diameter was considered to be in the range of 16–22 cm, as smaller head sizes are usually indicative of a lower seed number per head or poor center seed fill which cannot be fully compensated by higher plant populations. In contrast, large heads were usually found on plants with excessive leaf areas, fleshy backs of the head and often associated with slow drydown, large seeds with thick hulls and a reduced concentration of seeds per unit area of the head.

Figure 2. *Seed yield (t/ha) of the experimental hybrids and standards 2020-2021.*



The head diameter in the trials varied from 15 to 21 cm first year of investigation and 15-26 cm the second year. The largest head diameter was measured of hybrids 74 A x 140 R, 86 A x 180 R, 92 A x 430 R and 128 A x 434 R. Their vegetation period was 118-120 days. With ongoing climate change, sunflower, as a spring-sown rain fed crop, could be more exposed to the direct effect of heat stress at anthesis or during grain filling and to different and unpredictable drought scenarios during its growing cycle. These both factors resulting in severe yield losses, oil content decrease and alterations of fatty acid composition (Moriondo and Bindi, 2007; Debaeke *et al*., 2021). Similar results and inference were obtained during both years in DAI. High temperatures during flowering and seed set in 2020 reduced yield and oil content. Yield is generally reduced due to a reduction in seed number and increase in small grains.

Two-way analysis of variance (ANOVA) was applied for two independent variables (table 1).

Table 1. *Two-way analysis of variantce (year x hybrid).*

Characters	**MSh**	**MSy**	**MS yxh**	**MS error**	**LSD 5%**	**LSD 1%**	**LSD 0,1%**
Seed oil content	7,15**	68,1***	1,7	0,93	0,61	0,73	1,01
Oil yield	1194,7***	4723,1***	81,7	58,4	5,14	6,54	8,43
Seed yield	3788,4**	9230,7***	334	418	12,5	19,8	22,9
Plant height	4146,3***	2435***	1319,4***	30,5***	3,4	4,3	6,9
Head diameter	147,7***	31,6**	18,5*	2,6	1,1	1,3	1,4

** - statistical significant by p=0.01 , *** - statistical significant by p=0.001

The postulated statistical model is the following :

$$Xijk = X.. + Hi + Yj + (HY)ij + E ijk ,$$

where Hi is factor hybrid , Yj is factor years , (HY)ij is the interaction between both factors and E ijk is the error.

The selected hybrids have a statistical significant different genetic potential on the studied indices. The estimated statistical parameters proof the same

conclusion for the factor climatic conditions. The interaction of both factors is valid only for the factor plant height. The estimated LSD parameters give the possibility to compare the investigated hybrids on the studied indices.

The experimental hybrids have highest different genetic potential on indices oil yield and plant height. Hybrid combination 86A x 180R was distinguished with the highest seed yield during both years of investigation. It's head diameter was 25 cm and the vegetation period was 119 day.

Conclusions

The results showed that the experimental hybrids were distinguished on their ecological plasticity. The lowest susceptibility to different climatic conditions were established for the hybrids 74 A x 140 R, 86 A x 180 R, 92 A x 430 R and 128 A x 434 R. These hybrids were characterized with highest ecological plasticity, seed and oil yield respectively. Hybrid combination 86A x 180R was chosen to be included in official testing at the Executive Agency "Seed Testing, Crop Approbation and Seed Control".

Literature

1. Al-Khatib, K., J.R. Baumgartner, D.E.Peterson, R.S.Currie, 1998. Imazethapyr resistance in common sunflower (*Helianthus annuus*). Weed Science 46: 403–407.
2. Al-Khatib, K., J.F.Miller, 2000. Registration of four genetic stocks of sunflower resistant to imidazolinone herbicides. Crop Science 40: 869–870.
3. Debaeke Ph., P. Casadebaig, N.B. Langlade. 2021. New challenges for sunflower ideotyping in changing environments and more ecological cropping systems. OCL, 28 (2021) 29.
4. Demirci M., Kaya Y. 2009. Status of *Orobanche cernua* Loefl. and Weeds in Sunflower Production in Turkey. Helia, 32:153-160.
5. Elezovic, I. A. Datta, S. Vrbnicanin, D. Glamoclija, M. Simic, G. Malidza, S. Z. Knezevic. 2012. Yield and yield components of imidazolinone-resistant sunflower (*Helianthus annuus* L.) are influenced by pre-emergence herbicide and time of post-emergence weed removal. Field Crops Res. 128: 137–146.

6. Encheva J., G. Georgiev, N. Nenova, D. Valkova. 2015. Developing of sunflower lines and hybrids resistant to herbicides. Bulgarian Journal of Crop Science. LII (4): 3-11.

7. Encheva J., G. Georgiev, D. Valkova, V. Encheva. 2016. Development of sunflower hybrids resistant to herbicides. Proc. 19th Int. Sunflower Conference, 29 May-3 June, Edirne, Turkey, 2016, pp. 454-461.

8. Evci G., N. Sezer, V. Pekcan, M. I. Yılmaz, Y. Kaya. 2011. Chemical control of broomrape and weeds with Imidazolinone herbicide and resistant hybrids in sunflower production in Turkey. J. Acad. Sci. Moldova. 2 (314): 118-124.

9. Georgiev G., V. Encheva, N. Nenova, J. Encheva, D. Valkova, P. Peevska, G. P. Georgiev, E. Penchev. 2016. Production potential of new sunflower hybrids developed at Dobrudzha agricultural institute – General Toshevo. Proc. 19th Intern. Sunfl. Conference, 29 May-3 June, Edirne, Turkey, 2016, pp. 431-442.

10. Georgiev G., V. Encheva, J. Encheva, N. Nenova, D. Valkova, P. Peevska, G. Georgiev. 2018. Breeding of sunflower (Helianthus annuus L.) at Dobrudzha agricultural institute – General Toshevo. Journal of Agric., Food and Environmental Sciences, vol. 72 (No 2): 15-22.

11. Moriondo M., Bindi M. 2007. Impact of climate change on the phenology of typical Mediterranean crops. Ital J Agrometeorol 3: 5–12.

12. Kaya Y., G. Evci, V. Pekcan, I. M. Yilmaz. 2013. Clearfield Technology in Sunflower and Developing Herbicide Resistance Sunflower Hybrids. Soil-Water J., 2(2), 1713-1720.

13. Tan S., R. R. Evans, M. L. Dahmer, B. K. Singh, D. L. Shaner. 2005. Imidazolinone-tolerant crops: history, current status and future. Pest Management Sci. 61(3):246-57.

BRANDING OF AUTOCHTHONOUS CHEESES THROUGH GEOGRAPHICAL INDICATIONS IN THE REPUBLIC OF SERBIA

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Abstract

Geographical indications are used worldwide as an instrument for brand management and diversifying products. Branding of traditional products in modern business is a significant source of added value for consumers. Considering the current saturation of the market with the existing assortment, one of the ways of diversifying cheeses is protection through geographical indications. This paper discusses the limited ways in which branding strategies involving geographical indications can be used to protect traditional cheeses in the Republic of Serbia. The main aim of the research is the analysis of benefits for both producers and consumers in order to successfully position and brand autochthonous cheeses on the market. Additionally, a SWOT analysis that identifies and describes the current situation in the cheese market with protected geographical origins was conducted.

Key words: *brand, autochthonous cheeses, geographical indications, SWOT analysis*

Introduction

In recent decades, there has been a growth in producers', researchers', and consumers' interest in food products with quality schemes, which are frequently considered higher-quality products with unique sensory characteristics. A geographical indication (GI) is a designation for certain characteristics, reputations, or aspects of a product that could be linked to its place of origin (Fernández-Zarza et al., 2021). The success of the market of GI products is due to their suitability in responding to customers' expectations in terms of originality and authenticity in the face of food massification, thus rediscover-

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ing historic cultural traditions; this success underlined the value of agrifood product's geographical origin emphasized in the label to become a strategic instrument for differentiation (Belletti et al., 2009). Furthermore, the number of GI-protected products in the EU, as well as their market, has been growing.

Geographical indications provide information about a product's origin-bound characteristics. As a result, they serve as market differentiators by allowing customers to differentiate between products with geographical origin-based characteristics and others without those characteristics. Therefore, geographical indications can play an essential role in developing brands for quality-bound-to-origin products (WIPO, 2021). Furthermore, geographical indications help in the protection of traditional foods against imitation (Ittersum et al., 2007) and increase their level of recognition in the worldwide market, which contributes to the local economy. PDOs and PGIs aim to achieve different goals through their ability to communicate quality and their emphasis on maintaining a competitive market environment: to provide consumers with reliable information, to preserve the diverse traditional and cultural heritage of the EU, and to add value to agricultural food, thereby increasing producers' income (Cei et al., 2018).

Traditional food brand management is a marketing method that focuses on a certain product, product line, or brand. Branding of traditional products in modern business is a significant source of added value for consumers. The main purpose of branding is to protect the producers' property and on the other hand to help consumers in making a purchase decision (Veljković, 2010). Considering the current saturation of the market with the existing assortment, one of the ways of diversifying cheeses is protection through geographical indications. Indications of geographical origin represent an important form of differentiation and a source of comparative advantage in the market (Giovannucci et al., 2009). The branding of traditional products is considered to be a tool to support the local economy and/or rural areas. Therefore, it can be assumed that GIs are samples of brand management strategies (Mevhibe & Erdoan, 2010).

Understanding the effects of the GI policy on consumers, producers, and rural development is the main objective of this work. As an additional objective, we examine the traits that characterize the current state and tendency of the GI product market to identify its strengths and its weaknesses and to determine whether there is space for improvement and in what direction future activities should move.

The state of the GI product market

The European Union (EU) has established a regulatory framework for local products (Regulation No.510/2006) by implementing the protected designation of origin (PDO) and protected geographical indication (PGI) labels, as well as the traditional specialty guaranteed (TSG). The scheme of PDO and PGI is intended to assist producers related to a specific geographical area by ensuring fair returns for the qualities of their products; ensuring uniform protection of the names as an intellectual property right and providing consumers with clear information on the product's value-adding attributes (Regulation (EU) No. 1151/2012). The TSG scheme (Regulation No. 1151/2012) was created with the goal of conserving traditional production techniques and recipes by assisting traditional producers in distributing these products and informing customers about the qualities of traditional recipes and products with value-adding characteristics.

In Serbia, the Ministry of Agriculture, Forestry, and Water Management is in charge of administering the registration of products with a specified geographical origin and traditional quality. The purpose of this list of traditional products is to spread information about products obtained through traditional, historically well-established procedures. Currently, 79 products are currently protected, of which 53 products have a protected designation of origin, and 26 products have a protected geographical indication. The quality scheme for the protection of traditional specialties (TSG) is not defined by our law and in Serbia it is not possible to protect products with this label. The most significant participation is achieved by meat and meat products (18%), and in second place are autochthonous cheeses (15%). Indigenous cheeses in the Republic of Serbia have a great reputation among consumers due to their geographical and climatic factors, local production practices, as well as cultural and historical heritage.

Traditional food products influence producers, consumer behavior, long-term supply chain impact on rural development (Fernandez-Zarza et al., 2021) and contribute to local and national economies, as well as biodiversity, which will be explained in more detail below.

Analysis of benefits for consumers

The labels enable customers to identify the product, distinguish it from competing products, and allows them to make decisions according to their own

preferences (Vecchio & Annunziata, 2011). Labels give consumers clear information about a product's origin as well as any unique characteristics of the product that they acquire based on the origin. The name of the origin region provides consumers about the product's quality level, whereas geographical indications guarantee that the product purchased is the original product with that specific quality level. (Van der Lans et al., 2001).

According to Bowen and Mutersbaugh (2013), a regional product is frequently linked with higher quality or a distinctive taste in many parts of the world. The added value of these products is determined by consumers and how they are appreciated in the market. Consequently, consumers typically place a higher value on GI products than standard counterparts, and evidence suggests that this frequently translates into greater retail results (Cei et al., 2018). It is essential that the schemes are transparent enough to allow consumers to understand what they are purchasing (Užar et al., 2022). As a result, geographical indications play an important role in the transfer of information regarding product quality.

These products have a special value for ethnocentric consumers. Ethnocentrism is particularly popular with regard to food preferences in establishing culturally appropriate ways of perceiving thought and behavior. Ethnocentric consumers want to contribute to economic well-being by buying domestic products and therefore to political, social, and economic progress (Veljković, 2010). Product branding based on geographic origin can be a trigger for the appearance of local-ethnocentric consumers, who prefer products from their region. So, gaining essential insights into customers' motivations for purchasing regional items, as well as the processes underpinning these purchases, would enable marketers to develop, position, and advertise regional products more successfully (van Ittersum, 2001).

Analysis of benefits for producers

First of all, the label is an important marketing tool that differentiates labeled quality food from imitations in relation to the competition. It contributes to producers forming a unique offer on the market and to position themselves in the consumers' minds by creating a unique brand. In this way, producers are enabled to be recognized and protected from competition. Production under this approach improves quality and enables fair competition among producers. The label enables agricultural producers to increase their competitiveness, which is reflected precisely in the quality and characteristics of the

product, which distinguishes it from other products of similar categories. Secondly, when a local group of producers creates and maintains a geographical indicationscd (GI), it can be utilized as a tool to increase the sustainability of their production system by promoting a high-quality product with a recognizable origin (Vandecandelaere et al., 2021).

Using geographical indications allows producers to indicate quality and thus gain the possibility of charging at higher (premium) prices. Due to recognition, limited quantities, and specific method of production, the price of cheeses with a protected geographical indication is generally higher than industrial cheeses (Užar et al., 2019). First of all, it was determined that products with geographical origin labels have higher prices (on average by 20% to 50%) compared to products without labels. Additionally, Iraizoz et al. (2011) discovered that farms in Navarra rearing cattle for PGI production are more profitable than livestock farms in the same area that are not part of certification schemes. The increase in prices and higher incomes lead to the improvement of working and living conditions in the countryside, the development of infrastructure, the development of rural tourism, domestic crafts, and other activities. This could potentially significantly alleviate the main strategic problems that are expressed in the entire Republic of Serbia, namely migration from rural areas to cities, the death of villages, and poor demographics. In addition to the effect of increasing prices, sales, and turnover, the potential of labeling is reflected in the possibility of exporting to foreign markets, but also access to markets that have not previously served (Jantyik & Török, 2020).

An additional problem in our country is the fragmentation of farms that are small enough to provide quality to consumers. The designation of geographical origin can contribute special benefits to small food producers in Serbia, especially through the process of association for joint promotional and sales activities (online sales, sales on social networks, exhibitions at fairs and events, etc.), and common appearance on the market. The necessity of the existence of the cluster is reflected in the fact that our producers need a platform for cooperation, promotion, improvement of position, placement, and preservation of cultural and historical value. Clusters of cheese producers exist, but they are informal and rare.

Developing a common marketing strategy that allows these producers to attain a large enough scale of production to justify the investment in the differentiated product image increases the odds of success for these products

(Barjolle & Sylvander, 1999). When introducing products to the global market, traditional food producers should be aware of the financial advantages and opportunities that GI might present. Therefore, it is evident that raising awareness of GI issues is necessary.

Analysis of benefits for rural development

Several studies indicate that, under the appropriate circumstances, geographical indications can promote rural development (Belleti, 2000; Belletti et al., 2017; Vandecandelaere et al., 2021). PDO and PGI certifications can be recognized as instruments to improve a production site's sustainability, preserve biological resources and indigenous knowledge, support the development of rural communities, and incorporate improved agricultural practices into the system at issue (Rangnekar, 2004). Therefore, these labels may make a significant contribution to rural development. The development of the production of quality domestic products contributes to the development of the rural areas of our country, both through the strengthening of economic activities and through the increase of the share of employees and the realization of socio-cultural effects in those areas. The EU also anticipates favorable effects on rural development, a critical problem, particularly for neglected and underserved areas where GIs can assist fill the gap with wealthier regions (Cei et al., 2018).

The multidimensional nature of GIs also takes into account additional, but less measurable impacts on rural development and benefits such as increased income, job creation, and population retention in specific regions. Thus, for example, cheese production in developed countries enables efficient economic development based on a large workforce and employment per unit of production and improves sustainability through the realization of commercial benefits (Barjolle & Sylvander, 1999). Also, Chilla et al. (2020) emphasize that PDO labels enable increased production, development of agrotourism and prevention of youth exodus from rural area.

SWOT analysis

The GI product analysis was conducted by SWOT analysis, first, to define the major elements of system's ability to assure power and identify weaknesses in dealing with changes in a surrounding environment that are characterized by the agriculture sector, and second, to determine the current position of GI cheeses. To determine whether GI has been used as a development tool and to

respond to the listed objectives, we describe the primary strengths, weaknesses, opportunities, and threats (SWOT).

Table 1. *SWOT analysis*

Strengths	Weaknesses
• Enabled and guaranteed unique products of higher quality • Product authenticity • Easier access to products (healthy, traditional, quality) • Consumer information • Easier discernible producer responsibility • They ensure the preservation of universal values (cultural, traditional and ecological) through market mechanisms • Ecologically cleaner area • High involvement of the local communities • Sustainable income	• Lack of associations - low bargaining power • Inflexible packaging • Exclusivity can increase the price; • Weak financial ability of the producer • Weak ability for investing • Impossibility of exporting to EU countries without changing the way of production • Lack of promotional activities • Low availability in markets • Low level of consumers' education
Opportunities	**Threats**
• Higher income for producers • Protection of local culture and tradition • Product differentiation and brand competitiveness • Easier access to the market (foreign and domestic) • Export to non-EU countries • Positive externalities for the wider community (better employment, relations with local self-government, reduction of poverty) • Tourism development • Great consumer interest in products with a geographical indication	• Inconsistent national agricultural policy • High production costs • High administrative costs • Sanitary provisions • Higher requirements for local self-government • Existence of strong foreign competition • Logistical problems as a result of low volume production • Competition from established cheese brands

Source: Adaptation from Đorđević & Sredojević, (2014); Filipović et al., (2019)

Conclusions

In summary, bearing in mind the potential of resources, the existence of tradition and culture, and developed agricultural production, Serbia has the potential for branding products with a geographical indication. These are products with distinguishing characteristics that add market value.

Before discussing the demand side, some basic supply side findings should be discussed, as they are important for market positioning. Autochthonous cheeses provide a variety of strong aspects and opportunities, such as old tradition, authenticity, and great quality. To be effective in local branding, it is necessary to develop the circumstances for local brand ambassadorship by constructing the brand on the local population's and societal actors' sense of place and identity. On the other hand, there is still a need to educate Serbian consumers about the benefits of PDO/PGI certification.

Geographical indication is one of the most effective methods for developing successful brands. Increased promotion for both producers and consumers will provide producers the motivation to produce and protect more traditional products. Furthermore, rural development will be supported by allowing individuals to produce traditional food PDO/PGI products. It is critical that agricultural producers recognize that products bearing a label of origin reflect the region well- and the interests of people, as well as a significant driver of economic development, production, rural development, and tourism. For the development of branded products, it is necessary to educate consumers and producers about the benefits and importance for the local community and rural development. If the potentials are used, products with a mark of origin can be an important strategic element for the sustainable development of agriculture in Serbia.

Literature

1. Barjolle, D., & Sylvander, B. (1999). *Some factors of success for origin labelled products in agri-food supply chains in Europe: market, internal resources and institutions* (No. 730-2016-50586, pp. 45-71).
2. Belletti, G. (2000). Origin labelled products, reputation, and heterogeneity of firms. In Sylvander, B., Barjolle, D. and Arfini, F. (eds.), The socio-economics of Origin Labelled Products in Agri-Food Supply Chains. INRA Actes et Communications, 17-1: 239-260

3. Belletti, G., Burgassi, T., Manco, E., Marescotti, A., Pacciani, A., & Scaramuzzi, S. (2009). The roles of geographical indications in the internationalisation process of agri-food products. *International marketing and trade of quality food products*, 201-222.

4. Belletti, G., Marescotti, A., & Touzard, J. M. (2017). Geographical indications, public goods, and sustainable development: The roles of actors' strategies and public policies. *World Development*, *98*, 45-57.

5. Bowen, S. and Mutersbaugh, T. (2013), "Local or localized? Exploring the contributions of FrancoMediterranean agrifood theory to alternative food research", Agriculture and Human Values, Vol. 32 No. 2, pp. 201-213.

6. Chilla, T., Fink, B., Balling, R., Reitmeier, S., & Schober, K. (2020). The EU Food Label 'Protected Geographical Indication': Economic Implications and Their Spatial Dimension, Sustainability, 12(14), 5503; https://doi.org/10.3390/su12145503

7. Cei, L., Defrancesco, E., & Stefani, G. (2018). From geographical indications to rural development: A review of the economic effects of European Union policy. *Sustainability*, *10*(10), 3745.

8. Đorđević, T., & Sredojević, Z. (2014). Značaj brendiranja proizvoda putem zaštićenog geografskog porekla. U: S. Ognjanov, & G. Mitić (Urednici), Marketing prehrambenih proizvoda, 132-151, Beograd: Dosije studio.

9. Giovannucci, D., Josling, T. E., Kerr, W. A., O'Connor, B., & Yeung, M. T. (2009). Guide to geographical indications: Linking products and their origins (summary). *Available at SSRN 1736713*.

10. Fernández-Zarza, M., Amaya-Corchuelo, S., Belletti, G., & Aguilar-Criado, E. (2021). Trust and food quality in the valorisation of geographical indication initiatives. *Sustainability*, *13*(6), 3168.

11. Filipović, J., Stojanović, Ž., & Ristić, B. (2019). PGI sjenica cheese in Serbia. In *Sustainability of European Food Quality Schemes* (pp. 471-484). Springer, Cham.

12. Iraizoz, B.; Bardaji, I.; Rapun, M.; Bardají, I.; Rapún, M.; Bardaji, I.; Rapun, M. (2011). Do "Protected Geographical Indications" (PGI)-certified farms perform better? The case of beef farms in Spain. *Outlook Agric. 40,* 125–130.

13. Jantyik, L., & Török, Á. (2020). Estimating the market share and price premium of GI foods—the case of the Hungarian food discounters. *Sustainability*, *12*(3), 1094.

14. Mevhibe, A., & Erdoan, G. (2010). Implementations of geographical indications at brand management of traditional foods in the European Union. *African Journal of Business Management*, *4*(6), 1059-1068.

15. Rangnekar, D. (2004). The socio-economics of geographical indications. *UNCTAD-ICTSD Project on IPRs and Sustainable Development, Issue Paper*, *8*, 13-15.

16. Regulation (EU) 510/2006 on the protection of geographical indications and designations of origin for agricultural products and foodstuffs, available at: https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32006R0510&from=en

17. Regulation (EU) 1151/2012 on Quality Schemes for Agricultural Products and Foodstuffs, available at: https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2012:343:0001:0029:en:PDF

18. Užar D., Mugoša I., Radojević, V. (2019): Positioning of Private Label Cheese Brands in the Republic of Serbia, Contemporary Agriculture, 68(3-4): 80-87.

19. Užar, D., Dunđerski, D., & Pejanović, V. (2022). Consumers'intention to buy cheeses with geographical indications: The case of Serbia. *Economics of Agriculture*, *69*(3), 819-832.

20. Van der Lans, I. A., Van Ittersum, K., De Cicco, A., & Loseby, M. (2001). The role of the region of origin and EU certificates of origin in consumer evaluation of food products. *European Review of Agricultural Economics*, *28*(4), 451-477.

21. Van Ittersum, K. (2001). *The role of region of origin in consumer decision-making and choice*. Wageningen University and Research.

22. Van Ittersum, K., Meulenberg, M. T., Van Trijp, H. C., & Candel, M. J. (2007). Consumers' appreciation of regional certification labels: a Pan-European study. *Journal of Agricultural Economics, 58*(1), 1-23.

23. Vandecandelaere, E., Samper, L. F., Rey, A., Daza, A., Mejía, P., Tartanac, F., & Vittori, M. (2021). The geographical indication pathway to sustainability: A framework to assess and monitor the contributions of geographical indications to sustainability through a participatory process. *Sustainability*, *13*(14), 7535.

24. Vecchio, R., & Annunziata, A. (2011). The role of PDO/PGI labelling in Italian consumers' food choices. *Agricultural economics review*, *12*(389-2016-23464).

25. Veljković, S. (2010). Brend menadžment u savremenim tržišnim uslovima. CID: Ekonomskog fakulteta, Beograd.

26. WIPO (2021). Geographical indications: An introduction, 2nd Edition, available at: https://www.wipo.int/edocs/pubdocs/en/wipo_pub_952_2021.pdf

DIGITAL AGRICULTURE IS MOVING TOWARDS SUSTAINABLE AGRICULTURE

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Abstract

Since nowadays, the economic environment is driven by the need of sustainability and waste management models, the agricultural sector must adapt as well to overcome the main crisis that may occur in the future, such as: the fast population growing, the threat between food demand and supply and the climate change. Therefore, the agricultural mainstream based on digitalisation is slowly moving towards more sustainable approaches, implementing new business models based on nanotechnologies and sustainable alternatives to production and consumption. As a result, the main question is if the movement towards sustainable agriculture provides more added value by breaking the traditional linear consumption chain and implementing new procedures of reusing and recycling the limited resources available. Both the theoretical and practical approaches suggest the same answer, even if without the digital technologies, the sustainability goals would be harder to achieve.

Key words: *digital agriculture, sustainable agriculture, agricultural environment, literature review, agricultural models*

Introduction

After the determination of the United Nation to develop and to improve the directions for the development of the world economy based on the sustainability goals of 2030, agriculture represents one of the focus points for driving the environment to achieve the sustainability objectives.

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For increasing the agricultural output, with the limited input resources available, technological advancement have been implemented in the agricultural environment throughout most of the human history. Although, the actual scenario remarked in the current environment forced the agriculture and the economy to adapt for overcoming the predominant challenges: climate change, growing population, and the threat between food supply and demand (Khan et al., 2021). Meanwhile, as considered by the scientific literature, the application of digital technologies in agricultural business models and in agriculture in general could help the farmers and the institutions, public and private, to eradicate the extreme poverty and hunger, even in the current scenario of fast-growing population, and to find a solution for resource limitation by developing solutions to extend the life cycle of goods and to manage more efficient the waste of resources (Mushi et al., 2022).

Therefore, the problem being stated, the next question that should be addressed is connected to the observation that in the present time, digital agriculture is moving towards sustainable agriculture. This aspect can be easily identified in both theoretical and practical approaches, since the literature is also focusing in developing the database on sustainable agriculture and creating resources for implementing the agricultural models that will drive an increasement over the sustainability of the agricultural sector.

Digital agriculture

In the beginning, should be assessed the fact that digital agriculture does not represent a new concept to the mainstream of agriculture, hence multiple elements of digitalisation have been already implemented and used in current agriculture methods, giving the context of '*precision agriculture'*, based on elements such as using global positioning system on agricultural machineries and mapping the yield, therefore the scope of the new technologies is driving the traditional agriculture to develop and to be more relatable by using improved sensor capability, data connectivity and computer-based self-learning systems for increasing the efficiency of activities and a better linkage between the consumers and the farmers (Shepherd et al., 2018).

In their study, Birner, Daum and Pray (2021) have presented in detail that there are several drivers for digital agriculture: precision farming technologies for livestock and crop production; modern integrated technologies (robots and drones), and software digital technologies (advisory digital apps,

digital platforms, and software services for farm management). All of them implemented in order to digitize the agricultural environment by using the latest digital technologies. Meanwhile, the challenges and the transition costs should not be ignored. In the case of agriculture, beside the material costs that are required by the implementation of the latest technologies, some human capital costs it is required as well, since there are new skills required for using the benefits provided by the new technologies. Therefore, the farmers had to learn how to work and how to integrate the 'fruit' of digital agriculture. As challenges, the discussion is guided by: the nature of the goods; the complementary investments needed; the size of the market corelated with the development costs; and a conductive business environment being needed for the best outcome of implementing the new technologies in agriculture.

Overall, the latest digital technologies, while implemented in agriculture, allows: rapidly solving of the assigned tasks; the most cost-effective solutions and production models; data analysis by processing large amount of data, information and variables; and reduction of risk production (Sinitsa et al., 2021).

Therefore, the main instruments that have been implemented in the digital agriculture are strongly represented by the technologies based on sensors, IoT, and automatization of agricultural processes.

Moreover, the main goal and the reason why the digital technologies and data driving processes have been implemented in the agricultural activities is to help the agricultural sector to be more transparent, efficient, profitable, and responsible in both decision-making processes and resource using plans, facilitating agricultural advisory services, market linkages, financial services and insurance, agricultural research and development, sustainability, and the climate (Chandra & Collis, 2021). As a result, the agriculture took one more step further and nowadays the agricultural mainstream is moving towards sustainable agriculture.

Sustainable agriculture

As a broad definition, the sustainable agriculture represents the agriculture in which the integrated systems of plant and animal products practices will induce on the long-term benefits over: the satisfaction of human food; the environmental quality; the usage of renewable and regeneratable resources; and over the economic viability of all the farm operation (Velten et al., 2015).

But, even if the idea of sustainable agriculture gained more interest during the last years, there is no direct link between sustainable development and sustainable agriculture, since the sustainable agriculture can be approached using two different perspectives. The first one, by considering the farming system to be a closed area, the agriculture should be capable of sustaining itself in the long run by protecting its own natural resources such as soil fertility and groundwater. Therefore, there should be developed renewable energies and solutions for adapting the farming system to climate change, in order to achieve the sustainable agriculture. On the other hand, the second perspective suggest that the agriculture should contribute to the increasement in sustainability of large territories and of the social communities from those territories, by helping the urban areas to implement a better management over the waste (Lichtfouse et al., 2009).

As main instruments for achieving the sustainable agriculture, both the practice on the field and the scientific literature have identified the usage of nano-fertilizers which are described as modified or synthesized form of traditional fertilizers obtained by chemical, physical, biological, or mechanical methos with the usage of nanotechnology; as a solution for addressing the challenges determined by the intensity of present day agriculture and the persistent limitations of resources (Kumar et al., 2021), while the potential benefits have create a great interest in increasing the production of agricultural crops under the pressure of the current climate change scenario, as well as the impact on product quality and on yields, impact that will lead, most probably, to increases in farmers' profit margin alongside the return-on-investment (Zulfiqar et al., 2019).

Moving from digital agriculture towards sustainable agriculture

Even if the transition process from digital agriculture to sustainable agriculture represents a long-term oriented goal and requires transition cost, the main scope is to create a better environment for both agriculture and the society, since agriculture remains one of the most central pylons of government's duties for the society and its citizens.

The purpose of the current section of the paper is to highlight the relevance of the topic, providing short arguments for why the movement from digital agriculture to sustainable agriculture is important for the agricultural environment, alongside the theoretical attention allocated to the topic.

As following, providing an answer to the Research Question: *Does the shift towards sustainable agriculture returns value?* will offer a better understanding

of the scenario in which both digital agriculture and sustainable agriculture are current topics for the scientific literature, while the agriculture on fields is moving from more digitalization to more sustainability. For stating a valid answer, the author will use during the investigation process, the method of reviewing and analysing previous publications, as searched by the key words: '*digital economy'* and '*sustainable* agriculture'. The selection is based on the importance of the publications for the aim of the current paper, focusing on publications between 2009 and 2022, relevant to the purpose of the present study.

'In literature' movement

Table 1. *Digital agriculture literature vs Sustainable agriculture literature – Short analogy.*

Digital agriculture		**Sustainable agriculture**	
Themes	**Specifics**	**Themes**	**Specifics**
(D1) Adoption, uses and adaptation of digital technologies on farm	Cost and benefit modelling, econometrics, innovation systems	(S1) Overarching Goals	Ethics and stability
(D2) Effects of digitalization on farmer identity, farmer skills, and farm work	Political economy, actor-network theory, ethnography	(S2) Production-Specific Environmental Goals	Ecosystem function and natural resources conservation
(D3) Power, ownership, privacy and ethics in digitalizing agricultural production systems and value chain	Political economy, institutional economics, animal and human ethics	(S3) Non-Production-Specific Environmental Goals	Environment conservation and improvement
(D4) Digitalization and agricultural knowledge and innovation systems	Innovation systems, social media analysis, evolutionary economics, socio-technical transitions	(S4) Social Goals	Social responsibility (fulfilment of human needs, human health)
(D5) Economics and management of digitalized agricultural production systems and value chain	Business model theories, risk analysis, service economics	(S5) Economic Goals	economic growth

Source: Data processed by the author. [Digital agriculture: Klerkx et al. (2019); Sustainable agriculture: Velten et al. (2015)].

In order to provide a brief overview of the 'movement' from digital agriculture to sustainable agriculture, two papers based on literature review methods will be compared for highlighting the connections between the two topics of the current paper in the scientific literature.

As shown in the study conducted by Klerkx's et al. (2019), the data was used for providing an overall insight into the policies and practices of digital agriculture, summarizing, and synthesizing the most important aspects of the themes and specifics of the benefits of implementing the digital technologies in the agricultural activities. As per Velten et al. (2015), there are some themes and specifics that have contributed to the achievement of sustainable agriculture, considering the overall facilities provided by implementing the sustainable agriculture methods into daily agricultural activities. Even if the connection between the digital agriculture's themes and the sustainable agriculture's themes are not directly observable, a short introspection around them will provide a clear perspective of their linkage.

For a better understanding of the data presented in table, the following explanations will proceed with the elements described as (Dx) (themes of digital agriculture) and (Sx) (themes of sustainable agriculture). Considering (D1) and (S1), especially due to their primary position in the table, it is well known, and it has been demonstrated by previous studies that the implementation, the adoption, the usage, and the adaptation of digital technologies in business models and procedures have determined innovation and have increased the stability of the activities by automatizing them, providing more cost-effective solutions. At the same time, (D2) taking together with (D3), alongside (S2) and (S3) are the themes specific to the agricultural environment, both as natural resources and human capital. This is best seen in the fact that to plan, allocate and use the natural resources, limited by the environment, the managers/ leaders/ farmers need to be instructed in order to develop the skills that will provide them the knowledge of creating a functional ecosystem and to conserve the resources that are available in their regions or territories. Therefore, for the sustainable agriculture to be achieved properly, the business models of farms should be aligned with the economic and politic environments (D4), so the implementation of digital technologies in agricultural activities will provide the development needed for economic growth (S5).

Moreover, as presented in the summarized table, the themes and specifics of digital agriculture are corelated with the themes and specifics of sustainable

agriculture, highlighting the need of digital agriculture and sustainable agriculture to be approach together for obtaining the best scenario based on possible business models and strategies that can be implemented in the agricultural environment.

'On field' movement

Since from a theoretical approach, the digital agriculture has been the driver for sustainable agriculture to emerge, the similar hypothesis applies in the practical approach as well.

Moreover, since the digital agriculture is mostly based on the implementation and usage of digital technologies in agricultural activities, the sustainable agriculture took the principles one step further as in applying the principles of digital transformation into the resource management as well, using modern technologies to solve problems as resource limitation, waste management, reusing and recycling the existing resources in order to obtain more added value while extending the using cycle of already used resources (Basso & Antle, 2020).

Another evidence of the movement towards sustainable agriculture is the usage of plant-associated microbiomes in the current agricultural scenario. The microbiomes offer a strategical solution to help the production of agricultural goods to gain more sustainability while meeting the increasing demands for food, feed, and fibre. Also, due to the efficiency of digital technologies, the usage for microbiomes can be easily integrated in the agricultural activities while providing space for the full potential of microbiome enhancement to be still in development throughout the available technologies applied both in digital and sustainable agriculture (Trivedi et al., 2021).

Additionally, the usage of nanotechnology has bought new developments, challenges, and perspectives to the field of sustainable agriculture, especially during this transition point from the digitalization driven agriculture to a more sustainable agriculture, focused on susceptibility, human health, and healthy life. Therefore, by using the nanotechnology many benefits could arrive, for instance: increasing the quality and safety of food; reducing the agricultural inputs; and enrichening the absorption of nanoscale nutrients from the soil. This aspect is particularly important due to nanotechnology's capabilities of acting as sensors for monitoring the quality of the soil present in the agricultural fields and maintain the health of agricultural plants, increasing the possibility of achieving the food security and the improvement of agriculture overall.

Conclusions

Considering that the implementation of digital technologies has bought benefits to the agricultural environment, such as: increasing the quality of products and services; automatization of processes; machine learning applications; and cost-effective models for agricultural activities (Sharma et al., 2020), a first important step has been already taken into the transition to a sustainable agriculture.

Meanwhile, the importance of sustainable agriculture has been highlighted once more in the context of the COVID-19 pandemic in which the rise and spread of the coronavirus have impacted all the national economies and therefore the global economic environment. While some sectors have been impacted lightly, the agriculture and food sectors have been directly exposed to the action of the pandemic, by the reduction in the workforce and the globally impact of the overall supply chain from farmer to consumer. Therefore, for conserving natural resources and for achieving the sustainable goals, the prime focus of digital agriculture has been moved toward sustainable agriculture, based on urban agriculture, crop rotation, and hydroponics, which are techniques carried out through: artificial intelligence; machine learning; deep learning; and block-chain technologies (Sridhar et al., 2022).

Hence, even if based on the given definitions of both concepts analysed in the current paper, the movement towards a sustainable agriculture is inevitable, the fact that digital agriculture is the driver for sustainable agriculture is not to be ignored. The implementation, use, and adaptation of digital technologies in agricultural activities determined the movement from traditional business models to activities involving precision farming, waste management, and developing new sustainable solutions for agricultural challenges.

Overall, considering all the statements exposed in this current paper, the answer to the Research Question: *Does the shift towards sustainable agriculture returns value?*, is: *Yes*. The movement towards sustainable agriculture returns more value in both agricultural and economic fields, due to its condition of being still under development. Therefore, in the search for the optimal solutions for the current agricultural environment, improvements will be determined for new business models in agriculture, that will help farmers, farms, and governments to provide the resources needed to satisfy the main concern of population in general: food. Nevertheless, should not be overlooked the aspect that the sustainable agriculture derives directly

from the implementation of digital technologies in agriculture hence, it is impossible to analyse the digital agriculture without taking into consideration the sustainable agriculture, and vice versa.

The main goal of agriculture nowadays is to provide the food security and to use the reusable and regeneratable resources in producing more added value, while at the same time, to follow the development of technologies and instruments that can lead the agricultural sector to meet the sustainability goals well needed for how the economic, social, and agricultural scenario will evolve in the long term.

Literature

1. Basso, B., & Antle, J. (2020). *Digital agriculture to design sustainable agricultural systems*. Nature Sustainability, 3(4), 254-256.
2. Birner, R., Daum, T., & Pray, C. (2021). *Who drives the digital revolution in agriculture? A review of supply-side trends, players and challenges*. Applied Economic Perspectives and Policy, 43(4), 1260-1285.
3. Chandra, R., & Collis, S. (2021). *Digital agriculture for small-scale producers: challenges and opportunities*. Communications of the ACM, 64(12), 75-84.
4. Khan, N., Ray, R. L., Sargani, G. R., Ihtisham, M., Khayyam, M., & Ismail, S. (2021). *Current progress and future prospects of agriculture technology: Gateway to sustainable agriculture*. Sustainability, 13(9), 4883.
5. Klerkx, L., Jakku, E., & Labarthe, P. (2019). *A review of social science on digital agriculture, smart farming and agriculture 4.0: New contributions and a future research agenda*. NJAS-Wageningen Journal of Life Sciences, 90, 100315.
6. Kumar, Y., Tiwari, K. N., Singh, T., & Raliya, R. (2021). *Nanofertilizers and their role in sustainable agriculture*. Annals of Plant and Soil Research, 23(3), 238-255.
7. Lichtfouse, E., Navarrete, M., Debaeke, P., Souchère, V., Alberola, C., & Ménassieu, J. (2009). *Agronomy for sustainable agriculture: a review*. Sustainable agriculture, 1-7.

8. Mushi, G. E., Di Marzo Serugendo, G., & Burgi, P. Y. (2022). *Digital technology and services for sustainable agriculture in Tanzania: a literature review*. Sustainability, 14(4), 2415.

9. Sinitsa, Y., Borodina, O., Gvozdeva, O., & Kolbneva, E. (2021). *Trends in the development of digital agriculture: a review of international practices*. In BIO Web of Conferences (Vol. 37, p. 00172). EDP Sciences.

10. Sharma, R., Kamble, S. S., Gunasekaran, A., Kumar, V., & Kumar, A. (2020). *A systematic literature review on machine learning applications for sustainable agriculture supply chain performance.* Computers & Operations Research, 119, 104926.

11. Shepherd, M., Turner, J. A., Small, B., & Wheeler, D. (2020). *Priorities for science to overcome hurdles thwarting the full promise of the 'digital agriculture' revolution*. Journal of the Science of Food and Agriculture, 100(14), 5083-5092.

12. Sridhar, A., Balakrishnan, A., Jacob, M. M., Sillanpää, M., & Dayanandan, N. (2022). *Global impact of COVID-19 on agriculture: role of sustainable agriculture and digital farming*. Environmental Science and Pollution Research, 1-17.

13. Trivedi, P., Mattupalli, C., Eversole, K., & Leach, J. E. (2021). *Enabling sustainable agriculture through understanding and enhancement of microbiomes*. New Phytologist, 230(6), 2129-2147.

14. Velten, S., Leventon, J., Jager, N., & Newig, J. (2015). *What is sustainable agriculture? A systematic review*. Sustainability, 7(6), 7833-7865.

15. Zulfiqar, F., Navarro, M., Ashraf, M., Akram, N. A., & Munné-Bosch, S. (2019). *Nanofertilizer use for sustainable agriculture: Advantages and limitations*. Plant Science, 289, 110270.

ORGANIC SOYBEAN CULTIVATION WITH A SUSTAINABLE SYSTEM

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Abstract

The need for certified organic agricultural products is ever greater as in the World, so in Serbia. Triennial research was conducted with five soybean varieties and foliar treatment with aqueous extract and aminoacids aimed at esstablishing examined factors' influence on soybean yield and organic soybean cultivation system sustainability. A field experiment was set in four repetitions. All three examined factors have shown significant influence on soybean yield and that such a method of soybean cultivation is sustainable. However, in dry farming, soybean grain yield height is mostly influenced by weather conditions, primarily precipitation quantity and distribution, as well as temperature height during the vegetation period, hence yield height varies from year to year.

Key words: *amino-acids, organic cultivation, yield, soybean, aqueous extracts*

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Introduction

Conventional agriculture methods which were used for decades led to soil and water pollution. Abuse and excessive use of pesticides and various synthetic substances have a negative impact on the environment and biodiversity (Popović et al., 2016), but on human health as well. This fact indicates that methods applied in agricultural production should be altered and suited for organic plant cultivation systems, as to achieve sustainability and enable sufficient and quality food production (Subić et al., 2010).

Soybean is sorted among legumes and considered one of the oldest cultivated plant varieties in the world. During the last few decades, soybean has gained considerable significance in human nutrition and represents the greatest protein source in animal production. Soybean surfaces that are in an organic cultivation system are ever greater as in the world and Europe, so domestically. In the year 2020, organic cultivation system soybean surfaces amounted to 913,949 in the world, 272,445 in Europe and 789 ha domestically (FiBL, 2022).

Foliar soybean side dressing during the intensive growth phase increases yield (Miladinov et al., 2018), especially during unfavorable years with a distinct drought period, but also in years that are favorable for production (Dozet et al., 2015). Aqueous plant material extracts are ever more used in plant production, floriculture, vegetable growing, but also in arable farming, as organically, so conventionally (Đukić et al., 2021). Considering that soybean grain is used to obtain various products which are used in human alimentation, it is important for a part of total soybean production to be from an organic cultivation system, without applying mineral fertilizer and pesticides (Dozet et al., 2019). Aqueous plant material extracts, beside macro and trace elements, also contain physiologically active substances which boost plant gowth and development, often have fungicidal and insecticidal effects, are easily prepared within the farmstead, do not require greater investments and are suitable for organic production since their application does not have a negative impact on the environment.

In recent decades, climate change in the form of elevated mean daily temperatures in vegetation and on an annual basis were detected, along with ever greater precipitation oscillations, i.e. the shifting of pluvious and extremely arrid years, and these conditins are very unfavorable for soybean production (Đukić et al., 2018).

Aminoacids are very important for plant development and stress defense (Trovato et al., 2021). Yield oscillations in certain years confirm that weather conditions during vegetation have a great impact on soybean yield (Đukić et al., 2018; Miladinov et al., 2018; Dozet et al., 2019).

The goal of this paper is to observe the effects of aqueous nettle and common comfrey extracts, as well as the effects of aminoacids on soybean grain yield among five soybean varieties that differ in vegetation period length.

Material and work methods

In a triennial experiment, foliar aqueous nettle and common comfrey extract application's effects were observed, as well as aminoacids' on soybean yield among five different maturation varieties (Kaća 000 maturity group, Merkur 00 maturity group, Maximus 0 maturity group, Apolo I maturity group and Rubin II maturity group). The experiment was set on the Institute of Field and Vegetable Crops' experimental field in Rimski Šančevi, and the experiment variants were the control where the foliarly applied water quantity was identical to the quantity of aqueous extracts, aqueous nettle and common comfrey extraxcts application and aminoacids application with the preparation Trainer. Aqueous plant material extracts' and control variant water's application was conducted in the intensive plant growth phase, before the soybean flowering phase, with an amount of 300 litres of liquid per hectare in which the aqueous extract was diluted in a ratio of 1:15. Trainer was contemporaneously applied in a quantity of 1 litre per hectare. The experiment was set in four iterations, and the elementary plotlet size totaled 10 m^2 (four soybean rows, an inter-row distance of 50 cm and five meters of length).

Nettle (*Urtica dioica*) – used as an insecticide to protect other plants and as fertilizer. It is found in nature and plucked fom rudimentary habitats in direct proximity to spontaneously grown high trees and shrubs.

Common comfrey (*Pulmonaria officinalis*) – plucked from the same habitat as nettle. Contains iron, potassium, calcium, phosphorus and manganese, as well as a vitamin B complex. Used for producing excellent liquid organic fertilizer which enriches the soil with it's mineral compounds.

Aqueous extracts are made by drenching one kilogram of shreded plant material in 10 litres of rain water and, by stirring daily, the end of fermentation was awaited, after which the aqueous extract was strained through a gauze and

kept in glass bottles upon application. During the vegetation period, standard agrotechnical soybean production measures were applied, and during the harvest maturity phase, small operating hold combine harvesting was conducted, grain mass and moisture were neasured and yield per hectare with 14% moisture was calculated. Results were processed via trifactorial experiment variance analysis (program „Statistica 10“), and difference significance was tetsed via LSD test. Research results are exhibited in table form.

Meteorological conditions

The years in which this paper's research was conducted varied by meteorological parameters (Table 1).

Table 1. *Weather conditions in the study years.*

Month	Mean monthly temperature (°C)				Precipitation (lm^{-2})			
	2018	2019	2020	*Average*	2018	2019	2020	*Average*
IV	17.4	14.1	12.9	11.8	50.0	54.0	11.1	47.6
V	20.5	15.0	16.1	17.0	64.0	85.0	47.3	67.6
VI	21.7	22.6	20.7	20.1	164.0	64.0	161.9	88.6
VII	22.1	22.8	22.4	21.8	83.0	22.0	77.3	66.7
VIII	24,3	24.7	23,2	21.4	51.0	80.0	137.5	58.1
IX	19.5	19.2	19.1	17.0	27.2	54.0	31.4	47.8
Average, Total	20.9	19.7	19.1	18.2	439.2	359.0	466.5	376.4

Average temperatures during the vegetation period for the years 2018 (20.9°C), 2019 (19.7°C) and 2020 (19.1°C) were higher compared to the perennial average (18.2°C).

Temperatures in the year 2018 were high in the first part of vegetation (april and may 5.6°C and 3.5°C above the perennial average) and in august (2.9°C above average). In the year 2019, april temperatures exceeded the perennial average by 2.3°C, may temperatures were lower by 2.0°C, and in the time of flowering ang pod formation (june) and grain filling (august) temperatures were 2.5°C and 3.3°C above the perennial average, respectively.

In the year 2020, lower temperatures were recorded during the intensive plant growth period, may temperatures were lower than the perennial average by 0.9°C, while april temperatures were higher by 1.1°C, june and july temperatures by 2.1°C compared to the perennial average. The

greatest influence temperatures had on soybean yield was during the periods of flowering, pod forming and grain filling (Đukić et al., 2018). Very high temperatures in june and july along with precipitation deficiency do not favor soybean production (Dozet et al., 2021).

Average precipitation quantity in the soybean vegetation period in 2018 was higher by 62.8 lm^{-2}, and in 2020 by 90.1 lm^{-2} compared to the perennial average (376.4 lm^{-2}), while in 2019 there was less precipitation by 17.4 lm^{-2} compared to the perennial values. Precipitation deficiency in 2019 was pronounced in june, july and the first half of august, which, along with high temperatures, led to compulsory plant maturation and significant soybean yield decrease (Đukić et al., 2018). In 2018, precipitatio deficits occured in august and september, but the distribution was more favorable compared to the year 2020.

Research results and discussion

Observing soybean yield by certain years (Table 2), it can be noticed that the yield achieved in the year 2018 (5.085 $kgha^{-1}$) was statistically very significantly higher compared to 2019 (3.966 $kgha^{-1}$) and the year 2020 (3.793 $kgha^{-1}$). The lowest yield was recorded in 2020 and, compared to this value, soybean yield in 2018 was increased by 34.08% and in 2019 by 4.57%.

By observing soybean yield by variety it can be noticed that the greatest recorded yield was that of variety Rubin (4.847 $kgha^{-1}$), a statistically very significantly higher value compared to varieties Kaća (3.546 $kgha^{-1}$), Merkur (4.166 $kgha^{-1}$), Maximus (4.371 $kgha^{-1}$) and Apolo (4.476 $kgha^{-1}$). Statistically very significantly higher recorded yield was that of soybean varieties Apolo, Maximus and Merkur in comparison with the soybean variety Kaća. Compared to the variety Kaća, which has the shortest vegetation period and achieved the lowest grain yield per surface unit, variety Merkur's grain yield increased by 17.47%, variety Maximus's by 23.25%, variety Apolo's by 26.22% and variety Rubin's by 36.68%.

Table 2. *Average soybean grain yield (kgha^{-1})*

Year A	Variety B	Miror variant, C			Average AxB	Average A
		Control	Trainer	A.e*		
2018	Kaća	3.867	3.918	3.888	3.891	5.085
	Merkur	4.729	4.832	4.846	4.802	
	Maximus	5.385	5.437	5.425	5.416	
	Apolo	5.437	5.477	5.481	5.465	
	Rubin	5.794	5.884	5.877	5.852	
	Prosek AxC	5.042	5.110	5.103		
2019	Kaća	3.169	3.342	3.316	3.275	3.966
	Merkur	3.724	3.961	3.953	3.879	
	Maximus	3.869	4.024	4.107	4.000	
	Apolo	4.218	4.308	4.320.	4.282	
	Rubin	4.155	4.506	4.515	4.392	
	Prosek AxC	3.827	4.028	4.042		
2020	Kaća	3.359	3.523	3.534	3.472	3.793
	Merkur	3.689	3.876	3.882	3.816	
	Maximus	3.554	3.779	3.757	3.697	
	Apolo	3.492	3.762	3.790	3.681	
	Rubin	4.051	4.407	4.434	4.297	
	Prosek AxC	3.629	3.869	3.879	Average B	
Average BxC	Kaća	3.456	3.594	3.579	3.546	
	Merkur	4.047	4.223	4.227	4.166	
	Maximus	4.269	4.413	4.430	4.371	
	Apolo	4.382	4.516	4.530	4.476	
	Rubin	4.667	4.932	4.942	4.847	
Average C		4.166	4.336	4.342		
Average 2018-2020					4.281	
*Ae- Aqueous extracts						

LSD	A	B	C	AxB	AxC	BxC	AxBxC
5%	317	302	174	411	100	177	445
1%	211	216	117	291	71	122	317

By observing soybean yields by foliar application treatments it is noticable that the greatest recorded yield was that of the variant with foliar aqueous nettle and common comfrey extracts application (4.342 kgha^{-1}), a statistically very significantly higher value compared to the control variant (4.166 kgha^{-1}), while the yield achieved by the variant with aminoacids application, i.e. Trainer (4.336 kgha^{-1}), was statistically significantly higher compared to the control.

Compared to the experiment's control variant, soybean yield was increased via aminoacids application by 4.07%, and via aqueous nettle and common comfrey application by 4.21%.

By observing the same year and different soybean varieties, it is noted that in the year 2018 the greatest yield was achieved by soybean variety Rubin (5.852 $kgha^{-1}$), which is a statistically very significantly higher yield compared to the varieties Kaća (3.891 $kgha^{-1}$), Merkur (4.802 $kgha^{-1}$), Maximus (5.416 $kgha^{-1}$) and Apolo (5.465 $kgha^{-1}$). A statistically very significantly higher recorded yield was that of varieties Apolo and Maximus compared to the variety Merkur, as well as that of varieties Apolo, Maximus and Merkur compared to the variety Kaća. Compared to the soybean variety Kaća, variety Merkur's yield was increased by 23.42%, variety NS Maximus's by 39.19%, variety Apolo's by 40.45% and variety Rubin's by 50.39%.

In the year 2019, the highest yield was achieved by the soybean variety Rubin (4.392 $kgha^{-1}$), which is a statistically very significantly higher yield compared to the soybean varieties Kaća (3.275 $kgha^{-1}$), Merkur (3.879 $kgha^{-1}$) and Maximus (4.000 $kgha^{-1}$). A statistically very significantly higher recorded yield was that of soybean varieties Merkur, Maximus and Apolo (4.282 $kgha^{-1}$) compared to the variety Kaća, while a statistically significant higher recorded yield was that of soybean variety Apolo compared to the variety Merkur. Compared to the soybean variety Kaća, variety Merkur's yield was increased by 18.42%, variety Maximus's by 22.11%, variety Apolo's by 30.72% and variety Rubin's by 34.08%.

In the year 2020, the highest yield was achieved by soybean variety Rubin (4.297 $kgha^{-1}$), which is a statistically very significantly higher yield compared to the varieties Kaća (3.472,0 $kgha^{-1}$), Merkur (3.815,7 $kgha^{-1}$), NS Maximus (3.696,7 $kgha^{-1}$) and Apolo (3.68 $kgha^{-1}$). A statistically significant higher recorded yield was also that of soybean variety Merkur compared to the variety Kaća. Compared to the soybean variety Kaća, variety Merkur's yield was increased by 9.90%, variety Maximus's by 6.47%, variety Apolo's by 6.03% and variety Rubin's by 23.77%.

By observing the same year, yet different foliar application treatments, it is noted that the 2018 yield varied from 5.042 $kgha^{-1}$ (control variant) to 5.110 $kgha^{-1}$ (variant with foliar Trainer application), yet there were no statistically significant differences between treatments. The yield was increased by 1.33% by applying Trainer, and 1.21% by applying aqueous nettle and common

comfrey extract. In the year 2019, statistically very significant higher recorded yields were those where aqueous nettle and common comfrey extracts (4.042 kgha^{-1}) and aminoacids (Trainer) (4.028 kgha^{-1}) were applied compared to the experiment's control variant (3.827 kgha^{-1}). By applying aqueous nettle and common comfrey extracts, the yield was increased by 5.26%, and Trainer by 5.62%. In the year 2020 as well, statistically very significant higher recorded soybean yields were those where aqueous nettle and common comfrey extract (3.879 kgha^{-1}) and Trainer (3.869 kgha^{-1}) were applied compared to the experiment's control variant (3.629 kgha^{-1}). Trainer (aminoacids) application increased the yield by 6.625, and aqueous nettle and common comfrey extract application by 6.90%.

By observing soybean yields of the same varieties, yet different treatments, it is noted that variety Kaća's yield was statistically significantly higher with the Trainer application treatment (3.594 kgha^{-1}) compared to the control (3.465 kgha^{-1}). Aqueous nettle and common comfrey extract application increased the yield by 3.73%, and Trainer application by 3.30%. Variety Merkur's recorded yield was statistically very significantly higher when aqueous nettle and common comfrey extract was applied (4.227 kgha^{-1}) and statistically significantly higher when Trainer (4.223 kgha^{-1}) was applied compared to the experiment's control variant (4.047 kgha^{-1}). Triner application increased the yield by 4.34% and aqueous nettle and common comfrey extract application by 4.40%. The variety Maximus achieved a statistically significant higher yield when aqueous nettle and common comfrey extract (4.430 kgha^{-1}) and Trainer (4.413 kgha^{-1}) were applied compared to the control (4.269 kgha^{-1}). By applying aqueous nettle and common comfrey extract, the yield was increased by 3.37% and 3.76% by applying Trainer. The soybean variety Apolo's statistically significant high recorded yields were those of variants where aqueous nettle and common comfrey extract (4.530 kgha^{-1}) and Trainer (4.516 kgha^{-1}) were applied compared to the control (4.382 kgha^{-1}). Aqueous nettle and common comfrey extract application increased the yield by 3.04% and aminoacids (Trainer) application by 3.38%. Soybean variety Rubin's variants with aqueous nettle and common comfrey extract application (4.942 kgha^{-1}) and Trainer (4.932 kgha^{-1}) had a statistically very significant higher recorded yield compared to that of the experiment's control variant (4.667 kgha^{-1}). By applying Trainer, the yield was increased by 5.69% and 5.90% by applying aqueous nettle and common comfrey extract.

Conclusion

The year very significantly affects soybean yield, primarily depending on the amount and distribution of precipitation and temperature conditions during vegetation. Soybean varieties with a longer vegetational period have a greater yield potential compared to varieties with a shorter vegetation period. Aqueous nettle and comfrey extracts, as well as foliar application of aminoacids, significantly increase soybean yield. The examined soybean cultivation method is sustainable.

Acknowledgments

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Literature

1. Dozet G., Đukić V., Cvijanović M., Đurić, N.,Kostadinović Lj., Jakšić S., Cvijanović G. (2015): *Influence of organic and conventional methods of growing on qualitative properties of soybean*. Book of Proceedings from Sixth International Scientific Agricultural Symposium "Agrosym 2015", October 15-18, Jahorina, Bosnia and Herzegovina, 407-412.
2. Dozet G., Đukić V., Miladinov Z., Đurić N., Ugrenović V., Cvijanović V., Jakšić S, (2019): *Prinos soje u organskoj proizvodnji*. Zbornik naučnih radova Instituta PKB Agroekonomik, Vol. 25, br. 1-2, 173-180. Beograd, Srbija.
3. Dozet G., Đukić V., Cvijanović G., Đurić N., Cvijanović V., Miladinović J., Marinković J. (2021): *Uticaj folijarnog đubrenja na prinos soje*. Zbornik radova Nacionalnog naučno-stručnog skupa sa međunarodnim učešćem „Biotehnologija i savremeni pristup u gajenju i oplemenjivanju bilja" 15. decembar 2021. Smederevska Palanka, 301-308.
4. Đukić V., Miladinov Z., Balešević-Tubić S., Miladinović J., Đorđević V., Valan D., Petrović K. (2018): Kritični momenti u proizvodnji soje, Zbornik referata 52. Savetovanja agronoma i poljoprivrednika Srbije (SAPS), Zlatibor, 21-27. Januar 2018. Institut za ratarstvo i povrtarstvo, Novi Sad, 34-44.

5. Đukić, V., Miladinović, J., Mamlić, Z., Dozet, G., Cvijanović, G., Kandelinskaja, O., Miljaković, D. (2021): *Uticaj vodenog ekstrakta banane i koprive sa gavezom na prinos soje*. Zbornik radova Nacionalnog naučno-stručnog skupa sa međunarodnim učešćem „Biotehnologija i savremeni pristup u gajenju i oplemenjivanju bilja“ 15. decembar 2021. Smederevska Palanka, 285-292.

6. FiBL (2022): Data on organic area in worldwide. https://statistics.fibl.org/world/area-world.html (20.09.2022.)

7. Miladinov Z., Đukić V., Ćeran M., Valan D., Dozet G., Tatić M., Ranđelović P. (2018): *Uticaj folijarne prihrane na sadržaj proteina i ulja u zrnu soje*, Zbornik radova 59. Savetovanje industrije ulja: „Proizvodnja i prerada uljarica“, 17-22. Jun 2018, Herceg Novi, Crna Gora, 73-78.

8. Popović A., Golijan J., Babić V., Kravić N., Sečanski M., Delić N. (2016): *Organic farming as a factor for biodiversity conservation.* International scientific conference on Ecological crisis: Technogenesis and climate change. April 21-23, 2016 Belgrade, Serbia, pp. 61

9. Subić J., Bekić B., Jeločnik M. (2010): *Značaj organske poljoprivrede u zaštiti okoline i savremenoj proizvodnji hrane*. Škola biznisa, 3: 50-56.

10. Trovato Maurizio, Funkc Dietmar, Giuseppe Farlam, Sakiko Okumoto and Rachel Amir (2021): *Editorial: Amino Acids in Plants:Regulation and Functions in Development and Stress Dense*. Frontiers in Plant Science, Vol.12, No.772810, 1-5.

DIGITAL COMMUNICATION IN PUBLIC INSTITUTIONS. CHALLENGES AND OPPORTUNITIES

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Abstract

The article focuses on the use of new information and communication technologies in public institutions to simplify bureaucracy. The use of ICT (New Information and Communication Technology) is common practice to increase the efficiency and effectiveness of public organizations by improving services, providing better customer information and managing information securely. Digital communication methods are based on a network of sensors connected to a central server or database, using machine learning algorithms to classify user requests and suggest solutions. They contribute to better accessibility of public services for the underrepresented and can reduce costs.

Key words: *communication, digitization, debureaucratization, public institutions, public officials*

Introduction

The European Commission's digital strategy calls for the digital transformation of public administrations to face complex challenges arising from the new coronavirus pandemic. To this end, the strategy consists of four key pillars: reshaping applications and their services to meet citizens' needs; building a stronger core IT capability; making available and using more data; and improving public administration as an environment for innovation.[3]

There is growing evidence that public administrations need to transform to meet the challenges they face today. The European Commission's digital strategy calls

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3 Fletcher, G., & Griffiths, M. (2020). Digital transformation during a lockdown. *International Journal of Information Management.*, https://doi.org/10.1016/j.ijinfomgt.2020.102185 ;

for the digital transformation of public administrations to face complex challenges, including the novel coronavirus pandemic and data security. In particular, the strategy emphasizes the importance of data for the provision of better public services.[4]

Romania is constantly changing, but digital progress and public services are lagging behind. Digital public services are in last place among the 28 countries of the European Union, with only one online payment platform (giseul.ro) being used. According to the 2020 Digital Economy and Society Index, the country ranks 26 out of 28 countries assessed, showing insufficient progress in the implementation of digital technology, with less than 50% of citizens accessing online services.

In Romania, one of the main problems that could be solved is the fact that only 10% of Romanian citizens got information from the websites of public institutions in 2021, while the EU average was 47% (Eurostat, 2021). Eurostat presents new data on the effects of COVID-19, as well as other ways to combat disinformation, in a new report that also underlines the importance of information from official sources for the acceptance of restrictive measures.

In our opinion, the period of the Covid-19 pandemic was also a good time for many digital transformations in public administration, in the sense that it accelerated some processes, including in Romania.

Several indicators show that digital technologies were used more during the epidemic years than before or after. For example, according to news portals and aggregation platforms, the period from mid-2019 to mid-2021 saw a strong increase in the number of articles on the topic of digitalization technology and communication, by an average of 26% compared to previous periods.

Digital maturity is the degree to which an organization has been able to adapt to change, enable and adopt new tools and techniques, and improve its work. The Organization Development Institute (ODI) defines digitally mature organizations as those that have the ability to use technology effectively within their mission-critical functions while minimizing risk.

An organization that is more digitally mature can transform faster and more effectively than less digitally mature organizations. The digital maturity of a public institution is directly related to its ability to adapt to changing conditions.

4 Fletcher, G., & Griffiths, M. (2020). Digital transformation during a lockdown. *International Journal of Information Management*. https://doi.org/10.1016/j.ijinfomgt.2020.102185 ;

A digitally mature public institution can quickly adapt its product offering, organizational structure and leadership styles to seamlessly respond to public demand. Digital Maturity is a new type of performance measurement that spans the entire organization and is as much about processes and communications between people as it is about hardware and software options.

Institutions with a low degree of technological sophistication are more vulnerable and have limitations in their ability to adopt a flexible leadership style in the face of a changing environment. Studies suggest that in this area it is essential to pay more attention to digital capability, which can contribute to increasing organizational agility, agility being defined as the ability to quickly adapt to environmental changes or withstand external pressures.

The digital transformation process, which mainly aims to increase the efficiency and effectiveness of public services, as well as improve internal and external communication, also focuses on providing more accessible, timely and relevant services to citizens.

New information technologies play a key role in this process of change, through new ways of communicating and exchanging information, as well as through their ability to influence organizational behavior.[5]

Trust, considered an essential aspect of society, plays an important role both in the peaceful coexistence of citizens and institutions and in the effectiveness of democratic governance.[6]

In the case of Romanian society, trust in institutions is low, but this problem can be addressed by using technology to build better social interaction, which has both risks and benefits.[7]

According to data provided by Internet World Stats, the percentage of households in Romania that have access to the Internet in 2020, 74.8%, is below the European Union average, which is 89.4%.

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5 Mergel, I., Edelmann, N., & Haug, N. (2019). Defining digital transformation: Results from expert interviews. Government Information Quarterly, 36(4), 101385;

6 Ervasti, H., Kouvo, A., & Venetoklis, T. (2019). Social and institutional trust in times of crisis: Greece, 2002–2011. Social Indicator Research, 141(3), 1207–1231. https://doi.org/10.1007/s11205-018-1862-y ;

7 Feeney, M. K., & Porumbescu, G. (2020). The Limits of social media for Public Administration Research and Practice. Public Administration Review;

This statistic indicates a significant gap in access to the Internet and telephony, which are essential for accessing information from official and secure sources, as well as educational, financial, application and other public services in various economic sectors.

We believe that this gap needs to be bridged to enable equitable access and boost digital economic development. In terms of internet speed, Romania ranks among the countries with good performances, with a coverage of 87.1% in 2021, according to Eurostat data.

The effectiveness of a public institution is determined by the accessibility, quality and credibility of the information transmitted to employees and citizens. To increase citizens' awareness of information of public interest, institutions should be transparent and provide clear information through published documents, press releases and other online media channels.

Research shows that, in the age of social media, people interact more and more with the authorities through online tools, with a positive relationship between the number of online interactions and the level of trust of citizens in these institutions.

The use of social networks as a communication tool can contribute to strengthening citizens' trust in public institutions by facilitating the interaction and participation of citizens in the decision-making process. This approach provides transparency and accessibility of information, increasing trust in institutions and more efficient and transparent communication between authorities and citizens. This aspect is also underlined by studies carried out by experts in the field, such as Lovari & Materassi (2020), who found that public officials who manage these networks are aware of their strategic role in interacting with citizens and that their work involves a level of responsibility regarding the trust that can develop in the relationship between citizens and authorities.[8]

They found that those who manage these networks are aware of the strategic role they have to play in interacting with citizens and that their work involves a level of responsibility in terms of the trust that can develop in the relationship between citizens and authorities.

8 Lovari, A., & Materassi, L. (2020). Trust me, I am the social media manager! Public sector communication's trust work in municipality social media channels. *Corporate Communications: An International Journal*.

The authors argue that these civil servants have the quality of being perceived as liaisons, which can prove extremely useful, especially in times of uncertainty, as trust can be gained and managed through them. This can lead to a perception that there is a high degree of operational effectiveness due to the high productivity and efficiency of both the employees and the organization itself.

The importance of information from official sources and the level of trust in the authorities are determining factors for the success of a public institution. A key question is whether a new policy will be a success or a failure. This depends on the number of people who support and follow it.

Even if there is broad public approval, without proper implementation, a public policy can backfire. It is essential that public institutions collaborate both within and outside their own domain to ensure that everyone has access to valid information as quickly as possible. In what follows, we will present to you what are the post-pandemic opportunities within public institutions.

Post-pandemic opportunities in public institutions

The role of information and communication technologies in the latest pandemic was immense. To adapt, new procedures and platforms must be used. Where can these come from? In the current situation, various sources of communication have been sought, such as advanced technologies, data sharing platforms, etc.

All these approaches are valid technical solutions for the problem of automating processes and jobs to simplify the activity of civil servants in central and local public administrations.

Interactions between public institutions and between public institutions and citizens are much more effective as they adapt to new challenges and new information and communication technologies.

From a leadership perspective, post-pandemic opportunities have created new visions of public administration performance. This is a unique time that presents both challenges and opportunities for public service leadership. In the face of a pandemic, public officials must have the courage to act more boldly and creatively to address long-term and long-standing problems that suspend normal expectations.

Public service leaders can use the pandemic to promote a vision of a public institution that is long-term, forward-looking, flexible and responsive to the needs of the public it communicates with. In particular, the pandemic provided an opportunity to assess strengths and weaknesses and improve accountability for implementing policies in ways that benefit citizens.

The pandemic with the new coronavirus highlighted the importance of public services in society and showed how vital is the ability of public institutions to quickly adapt to changes. This brought an opportunity to review and improve the way public institutions relate to the public, to promote a modern image of public administration.

An important part of this relates to the process of de-bureaucratizing public administration and simplifying administrative procedures, this can lead to better interaction with the public and more opportunities for citizen involvement and can also contribute to improving the image of the public sector and to attract young professionals.

By simplifying administrative procedures and promoting a modern image, the public sector can become more attractive and attract people who are interested in pursuing a career in the public domain with the aim of contributing to the welfare of society.

Bureaucracy and de-bureaucratization of public administration

By bringing together a wide range of things, debureaucracy helps people and businesses access public services in a fast, simple and transparent way. The website and mobile app allow citizens to find information quickly and easily on the topics that matter most to them.

Streamlining information sharing in public administration is likely to make service delivery more efficient, transparent and responsive; it will increase citizen satisfaction; will improve the image of the public administration.

The digitization process is also vital to achieve effective de-bureaucratization and simplification of administrative procedures. A process of simplification should be carried out by reducing as much as possible in the regulations, especially in the secondary regulations, those procedures which are unnecessary and useless.

One solution regarding de-bureaucratization is e-Government. E-Governance is a set of policies, technologies, services and frameworks that ensure an

electronic communication and interface between citizens and administration. The term covers several aspects such as the digital representation of new information and communication technology.

The increase in digitization plays an important role in the de-bureaucratization of public institutions. In public administration, digitization generates a multitude of benefits that should be reflected in the institutional strategic approach and promoted by its leaders. Digital services offered by public agencies can play a crucial role in achieving better citizen engagement with public administration institutions, as well as increasing customer satisfaction, transparency and accountability.

Highlighting the power of digital technologies is essential for public institutions to transform their approach to service delivery, information and competitiveness.

On the other hand, digitization is also becoming increasingly problematic and disruptive for organizations, as it requires professionals to adapt and change to keep up with its demands.

The digital divide can be bridged by using technology at all stages of the policy-making process: from applying for funding - so that no one is left out because of manual forms or a lack of digital literacy; from communicating with citizens and public offices - ensuring that everyone has access to communication services; and through the exchange of best practices and collaboration for knowledge sharing.

Digitization creates new opportunities for public services by enabling institutional capacities and capabilities that can deliver innovative public services to citizens. This can be achieved by combining technology, management and strategy, providing new ways for public institutions to become more efficient through the use of digital methods, such as online reporting and transactions, communication and the release of documents in the digital environment.

Digital governance involves the creation and development of an adapted set of services to provide efficient strategies and effective solutions in public sector organizations, these services being provided for in the National Recovery and Resilience Plan.

In this sense, the main public policy recommendation refers to the rethinking of the governance system of digital public services, not only in terms of compliance with some of the principles stated in European documents, but, above all, through the clear organization of a digital governance framework.

This framework would provide for progressive forms of participation of a plurality of actors in terms of its implementation as well as its evaluation. This can be done through several types of mechanisms that allow everyone to contribute directly to specific topics, or through more general mechanisms such as encouraging contributions from citizens and ordinary users through social media.

This also includes providing access to information on how public services work and how they could be improved or adapted to better meet citizens' needs and expectations, such as updating user interfaces and making them easier to use by to people with reduced mobility.

This approach should aim at strengthening the management of public services, through an organized system of governance, which will play a central role in preventing or solving problems arising from the development of new digital services.

Digital governance is a concept that refers to internal and external processes and mechanisms in the public sector. It helps public institutions, agencies, organizations and governments to use digital technologies to enable better communication, delivery of public services, while providing value for citizens.

Digital governance seeks to understand the role of information and communication technology in shaping the way public institutions operate, to identify opportunities for change based on emerging developments, and to design appropriate strategies to deal with these new realities.

The principles of digital governance are essential if we are to identify how digital technologies can be managed effectively. There are many forms of online management that do not involve process change but can also go in the direction of moving existing bureaucracy online.

The digitization of public services requires a rethinking of the way public institutions design, deliver and manage their operations. So far, the focus has been on the technological challenges involved in implementing new systems and processes to enable digitized communication.

However, the digitization of communication also involves redesigning the way public institutions operate to ensure that citizens' needs are met in a timely manner and at appropriate costs.

The introduction of digitization in public services will create efficiency and predictability in the interactions between citizens and public institutions. The reduction of public expenses will be achieved through the use of new technologies and applications. Digitization of public institutions brings with it increased efficiency and transparency and should be a pillar of any smart community.

These digital services will make the services of key institutions more accessible and give citizens access to better service delivery at lower costs. Digitization means an approach to services and activities where the public sector uses ICT (New Information and Communication Technology) to improve its effectiveness, efficiency and transparency.

It is a process that starts with legislation, develops over time through implementation and monitoring, and gives birth to new sustainable models of interaction with citizens.

The strategic objective of the digitization of public administration is to transform the relationship between public administration and society, so that citizens perceive the administrative act as responsive, accessible, transparent, responsible, participatory, efficient, effective and adapted to the digital paradigm in which we find ourselves.

In this way, citizens will be better informed about the actions of public administrations. Therefore, it is necessary for every level of government to invest in information technology (IT) solutions that are adapted to the performance expectations of users every day.

The future of the public sector is based on ensuring that users have access to the best information and services available. The administrative performance of any public institution is now and will continue to be evaluated according to the level of de-bureaucratization and digitization.

Digital tools are used to transform the interaction between citizens and public administration into a positive and constructive one. An effective digitization of public administration requires, first of all, goodwill and flexibility on the part of both the citizens and the administration.

The digitization process, in the context of the entire administration, must go beyond the simple collection and sharing of data to provide a deeper insight. New skills and abilities are needed for a digital public administration that constantly adapts to the new possibilities of interaction with citizens.

The objective is a responsive, open and innovative management based on a set of flexible digital procedures. This requires a continuous dialogue between different actors (citizens, civil servants) and effective management of the risks involved in this complex transformation process.

Conclusions

In this article we aimed to identify not only the new technologies of information and communication, but also how they are approached and how the new programs and digital platforms manage to simplify the bureaucracy in public institutions.

The use of ICT (New Information and Communication Technology) is not new for public organizations; however, it has recently become more common because of technological advances. ICT is used to improve the efficiency and effectiveness of public organizations.

They can be used to increase the capacity of public services by improving the quality-of-service delivery, by providing better information about customer needs and expectations, and by managing information securely.

New digitized ways of communicating are a concept that aims to speed up the process of obtaining information on public services by using a network of sensors connected to a central server or database.

The system uses machine learning algorithms to classify requests based on user characteristics. It then searches for relevant data sources and provides users with an online form where they can provide additional information, such as the service they are requesting or their location.

Also, digital programs may be able to suggest solutions based on previous user requests. They are an example of what can be achieved when advanced technologies are combined with innovative approaches to the provision of public services and communication.

It also shows how new technologies can help improve access to public services for those who are currently underrepresented in society (those without access to computers).

New Information and Communication Technology enables a significant reduction in handling, information and compliance costs. ICT enables the

sharing of more data between different information systems, reducing time and costs.

To improve the quality of information exchanged through these technologies, we recommend that the public administration in Romania should first identify the reasons why they decided to communicate through them. In particular, public institutions should consider the motivations that led them to choose certain digital platforms or programs as a means of communication. Once this motivation has been identified, public institutions can decide which aspects are most important to address when creating a strategy to improve the use of these technologies!

It is clear that ICT is changing the way we interact with institutions. Digitization offers public institutions the opportunity to become more transparent, accountable and collaborative, while allowing citizens to engage and participate more in governance.

In this way, new communication platforms can be seen as a new channel through which people can communicate more effectively with public institutions, but also a way to distract public officials from the essentials.

Considering the above, in Romania, public institutions also use digitization as a promotion tool. They use it to transmit information about their activities. In this sense, we believe that employees should use digitization as a tool to improve their job skills. In a world where communication is the key to success, the ability to communicate effectively is essential.

Debureaucratization can be achieved by bringing together a wide range of things, such as the website and mobile app that allow citizens to access public services in a fast, simple and transparent way. Streamlining the exchange of information in public administration can lead to more efficient, transparent and responsive provision of services, as well as increasing citizen satisfaction and improving the image of public administration.

Digitization plays an important role in this process by implementing solutions such as e-Governance, which provides a set of policies, technologies, services and frameworks that enable an electronic communication and interface between citizens and administration. Digital services provided by public agencies can contribute to better citizen engagement, increased customer satisfaction, and increased transparency and accountability. However, it must be remembered that digitization can be difficult and disruptive for organizations and can lead

to a digital divide, which can be overcome by using technology at all stages of the policy-making process.

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Literature

1. Bădărău Ionuț, (2019), *„Comunicarea instituțională în era digitală”,* Editura Economică, București;
2. Bărbulescu Andreea-Maria, (2022), *„Comunicarea în relațiile cu publicul în organizații”,* Editura Universității din Craiova, Craiova;
3. Cristea Ana Lucia, Franc Valeriu Ioan, Popescu Constanța, (2020) *”Metodică în cercetarea științifică”,* Ed. Expert, pag. 115 – 181;
4. Dumitrașcu Alexandru, (2022) *„Comunicarea prin intermediul rețelelor sociale în organizații”,* Editura Corint, București
5. Negoiță Ionuț și Anghel Maria-Alexandra, (2021) *„Comunicarea în instituții: abordări teoretice și aplicații practice”* Editura Universității din București, București;
6. Sorescu Maria, (2022) *„Comunicarea in era digitala: provocări si soluții”,* Editura Teora, Cluj-Napoca;
7. Stănescu Adrian, (2022) *„Comunicarea in organizații: tehnici si strategii”,* Editura All, Timișoara;
8. Stănescu Maria, (2021) *„Comunicarea Organizațională”,* Editura Universității din București, București;
9. Stănilă Ionuț, (2022) *„Comunicarea organizațională și managementul schimbării”,* Editura ASE, București
10. Tănăsescu Loredana, (2022) *„Comunicarea organizațională în domeniul public”,* Editura Economică, București;
11. Trosa S., Bartol A., (2016) *„Paradoxurile managementului”,* Presses de l’EHESP.

ECONOMIC AND FINANCIAL ASPECTS OF CABBAGE PRODUCTION ON THE FAMILY FARM[1]

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Abstract

The paper primarily presents the production results of cabbage production research in the Republic of Serbia and then the research is focused on the economic and financial aspects of production on the selected family farm. Research is based on real data from practice, collected from cabbage producers in Glogonj place, which belongs to the territory of the city of Pančevo in the South Banat district, AP Vojvodina, Serbia. A calculation was made for one production cycle per unit of area and per unit of yield, as well as critical values that follow the production of cabbage in the open field.

The research results showed that the total costs of cabbage production on a representative agricultural farm are relatively high and amount to 6,783.95 Euro/ha. However, with the realized income of 12,758.36 Euro/ha, the annual financial result is favorable and amounts to 5,974.40 Euro/ha. Cabbage yields or prices can drop by 53.2% while production still generates a positive financial result. The economic and financial results of the research are outstanding and show that cabbage production in this part of Serbia is extraordinarily profitable.

Key words: *cabbage, production, economic analysis, financial result.*

Introduction

Vegetable production in Serbia has a long tradition, and this production is carried out in rural areas and rural households. In the past, the production of vegetables

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had an exclusively seasonal character, while in the winter months vegetables were stored either underground and/or processed in the family farm. Nowadays, fresh vegetables are intensively produced throughout the year, either in the open field or in a sheltered area, through the rotation of two to three types of vegetables during the year (Ilin et al., 2019, Kljajić et al., 2014). Despite this fact, the total production of vegetables in Serbia is below realistic possibilities. Reasons are numerous and some of them are: the fragmentation of the land holdings of agricultural producers, the obsolescence of machinery, the lack of capacity for storage and processing of vegetables, errors in cultivation technology that can occur at critical moments of production and that can be related to the preparation of land for planting, quality of planting material, nutrition, plant care, phytosanitary protection, irrigation in terms of watering norms and water quality, etc. (Moravčević et al., 2019, Moravčević et al., 2021). In addition to favorable natural resources (land, water and biodiversity), which our country possesses, the greatest resource is the individual agricultural producers of vegetables who have maintained this production through the various periods of transition that our country has gone through. Considering all of the above, the intensification of vegetable production in Serbia is realistically possible through the application of complex, modern agro technical measures and innovative technologies, as well as the support of the relevant Ministry through various subventions and other incentives, as well as scientific institutions and expert advisory services from this area (Grujić et al., 2014).

According to the agricultural census of the Republic of Serbia (Survey 2018), the production of vegetables in the Republic of Serbia totaled 1,300,347 tons in 2018. In the structure of the total value of vegetable production, vegetable production in AP Vojvodina amounted to 389,447 t, which is approximately 30% (29.95%) in relation to production in the territory of the Republic of Serbia (https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl&displayMode=table&guid=5e42d908-b307-49e4-adb6-47b59f167a3elink).

According to the same data source, in the Republic of Serbia, vegetables (vegetables, watermelons and strawberries) are grown on a total of 50,107 ha, on the land of a total of 114,643 family farms. Therefrom, vegetables in greenhouses and plastic greenhouses as protected areas occupy a total area of 3,834 ha on the land of 22,680 family farms. Vegetables for fresh consumption are grown outdoor on a total of 34,190 ha on the land of 98,543 farms, while vegetables for industrial processing are grown on a total of 12,083 ha on the land of 4,326 farms (Table 1).

Table 1. *Areas under vegetables and the number of farms in the territory of the Republic of Serbia (2018).*

	Type of production	Area (ha)	Number of family farms
Republic of Serbia	Vegetables, watermelons and strawberries (in total)	**50,107**	114,643
	Vegetables in greenhouses and plastic greenhouses	3,834	22,680
	Outdoor vegetables for fresh consumption	34,190	98,543
	Outdoor vegetables for industrial processing	12,083	4,326
South Banat region	Vegetables, watermelons and strawberries (in total)	**2,557**	2,261
	Vegetables in greemhouses and plastic greenhouses	36	324
	Outdoor vegetables for fresh consumption	1,667	2,010
	Outdoor vegetables for industrial processing	854	61
The city of Pančevo	Vegetables, watermelons and strawberries (in total)	**282**	496
	Vegetables in greenhouses and plastic greenhouses	15	91
	Outdoor vegetables for fresh consumption	258	432
	Outdoor vegetables for industrial processing	8	5

Source: https://data.stat.gov.rs/Home/Result/1300020203?languageCode=sr-Latn&displayMode=table&guid=90941dad-5472-49d5-b69a-9482d4d4ec06

Only 5.1% of the total vegetable production in the Republic of Serbia is realized in the South Banat Region. Vegetable production takes place on a total of 2,557 ha, which includes the land of 2,261 family farms. Therefrom, outdoor vegetable production accounts for 98.6% of production, while only 1.4% is produced in protected areas.

In the area of the city of Pančevo, where the Glogonj settlement belongs, vegetables are grown on a total of 282 ha, predominantly outdoors, for fresh consumption and for industrial processing (266 ha on the land of 437 family farms). The production of vegetables in greenhouses and plastic greenhouses accounts for only 5.3% of the total production of vegetables in the area of the city of Pančevo.

The official statistics of the Republic of Serbia monitor the production of 11 types of vegetables (potatoes, tomatoes, peas, cabbage and kale, onions, peppers, beans, melons and watermelons, carrots, cucumbers, garlic). The

research in this paper refers to cabbage, which is intensively produced in the area of the city of Pančevo.

Cabbage is a biennial herbaceous plant that belongs to the Brassicaceae family. It is the leading representative of cruciferous vegetables in our country. It contains on average 6-10% of dry matter, 4-1% of carbohydrates, 1-2% of proteins as well as 3-50 mg of vitamin C, which is especially important in the diet during the winter months. Raw cabbage contains 4.2-5.8% carbohydrates, 1.6-1.9% protein, 0.8-1.3% cellulose, 0.12-0.18% vegetable oils and 0.7 -1.2% mineral substances. The share of vitamin C and vitamin B1 is 38 mg. Mineral substances mainly contain potassium, calcium and sulfur (Moravčević et al., 2005). Cabbage produces vegetative organs in the first year, and a flowering stem and seeds in the second year. It easily adapts to different climatic and soil conditions, but it is best suited to wet areas. Although cabbage tolerates low temperatures, the optimal temperature for its growth and development is 15-20 °C. Both optimal soil moisture and optimal air humidity are necessary for the development of cabbage. The optimal soil moisture is about 80% of the field's water capacity. In the absence of water, cabbage yields are significantly lower and the heads of cabbage are smaller. Cabbage needs the most water at the beginning of the formation of its heads. The optimal air humidity is in the range of 85% to 90%.

Cabbage is most successfully grown on alluvial, medium-heavy, deep soils rich in humus. With earlier varieties of cabbage, slightly lighter sandy-loam soils can be used for cultivation. Soils with a heavy mechanical composition, impermeable to water and with little organic matter are completely unfavorable for growing cabbage. The optimal soil pH value for cabbage is 6.0-6.5. On acidic and heavy soils, production can only succeed with the addition of manure in larger quantities.Cabbage must be grown in a crop rotation due to its high sensitivity to diseases and pests, and it should be only grown to the same surface after 3 years.

The best pre-crops for cabbage from fodder and field crops are perennial legumes such as alfalfa and various types of clover, grasses and cereals (barley, wheat...). Vegetables include beets, celery, lettuce, peas and beans, tomatoes, cucumbers and potatoes. On the other hand, cabbage can be a good starter for most vegetable types. The reason is that behind the cabbage, the soil is not burdened by roots, and at the same time, it is very loose.

Yields of early varieties of cabbage under normal production conditions reach a value of 30-40 t/ha, mid-early varieties around 60 t/ha, and late varieties and hybrids over 80 t/ha.

Cabbage can be used raw, cooked or canned (Moravčević et al., 2005, Moravčević et al., 2011).

Materials and methods of research

The paper first shows the production of vegetables at the level of the Republic of Serbia, AP Vojvodina, then at the level of the South Banat region and within it at the level of the city of Pančevo, because the calculation made refers to the selected family farm in a populated place belonging to the city of Pančevo. The presentation of cabbage export and its purchase price for the last three years is also given.

For the research in this paper, data from the Statistical Office of the Republic of Serbia, Belgrade, data from the Trade Statistics for the Development of International Business (Trade Map), the results of previous research by domestic and foreign authors' on this topic, etc., were used. The research is based on real data from practice, collected from cabbage producers from family farms in the South Banat region.

Based on the collected data, a calculation was made for one production cycle per unit of area and per unit of yield, as well as the critical values that follow the outdoor production of cabbage.

Economic analysis determined more important indicators: income, variable costs, coverage margin and critical production values. The data are presented in tables and in graphs using statistical and calculative methods for solving such tasks and problems in science and practice.

Research results and discussions

Significant areas are covered by cabbage in the vegetable seeding structure. Average harvested area under cabbage was 7,672 ha for the period 2019-2021 in the Republic of Serbia. The areas under cabbage were decreasing by 2.80% on average per year. Average total production was achieved in the value of 181,001 t, which was increasing by 1.96% on average annually. The average cabbage yield of 23.9 t/ha was decreasing by 2.78% on average per year (Table 2).

Table 2. *Average values of areas, total production and yield of cabbage and kale in the Republic of Serbia for the period 2019-2021.*[4]

Research period	Harvested area, ha /arable land, ha	Index (2019=100)	Total production (t)	Index (2019=100)	Yield, (t/ha)	Index (2019=100)
2019	7,957	100,00	178,308	100,00	25,4	100,00
2020	7,547	94,85	179,377	100,60	22,4	88,19
2021	7,513	94,42	185,317	103,93	23,8	93,70
Average	**7,672**		**181,001**		**23,9**	
Average annual rate of change (%)	***-2,80***		***1,96***		***-2,78***	

Source: https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl&displayMode=table&guid=60471cb4-72eb-4225-920b-61caef71e634

Only 17.31% of the total vegetable production in the Republic of Serbia is realized in the area of AP Vojvodina. In the area of AP Vojvodina, the average value of the area under vegetables for the same period was 1,080 ha, and that area was decreasing by 2.45% on average per year. The achieved average total production was 31,332 t and it was increasing by 1.75% on average per year. The average yield of 29.0 t/ha was increasing by 4.25% annually (Table 3).

Table 3. *Average value of areas and yield of cabbage and kale in the area of AP Vojvodina for the period 2019-2021.*

Research period	Harvested area, ha /arable land, ha	Index (2019=100)	Total production (t)	Index (2019=100)	Yield, (t/ha)	Index (2019=100)
2019	1,111	100,00	30,768	100,00	27,7	100,00
2020	1,071	96,40	31,373	101,97	29,3	105,78
2021	1,057	95,14	31,855	103,53	30,1	108,66
Average	**1,080**		**31,332**		**29,0**	
Average annual rate of change (%)	-2,45		***1,75***		***4,25***	

Source: https://data.stat.gov.rs/Home/Result/130102?languageCode=sr-Cyrl&displayMode=table&guid=60471cb4-72eb-4225-920b-61caef71e634

The average export of cabbage from Serbia to all countries of the world for the three-year period of analysis was 3,511.6 t with an average value of 1,160.3

4 In the database of the Republic Institute of Statistics (harvested area in ha, total production in t, and yield in t/ha), cabbage is tracked as a category of cabbage and kale

thousands USD. However, the largest amount of cabbage was exported to the countries of the European Union. For the same period, an average of 2,622.7 t of cabbage was exported to the countries of the European Union, which is 74.7% of the total export of cabbage, in the value of 939.6 thousands USD (Table 4).

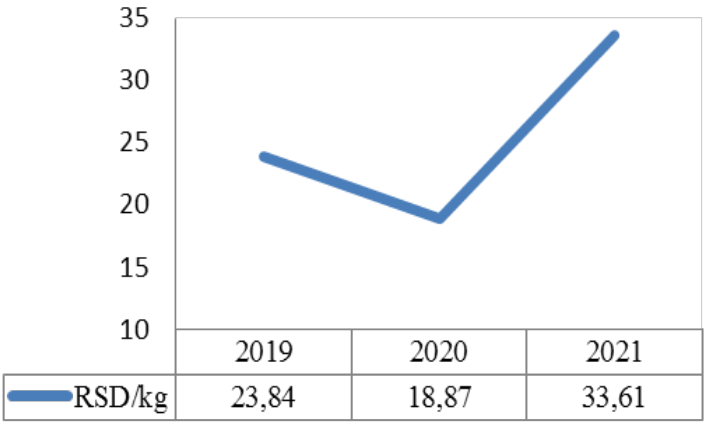
Table 4. *Export of cabbage*[5] *from Serbia for the period 2019-2021.*

Years	All countries		The European Union countries (28)	
	Quantity (t)	Value in thousands of USD	Quantity (t)	Value in thousands USD
2019	4,593.5	1,641.8	3,906.8	1,455.7
2020	3,880.9	1,031.1	2,695.4	810.9
2021	2,060.3	807.9	1,266.0	552.2
average	**3,511.6**	**1,160.3**	**2,622.7**	**939.6**

Source: https://data.stat.gov.rs/Home/Result/170304?languageCode=sr-Cyrl&displayMode=table&guid=f229f7f6-fce9-48c3-9ff7-cbebcb05f01a

In the previous three years, cabbage was selling at an average purchase price of 25.44 dinars/kg (Graph 2). The lowest price was in 2020. while the highest was in 2021.

Graph 2. *Average annual purchase prices of cabbage in the Republic of Serbia for the period 2019-2021. year*

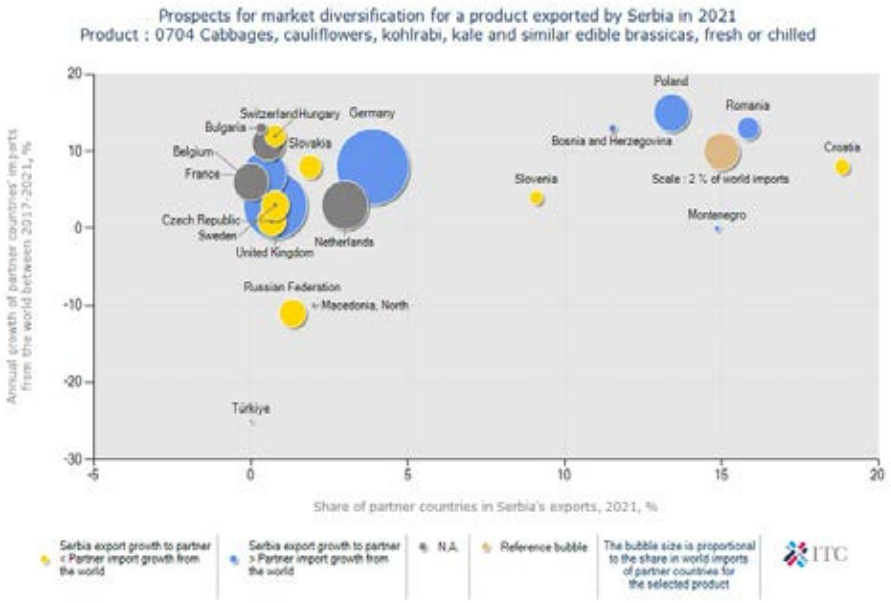


Source: https://data.stat.gov.rs/Home/Result/0302010302?languageCode=sr-Cyrl&displayMode=table

5 In the export category of the database of the Republic Institute of Statistics, cabbage follows cabbage, kohlrabi and similar edible vegetables, fresh

The countries to which most cabbage is exported from the Republic of Serbia are Poland, Romania, Croatia, Slovenia, Bosnia and Herzegovina and Montenegro (Figure 1 taken from): *https://www.trademap.org/Country_SelProductCountry_Graph.aspx?nvpm=%7c688%7c%7c%7c%7c0704%7c%7c%7c4%7c1%7c1%7c2%7c1%7c1%7c2%7c1%7c%7c2*

Figure 1. *Export of cabbage from Serbia in 2021 %*



A smaller percentage of cabbage is exported from Serbia to other countries of the world: Germany, Great Britain, France, Holland, Belgium, Switzerland, Sweden, Russia and others.

Economic results of cabbage production on the family farm

The economic analysis of cabbage production achieved during 2021 on the family farm in the South Banat region is based on the calculation of production on an area of 1.0 ha (Table 5). The family farm produces cabbage from seedlings, taken from a local certified nursery garden. The family farm has all the necessary machinery and equipment for carrying out work in growing vegetables. Production is carried out in an open field with the application of complete agrotechnics, including drip irrigation. Harvesting is done manually, during the most intensive harvest, additional labor is hired, i.e. pickers

from the local area, and harvesting is carried out in several passes. After harvesting, the heads of cabbage are classified according to weight and health criteria and packed in cardboard boxes. On average, the weight of a head of cabbage is about 2 kg. Produced cabbage is mainly sold on the quantum markets, wholesale or on the farm itself to known customers from the surrounding area. A certain part is processed into cabbage products.

Table 5. *Cabbage production calculation (P= 1.0 ha)*

Description	Quantity	Unit of measure	Price per unit of measure	Total RSD/ha	Total Euro/ha
A Income					
Cabbage	50,000.00	kg	30.00	1,500,000.00	12,758.36
Subventions				0.00	0.00
Total				**1,500,000.00**	**12,758.36**
B Variable costs					
Seedlings	50,000.00	struk	3.90	195,000.00	1,658.59
Fertilizers				40,560.00	344.99
Plant protection products				38,480.00	327.29
Packaging (cardboard box)	1,900.00	komad	50.00	95,000.00	808.03
Loading, export and spreading of manure				4,062.50	34.55
TIllage				15,600.00	132.69
Seed preparation				7,800.00	66.34
Scattering of mineral fertilizers				2,600.00	22.11
Spraying				13,000.00	110.57
Costs of planted seedlings - machines				6,500.00	55.29
Costs of planted seedlings - labors				10,000.00	
Hoeing	40.00	sat	300.00	12,000.00	
Harvest costs (with packaging)	400.00	sat	300.00	120.000,00	1,020.67
Drip tapes	14,400.00	m	9.10	131,040.00	1,114.57
Irrigation costs (diesel generator 7.5 KW)	430.00	l			

Description	Quantity	Unit of measure	Price per unit of measure	Total RSD/ha	Total Euro/ha
Maintenance costs of irrigation systems and aggregates				5	
Engaged labour (other)	36.00	sat	250	9,000.00	76.55
Other costs (electricity, small inventory, etc.)				1,370.00	1
Total B				**797,589.50**	**6,783.95**
V Profit (A-B)				**702,410.50**	**5,974.40**

Source: Authors' calculation based on field research (2021)
* NBS exchange rate per day 31.07.2021 (1 RSD= 117,57 €)

On the family farm in the analyzed year, a yield of 50,000 kg/ha was achieved. Total costs, market value of production and realized profit were obtained based on collected data on costs in the production process and the amount of yield. Costing includes total costs, where material costs are calculated based on market prices. All the necessary materials for production are bought on the territory of the cities of Pančevo and Belgrade. During the calculation, the purchase price of cabbage was used, which was achieved in 2021 and was approximately 30.0 dinars/kg.

The total costs in the regular production of cabbage on the family farm amount to €6,783.95/ha. If this cost were to be translated to a kilogram, it amounts to 0.14 €/kg, which compared to the selling price of cabbage is a lower value and represents a benefit for the producer. When comparing the production costs and the realized income in the production of cabbage in 2021, which amounted to €12,758.36/kg, the realized profit is €5,974.40/ha, i.e. €0.12/kg, at the selling price of cabbage in 2021. , year of 30.0 din/kg, i.e. 0.26 €/kg.

The economics of cabbage production as a ratio of realized production value and total costs in the production process is 2.14. This value is an indicator of how many euros of production value were realized per euro of total production costs *(Jeločnik M., et al., 2021).*

Table 6 shows the critical values in cabbage production. If the yields and prices of cabbage are taken into account, its production can be characterized as moderately risky.

Table 6. *Critical values of cabbage production*

Description	RSD (kg/ha)
Expected yield (EY)	50.000,00
Expected (average) price (EP)	30,00
Subventions (S)	0,00
Variable costs (VC)	797.589,50
Critical price: CP = (VC - S) / EY	**15,95**
Critical yield: CY = (VC - S) / EP	**26.586,32**
Critical variable costs: CVC = (EY x EP) + S	**1.500.000,00**

Source: Authors' calculation based on field research (2021)

The values at which the profit is equated to zero, that is, the critical values that accompany the production of cabbage show that the yields or the price of cabbage can fall by 53.17%, that is, to 15.95 dinars/kg and to the value of the total production per hectare per year of 26,586.32 t, while production still generates a positive financial result.

Conclusion

Cabbage production on the family farm in the place of Glogonj provides an annual income of €12,758.36/ha. The total costs of regular cabbage production on this family farm are €6,783.95/ha. In the structure of variable costs, the biggest share is the costs related to cabbage seedlings, irrigation and harvesting (67.2%). A positive financial result of €5,974.40/ha was achieved.

It can be concluded that the production of cabbage in this part of Serbia is economically profitable according to the established economic indicators.

Production on the family farm can be completed and thereby the family farm can be strengthen on the market through the association of several producers in specialized cooperatives and associations of vegetable producers, then by processing and packaging a quantity of produced vegetables, as well as by improving production through the introduction of innovations and new scientific knowledge into practice.

Literature

1. Ilin Žarko, Mutavdžić Beba, Adamović Boris, Novković Nebojša, Ilin Sonja (2019): "Sustainability of production, processing and foreign trade exchange of vegetables in Serbia". Serbian Academy of Sciences and Arts. Scientific gatherings. Book CLXXIX. Department of Chemical and Biological Sciences. Book 14. Str. 175-197.

2. Jeločnik Marko, Subić Jonel, Nastić Lana (2021): "Cost management on agricultural holdings". Monograph. Institute for Agricultural Economics, Belgrade, Republic of Serbia.

3. Grujić Biljana, Kljajić Nataša, Roljević Svetlana (2014):*„Impact of globalization on vegetable crops production per capita in Serbia (2000-2012)",* Journal *„Ekonomika",* Vol. 60, No. 4, Society of Economists „Ekonomika", Niš, CIP 338 (497,1), E-ISSN 2334-9190, ISSN 0350-137X, UDC rada 338(497,1), COBISS.SR-ID 26903, pp. 241-251.

4. Kljajić Nataša, Grujić Biljana,Vuković Predrag (2013): *"Analysis of vegetable production in the Republic of Serbia"*, Collection of scientific papers from the XXVII consultation of agronomists, veterinarians, technologists and agricultural economists, Vol. 19, no. 1-2, p. 261-272, PKB Agroekonomik Institute, Belgrade, Serbia.

5. Moravčević Đorđe, Bjelić Vukašin, Vučković Savo (2005): „Effect of crop density on fodder yield in cabbage production". Biotehnology in Animal Husbandry 21 (5-6), pp. 159-162. Publisher: Institute for Animal Husbandry, Belgrade-Zemun.

6. Moravčević Đorđe, Beatović Damir, Bjelić Vukašin (2011): "The influence of the quantity of seeds on the quality of cabbage seedlings", Proceedings from the XXV consultation of agronomists, veterinarians and technologists. Vol. 17. no. 1-2. p. 125-130.

7. Moravčević Đorđe, Ćosić Marija, Zarić Vlade (2019): "Possibilities of improving vegetable production in rural areas through sustainable use of natural resources". Serbian Academy of Sciences and Arts. Scientific gatherings. Book CLXXIX. Department of Chemical and Biological Sciences. Book 14. p. 275-291.

8. Moravčević Đorđe, Zarić Vlade, Ćosić Marija, Pavlović Nenad, Savić Slađana, Ugrinović Milan, Marjanović Milena (2021): "Serbian vegetable production - challenges and opportunities". Proceedings: Biotechnology and modern approach in growing and breeding plants. National scientific and professional meeting with international participation, Smederevska Palanka, December 15, 2021. p. 31-47.

9. https://data.stat.gov.rs

10. https://www.trademap.org

IMPROVING THE RURAL ECONOMY AS A FUNCTION OF SUSTAINABLE DEVELOPMENT IN SERBIA[1]

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Abstract

Improving the rural economy is key to sustainable development in Serbia. There are a number of ways this can be achieved. First of all, by improving production and increasing agricultural productivity, rural areas can generate higher incomes and improve the standard of living of the population. Accordingly, the development of small and medium-sized enterprises in rural areas, which represent a valuable support in improving the rural economy, is gaining importance. In order to realize this, it is necessary to provide adequate education and training to the population in rural areas. However, unfavorable demographic trends are one of the biggest development problems in rural areas of Serbia. The Republic of Serbia is in a long phase of demographic transition, with a number of serious demographic problems. In the coming period, it is expected to acquire the prerequisites for withdrawing as much funds as possible from EU funds intended for sustainable management of natural resources, environmental and climate challenges, as well as rural infrastructure.

Key words: *rural economy, sustainable development, natural resources, training.*

Introduction

Recent decades have seen a growing interest in the long-term sustainability of economic development. Overexploitation of natural resources and pollution are the two basic environmental issues that brought about the emergence

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of the ideas of sustainable development and circular economy. One of the first definitions of sustainable development says that decisions made today should not threaten the prospects of preserving or improving the living standards of the future.

Increasing the competitiveness of the rural economy, sustainable management of rural resources, and the social aspects of rural development are some of the most important questions occupying the attention of the scientific community. While the amount of food that needs to be produced is increasing, the rural workforce (i.e., farmers) is decreasing; a consequence of urbanization. In the period between 1960 and 2015, the rural population decreased from 66.4% to 46.1%. In 2017, the urban population was more than 54% of the overall world population. Almost the entirety of the future world population growth will take place in urban areas, and by 2050 66% of the world's population will be living in cities (Perović et al., 2020, p. 16).

The nature, role and significance of agriculture, including multi-functional agriculture, as well as the rural economy as a whole, has of course changed throughout the years, in accordance with the political processes and the strategy of rural development. The concept of rural development has been in the making for several decades and is permanently being transformed. It started in the early 1960s when rural development was first written about in the documents of the Union. Then, moving on to the 80s, which saw the first usage of the phrase "integrated rural development", as well as the establishment of structural funds for this kind of development. Today, this concept has grown to be a crucial, very ramified, well-integrated, coherent and productive instrument of social development in the Union, described separately in the *Agenda 2000*. The key goals of this agenda are the restoration and preservation of the environment; more even regional development; the development of alternative kinds of production; the spread of organic, safe, and healthy food; the restoration, preservation, and development of rural communities i.e., the affirmation of a new way of life, that can represent a good alternative to the evident drop in the quality of living, or at least some aspects of it, in urban areas.

Rural development policies of the European Union

The evolution of agriculture brought about the rise of sustainable agriculture. It is based on the principles of ecosystem sustainability and coordination between economy and ecology. It was a consequence of recognizing the negative effects

of the green revolution. The emergence of the environmental movement during the 1960s could be considered the precursor to the emergence of the sustainable method of agricultural production. Global conferences were held, whose declarations propagate environmental protection. The governments of the most developed countries limited the rise in pollution through legislation. The environmental principles of organic agriculture say that the exploitation and management of natural resources should not create social and environmental injustice, but that these resources should instead be bequeathed to future generations in a well-preserved and possibly even improved state. The primary goal of agriculture used to be increasing the yield. Over time, the consequences of the conventional method of production started to surface. In the 70s, people started turning to the organic method of production. The ecological disasters and the food contamination crises that took place in the 1990s only served to increase people's concerns over the food that they were using. The rural development policy of the European Union is tied to the *Common Agricultural Policy* – the most significant and oldest EU policy. During fifty years of reforms, this policy has moved from productivity (1970) to competitiveness (1992), to sustainability (2000).

Rural development in line with smart, sustainable, and inclusive growth, was linked to the EU's *Strategy 2020*, which advocated for *green growth* in agriculture and the rural economy. In the *Biodiversity Strategy for 2030*, the emphasis is on the long-term protection of nature and reversing the degradation of ecosystems. The *Common Agricultural Policy* for the period 2021-2027 expresses higher ambition in the field of environmental and climate measures and rests on a fairer deal for farmers while maintaining the special status of agriculture as a backbone of European society. According to the United Nations report for 2021, malnutrition on a global level is unacceptably high and affects all countries. Today, more than three billion people are malnourished, whereas seven billion inhabitants of our planet have a nutritionally poor diet. At the same time, the world population keeps expanding, with a tendency to reach 10 billion people by 2050. When it comes to the sustainable food supply, the goal is to secure access to high-quality and nutrient-rich food in sufficient quantities. Research shows that issues with global food supply are a consequence of conflicts and emergencies, but can also be their cause, and lead to an increase in poverty rates. The food supply system, as the candidate estimates in their paper, is directly impacted by climate and environmental issues. Environmental protection, as an important segment of sustainable development, can contribute to building a better food supply. It is essential to recognize and analyse the environmental issues in Serbia, in order to take necessary measures in a timely fashion and ensure a sustainable food supply in our country.

Circular economy, ecological footprint, and climate change

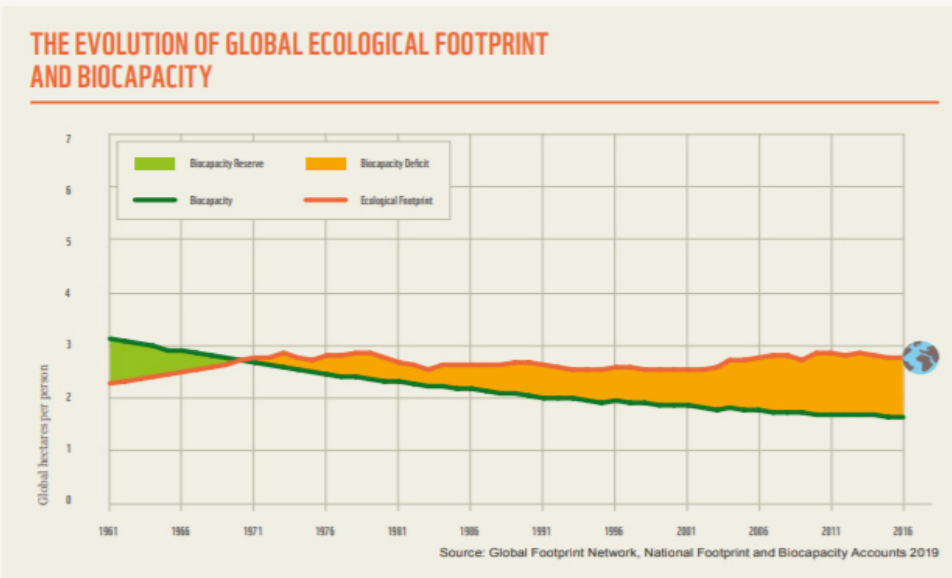
Globally speaking, only 9% of the world economy is circular (Perović et al., 2020). The basic features of the linear economy that require the fastest possible transition to a circular economy are precisely the overexploitation of limited natural resources and the excessive generation of waste that threatens the environment, as well as the burning of fossil fuels (the basic way to generate energy in the linear system), which is the main source of carbon-dioxide – the gas that causes the greenhouse effect.

The agenda for sustainable development (that includes a world without hunger) points to one of the greatest challenges that the world is facing, which is ensuring that the growing nutritional needs caused by the increase in global population are met (it is estimated that the population will increase by 2 billion people by 2050). To feed an additional 2 billion people, it would be necessary to increase food production by 50% (Goddek et al., 2019, p. 5).

Dignified work and economic growth – new circular business models are the main potential sources for growth in the effectiveness and efficiency of resources, waste valorisation, and green jobs. Studies show that implementing a circular economy on a global scale could create multi-trillion-euro opportunities, with an annual net benefit of €1.8 trillion in the EU alone by 2030 (Schroeder, 2018). The European Union has only recently recognized the significance of the circular economy. In 2015, the European Commission adopted a new legal framework i.e., a package of European regulations pertaining to the circular economy, which will help European companies and consumers transition to a circular economy, where resources are used more sustainably. This package seeks to incentivise the transition to a circular economy through investments, in order to modernize and strengthen the European economy, increase its competitiveness, and ensure sustainable economic growth in the future. Additionally, it aims to reduce waste generation, increase the quality of waste disposal, save energy, and minimise resource consumption by 2030. To realize these goals, the European Union continually carries out various actions. For example, the beginning of 2018 saw the adoption of the European Plastics Strategy (a part of the transition to a circular economy) which states that by 2030, the EU market will use only recyclable plastics, will decrease the usage of single-use plastics, and will restrict the intentional usage of microplastics (European Commission, 2018). In addition to the European Union, many countries worldwide have perceived the importance of transitioning to

a circular economy and are carrying out various contributing actions. A good example of that is Japan, which, as early as 2000, enacted eight new laws that cover all areas pertaining to the production of goods. Among them, is the *Basic Act on Establishing a Sound Material-Cycle Society* (Mitrović, 2015). There is only one planet Earth, but by 2050 the world consumption would require the equivalent of 3 Earths. It is projected that the global consumption of materials such as biomass, fossil fuels, metals, and minerals will double in the next forty years. Furthermore, the annual waste generation is projected to increase by 70% by 2050. The extraction and processing of natural resources make up half of the global greenhouse gas emissions and are the cause of more than 90% of biodiversity loss and water stress (European Commission, 2020).

Figure 1. *The evolution of global ecological footprint and biocapacity, 1961-2016.*

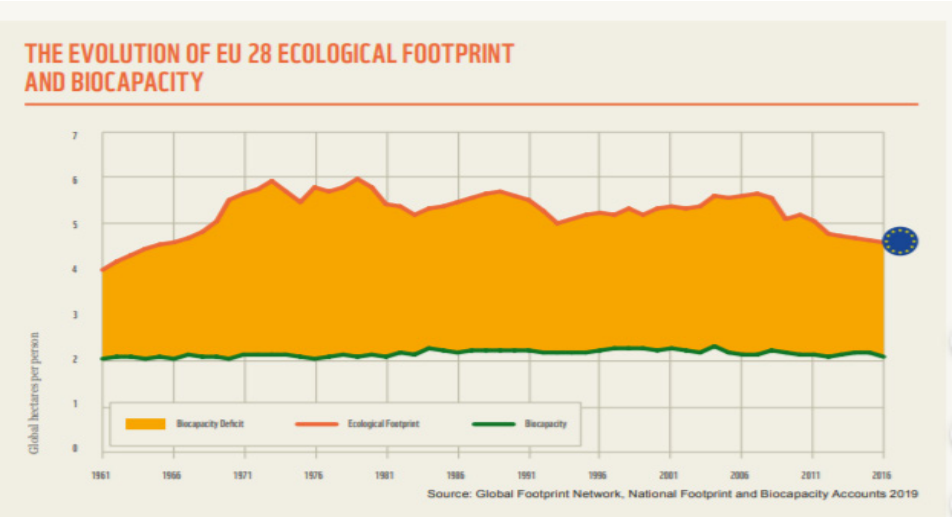


Source: Vandermaesen T., Humphries R., Wackernagel M., Murthy A., Mailhes L., (2019), Living beyond nature's limits, World Wide Fund for Nature, Brussels, Belgium.

Figure 1 shows the evolution of global ecological footprint and biocapacity in the period from 1961 to 2016. Here we can see that up until the early 1970s, our planet was able to provide more than what humanity demanded. Since then, our rate of consumption has increased and is now significantly higher than the Earth's rate of renewal. The increasing ecological footprint and the decreasing biocapacity, have led to the occurrence of a biocapacity deficit. Meeting the current global need for resources would require the equivalent of 1.7 Earths

(Vandermaesen et al., 2019). The primary goal needs to be turning towards a circular economy. If we look at the EU alone this need is even greater, since the EU and its citizens are currently using twice more resources than what the EU's own ecosystems are able to renew. The EU's share in the planet's resources itself is also inequitable – it uses almost 20% of the Earth's biocapacity, but it comprises only 7% of the world population. If everyone consumed natural resources at the rate of the average EU resident, 2.8 planets would be required to meet global needs. This is well beyond the aforementioned world average, which is 1.7 planets. The evolution of the EU ecological footprint and biocapacity is shown in the following figure (Vandermaesen et al., 2019).

Figure 2. *The evolution of EU ecological footprint and biocapacity, 1961-2016.*



*Source***:** Vandermaesen T., Humphries R., Wackernagel M., Murthy A., Mailhes L., (2019), Living beyond nature's limits, World Wide Fund for Nature, Brussels, Belgium.

Unlike the global average data displayed in Figure 1, where we could see the consumption rate rise above the biocapacity rate in the early 1970s, the ecological footprint of the EU has been considerably bigger than its biocapacity since the beginning of the observed period. The total ecological footprint of the EU member states had a steep rise during the 1960s and the 70s, was then relatively constant since the 80s, and eventually started to drop between 2010 and 2016. Simultaneously, the total biocapacity of the region also suffered a mild decline. Such a high ecological footprint leads to a significant ecological deficit because the total demand for ecological goods and services exceeds what European ecosystems can supply. The total ecological footprint of the

EU member states is more than twice the size of their biocapacity (Vandermaesen et al., 2019). Considering this information, a complete transition to a circular economy with efficient use of resources would need to take place in the shortest time possible. The world population is growing and with it, the need for increased food production. Food production is based on resources such as soil, water, fossil energy sources, and nutrients. Increased production means an increased need for these resources. The problem is, most resources don't follow this increase, but rather stay limited in a certain way. Fossil fuels, for example, are a non-renewable resource, while the soil, although renewable, requires a very long period of regeneration.

Competitiveness of rural economy in Serbia

Innovations, computer literacy, and social and ecological awareness are some of the most significant sustainable sources for growth and development. The issue of inheritance, the transfer of skills and knowledge, access to the financial market and access to land are some of the most common problems faced by young farmers worldwide. Adverse demographic trends are one of the biggest development problems in rural areas in Serbia. The Republic of Serbia is currently in a long stage of demographic transition, with a multitude of serious demographic issues. According to the estimates of the Statistical Office of the Republic of Serbia, the population of our country has been continuously declining since the beginning of the current century. Besides the aforementioned demographic and migration issues faced by our country, rural areas are impacted by numerous other socio-economic problems, such as poverty and social exclusion, regional differences and inequality, the lack of local initiative and competitiveness, and loss of cultural identity. The challenges and obstacles to the development of the Serbian agrarian sector, and our rural areas in general, are serious and deep. It is expected that, in the upcoming period, Serbia will become eligible to draw heavily on the EU funds intended for sustainable management of natural resources, environmental and climate challenges, and rural infrastructure. There are pilot projects planned in Serbia, supported by international donors, which will carry out agroecological measures in pilot regions. Rural development, as a modern way of achieving sustainability, treats evenly economic activities, as well as other aspects of social development – the environmental, sociocultural, political and institutional ones. The cross-border cooperation of Serbia with the countries in the region is primarily carried out in rural areas, where the project approach to

solving problems of cross-border territories is financed both by the European Union and from national sources. Cross-border cooperation offers some solutions. When considering the financing of cross-border cooperation, the emphasis should be on the priorities related to agrarian matters and the needs of the agricultural population. One of the goals of this project is the creation of infrastructure necessary for the long-term development of rural areas.

Apart from investing in equipment and machinery, one of the key investments in increasing the competitiveness of Serbian agriculture is the support for agricultural extension services. It can be further intensified and expanded through a system of contracts with the experts of the agricultural extension services, which would assist farmers in the modernization of their production process, to make it more productive and more profitable. Via public competition, the Ministry of Agriculture will select the institutions that are eligible to provide the required services, which will include: 1) A programme of tracking the selected agricultural holdings; 2) A programme of tracking the sowing, production process, and harvest of crops; 3) The collection and distribution of market-related information for the Agricultural Market Information System; 4) Advisory work realized through organizing seminars, field days, demonstrations of modern technologies and modern varieties/breeds, visitations to producers as well as other advisory work directed at increasing productivity; 5) Special projects for: education of trainers in extension services; education of advisors and farmers, providing knowledge and skills required by the modern agricultural production, the diversified rural economy, and farm production; education in marketing and farm financial management; introducing modern methods of farm production and management; rural village development; environmental protection etc. The competitiveness of the Serbian economy has only recently become the subject of systematic consideration, and that by international institutions. This is especially true for the agriculture sector. An analysis of the competitiveness of Serbian agriculture has never been done before, and what is particularly noticeable here is the passivity and the lack of interest by domestic institutions.

The methodological framework for the analysis of agricultural competitiveness is based on the Porter model. According to this model, it is the characteristics of the operating environment of a business, that are essential to its competitiveness. These are (1) general conditions; (2) business strategy, structures, and interfirm rivalry; (3) terms of demand; (4) related and supporting industries. A special fifth (5) factor is the state i.e., the government, which through its policies and measures affects all four previously mentioned factors. Finally, unplanned

events such as natural disasters and wars are also a factor of competitiveness. The latter ones act indiscriminately and affect all actors in a certain territory.

The characteristics of the Serbian agrarian sector currently are small holdings, obsolete varieties, low yield, outdated households, poor communication between the Ministry of Agriculture and the producers, lack of long-term plans, and especially the lack of standards. Through the emergence of vertical integration in the area of food production and distribution, a system is created on fresh foundations. That way, the competition between integrated systems too, is becoming more and more pronounced. The first step would be to group smaller and larger holdings into cooperatives, on a regional level. When it comes to ways of acquiring new technologies, it is said that licensing is the most common one in Serbia.

According to a survey, it is foreign direct investments that significantly contribute to the arrival of new technology. Since the share of technology in the export of agricultural products is low, it can be concluded that new technology arrived in some other sectors via FDI, but not the agri-food sector. The role of the government was positively evaluated since the respondents think that its decisions regarding the purchase of technology are mostly driven by the technology itself and the desire to stimulate innovation, and less by the price of the said technology. This is an encouraging finding that points to the conclusion that there is a strategic orientation in government decisions, after all.

Conclusions

The modern concept of sustainable development links economic growth, social inclusion, and environmental protection into a well-rounded image of a developing modern world. Food security is directly linked to climate change and its biophysical impacts on agricultural holdings as well as on uncultivated plants and vegetation and the animal world. The focus of rural development is on expanding non-farming activities, by evaluating various local resources and potentials for development based on the appropriate institutional and infrastructural capacities. Rural development rests on the knowledge economy, diversification, and multi-functionality, with its goal being to bolster competitiveness and increase comparative advantages.

The supporters of the circular economy think that it offers Europe a chance to increase resource productivity, employment rate, growth, competitiveness, and innovation, as well as to decrease resource dependence and waste of re-

sources. Overcoming the relative underdevelopment of rural areas in the Republic of Serbia is possible by way of identifying both internal and external challenges of rural development, and taking proactive action. The role of the government in relation to the development of new technologies is to stimulate research and development projects, but also to encourage the application of modern technologies in the production processes. These measures are especially important for the less-developed regions and are not contrary to the provisions of the WTO. Furthermore, the EU assists with the development of less-developed regions through various measures and their experiences could be applicable in Serbia. When it comes to increasing exports, a significant role belongs to the *Development Agency of Serbia*.

Literature

1. European Commission, (2018): *A European strategy for plastics in a circular economy*, Publications Office of the European Union, Luxembourg.
2. European Commission, (2020): *A new circular economy action plan*, Publications Office of the European Union, Brussels.
3. Goddek, S., Joyce, A., Kotzen, B., Burnell, G.M. (2019): Aquaponics Food Production Systems, Springer Nature Switzerland AG, Switzerland.
4. Mitrović, Đ. (2015): *Tranzicija od linearne ka cirkularnoj ekonomiji* - Tematski zbornik radova Ekonomska politika i razvoj, Centar za izdavačku delatnost Ekonomskog fakulteta u Beogradu.
5. Perović, S., Vučinić, A., Kamberović, S., Godina Košir, L., Korpar, N. (2020): Mapa puta za cirkularnu ekonomiju u Srbiji, Ministarstvo zaštite životne sredine RS, Beograd.
6. Schroeder, P., Anggraeni, K., Weber, U. (2018): *The relevance of circular economy practices to the sustainable development goals*, Institute of Development Studies, University of Sussex, Brighton, Brighton and Hove, United Kingdom.
7. Vandermaesen, T., Humphries, R., Wackernagel, M., Murthy, A., Mailhes, L. (2019): *Living beyond nature's limits, World Wide Fund for Nature*, Brussels, Belgium.

INFLUENCE OF FINANCING METHOD ON EFFICIENCY OF INVESTMENTS IN BLUEBERRY PRODUCTION[1]

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Abstract

Serbian producers have favorable natural conditions for blueberry production, while this production is recognized for its potential for achieving high economic effects. Various ways of financing blueberry production influence economic efficiency of investments needed to establish blueberry production, as well as liquidity of such investments. Investments in blueberry production are usually financed by combination of own and borrowed funds. The goal of this research is to investigate effects of financing sources on investments in blueberry production. Thus, authors discussed possible participation of borrowed funds in the financial structure of investments in blueberry production.

Key words: *blueberry, investments, financing, borrowed funds*.

Introduction

In line to available climate and natural potentials, export possibilities and rise in global demand for blueberry, areas under the blueberry plantations have been increase for almost 9 times in last decade (from 220 ha in 2015 to 1,900 ha in 2020), (Zlatković et al., 2022).

Despite the satisfactory conditions for blueberry growing in several areas of Serbia, the high yields are usually lacking as a consequence of poor use of optimal varieties and modern growing technology (Leposavic et al., 2020). On the other hand, constant growth in produced quantities (globally and locally) is the result of quite a health impact that blueberry has in human nutrition (Rodriguez Mateos et al., 2014), as well as good profitability derived from made investment in

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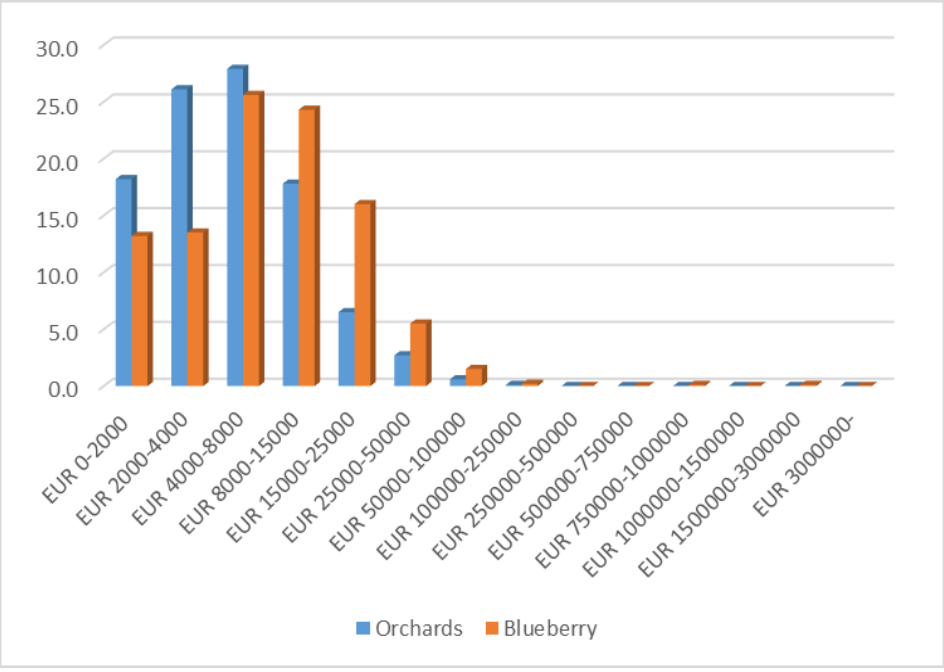
plantations, and high merchantability of final product (in fresh condition or as processed), (Leposavić et al., 2016; Gallardo, Zilberman, 2016).

Although establishment of blueberry plantations and its sustainable production the most often follow the high level of investments (Subić et al., 2022), mitigation of noticed limitation is usually done by the use of available public incentives (in Serbia they range from 50-70% of invested amount), (Kljajić, Grujić Vučkovski, 2022). According to Farm structure survey, the most of the farms involved in fruit growing (SORS, 2018) have the economic size in range 2,000-4,000 EUR (26,1%) or 4,000-8,000 EUR (27,9%). At the farms that are involved in blueberry production, the current state is much more favorable, there are the most of the farms with the economic size in range 4,000-8,000 EUR (25,6%), or 8,000-15,000 EUR (24,3%), (Graph 1.).

Graph 1. *Structure of farms according to economic size (in %)*



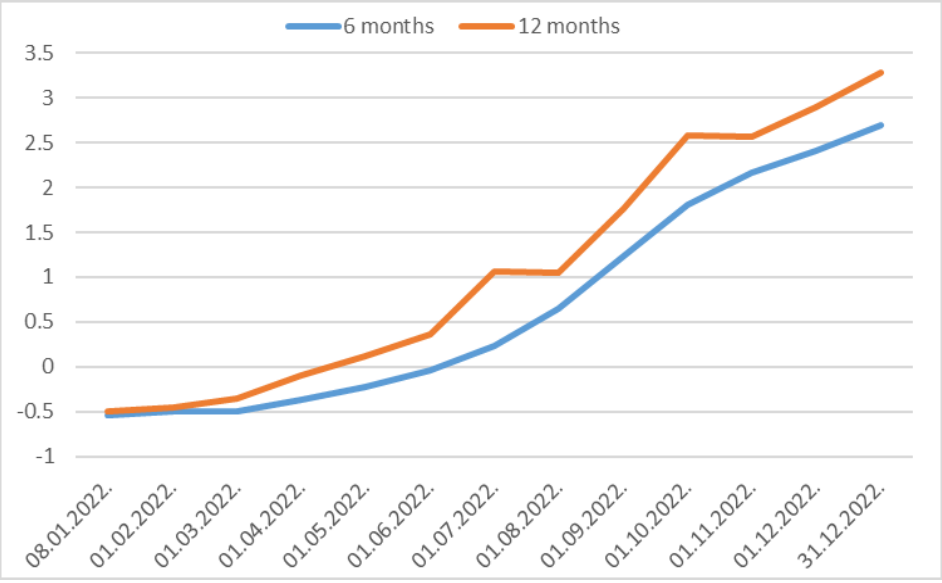
Source: SORS, 2022.

So, the majority of farms oriented to fruit production are economically so weak to follow the contemporary technological requirements or current plantation expansion, especially in blueberry production that is investment intensive line of fruit production (Sullca et al., 2019). As for establishment of blueberry plantations are

required large investments, farms that are planning to be involved in this production in the most cases are forced to go into the credit arrangement with certain commercial bank. Crediting conditions have significantly worsened in 2022, due to global rise in interest rates (Mulino, 2022). There is a common practice that farmers mostly take the loans with the variable interest rates, where the total level and amount of interest rate strongly depend on the value of EURIBOR (Delgado Tejero, 2022).

During 2022, there was not only an increase in general interest rates, but also an increase in the value of EURIBOR that is upgraded them. In calculating of overall interest, the six and twelve-month EURIBOR could be used, while their trends in 2022 are presented in next graph (Graph 2.).

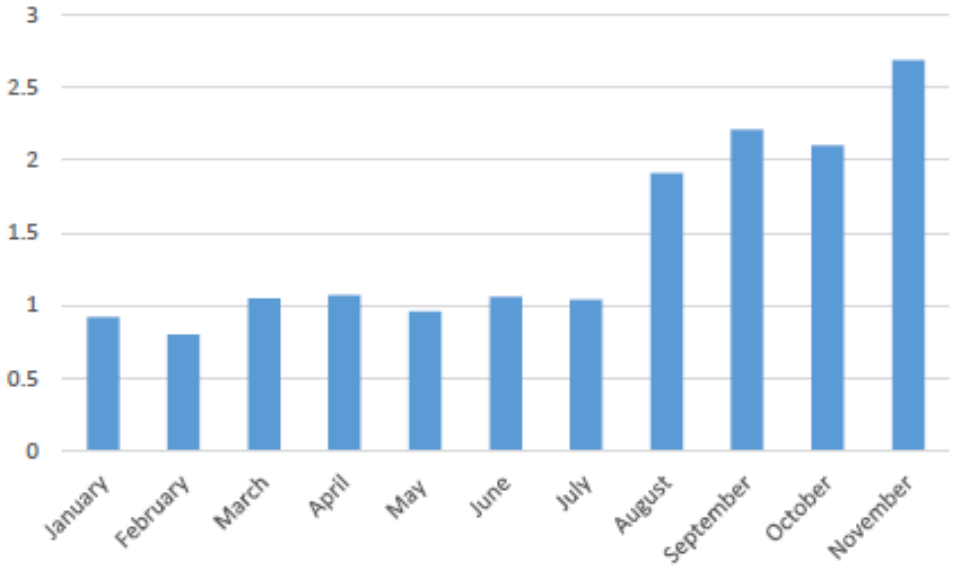
Graph 2. *Trend of 6 and 12 months EURIBOR rates in 2022 (in %)*



Source: NLB, 2022.

In line to rise in interest rate at the capital market (on credits), in 2022 there also come to increase in interest rates on citizens' savings (Graph 3.). Besides, this kind of growth in interest rates furtherly leads to increase in discount rates (linked to investments) that affects the level of economic effectiveness of investments (it initiates the lowering of their net present value).

Graph 3. *Interest rates on citizens' savings – new saving-accounts (in % at annual level)*



Source: NBS, 2022.

Therefore, in conditions of permanent growth in interest rates, both the economic effectiveness of investments and their financial acceptability (liquidity) could be called into the question. This problem is particularly pronounced due to the fact that there is still unknown the level to which the interest rates will continue to rise in next period. Therefore, for investors exists a need to determine the upper limit of discount rate up to which investments in blueberry production is profitable (i.e. the level of the internal interest rate), as well as the highest level of indebtedness that enables the investment liquidity.

Methodological framework

The research realization was based on next data sources: in-depth interviews with selected blueberry producers and fruit-growing experts, available scientific literature directed to technological aspects of blueberry production, as well as data sets of national bank and commercial banks linked to trends in interest rates towards credit arrangements in agriculture (in EUR), or interest rates on citizens savings (in EUR).

The research realization was based on the appliance of next methodological framework (analysis leans on methodological approach used by Gogić, 2009): It was determined the level of used investments in establishment of blueberry production in common pots at one hectare (Subić et al., 2022; Nastić, Bekić, 2022), while the analytic calculations of overall incomes and costs in blueberry production were developed. Economic effectiveness of made investments were assessed by the dynamic methods of investment analysis (Subić et al., 2011; Subić et al., 2021), i.e. the net present value and internal rate of return. Besides, there was determined the financial feasibility of made investments.

So, in paper was done the analysis of different share of borrowed and own financial assets used in overall investment. Investment analysis involves the blueberry growing in common pots. There were analyzed next examples of investment financing: 100% from own financial resources; 50% from own resources and 50% from the bank credit; and 100% from the bank credit.

Results with discussion

As blueberry has specific requirements towards the soil conditions and applied growing methods, there come to increase in number of producers that decide to apply the modern production system (growing in pots). So, caused by this fact in paper was assumed mentioned method of growing, i.e. its economic and financial evaluation was performed.

The total value of investment in establishment of 1 ha of blueberry plantation amounts to 160,457 EUR (calculations were made according to prices from 2022). In both variants that imply borrowed assets, the average interest rate of commercial banks that was valid in the mid of year (2022) was used. Grace period in credit repayment was two years. Of course, it is important to note that in practice there are significant difference between the farms related to level and way of investment, the level of interest rates and achieved business results (these is affected by several factors).

The applied method of financing the investment affects not only to the possibility of credit repayment, but also to the value of net present value as one of the main indicators used in assessment of the economic effectiveness of investment (Table 1.). It affects through the value of the discount rate, which is formed as a weighted average cost of used capital. Thus, it can be seen that there is a difference in derived net present value, i.e. it is for 51.7% lesser if investment is financed completely with borrowed assets compared to financing just with own farm assets.

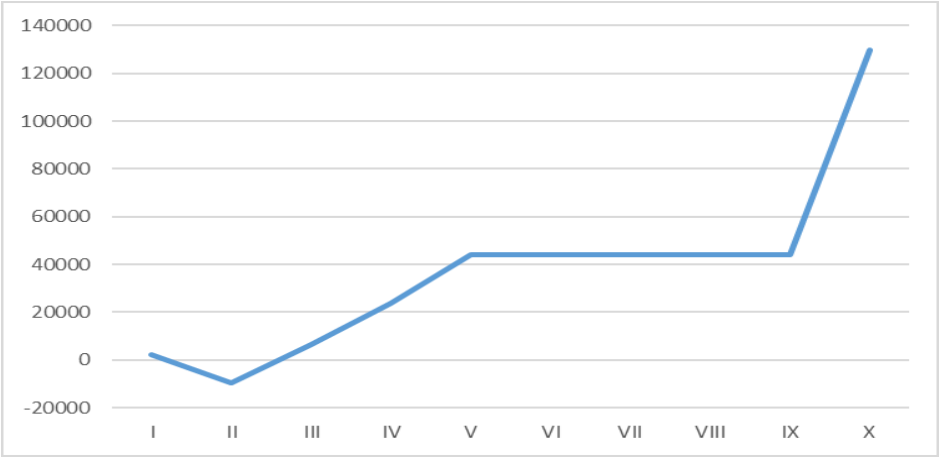
Table 1. *Level of net present value and internal rate of return*

Way of production financing	Discount rate (in %)	Net present value (in EUR)	Internal rate of return (in %)
100% - own resources	2.00	158,830.04	11.64
50:50% - own resources: credit	4.00	114,152.93	11.64
100% - credit	6.00	76,755.12	11.64

Source: IAE, 2022.

Gained results show that the investment is economically justified in all applied methods of investment financing, as the all net present values are positive. The analysis has been also shown that the upper limit of discount rate (i.e. the internal rate of return) for all financing methods is higher than the used discount rates. Influence of financing method on financial acceptability in case when the overall investment is financed by own assets is shown at the Graph 4.

Graph 4. Net receipts from the cash flow if the investment is financed entirely by own assets



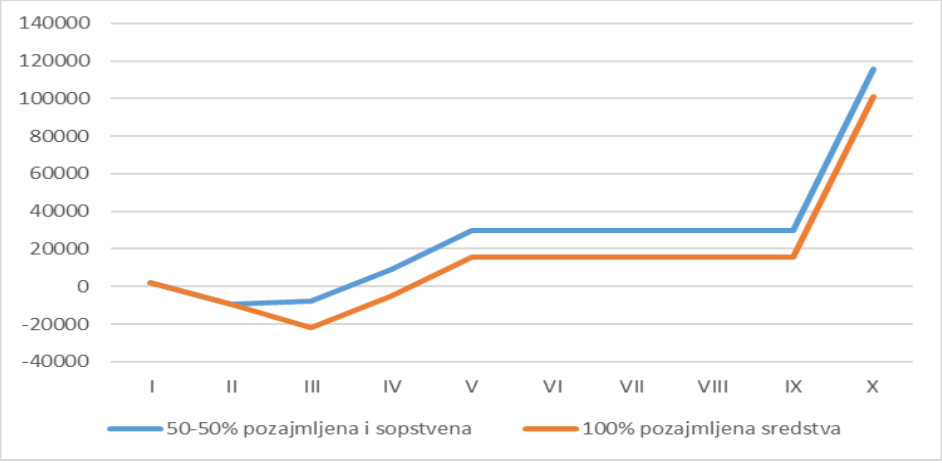
Source: IAE, 2022.

As it can be seen, only the net receipts from the cash flow in second year of the investment exploitation is negative, while all other have a positive value. The positive value in the first year mainly derives as result of the use of available public incentives for establishment of fruit plantations (OGRS, 2021). Since in the second year are gained negative receipts from the cash flow (investment is financially unacceptable in that year what is primarily caused by low initial yields),

it is necessary for farmer to provide additional financial assets for further production functioning. As the blueberry yield gradually increases within the next couple years, there come to rise in gained net income from the financial flow.

Contrary to financing the investment completely from farm's own assets, there are also possibilities in borrowing the certain part of required financial assets from commercial banks. There are analyzed two options (Graph 5.), borrowing of 50% or 100% of needed financial assets. At these two options, the investment is not financially acceptable not only in the second, but also in the third year. In some extent the more favorable situation in the third year of investment exploitation is within the financing option 50-50%. Meanwhile, if the investment is financed entirely from the credit, it is not financially acceptable even in the fourth year of exploitation.

Graph 5. *Net receipts from the cash flow if the investment is financed form the credit and own assets (50-50%) or entirely from the credit*



Source: IAE, 2022.

In order to affect the better farm business operations, there are calculated the exact share of required farms' own and external financial assets that will enable achieving the positive net income in cash flow within the third year of investment exploitation. Such results can be achieved during the investment financing by the 77.1% of own assets and 22.9% of borrowed financial assets, whereby (by the use of appropriate discount rate) is gained the net present value of investment in value of 137,276.7 EUR. So, with mentioned structure of investment financing it could be achieved its financial acceptability.

Conclusion

Performed analysis have been showed that the shift in structure of financing sources towards external sources affects the liquidity of investments more than their economic effectiveness. Indebtedness over the established limits leads to ruined financial acceptability (liquidity) of investment in second, third, or even fourth year of investment exploitation, while the investment is economically justified in entire period. Mentioned facts may affect investors that have not available sufficient sum of own financial assets to give up investing in blueberry production, what could be even more worsened in conditions of further increase in interest rates at national capital market.

Literature

1. Delgado Tejero, M. (2022). Economic prospects and impact on the financial system. Economic bulletin - Banco de Espana, 2022(4):1-6.
2. Gallardo, R., Zilberman, D. (2016). The economic feasibility of adopting mechanical harvesters by the highbush blueberry industry. HortTechnology, 26(3):299-308.
3. Gogić, P. (2009). Ekonomska efektivnost podizanja višegodišnjih zasada. Faculty of Agriculture, University in Belgrade, Serbia.
4. IAE (2022). Data and information linked to blueberry production. Internal data, Institute of Agricultural Economics, Belgrade, Serbia.
5. Kljajić, N., Grujić Vučkovski, B. (2022). Agro-tehnološki zahtevi i implementacija ruralne politike kao izazovi u savremenoj proizvodnji borovnice. In: Analiza ekonomskih efekata unapređenja proizvodnje borovnice u Republici Srbiji, (edt.) Subic, J., Institute of Agricultural Economics, Belgrade, Serbia, pp. 7-31, link: www.iep.bg.ac.rs/images/2022/Projekat%20borovnica/Borovnica%20lq.pdf
6. Leposavić, A., Mitrović, O., Popović, B., Jevremović, D., Đurović, D. (2016). Yield and quality of fruit of highbush blueberry cultivars grown in western Serbia. Journal of Mountain Agriculture on the Balkans, 19(5):148-158.
7. Leposavic, A., Mitrovic, O., Popovic, B., Jevremovic, D., Koricanac, A., Vasic, T. (2020). Yield and quality of highbush blueberry fruit grown in western Serbia. Indian Horticulture Journal, 10(3-4):29-35.

8. Mulino, M. (2022). Box 3. An approach to the possible impact of the rise in interest rates on firms' financial position. Economic bulletin - Banco de Espana, 2022(3):46-48.

9. Nastić, L., Bekić Šarić, B. (2022). Ekonomsko - ekološki aspekti unapređenja proizvodnje borovnice. In: Analiza ekonomskih efekata unapređenja proizvodnje borovnice u Republici Srbiji, (edt.) Subic, J., Institute of Agricultural Economics, Belgrade, Serbia, pp. 55-78, link: www.iep.bg.ac.rs/images/2022/Projekat%20borovnica/Borovnica%20lq.pdf

10. NBS (2022). Trend of interests on savings' accounts. National Bank of Serbia (NBS), Belgrade, Serbia, link: https://nbs.rs/sr_RS/drugi-nivo-navigacije/statistika/ks_stat/

11. NLB (2022). Trend of referent values of interest rates in 2022. NLB Komercijalna banka, Belgrade, Serbia, link: www.nlbkb.rs/ref-kompletna-arhiva.php

12. OGRS (2021). Rulebook towards the incentives for improving the competitiveness for investments in physical assets of farms throughout the support for the establishment of fruit and hop plantations. Official Gazette of the Republic of Serbia (OGRS), no. 41/21 from 23rd April 2021.

13. Rodriguez Mateos, A., Pino Garcia, R., George, T., Vidal Diez, A., Heiss, C., Spencer, J. (2014). Impact of processing on the bioavailability and vascular effects of blueberry (poly) phenols. Molecular nutrition & food research, 58(10):1952-1961.

14. SORS (2018). Farm structure survey. Statistical office of the Republic of Serbia (SORS), Belgrade, Serbia, available at: www.stat.gov.rs/sr-latn/oblasti/poljoprivreda-sumarstvo-i-ribarstvo/anketaostrukturipopgazdinstava/

15. SORS (2022). SORS e-data base. Statistical office of the Republic of Serbia (SORS), Belgrade, Serbia, available at: https://data.stat.gov.rs/

16. Subić J., Jeločnik M., Ivanović L. (2011). Dynamic evaluation of investment projects - practical approach to sustainable development of agriculture in Serbia. Quality - Access to Success, 12(supp. 2):136-143.

17. Subić, J., Jeločnik, M., Nastić, L. (2021). Economic Effects of Plum Plantation Establishment. In: Sustainable Agriculture and Rural development (edt.) Vuković et al., Institute of Agricultural Economics Belgrade, Serbia, pp. 149-162.

18. Subić, J., Jeločnik, M., Potrebić, V. (2022). Ekonomska opravdanost inovativnog načina proizvodnje borovnice. In: Analiza ekonomskih efekata unapređenja proizvodnje borovnice u Republici Srbiji, (edt.) Subić, J., Institute of Agricultural Economics, Belgrade, Serbia, pp. 79-118, link: www.iep.bg.ac.rs/images/2022/Projekat%20borovnica/Borovnica%20lq.pdf

19. Sullca, C., Molina, C., Rodriguez, C., Fernandez, T. (2019). Diseases detection in blueberry leaves using computer vision and machine learning techniques. International Journal of Machine Learning and Computing, 9(5):656-661.

20. Zlatković, N., Aleksić, G., Gašić, K. (2022). First report of bacterial canker on blueberry (Vaccinium corymbosum) caused by pseudomonas syringae pv. syringae in Serbia. Plant Disease, 106(3):1057.

IMPLEMENTING SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT CONCEPT IN THE EU AND SERBIA

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Abstract

The concept of sustainable agriculture and rural development is recognized both in theory and in practice. Nonetheless, the ideal model and method of institutional support that would ensure the best possible harmonization of the economic, environmental and social components of sustainable development of agriculture and rural areas, is still being sought. Thus, the subject of research conducted in this paper is the implementation of the concept of sustainable agriculture and rural development in the European Union (EU) and the Republic of Serbia. The aim of the research is to indicate the possibilities of sustainable agricultural and rural development in modern circumstances. The research results show that the concept of sustainable agriculture and rural development has been successfully implemented in the EU over a long period of time, however, it is accompanied by a number of limitations. In terms of Serbia, numerous weaknesses and risks relating to the process of sustainable development of agriculture and rural areas have been identified, as well as significant resource potentials and development opportunities, which should be exploited more effectively and efficiently.

Key words: *sustainable development, agriculture, rural areas, European Union (EU), Republic of Serbia.*

Introduction

Sustainable development seeks to ensure long-term balancing of the economic, environmental and social goals in the development process. In an effort to better understand and implement the concept of sustainable development,

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the fourth component (institutional dimension) has emerged as an important factor in supporting sustainable development.

The concept of sustainable development is increasingly becoming the focus of interest worldwide, which is further confirmed by the Agenda 21 (UNCED, 1992), the United Nations Millennium Declaration (UN, 2000) and the more recent 2030 Agenda for Sustainable Development (UN, 2015) including its sustainable development goals (SDGs) endorsed by the European Union (EC, 2017), the Republic of Serbia (PPS, 2017) and other world countries.

Over the last decades, the concept of sustainable development is considered relevant, both in theory and in practice, especially concerning its mainstreaming into the national- and local-level strategies of many countries, as well as the development of various sectors of the economy, including agriculture and rural economy.

Given the topicality of the issue of sustainable agriculture and rural development, the subject of the research in this paper is the implementation of the concept of sustainable agriculture and rural development in the European Union (EU) and in the Republic of Serbia. Specifically, the research focuses on whether and to what extent this concept has been implemented in the EU and Serbia, as well as if its implementation can be more successful in the future in terms of the economic, environmental and wider social context.

The aim of the research is to bring attention to the opportunities for sustainable agriculture and rural development in contemporary circumstances, particularly considering the Republic of Serbia and its process of harmonization with the EU policies and current tendencies.

The research builds on the following hypothesis: A successful implementation of the concept of sustainable agriculture and rural development in practice is unattainable, unless, considering the modern conditions, the implementation of the long-term strategies for sustainable development of agriculture and rural areas is adapted to the everchanging environment relating to the world economy and society, as well as the national and local frameworks.

For the purposes of the research conducted in this paper, comparative, descriptive and historical methods are used, as well as the SWOT analysis. Accordingly, the research is greatly complemented by: numerous scientific papers and websites on sustainable development; strategic documents, official statistical data, periodic reports and relevant publications on agriculture and rural development in the EU and Serbia.

Literature review

In addition to the efforts of the UN (United Nations) and a number of individual countries, including EU member states and Serbia, many scientists research the issue of sustainable development of agriculture and rural economy in their scientific studies. Dos Santos & Ahmad (2020) analyse the sustainability of the development of European farm holdings and emphasize the necessity of greater promotion and facilitation of the implementation of the sustainable agriculture development concept in Europe. Jurkėnaitė et al. (2022) observe, through the sustainability prism, the structural changes in agriculture that EU member states are often faced with, therefore, in this particular context, they further study the issues relating to production, employment, energy, etc. Schebesta et al. (2020) analyse the latest EU agriculture and rural development strategies from the perspective of sustainability of development and social responsibility of business in the entire chain of food production and marketing. Bonfiglio et al. (2017) explain, using the example of the EU, the great importance of knowledge transfer and innovation for sustainable rural development. Kernecker et al. (2020) investigate the experiences and expectations of European farmers relating to the application of modern technologies in agriculture. Cojocaru et al. (2022) emphasize the significant role of efforts at the national and EU level for the sustainable development of rural areas, within the framework of a large number of strategic documents, regulations and budget allocations.

Given that the Republic of Serbia is currently in the process of EU accession, as well as the country's efforts to meet the sustainable development requirements which are the important element of this process, the issue of agricultural and rural sustainability is being given great attention, both by institutions and individual authors and researchers, since this concept promises a more harmonious realization of development goals. Veselinović et al. (2022) analyse agrarian policy as a very important factor of sustainable rural development in the Republic of Serbia. Vujičić et al. (2013) indicate the great importance of local initiatives for sustainable rural development in the Republic of Serbia. Veličković & Jovanović (2021) point to the most important problems and possible directions of sustainable rural development of the Republic of Serbia. Zečević et al. (2019) propose a business model, which if implemented in Serbian agriculture, will lead to sustainable development, at the same time underlining the importance of the more rational use of available rural resources and more adequate waste management. In addition to the

above stated, a large number of other authors, as well as competent institutions, analyse the situation in agriculture and rural areas of the Republic of Serbia from various relevant aspects of sustainability, suggesting innovative concepts and approaches that could be successfully implemented in practice.

The EU's strategic directions regarding sustainable agricultural and rural development

The realization of the sustainable development concept is best represented using the SWOT analysis, since this is a tool which concisely and unambiguously identifies the potentials, limitations, opportunities and risks in the process of sustainable agricultural and rural development in the EU (Table 1). For the purpose of the SWOT analysis conducted in this paper, EC DG AGRI (2022) data and other sources that do not represent the official EU position, however, are relevant from the point of their specific analyses and research of the related aspects of the sustainability of agriculture and rural development in the EU, as well as other important related issues, are considered useful. Therefore, due to their contribution to a better understanding of the issues studied in this paper, they are included in the analysis.

The SWOT analysis presented in this paper which builds on comprehensive and predominantly recently produced literature in this scientific field, indicates that a very active policy of supporting the sustainable development of agriculture and rural areas in the EU is being implemented, however, certain limitations are also identified, such as the fact that some "green mechanisms", which represent an important feature of sustainable development, do not promise farmers large profits, but rather focus on the environmental component of sustainable development. These mechanisms are not entirely acceptable to EU farmers, as it is questionable whether green approaches will be able to completely replace conventional and highly profitable forms of agriculture. At the same time, large allocations from the EU budget for the needs of sustainable development of agriculture and rural areas also represent a problem, because not all EU member states agree with such an approach, while other non-EU countries have been voicing their disagreement with such an approach over a relatively long period of time.

Table 1. *SWOT analysis of sustainable agriculture and rural development in the EU*

STRENGTHS	WEAKNESSES
• Establishment and reform of the Common Agricultural Policy (CAP) • Six-year programming periods • Single market and trade preference of the EU • Agriculture and rural development funds • Direct payments • Introduction of environmental protection measures • Diversification of the rural economy • The European Network for Rural Development (ENRD) • Long-established protectionist policy of the EU farmers' status and income, thus their more favourable position compared to the non-EU farmers • Leading position on the agricultural market, in rural tourism and etc.	• Protectionist CAP, especially in the past period, in terms of exports, market interventions and price protection which coupled with dissatisfaction of non-EU countries and small EU farmers results in surpluses of certain products, negative impacts on the environment due to intensive agricultural production and etc. • Huge allocations from the EU budget for agriculture and rural development • Uneven development of agriculture and rural areas in the EU - old and new member states • Strong EU farmers' biases concerning certain green instruments • Brexit, slow pace of the EU enlargement process, complicated procedure of harmonization with the EU, pre-accession funds are not adapted to the specific circumstances and needs of the EU candidate countries
OPPORTUNITIES	THREATS
• Achievement of a long-term vision for rural areas (LTVRA) up to 2040 • Implementation of the Farm to Fork Strategy, the Green Deal, the Rural Pact and the EU Rural Action Plan • Greater resiliency to climate change, natural disasters, economic and energy crises, pandemics and corresponding contemporary challenges • Keeping a leading position on the world agricultural market, as well as in the development of rural tourism and etc. • Precision agriculture and social innovations - implementation of the "Smart Villages" concept • Green economy, bioeconomy and circular agriculture • Renewable energy • International cooperation • Improvement of the agrarian and rural policy and relevant legislation • Diversification in the emerging sectors of the rural economy • More equitable development of rural areas	• Financial limitations • Climate change • International relations • Problems relating to supplying food, energy, agricultural inputs and etc. • Expansion of GMO production and amplified trade in GMOs • Disagreement of farmers in the EU with all environmentally-oriented measures • Strengthening of competition on the international agricultural market • Emergence of the new rural destinations across the world in the non-EU countries • Demographic challenges • Declining attractiveness of the EU • Establishment of new international integrations • Excessive red tape which impedes flexibility and quick responsiveness • Emerging contemporary challenges that continually appear in the fields of economy, law, politics, environmental protection, health, migration, employment, science, education, culture, technology and etc.

Source: authors' research.

In addition to the aforementioned, numerous modern problems (the COVID-19 crisis, climate change, international conflicts, the problem of food and energy supply, etc.) further complicate the realization of the concept of sustainable agricultural and rural development in the European Union. If the increased risk of the emergence of new restrictions is also taken into consideration, and this is certainly expected in the coming period, it is quite clear that the European Union will have to additionally reform, improve and modernize its policy in the field of sustainable development of agriculture and rural areas.

Sustainable development of agriculture and rural areas in the Republic of Serbia

The SWOT analysis of the sustainability of the development of agriculture and rural areas in the Republic of Serbia, as well as in the case of the European Union (EU), identifies resource potentials, issues, feasible directions of development and potential limitations in this process (Table 2).

The analysis relies greatly on the current strategy, national programmes and reports on the state of agriculture and rural areas in the Republic of Serbia (MAFWM, 2022).

SWOT analysis is a widely used and a very powerful instrument in researching the state and prospective directions of development of agriculture and rural areas, therefore, it is important to carry out this analysis periodically, due to the emergence of new factors which can greatly affect the sustainability of agricultural and rural development.

The sustainable development of agriculture and rural areas in the Republic of Serbia is an exceptionally important task for the state institutions, the agricultural community and the non-agricultural rural population, as well as for the local economy and society.

Monitoring the situation in agriculture and rural areas, with a view to strategic importance of the long-term and stable agricultural production, security of appropriate food quality supply, increase in exports, rational use of available rural resources and concern for the rural population, can greatly contribute to the realization of the concept of sustainable development of the Republic of Serbia in the process of European integration, as well as within the framework of broader international cooperation.

Table 2. *SWOT analysis of sustainable development of agriculture and rural areas in the Republic of Serbia*

STRENGTHS	WEAKNESSES
• Natural resources and favourable natural conditions for agricultural production • Regions suitable for arable farming, fruit growing, viticulture and grazing cattle breeding • Long agricultural tradition • Specific features of Serbian villages and agriculture • Strategy and national programmes for agriculture and rural development • Examples of good practice in agriculture • Examples of good practice relating to non-farming activities in rural areas • Rural tourism in certain regions	• Decades-long insufficient institutional support for agriculture and rural development • Insufficient investment in agriculture and rural areas • Obsolete agricultural machinery • Small-sized agricultural land area • Unfavourable demographic structure and migrations of the rural population • Underdeveloped agriculture and non-agricultural activities in rural areas • Insufficiently developed rural infrastructure • Inadequate waste and environmental protection management
OPPORTUNITIES	THREATS
• Adoption and implementation of a new sustainable development strategy with a special emphasis on agriculture and rural development • Greater institutional support for sustainable agriculture and rural development • Utilization of IPARD funds • Development of rural infrastructure • Sustainable models of development of agriculture and non-agricultural activities in rural areas • Organic production • Export of high-quality agricultural and food products • Sustainable types of tourism in rural areas • Innovative approaches	• International economic and political relations • Food prices, agricultural land prices, energy prices and prices of other agricultural inputs • Competition in the field of agriculture and rural development • Climate change • Growing environmental challenges • Pandemics • Limited budget resources • Requirements of EU pre-accession funds • Rural poverty and social exclusion • Purchasing power of the population • Insufficient interest of investors in agriculture and rural economy

Source: authors' research.

Conclusion

Based on this research, while also taking into account the results of earlier research in this field, it can be concluded that the concept of sustainable agriculture and rural development has been implemented successfully in the EU for a relatively long time, however such development has also been accompanied by numerous limitations concerning all programming periods of the EU agriculture and rural development policy implementation. In contemporary conditions, the EU insists on more intensive introduction of environmentally-friendly and conservationist approaches in agricultural and rural development, that is, on encouraging the green agrarian and rural economies, which is neither

simple, nor entirely acceptable for all farmers and non-agricultural rural population in the EU. In addition, financial restrictions, the circumstances surrounding pandemic outbreaks, the food and energy supply issues and the deteriorating international relations of the EU, greatly require greater flexibility and the reformation of certain directions of the development of agriculture and rural areas in the EU, considering that the EU strives to achieve sustainable, i.e., long-term coordinated development of agriculture and rural economy.

In terms of Serbia, there are numerous weaknesses and many limiting factors in the process of sustainable development of agriculture and rural areas, but also significant resource potentials, primarily natural resources, and therefore development opportunities that should be used more creatively. With adequate institutional support and greater use of available funds for sustainable agricultural and rural development, the concept of sustainable agriculture and rural development in the Republic of Serbia could be implemented much more successfully in the future. This concept should be a framework for achieving economic, ecological and social goals and their adequate implementation in practice and which are also relevant for domestic farmers and other rural population, as well as for the wider social community and the national economy.

In accordance with the afore presented analysis, it can be concluded that the hypothesis set in this paper as the basis from which the further research started, has been confirmed - that is, successful implementation of the concept of sustainable agricultural and rural development in practice is unattainable, unless, considering the modern conditions, the implementation of the long-term strategies, programmes and plans for sustainable development of agriculture and rural areas are adapted to the everchanging environment relating to the world economy and society, as well as the national and local frameworks.

Literature

1. Bonfiglio, A., Camaioni, B., Coderoni, S., Esposti, R., Pagliacci, F., Sotte, F. (2017): *Are rural regions prioritizing knowledge transfer and innovation? Evidence from rural development policy expenditure across the EU space,* Journal of Rural Studies, 53, pp. 78-87.
2. Cojocaru, T. M., Pirvu, R., Dinulescu, S., Tenea, L. (2022): *National and European Actions for the Development of Rural Areas - Stimulus for Ensuring the Sustainability of Economic Development,* Journal of Environmental Management and Tourism, 13(2), pp. 586-599.

3. Dos Santos, M. J. P. L., Ahmad, N. (2020): *Sustainability of European agricultural holdings*, Journal of the Saudi Society of Agricultural Sciences, 19(5), pp. 358-364.

4. EC (2017): *Sustainable Development Goals – EU delivering on the UN 2030 Agenda*, European Commission, Brussels.

5. EC DG AGRI (2022): *Agriculture and Rural Development,* European Commission – Directorate-General Agri, EU.

6. Jurkėnaitė, N., Baležentis, T., Štreimikienė, D. (2022): *The sustainability prism of structural changes in the European Union agricultural system: The nexus between production, employment and energy emissions*, Business Strategy and the Environment, 31(1), pp. 145-158. https://doi.org/10.1002/bse.2879

7. Kernecker, M., Knierim, A., Wurbs, A., Kraus, T., Borges, F. (2020): *Experience versus expectation: farmers' perceptions of smart farming technologies for cropping systems across Europe*, Precision Agriculture, 21, pp. 34-50. doi.org/10.1007/s11119-019-09651-z

8. MAFWM (2022): *Documents & Announcements*, Ministry of Agriculture, Forestry and Water Management, Republic of Serbia, Belgrade, www.minpolj.gov.rs

9. PPS (2017): *Serbia and 2030 Agenda,* Government of the RS - The Public Policy Secretariat of the Republic of Serbia, Belgrade.

10. Schebesta, H., Bernaz, N., Macchi, C. (2020): *The EU Farm to Fork Strategy: Sustainability and Responsible Business in the Food Supply Chain*, European Food and Feed Law Review, 15(5), pp. 420-427.

11. UN (2000): *Millennium Declaration*, United Nations, NY.

12. UN (2015): *Transforming our world: The 2030 Agenda for Sustainable Development,* United Nations, NY.

13. UNCED (1992): *Agenda 21*, United Nations Conference on Environment and Development, Rio de Janeiro, Brazil.

14. Veličković, J., Jovanović, S. (2021): *Problems and possible directions of the sustainable rural development of Republic of Serbia*, Economics of Sustainable Development, 5(1), pp. 33-46.

15. Veselinović, P., Despotović, D., Ristić, L., (2022): *Agricultural policy as an element of sustainable rural development of the Republic of Serbia*, In: (Eds): Jonel Subić, Predrag Vuković, & Jean Vasile Andrei, Sustainable agriculture and rural development II (pp. 121-130), Institute of Agricultural Economics, Belgrade.

16. Vujičić, M., Ristić, L., Ćirić, N. (2013): *Local Initiatives for Rural Vitality and Social Inclusion: Some Experiences from Serbia,* Eastern European Countryside, 19, pp. 105-126. DOI:10.2478/eec-2013-0006

17. Zečević, M., Pezo, L., Bodroža-Solarov, M., Brlek, T., Krulj, J., Kojić, J., Marić, B. (2019): *A business model in agricultural production in Serbia, developing towards sustainability*, Economics of Agriculture, 66(2), pp.437-456. doi.org/10.5937/ekoPolj1902437Z

THE LEGAL NATURE OF AGRICULTURAL LAND DIVISION AGREEMENTS WITH REFERENCE TO THE PRINCIPLE OF REGISTRATION AND RELIANCE IN THE CADASTRE

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Apstract

In this paper, the author analyzes the legal nature of the contract on the physical division of agricultural land, which is the basis for acquiring ownership rights to real estate created by division. The contract is concluded in the form of a notarial document, which proves the resulting legal relationship and represents the assumption of the accuracy of the data specified in the contract. The burden of proving the falsity of the data is borne by the one who disputes its veracity. The notary public has the obligation to check whether the transaction is permitted and to warn the parties of the legal consequences of the transaction.The purpose of real estate records is to provide reliable evidence of ownership or other rights to real estate. In the practice of Serbia, it has been shown that there are errors in the cadastre records, which is contrary to the general principles of cadastre management, but leads to errors in the contract. In the case of a dispute for the annulment of the document, the contractors would have to prove separately that the facts were untruthfully stated in the document or that it was drawn up improperly, due to an error in the cadastre. To achieve the purpose of the principle of reliability of registration in the cadastre, the creators of the regulations, as well as those who apply them, are responsible.

Key words: *Physical division, contract, constitutivity, principle of reliability of registration in the cadastre, errors in the cadastre.*

Introduction

Rights and obligations between market participants can arise on various grounds. In all national regulations, contractual relations are mainly regulated by dispositive norms, that is, norms whose form and content the contracting parties can contract, change at will and adapt to their interests (Rajnović 2021). Obligations between business entities arise by concluding contracts,

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in various forms or informally, when agreement is reached on the essential elements of the contract. The contract is the work of the parties. That power of legal subjects to create, change or cancel binding legal relations of their own free will is based on the generally accepted principle of autonomy of will *or freedom of contract.*

Co-ownership is the property right of several persons on the same thing that is not physically divided. The shares of co-owners are aliquoted, ideal, undetermined. Shares of co-owners are determined by fractions or percentages. If the size of the co-ownership shares is not precisely determined, there is a presumption that the shares are equal. Co-ownership is created in various ways: a gift contract, sale, exchange, will, court decision, etc. The co-owner has the right to dispose of his co-owned part. If he wants to sell his co-ownership share, he must first offer it to the other co-owners with the right of first refusal. The co-owner has the right to demand the division of things at any time, except when the division would be to the detriment of other co-owners, unless otherwise stipulated by law.

A contract on the physical division of agricultural land is a contract on the basis of which the (exclusive) right of ownership is acquired on real estate that is created by division. The contract is concluded in the form prescribed for real estate contracts, which have changed over time (Act on Public Notaries). The Law on Obligations stipulates that a contract that is not concluded in the prescribed form has no legal effect, if something else does not follow from the purpose of the regulation that determined the form. The Law on the Basics of Property Relations stipulates that the right to property is acquired according to the law itself, on the basis of a legal transaction, by inheritance, by a decision of a state authority, etc. When ownership of real estate is acquired on the basis of a legal transaction, it can be acquired and lost only by registration in the real estate cadastre, which means that the registration in the cadastre, on that basis, has a constitutive character.

Metodology and data sources

The information and data used for the research in this paper were obtained by analyzing the case of the division of agricultural land. Information related to data entered in the cadastre, errors in entered data, are the result of years of research by the author, analysis of examples from practice and publicly available information via the Internet and other means of information.

The main goal of this paper is to show the legal nature of the contract on the division of agricultural land and the importance of the reliability of registration in the real estate cadastre. The research was conducted on the Serbian market in the last three years. In order to collect and evaluate relevant information, the following methods were used:

- case analysis, which refers to the division of agricultural land,
- interviews with 100 owners of agricultural land as a descriptive method, the subject of which is the research of fees paid for drainage by JP Voda Vojvodina, because it was noticed that there are thousands of cases of improperly determined fees in the territory of Vojvodina,
- the comparative method enabled the author to reach generalizations or new conclusions by comparing the same or similar phenomena or establishing similarities and differences between them,
- the synthesis method was used to summarize the conclusions, while giving recommendations for the application of good rules in this area.

From the analysis of all collected data and the fact that Serbia is predominantly a rural country, which is important for the entire economy, the author came to the knowledge that the real estate cadastre does not function reliably and efficiently. Considering the importance of the real estate cadastre, it is necessary to improve the operation of the cadastre as soon as possible, for which the state is responsible. Also, there are evident differences in the regulations related to the legal nature of the partition agreement.

Results with discussion

Division of co-ownership

In order to precisely determine which part of the real estate belongs to each co-owner, it is necessary to divide the property. The right to demand the division of things does not expire, and any waiver of the right to division is null and void. When the co-owners decide to divide the real estate, the question of the form of the division agreement arises. In judicial practice and doctrine, (complete) physical division can be done in two ways:

- division in which the co-owners acquire exclusive ownership of the immovable property being divided, in proportion to the ideal parts of each of them and

- division in which the co-owners perform a physical division of the property out of proportion to the corresponding co-ownership shares.

There is an understanding that the first (partition) does not represent turnover and the second represents a partial turnover, a gift or a sale, depending on whether compensation is given for the difference or not. The division of things can be physical or civil. First of all, it is determined whether it is possible to physically divide the real estate so that separate parcels are formed from it in proportion to the shares owned by the co-owners. If this is not feasible, the court will order a civil division, which means the sale of the real estate and the distribution of the compensation received in proportion to the shares of the co-owners. If the item does not sell on the first try, the items are sold below market value on the second try. The court makes a decision to carry out the division by selling things if physical division is impossible or is possible only with a significant reduction in the value of things.

The proposal submitted to the court for the division of real estate must include all co-owners. If, during the procedure, the participants reach an agreement on the conditions and method of division, the court enters that agreement into the minutes, making sure that the settlement settles all disputed issues between the co-owners, as well as the real rights of other persons on the subject of the division. If the participants do not reach an agreement on the division, the court is obliged to listen to the participants, present the necessary evidence, and if necessary, expert testimony, and based on the results of the entire procedure, the court makes a decision on the division of common property, taking care to satisfy the justified demands and interests of the co-owners.

Legal nature of the agreement on the division of agricultural land

In judicial practice in Serbia, opinions related to the nature of the contract on the division of the co-ownership community are divided, sometimes contradictory. This well illustrates the position according to which the partition agreement does not constitute a real estate transfer agreement, so its validity and validation do not require conditions from the law on real estate transfer, and that: to be concluded in the form of a notary public (solemnization) certificate and to be certified by a notary public on whose territory the immovable property is located (Act on the Transfer of Immovable Property). If an oral agreement on partition has been executed, the conditions for its validation are evaluated based on the provisions of the law on obligations, which stipulates that an agreement for the

conclusion of which a written form is required is considered valid even if it was not concluded in that form if the contracting parties have fulfilled their obligations , in whole or in most part, unless something else obviously follows from the purpose for which the form is prescribed. (Supreme Court of Serbia, 1996; Bulletin of the District Court in Belgrade, 2006; Ćosić, F., 1960). At first glance, the form is not required, but if the court is talking about convalidation, it is a formal contract, and there was no other regulation that stipulated the form except for the law regulating the sale of real estate at the time of the decision. (Hiber, D., 1998)

The provision of the Law on State Survey and Cadastre has a different attitude, which stipulates, among other things, that a private document, i.e. a document on a legal transaction, in order to be eligible for registration in the real estate cadastre, must be drawn up in written form with the signature of the contractor certified, if a different form documents is not prescribed by a special law. Also, it is stipulated that the contract must contain a statement on the registration permission, which is neither conditional nor time-bound (clausula intabulandi), and if the registration permission statement is not included in the contract, it can be given in a separate document with the signature of the person making the statement certified. It follows from the above that the partition agreement is a document that is the basis for the registration of real rights in the real estate cadastre, but that as a private document, it can be in the form of signature verification.

Before drawing a conclusion about the necessary form of the partition agreement, the purpose of the form must be taken into account. Bearing in mind the importance of the real estate cadastre, it could be said that the form of the partition agreement is necessary above all for the protection of public interests, and that the provisions on the form of the contract relating to the transfer of real estate should be applied analogously to all types of partition agreements and should interpret them in connection with other provisions of the law regulating real estate transactions. Furthermore, the provisions of the Family Law prescribe that the agreement on the division of common property acquired in marriage is concluded in the form of a notarized (solemnized) document. When all the above circumstances are taken into account, it can be concluded that the contract on the physical division of real estate represents:

- basis for the creation of new immovable properties (i.e. physical parts of the same immovable property) as well as

- basis for acquiring (registration) of ownership rights on that new immovable property in the immovable cadastre.

The legal question is whether it has a translational and at the same time constitutive effect, that is, whether the participants in the subdivision acquire ownership of the new object or whether it only has a declarative effect, so that it only determines the already existing property right. In support of the first understanding, according to which we are talking about the acquisition of the exclusive right of ownership, and thus the transfer, is the position that no co-owner was the exclusive owner of any piece of immovable property and that he acquires exclusive ownership based on the partition agreement and registration in the cadastre. In support of the second understanding, according to which there is no turnover, but that it is only a declaration, the position is that each co-owner was already (in proportion to his share) the owner of each piece of immovable property that is the subject of division, and thus of the newly created immovable property. The author believes that, according to the law governing the real estate cadastre, the declarative effect of the contract is in question. This is supported by the tax regulations that regulate the division of co-ownership in the tax sense.

Tax treatment of contracts on the division of agricultural land

In practice in Serbia, the derived question of the application of tax rules to the contract on the division of immovable property has arisen: is it a transfer of absolute rights or not, has there been a taxable case to which the rules on taxation of transfer of absolute rights on immovable properties are applied? The legislator solved the dilemma by deciding to exempt that case from taxation (Law on Property Taxes). Payment of tax on the difference (disproportion) allows the attitude that in the basic part that transaction is treated as a real estate exchange contract.

The principle of trust in the real estate cadastre

Historically speaking, the purpose of real estate records has always been to provide reliable proof of ownership and other rights to real estate. Viewed from that aspect, the goal of the legator is to ensure the safety of legal transactions, the safety of the holders of existing rights on chattels, but also of conscientious third parties who appear as potential holders. (Cvetić, R. 2015). The principles of real estate registration should represent the most general

rules on which it is based, i.e. should represent the conceptual framework that is the basis for its arrangement (Vodinelić, V. 2014). At the same time, there are great differences in legal theory when determining which rules should be given the most general character, especially in the case when the legislator does not reserve this role for himself. The character of the most general rules of land registry law in our legislation is given by the principles of registration, trust, legality and priority order (Orlić, M., Stanković, O., 1996).

The principle of trust is the most important principle in legal transactions. It guarantees that the data in the cadastre is accurate, true, reliable and up-to-date. The main legal consequence of this is that no one can bear adverse consequences for relying on the correctness of cadastral data. The principle of trust guarantees legal certainty to all economic entities.

Legal theory talks about the operation of the principle of trust in a double sense. This means that a conscientious acquirer can rely on the veracity of the data entered in the real estate cadastre and the completeness of the cadastre as a public register of real estate rights. In doing so, the question arises as to whether the assumptions about the truth and completeness of the register are irrefutable or rebuttable. The principle of reliability protects only the conscientious acquirer, i.e. the one who justifiably believed that the data entered in the real estate cadastre are correct. Conscientious persons cannot have negative consequences even in a situation where the written state differs from the actual state (Orlić, M., Petrović, D.,1976).

Considering the long-term unsatisfactory state of real estate records in Serbia, the principle of reliability of registration in the real estate cadastre has been seriously questioned. In practice, numerous cadastre omissions are evident. It is common knowledge that in the observed period there were about 10,000 complaints from owners of agricultural land on decisions on the determination of drainage fees only in the territory of AP Vojvodina. The mentioned fees are paid according to the decision issued by JP Vode Vojvodina and are calculated on the basis of data provided by the cadastre on the area of land owned by each taxpayer. In the observed period, the number of complaints from taxpayers indicates the number of cadastre errors, so many administrative disputes, costs for taxpayers that will ultimately be borne by whoever made the mistake. Out of 100 owners of agricultural land, interviewed for the purposes of the research of this work, it was determined that in 46% of cases there was a cadastral error in the submitted information about the area of owned land. In addition to the

above, numerous omissions were caused by taking over old non-existent mortgages from the land registers, then omitting personal data, such as registration numbers, addresses, etc. owner of the property.

Example of a contract on the division of agricultural land

Three persons became co-owners of 1/3 of plot number 118, a first-class field with an area of 4ha 47a and 12m2, based on the probate decision of the court from 1978. After that, in 2016, the Disposition, the division of the said field, was made at the request of the three co-owners by the surveyor. It was then realized that, without any prior information, the said plot was divided in the cadastre into a plot of the first class sub-number 1 and a plot of the second class sub-number 2. By disposition, the plot was divided into three cadastral plots numbered 118/1, 118/2 and 118/3. The competent cadastre office carried out the described division, but in such a way that the co-owners of each plot were all three contractors. The cadastre continues to make a mistake and unjustifiably divides each of the three parts of the plot into first and second class plots, even though this is physically and legally impossible. In this way, all three co-owners become co-owners of six ideal parts of the plot, namely three parts of the first class plot and three parts of the second class plot.

The contractors certified the contract on the division of the field with a notary public. Each of these parcels, due to a cadastre error, was divided into two parcels, one of which is of the first class and the other of the second class. The area of the divided property corresponds to the previous co-ownership shares. The division of immovable property resulted in new plots, marked with different numbers. After the division, the contractors have a difficult road to rectify the mistake.

Conclusion

Real estate is one of the most important elements of the social and economic system of Serbia, and that is why it is in the interest of the state and individuals to keep accurate and systematic records of them. The main interest of the state is the possibility of insight into all transactions related to real estate, first of all for legal security, but also for other reasons, in which we primarily count public revenues. Individuals, on the other hand, are most interested in fast and easy real estate transactions, up-to-date and accurate records, so that they can be sure that their property is legally protected and that the possibility of negligent behavior is excluded.

When it comes to the form of the contract on the physical division of co-ownership, it could be concluded that the form is necessary above all for the protection of public interests. It is a legal question whether the agreement on the division of immovable property has a constitutive effect or only a declarative effect, so that it only determines the already existing right of ownership. In support of the declarative effect, the law that governs the cadastre and the tax regulations that regulate the division of co-ownership in the tax sense speaks.

It is obvious that there is a need to have a complete and comprehensive public register, which would consistently apply the principles of registration and trust in the register. Therefore, it is necessary to eliminate the shortcomings that occur in practice. The creators of the regulations, as well as those who implement them, are responsible for that. Also, it is necessary to review the practice of notaries public, because if the contract on the physical division of immovable property is of a declarative nature, in that case only the signature is notarized by a notary public, and constitutiveness is acquired by entering it into the real estate cadastre.

Changes in legal rules and institutions should follow the development of social relations and the demands arising from that development, but at the same time they must be imbued with the principle of legal certainty, which must constantly follow the law in its dynamics and which is an inevitable attribute of every legal order. Therefore, the principle of reliability must not be questioned. The basic specificity of the state is that, with its policies that it creates and implements, it should define the key issues of the rules of the game for all market participants.

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Literature

1. Cvetić, R. (2015). The reach of the principle of registration and the principle of trust in the real estate cadastre in our judicial practice, Proceedings of the Faculty of Law in Novi Sad 3/2015, Faculty of Law of the University of Novi Sad, doi: 10.5937/zrpfns49-9508, p. 1017-1036.
2. Hiber, D., (1998). Consolidation of property rights in the land registry system, foreword for the reprint of the book Dragoslav Matić, Tihomir Đoković, Land registry procedure, Belgrade, 1998. XIII.

3. Orlić, M., Stanković, O., (1996). Real law, Faculty of Law, University of Belgrade, p. 327 – 343.

4. Orlić, M., Petrović, D., (1976), On the scope of the principle of trust in our legal system, Pravni život, Association of Lawyers in the Economy of Serbia, p. 330-340.

5. Perović, S., (1995). Commentary on the Law on Obligations, Modern Administration d.d. Belgrade.

6. Rajnovic, Lj., (2021), Contracts in the economy with reference to external influences on the contractual relationship, Institute of Agricultural Economics, Belgrade.

7. Vodinelić, V. (2014). Civil Law, Introduction to Civil Law and General Part of Civil Law, Faculty of Law, University of Belgrade, p. 41 – 49.

8. The Supreme Court of Serbia Rev. no. 3608/96, dated November 13, 1996 - Bulletin of the District Court in Belgrade, No. 70/ 2006).

9. Ćosić, F., (1960) Acquiring ownership rights to immovable property by registration in land registers, Legal life, 11.12/1960, p. 76.

10. Law on State Survey and Cadastre ("Official Gazette of the RS", no. 72/2009, 18/2010, 65/2013, 15/2015 - decision of the US and 96/2015).

11. Law on Public Notary ("Official Gazette of RS", no. 31/2011, 85/2012, 19/2013, 55/2014 - other laws, 93/2014 - other laws, 121/2014, 6/2015 i 106/2015).

12. Law on Obligations ("Official Gazette of the SFRY", no. 29/78, 39/85, 45/89 - decision of the Supreme Court of Justice and 57/89, "Official Gazette of the SFRY", No. 31/93 and "Official Gazette SCG", No. 1/2003 - Constitutional Charter).

13. Law on the Basics of Property Relations ("Official Gazette of the SFRY", no. 6/80 and 36/90, "Official Gazette of the FRY", no. 29/96 and "Official Gazette of the RS", No. 115/2005 - other laws).

14. Law on Property Taxes ("Official Gazette of the RS", No. 26/2001, "Official Gazette of the FRY", No. 42/2002 - decision of the SUS and "Official Gazette of the RS", No. 80/2002, 80/ 2002 - other laws, 135/2004, 61/2007, 5/2009, 101/2010, 24/2011, 78/2011, 57/2012 - US decision, 47/2013 and 68/2014 - other laws)

15. Law on Inheritance (“Official Gazette of RS”, No. 46/95, 101/2003 - decision US RS and 6/2015).
16. Family Law (“Official Gazette of RS”, No. 18/2005, 72/2011 - other laws and 6/2015).
17. Law on Real Estate Transaction (“Official Gazette of RS”, No. 93/2014, 121/2014 and 6/2015).

SHORT SUPPLY CHAIN - BIBLIOMETRICS ANALYSIS

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Abstract

Short supply chains are seen as food distribution alternatives of economic, social and environmental importance. Through bibliometric analysis, guidelines for the main topics interlinked with the „short supply chain" and research directions were drawn. Research results were analysed through visual mapping and researchers' concerns for the value chain, food industry, rural development, risks, productivity, biodiversity were identified. According to years, the terms related to the researched topic show that in 2010-2013 the main topics were food, in 201-2016 the main topics were consumers and food impacts, and later the focus was on circular economy, covid-19 and agriculture.

Key words: *short chain, bibliometric analysis, European Union*

Introduction

Short chains include several operating systems and can be of different types. Farmers can sell their products through intermediary trade (supermarkets, specialized shops, cooperative shops), or in markets, bazaars, self-owned shops or even public institutions such as schools, canteens, restaurants or even at the farm gate (Dumitru et al., 2021).

Moreover, in recent years it has been proven that the internet can be a real product marketing method. Stakeholders in the context of short supply chains are consumers and farmers, and success depends on expectations and impact on each market segment (De Fazio, 2016). In the case of farmers, expectations are related to prices, price stability over time, access to information and communication with final consumers, variety of range of offers, long-term oriented commercial relationships, but also persistence and participation in environmental protection.

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The food supply chain connects three main sectors: agriculture, food industry and distribution, while involving a wide variety of stakeholders: farmers, food processors, traders, wholesalers and retailers, from SMEs to ultra-large companies. Across the EU, consumers are increasingly opting for local produce from the farm gate, farmers' markets, container delivery schemes, or other community-supported agricultural schemes. European customers tend to associate locally sourced products with higher quality standards (freshness, nutritional value), healthy eating, greener production methods and a smaller carbon footprint (Motofeanu et al., 2022). They also prefer to be in direct contact with producers so they know the source, hoping to support agriculture and the local economy by buying food at reasonable prices (Dumitru et al., 2022, Tudor et al., 2022).

Entering the local food industry requires entrepreneurship and the development of many new skills, and in an ageing industry, it is hard to make the effort to do meaningful things and use new production methods. At the same time, young producers may have an entrepreneurial flair and need new skills. The most successful examples of short chains rely on new forms of governance and the networks needed to support them. Therefore, forms of governance as well as community support are needed for food chain organisation (Ladaru et al., 2020).

Building trust with other businesses that would previously have been seen as competitors, as well as developing relationships with the public sector and community organisations is essential but takes time and dedication. The challenge for public sector authorities is not just the need to identify ways to support sector development (Petre et al., 2019).

The Farm-to-Fork Strategy is a strategy to address the challenges of sustainable food systems, recognising that healthy people, healthy societies and a healthy planet are inextricably linked (Farm to Fork Strategy) The COVID-19 pandemic has highlighted the need for a resilient and robust food system, that can function in all circumstances and demonstrate the ability to offer consumers a wide variety of affordable products In addition to the COVID pandemic, the rise of droughts, floods and wildfires is a constant reminder that our food systems are under threat and need to become more sustainable and durable. The Farm-to-Fork strategy is a new and integrated approach that shows how Europeans value food sustainability. This is an opportunity to improve lifestyle, health, and the environment (Farm-to-Fork Strategy, Rădulescu et al., 2020).

Methodology

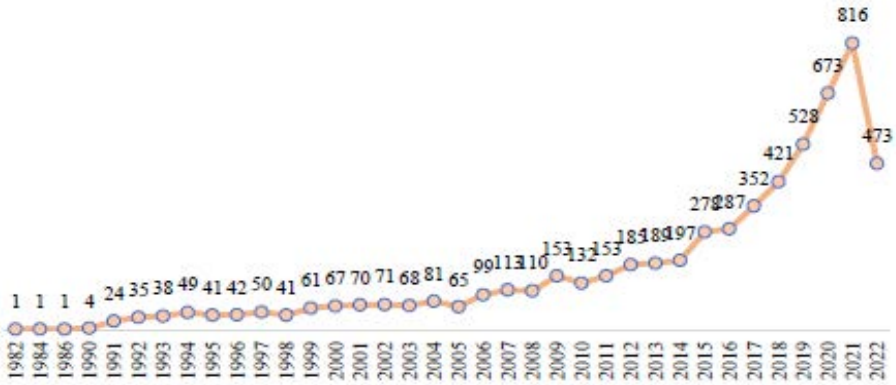
Bibliometric analysis is an alternative method of studying fields of interest to researchers both in specific countries and worldwide. Quantitative assessment of performance, structures, and identification of how countries collaborate allows quantitative analysis to be carried out.

To perform the analysis, a topic of interest is chosen and queried in the Web of Science database, and then exported and entered into VosViewer software. Through the software, different maps are generated for terms related to the topic, their use according to years, and the link between co-author countries showing us the degree of collaboration and research directions (Ellegaard et al., 2015, Iancu et al., 2022).

Results and Discussions

The total number of papers written on the topic „short food chain" illustrates the concerns of researchers on this topic, where 5,960 papers were written.

Figure 1. *Number of papers on „short food chain"*



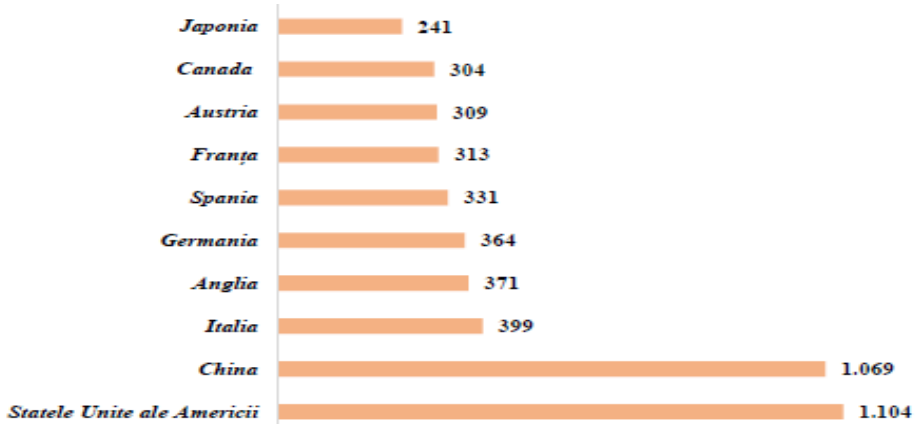
Source: own processing based on WoS data

The research areas are diverse, with most falling into: food science technology (1,373 papers), dietetic nutrition (792 papers), environmental studies (677 papers), applied chemistry (451 papers), biochemistry and molecular biology (393 papers), biotechnology and applied microbiology (322 papers), multidisciplinary agriculture (261 papers), dairy farming and animal science (201 papers) (Figure 1).

The topic „short food chain" began to be addressed as early as 1982 where, according to the Web Of Science database, only one paper was written, since

1991, the number of papers has increased substantially, reaching 816 publications in 2021 (Figure 1).

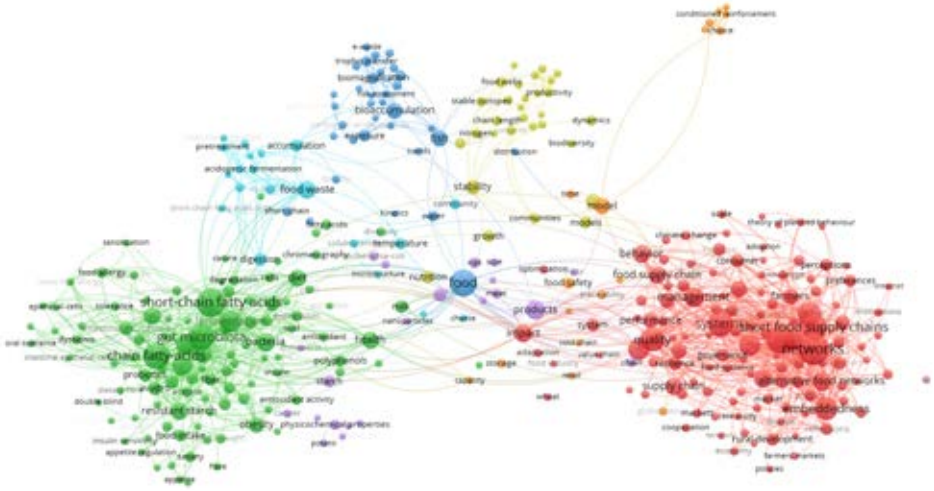
Figure 2. *Top 10 countries that have written the most publications on the subject studied*



Source: own processing based on WoS data

The United States produced the most publications (1,104 papers) on the subject of short food chains, followed by China (1,069 papers), and Italy (399 papers), England (371 papers). According to the database, Romania wrote a total of 48 papers (Figure 2).

Figure 3. *Link between short food chains and other related terms*



Source: own processing based on WoS data

Using the Web of Science database, a text database was generated containing all the publications with the topic „short food chain" and with the help of Vosviewer software, different maps were generated including the keywords mentioned in the publications at least 5 times.

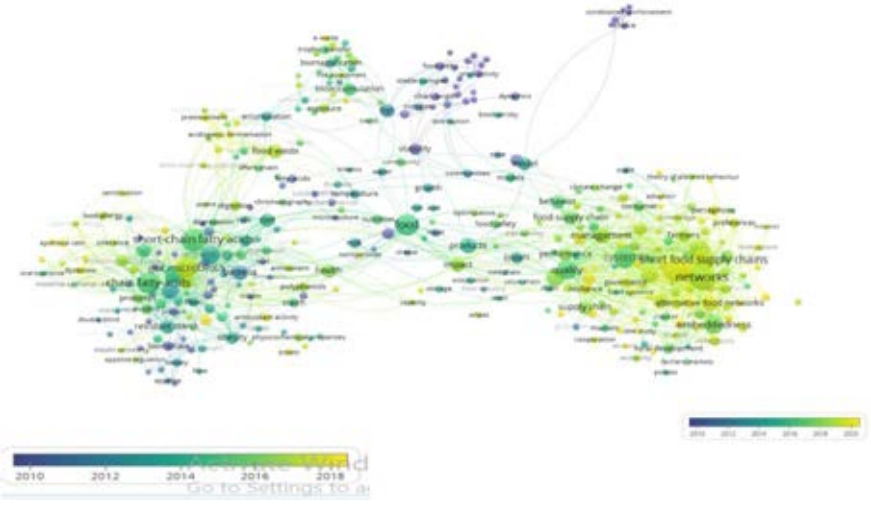
The figure shows that the main keywords are: food, short food chain, security, productivity, nutrition, farmers, sustainability, carbon footprint, stability (Figure 3). These are grouped into clusters. The first cluster entitled „food" includes terms such as: temperature, water, community, trends, food waste, short chain, pre-processing, accumulation, bioaccumulation, risk assessment, distribution, cheese, fish.

The second cluster is called „short food supply chain" and includes food industry, impact, optimization, system, adaptation, value chain, wheat, cooperation, rural development, case studies, policy, governance, management, farmers, adaptation, climate change, perceptions, system preferences, consumers.

The third cluster „short chain with fatty acids" includes: health, diabetes, prebiotics, bacteria, tolerance, epithelial cells, acetate, antioxidants, fatty acids, diversity, food allergy, fibre, appetite, satiety obesity, antioxidant activity.

Cluster number 4, also called „stability", includes keywords such as: nutrition, evolution, community, biodiversity, dynamics, productivity, nitrogen, chain size, choice. Cluster number 5, called„products", includes: chain, risk, name, physicochemical properties (Figure 3).

Figure 4. *Link between short food chains and other related terms by year*



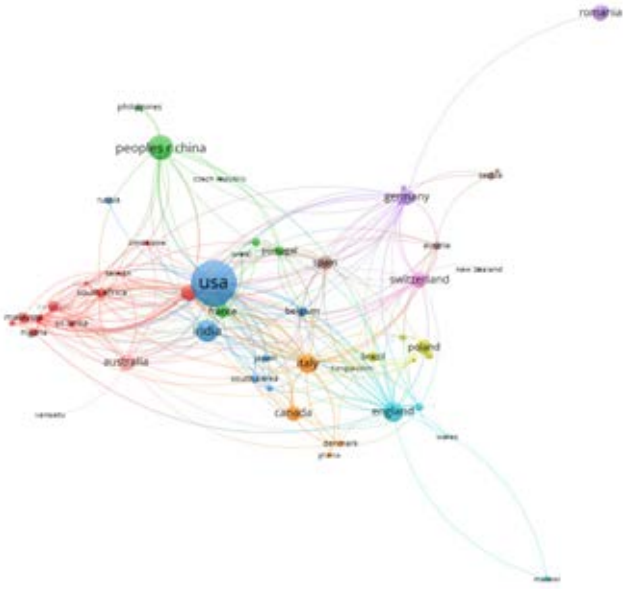
Source: own processing based on WoS data

In the figure above, keywords used in scholarly works are shown by year. Thus, from 2010-2013, researchers were concerned with food where they used keywords such as: food, food chain, food webs, stability, fatty acids, chain size, productivity, homogeneity, choice, degradation, absorption.

From 2014-2016, the main topics targeted consumer issues such as: food, productivity, patterns, community, short food chain, obesity, diet, quality, behaviour, bacteria, fermentation, protein, nutrition.

From 2017 to 2020 the focus was on: microbacteria, food waste, management, farmers, knowledge, circular economy, covid-19, agriculture, sustainability, outlook, local food, security, case studies, environmental impact, carbon footprint, community supporting agriculture (Figure 4).

Figure 5. *Link between coauthor countries*



Source: own processing based on WoS data

The degree of connection between countries on the topic under study shows the interest of each country, illustrated by the size of the nodes; the diversity of colors shows the multitude of research directions, and the thickness and distance of connections between countries show the level of cooperation between them. As a result, China, the United States, Italy, France, England, and Austria are particularly interested in the subject. The map shows seven research di-

rections, where Romania together with the Netherlands, Greece, Switzerland, Austria, and Africa show the same research direction (Figure 5).

Conclusion

Thus, we can say that the subject of the „short food chain" is a topic that has been increasingly addressed in recent years, with research showing consumer concerns about product traceability illustrated by: quality, local food, protein, fatty acids, fibre, allergens, and physicochemical properties. Consumers are also concerned about nutrition, health, diet, perceptions, obesity, trends, and food waste. On the other hand, researchers are interested in optimising and improving the short food chain through management, policy, cooperation, climate change adaptation, circular economy, knowledge, and community-supporting agriculture. The interest in the environment is illustrated by the literature work done in recent years including: circular economy, sustainability, environmental impact, carbon footprint, and degradation.

Following the generation of the map showing the degree of interrelationship between countries, China, the United States, Italy, France, England and Austria take a particular interest in the subject. According to this, the European Union is also concerned by the subject studied. This can be explained by the interest of EU consumers in local products, which are often associated with high quality standards, healthy eating and environmental care.

Short chains, seen as an alternative to conventional chains, can bring multiple benefits to both producers and consumers. From the producer's point of view, the market value share of the product is much higher; with the elimination of the middleman, bargaining power increases, and the consumer benefits from healthier and safer products.

Literature

1. De Fazio, M. (2016). Agriculture and sustainability of the welfare: the role of the short supply chain. Agriculture and agricultural science procedia, 8, 461-466.
2. Dumitru, E. A., Micu, M. M., & Sterie, C. M. (2022). The key to the development of agricultural cooperatives in Romania from the perspective of those who run them. Outlook on Agriculture, https://doi.org/10.1177/00307270221138118.

3. Dumitru, E.A., Ursu, A., Tudor, V.C., Micu, M.M. (2021). Sustainable Development of the Rural Areas from Romania: Development of a Digital Tool to Generate Adapted Solutions at Local Level. Sustainability, 13, 11921. https://doi.org/10.3390/su132111921 .

4. Ellegaard, O., & Wallin, J. A. (2015). The bibliometric analysis of scholarly production: How great is the impact?. Scientometrics, 105(3), 1809-1831.

5. European Commission, Farm to Fork Strategy, For a fair, healthy and environmentally-friendly food system.

6. Iancu, T., Tudor, V. C., Dumitru, E. A., Sterie, C. M., Micu, M. M., Smedescu, D., ... & Costuleanu, L. C. (2022). A Scientometric Analysis of Climate Change Adaptation Studies. Sustainability, 14(19), 12945. https://doi.org/10.3390/su141912945.

7. Ladaru, G. R., Ilie, D. M., Diaconeasa, M. C., Petre, I. L., Marin, F., & Lazar, V. (2020). Influencing factors of a sustainable vegetable choice. The Romanian consumers' case. Sustainability, 12(23), 9991.

8. Motofeanu, M., Petre, I. L., Dumitru, E. A., & Sterie, M. C. (2022). Romania's Agricultural Labour Force–Trends, Mutations And Disturbances. Int. J. Innov. Sci. Res. Technol, 7, 1683- 1691.

9. Petre, I. L., & Ion, R. A. (2019). The impacts of the investments in agriculture on economic growth in rural communities in Romania. Економика пољопривреде, 66(4), 955-963.

10. Radulescu, C. V., Ladaru, G. R., Burlacu, S., Constantin, F., Ioanăș, C., & Petre, I. L. (2020). Impact of the COVID-19 pandemic on the Romanian labor market. Sustainability, 13(1), 271.

11. Tudor, V.C., Dinu, T.A., Vladu, M., Smedescu, D., Vlad, I.M., Dumitru, E.A., Sterie, C.M., Costuleanu, C.L. (2022). Labour implications on agricultural production in Romania. Sustainability, 14, 8549. https://doi.org/10.3390/su14148549.

12. https://clarivate.com/

PROBLEMS AND OPPORTUNITIES IN THE TRADE EXCHANGE OF AGRICULTURAL PRODUCTS BETWEEN SERBIA AND THE EUROPEAN UNION

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Abstract

During the process of joining the European Union, Serbia is faced with a number of requirements that it needs to fulfill. One of them refers to the process of trade exchange of agricultural products, further discussed in the paper. This primarily refers to the adjustment of the assortment of agricultural products, the method of production and processing, packaging, as well as the fastest form of transport to the end consumers. One of the ways in which Serbia could increase its competitiveness is various forms of promotion of the products themselves, as well as tying end consumers to a brand that signifies the quality and freshness of the product, which has a mark of origin, which will be discussed more in the paper itself. The authors will give their opinion and suggestions for improving the competitiveness of Serbia and increasing the chances for greater export of agricultural products. The importance of trade exchange is great and has positive tendencies.

Key words: *trade exchange, agricultural products, competitiveness, end consumers, quality, Serbia*

Introduction

During the process of joining the European Union, numerous requirements are put before Serbia that it needs to fulfill in order to become a full member. One of these demands refers to trade in agricultural products. In order for agricultural products to be exported, it is necessary that they meet numerous requirements. In order for exchange to exist, on the one hand we have importing countries of agricultural products and on the other hand exporting countries where Serbia belongs. More than half of the produced agricultural products are exported to the European Union market.

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Methodology

In the paper, the authors used a comparative method, on the basis of which they came to conclusions, as well as to predict future trends in trade exchange between Serbia and the European Union. Using the descriptive method, in the description of phenomena and processes, important conclusions were reached, which relate to the movement of export and import of agricultural products. During the writing of the paper, the authors used the methods of studying literature, both domestic and foreign authors.

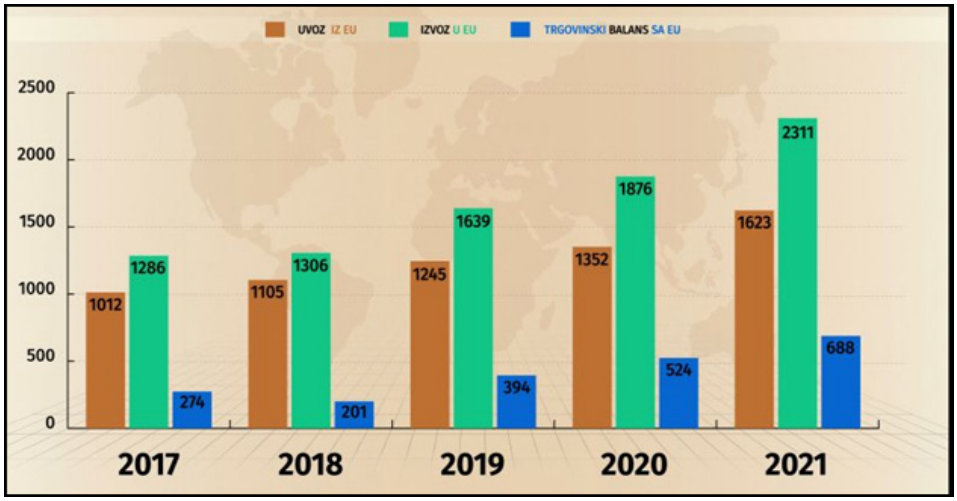
Trade exchange between Serbia and the European Union

More than half of the total products produced in Serbia are exported to the European Union, so the European Union market is very important for a small country like Serbia.

On the Figure 1. the first column represents imports from the European Union, the second column exports to the European Union, and the third column their difference, i.e. the balance, and in the observed case, since exports are greater than imports, we can say a surplus, i.e. a positive trade balance (exports - imports). Part of these funds should definitely be invested in the modernization of the agricultural sector, as well as the necessary training of professional staff.

If we look at the year 2021, it can be seen that Serbia has a surplus (exports are greater than imports) and that the exchange of agricultural products amounted to 688 million Euros in 2021, which is a significant increase compared to 2017, when this surplus was much smaller, amounting to only 274 million Euros, since exports were 1,286 million Euros, and imports were 1,012 million Euros, especially since 2000., when Serbia was in the process of joining the European Union.

Figure 1. *Trade exchange between Serbia and the European Union, numbers are in millions of Euros*



Source: https://europa.rs/serbia-and-the-eu/trade/serbia-eu-trade-in-agricultural-products/?lang=en

On the Figure 1. it can be seen that the export to the member countries of the European Union was 2311 million Euros, and the import was 1623 million Euros, on the basis of which we arrive at the data that Serbia has a surplus in the amount of (2311 million Euros - 1623 million Euros), i.e. the surplus was 688 million Euros . In addition to the members of the European Union, it is necessary to mention that Serbia has a significant trade exchange with the CEFTA member countries. The largest number of requirements that Serbia needs to fulfill is related to food products and their quality.

It can be seen that during the entire observed period from 2017. to 2021., Serbia realized a surplus in the exchange of agricultural products with the European Union. This surplus looked like this by year: The numbers are in millions of Euros:

2017.: (1286-1012 = **274**),

2018.: (1306-1105 = **201**),

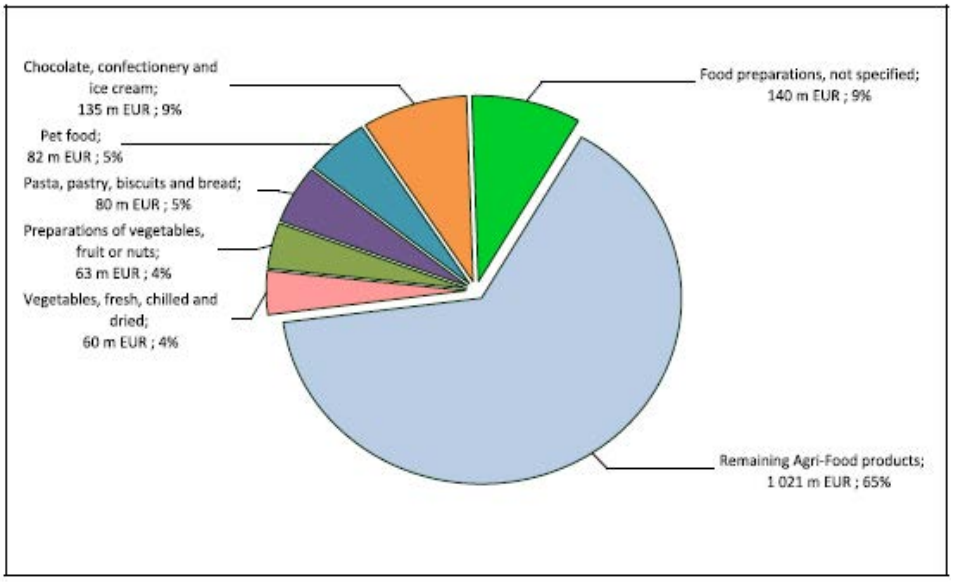
2019.: (16391245 = **394**),

2020.: (1876-1352 = **524**),

2021.: (23111623 = **688**)

Considering its extremely favorable geographical position of Serbia, the wealth of agricultural land, a large number of pastures suitable for growing agricultural products, especially cereals, if you look at Vojvodina, the information about the trade surplus during all these years is not surprising. This is very important for the economy of a country, such as Serbia. We could see the true significance of this during the period of the Covid-19 pandemic, where due to the shortage of certain raw materials and the impossibility of importing, we were forced to turn around and start domestic production. necessary for the production of both bread and most bakery products.

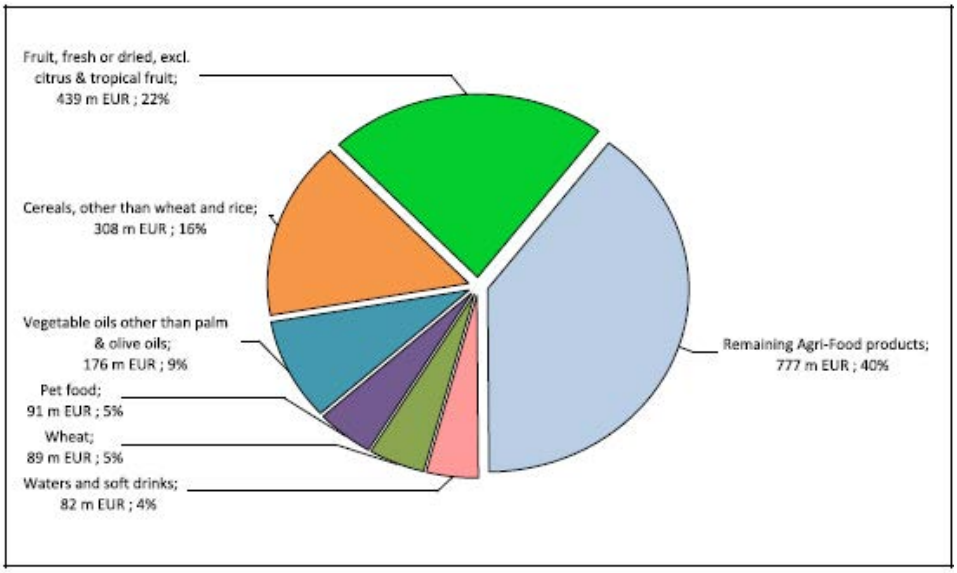
Figure 2. *Agri-food exports to Serbia in 2021.* (*in millions of Euros and in %)*



Source: European Delegation in Serbia: Agri-Food Trade Statistical Factsheet. EU Agri-Food Trade with Serbia, p.4

Based on Figure 2, we can conclude that in the total **import** in Serbia from the European Union, **1581** million Euros, was the import of agricultural products in 2021. Based on this data, we can conclude that the European Union is an important trading partner of Serbia, especially if we look at agricultural and food products.

Figure 3. *Agri-food imports from Serbia in 2021. (in millions of Eur. and in %)*



Source: European Delegation in serbia: Agri-Food Trade Statistical Factsheet. EU Agri-Food Trade with Serbia, p.6

Based on Figure 3., we can say that Serbia's total agricultural products **export** to the European Union has been about **1962** million Euros, which is very significant for the development of the entire economy and economy of a small country like Serbia. From the previously mentioned it can be concluded that total exchange between Serbia an EU, in 2021. has been about 3543 millions Euros for agri-food trade **(55.38% export from Serbia** to EU, and **44.62% import to Serbia** from EU).

Numerous demands are being made to Serbia by the European Union, in order to increase this not so small percentage, which will be discussed in the continuation of the work. A large number of experts dealt with the problem of Serbia's exports to the European Union, as well as with the issue itself. It must not be forgotten that Serbia inherited certain problems from the transition period, but this does not represent an insurmountable obstacle for this percentage to increase. When planning exports, care should be taken to first meet the needs of the domestic population, and only then to export the surplus, in order not to get into the problem of having to be dependent on the import of grain and other food products, because we export our agricultural products, not leading takes into account the needs of the local population.

It is necessary to increase investments in the agricultural sector, to motivate small producers to invest in the production of food products as well as in the processing of their crops, so that they can ensure the necessary quality. Some measures are in force, but they are not enough for now, in order for small producers to be motivated and to be able to live off their work. First of all, this refers to numerous subsidies, which would help small producers to take the best quality seeds for agricultural products, in order to increase the number of grazing animals, and not reduce them, as there are tendencies in some parts of Serbia today. Much larger investments are necessary than in the past, primarily in the livestock fund, because on the one hand there are retail chains that offer fresh meat at prices that are significantly below what is acceptable from the point of view of the domestic producer, who needs a return on the investment, and what's more, that he can survive, even next year to invest in his cattle fund, and not to think about selling it. This includes investing in machinery, necessary for tilling the land, and increasing subsidies for the purchase of new machines, which have already worn out.

It is necessary to preserve the unpolluted mountain glades, which with their vegetation enable the grazing of primarily domestic animals, on the one hand, and on the other hand, they have a wealth of flora and fauna, medicinal herbs, as well as spices, which can be exported. The export of agricultural products has increased almost four times in the past decade, from 640 million Euros in 2009 to over 2.3 billion Euros in 2021[3].

The proposed rural development measures are mostly comparable to the EU program guidelines for the periods 2007-2013 and 2014-2020. The measures are mainly aimed at the following areas[4]:

- Support for farm investments, development of agricultural infrastructure investment in food processing, marketing and promotion, improvement of product quality and ensuring food safety standards

- Support for the implementation of good agricultural practices.

3 https://europa.rs/trgovina/ , https://europa.rs/serbia-and-the-eu/trade/serbia-eu-trade-in-agricultural-products/?lang=en

4 JRC Monitoring of agricultur policy developments in the Western Balkan countries Serbia.pdf, p.16

Proposals for improving the exchange of agricultural products between Serbia and the European Union

Some of the most common requirements of the European Union, which relate to the export of agricultural products, concern, first of all, its quality, the amount of investment in processing, choosing the fastest mode of transport, meeting the necessary quality standards, so that agricultural products find their way to the end consumers and how the acquired trust would be maintained. First of all, it should be taken into account that once consumers are disappointed with the product and let themselves down, much more investment is necessary in building trust again. One of the important proposals concerns investments in the modernization of the agricultural products processing sector, for which much larger investments are necessary both from the state itself and from the funds of the European Union.

Large investments are necessary both in the agricultural sector and in other sectors of the economy, because they are closely connected, for example, the agricultural sector with the transport sector. Enable greater competitiveness of products from Serbia, which have the label "Made in Serbia". Enable a greater presence of Serbian products at fairs in the countries of the European Union, where consumers could taste specific products (e.g. honey, sweet and brandy fairs) and see for themselves the quality of the products[5].

It is necessary to provide the necessary support, first of all, to small households, to enable them to more easily obtain subsidies and funds necessary to maintain the smooth production of agricultural products. It would help them a lot if the purchase price of agricultural products (primarily milk) were increased, so that they could survive, because end consumers pay many times higher prices than small producers get.

5 Ignjatijević, S, Cvijanović, D. (2018). Exploring the Global Competitiveness of Agri-Food Sectors and Serbia's Dominant Presence: Emerging Research and opportunities. USA: IGI Global

Table 1. *Premiums for dairy products in Serbia (EUR/liter), from 2010 - 2015*

Description	2010	2011	2012	2013	2014	2015
Premium for dairy products (awarded for cow, sheep or goat milk delivered to dairies, specified minimum and maximum amount for payment)	0.04	0.05	0.04; 0.06	0.06	0.06	0.06

Source: JRC-2_Monitoring-of-agricultural-policy-developments-in-the-Western-Balkan-countries_SRB.pdf, p.88

Based on Table 1., it can be seen that the premium for dairy products grew in the period from 2010, when it amounted to 0.04 Euros per liter, to 0.06 Euros per liter, which represents an increase of 0.02 Euros per liter, with a further upward trend, from which can conclude that work is being done to improve the situation of small producers in the countryside, but it is necessary to continue working and subsidizing in this field.

The following Table 2., shows the export of fruit to the countries of the European Union in 2018. The quantities are given in tons. In first place are plums with 558,930 tons, followed by apples, grapes, raspberries, cherries, pears, peaches, strawberries. This is primarily an export of raw products, and one of the proposals is to export processed fruits as well agricultural products.

Table 2. *Export of fruit from Serbia to the European Union in 2018.*

Fruit Production, 2018	Quantity (Tones)
Plum	558,930
Apple	499,578
Grape	163,516
Raspberry	120,058
Sour cherry	96,965
Pear	54,859
Peach	48,204
Strawberry	19,608

Source: Statistical Office of the Republic of Serbia, https://ras.gov.rs/en/sector/agri-food-industry

Conclusion

During the process of joining the European Union, Serbia is expected to fulfill many requirements. One of them concerns investments in the agricultural sector. Serbia received funds from the European Union, primarily its accession funds, which it invests in agriculture. We see that the exchange of agricultural products with the European Union is increasing from year to year. It is necessary to go for diversification, modernization, export primarily of processed products, investment in processing technology, greater participation in fairs with recognizable products such as brandy, honey. Investment in people's education must not be forgotten. The agricultural sector is closely connected with other sectors of the economy, primarily transport. At the same time, we should take care of small producers, who in the last few years have started to join cooperatives, in order to be more competitive, give them greater incentives and subsidies, so that as many young people as possible decide to stay in the countryside after finishing school and not to go to big cities. This would partially solve the problem of elderly households and deserted villages.

Literature

1. Božić Miljković, I. (2018). Economic Cooperation Between Serbia and the Member States of the Eurasian Economic Union: Constraints and Potentials. Eurasian Journal of Business and Economics 11 (22). Bishkek: Ala-Too International University, pp. 105-121.
2. European Delegation in Serbia: Agri-Food Trade Statistical Factsheet. EU Agri-Food Trade with Serbia.
3. Ignjatijević, S, Cvijanović, D. (2018). Exploring the Global Competitiveness of Agri-Food Sectors and Serbia's Dominant Presence: Emerging Research and opportunities. USA: IGI Global
4. JRC-2_Monitoring-of-agricultural-policy-developments-in-the-Western-Balkan-countries_SRB.pdf
5. Statistical Office of the Republic of Serbia, https://ras.gov.rs/en/sector/agri-food-industry (13.12.2022.)
6. Wigier M. i Kowalski A. (2018). The Common Agricultural Policy of the European Union – the Present and the Future. EU Member States Point of View. Warsaw: Institute of Agricultural and Food Economics.

Internet sources:

7. https://europa.rs/trgovina/ (13.12.2022.)
8. https://europa.rs/serbia-and-the-eu/trade/serbia-eu-trade-in-agricultural-products/?lang=en (13.12.2022.)

INNOVATION POTENTIAL OF AGRICULTURAL COMPANIES IN SERBIA

Marija Mosurović Ružičić[1], *Marija Lazarević Moravčević*[2]

Abstract

The influences from the environment mostly triggered by the crisis situations, caused by the COVID-19 pandemic and the ongoing armed conflict, have caused some changes in the structure of all industrial sectors, putting considerable pressure on agricultural and food companies worldwide. Moreover, the growing need for agricultural and a food product increases the need for the accelerated development of this sector, which cannot be achieved unless innovative technologies and solutions are introduced.

The indicators of the innovation activities in Serbia for the period from 2018 to 2020 suggest that the innovations in this sector were at the lowest level, which determined the subject of the research of this paper. Applying the methodology of EUROSTAT and the OECD, the authors analyse the innovation potential of the companies operating in the agricultural sector. The aim of the paper is to emphasise the importance of these innovations in overcoming the problems faced by the agricultural sector in Serbia, as well as to highlight their impact on the growth of the productivity and competitiveness of the sector.

In accordance with the findings, the recommendations for decision-makers will be presented and possible directions for a further research will be recommended.

Key words: *innovation, agricultural sector, innovation potentials, competitive advantage*

Introduction

The development of the agricultural sector needs to be estimated not only through researching the development of primary agriculture, along with the food industry when trying to achieve higher social growth, but it is also necessary to take into account the wider context - the quality of life of inhabitants in terms of reducing

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poverty and inequality (Jovanović, 2021). Due to the fact that the Republic of Serbia is situated in a favourable geographical position and possesses significant natural resources, accompanied with quality workforce, it can be concluded that "with its recognizable development potential, agriculture is an economic activity that significantly contributes to its economic growth" (Jovanović et al., 2018).

The influences from the environment mostly triggered by the crisis situations, caused by the COVID-19 pandemic and the ongoing armed conflict, have caused certain changes in the structure of all industrial sectors, putting considerable pressure on agricultural and food companies worldwide. Moreover, the growing demand for agricultural and food products increases the need for the accelerated development of this sector, which cannot be achieved unless innovative technologies and solutions are introduced. The movements in this sector are stimulated by the events at the macro level and depend on the movements in the economic and political environment, product market and factors of production, along with technology transfer as well (Rohne Till, 2022). It has been noticed that the transfer and diffusion of technology present a critical factor in the development of rural agricultural areas (Brychan, 2002).

Agriculture is an extremely specific economic activity and "it has specific features associated with knowledge, innovation and transfer of new technologies within the knowledge and information system" (Tomaš Simin & Janković, 2014). Monitoring the innovation potentials of the agricultural sector enables defining the strategic priorities for the development of the sector at the national level. Interestingly, the companies in this area, which until recently used to be considered less innovative, are increasingly turning to innovation so as to improve their products and processes (Aibar-Guzmán et al., 2022; Pavlova et al., 2018). The companies in this area are shifting their strategic focus to innovation aiming to enhance their products and processes. The authors Pavlova et al., (2018) believe that the insufficient use of the innovation potentials mostly results from the lack of institutional support emphasising the importance of national, sectoral and regional innovation development programs.

The indicators of the innovation activities in Serbia for the period from 2018 to 2020 suggest that the innovation in this sector were at the lowest level, which determined the subject of the research of this paper. Applying the methodology of EUROSTAT and the OECD, the authors analyse the innovation potential of the companies operating in the agricultural sector. The aim of the paper is to emphasise the importance of these innovation in overcoming the problems

faced by the agricultural sector in Serbia, as well as to highlight their impact on the growth of the productivity and competitiveness of the sector.

Agriculture within the framework of green economy and sustainable development

The differences in the growth rates in certain industries are well-known and obvious, that is, the growth rates in certain industries are increasingly declining, whereas the others are recording highly intensive growth. Majority of high R&D-intensive industries emerged in the 20th century and have been experiencing substantial growth ever since. It is quite obvious that these high growth rates are associated with a greater share of technological innovations in new products and processes and a high rate of diffusion of these innovations in the global economy. Conversely, the industries that record declining growth rates are mostly linked with insufficient research and development intensity and a low rate of technological change (Mosurović-Ružičić et al., 2018). Nevertheless, the existence of a statistical relationship between technological progresses and the growth of an industry does not necessarily mean that only technological innovations can boost growth (Freeman, 1982). Similarly, it does not necessarily mean that the companies operating in low-tech sectors benefit less from their innovations. For a long time, the term innovation was associated only with high-tech sectors. However, today it is quite clear that innovation is a phenomenon that affects all sectors, and it is significant for both the sectors with a higher and lower technological level (Cornell University et al., 2017; Drucker, 2020), and the agriculture sector as well.

For better understanding and monitoring of an innovation process in a company and its impact on other actors of the national innovation system, OECD experts defined the Oslo manual in 1991. In addition to the activities that take place in innovative companies (innovation activities, innovation expenditures, hampering innovation factors, etc.), the document also presents detailed information on the links between business entities and other stakeholders within the National Innovation System. Moreover, here you can find methodological recommendations for the classification of innovations as well as the identification of the factors that influence the performance of innovative companies and their effects on the entire national innovation system (OECD/Eurostat, 2018; Ružičić Mosurović & Kutlača, 2019). Four editions of this manual have been published up to now, having been methodologically improved with every new edition.

The definition of innovation has not undergone significant changes though: "*An innovation is a new or improved product or process (or a combination thereof) that differs significantly from the unit's previous products or processes and that has been made available to potential users (product) or brought into use by the unit (process).*" (OECD/Eurostat, 2018, p.32).

The fourth, last edition of the Oslo manual is compiled in accordance with the requirements of the contemporary modern business environment and fully incorporates the principles of the 2030 Agenda for Sustainable Development, which was adopted by the United Nations in 2015 (United Nations, 2015). The Sustainable Development Goals (SDG) are defined within the Agenda, where the development of agricultural production plays an important part, with a special emphasis on strengthening the role of women in agriculture, emphasising the importance of the development of agricultural sector in developing countries.

On the other hand, there is a causal link between sustainable development and the green economy. The green economy concept is seen as a means to achieve sustainable development goals. The authors Karuppiah et al., (2022) believe that the green economy concept enables the transformation of natural resources into sustainable wealth. In the literature, it is accepted that organic agriculture is a significant indicator of the transition of the agricultural sector towards the green economy model. The authors Akhmetshina et al., (2018) also highlight the importance of innovations in organic agriculture as a way of overcoming social, economic and environmental challenges, especially when it comes to developing countries. Ecological, i.e. organic production is in itself a social innovation and what distinguishes it from traditional agriculture is "the systematic and continuous application of knowledge and modern achievements" (Tomaš Simin et al., 2016). It is important to underline the fact that organic agriculture "unequivocally contributes to the achievement of sustainable development" (Đurić et al., 2021) and that its further development, besides the positive trend, is determined by numerous factors. The authors Đurić et al., (2021) state that in addition to the institutional and legal framework, the subsidies from the agricultural budget also play a significant role in the development of this production system in Serbia. Furthermore, certain trends, such as the increase in the number of consumers who opt for organic products, the insufficient supply of these products on the global market, as well as significantly higher price of organic products compared to conventional ones, are just some of the reasons that make organic agriculture an attractive area for investments (Jovanović et al., 2018).

Table 1. *Key indicators and top countries in organic agriculture*

Indicator	World	Top countries
Countries with organic activities	2019: 187 countries	
Organic agriculture land	2019: 72.3 million ha (2011:11.0 million ha)	Australia (35.7 million ha) Argentina (3.7 million ha) Spain (2.4 million ha)
Organic share of total agriculture land	2019: 1.5 %	Liechtenstein (41.0%) Austria (26.1%) Sao Tome and Principe (24.9%)
Wild collection and further non-agricultural areas	2019: 35.1 million ha (1999: 4.1 million ha)	Finland (4.6 million ha) Zambia (3.2 million ha) Namibia (2.6 million ha)
Producers	2019: 3.1 million producers (1999: 200 000 producers)	India (1 366 226) Uganda (210 353) Ethiopia (203 602)
Organic market	2019: 106.4 billion euros (2000: 15.1 billion euros)	US (44.7 billion euros) Germany (12.0 billion euros) France (11.3 billion euros)
Per capita consumption	2019: 14.0 euros	Denmark (344 euros) Switzerland (338 euros) Luxemburg (265 euros)
Number of countries with organic regulations	2019: 108 countries	
Number of affiliates of IFOAM- Organic International	2020: 718 affiliates	Germany: 79 affiliates India: 52 affiliates USA: 48 affiliates Italy: 46 affiliates

Source: The World of Organic Agriculture Statistic and Emerging Trends 2021; Willer et al., (2021) based on FiBL Survey 2021, national data sources, the data from certifies and IFOAM - Organic International

Having presented all the facts above, it can be concluded that the green economy and the agricultural sector are closely related, therefore agriculture plays an important part in the development of the green economy since it has both direct and indirect impact on people and the environment (Akhmetshina et al., 2018; Musvoto et al. al., 2018).

The World of Organic Agriculture Statistics and Emerging Trends report presents the basic indicators related to the organic production in 2021 indicating that the largest share of organic agriculture in the total agriculture is situated in Liechtenstein, and the largest markets for the placement of organic production are in

America, Germany, and France (Table 1). Unfortunately, there is a lack of legal regulation in the field of organic agriculture in a large number of countries, in 108 countries out of a total of 187 identified as the producers of organic products (Willer et al., 2021).

Innovations in the agricultural sector in Serbia

The statistical monitoring of the innovation activities in Serbia is conducted by the Statistical Office of the Republic of Serbia, using the methodology of the Oslo Manual. The reports are published every third year for the previous two years and provide an insight, among other things, into the innovative activities of the business entities in Serbia by sectors, which is presented in Table 2 for the period 2010-2020. The innovative business entities are those who, in the analysed period, implemented some innovations in a product/service, business process, or had either ongoing innovations or innovation failures (Table 3).

Based on the data of the Statistical Office of the Republic of Serbia regarding the indicators of the innovative activities for the period 2010-2020, there is a tendency that the sector related to agriculture, forestry and fishing is mostly in the rank of less innovative sectors. The sector was identified as the second one with the lowest level of innovation for the period 2010-2014, the situation slightly improved during the period 2014-2016, but it is still at the very bottom when it comes to (non)innovativeness in this sector. A leap in innovation in this sector compared to the others was recorded in the period 2016-2018 (Table 2).

Table 2. *Innovative business entities by sectors*

%		2010-2012	2012-2014	2014-2016	2016-2018	2018-2020
		%	%	%	%	%
In total		44.6	40.5	41.2	50.2	54.8
A:	Agriculture, forestry, and fishing	30.3	22.9	41.9	49.3	34.7
B:	Mining and quarrying	37.0	19.3	27.1	41.9	54.4
C:	Manufacturing	50.5	42.7	47.9	58.2	56.5
D:	Electricity, gas, steam, and air conditioning supply	46.2	53.2	53.7	21.3	37.2
E:	Water supply; sewerage, waste management and remediation activities	32.5	35.1	31.1	45	46.9
F:	Construction	40.6	36.2	36.7	42.6	44.1

%		2010-2012	2012-2014	2014-2016	2016-2018	2018-2020
		%	%	%	%	%
G:	Wholesale and retail trade; repair of motor vehicles and motorcycles	42.0	40.7	31.0	42.8	54.6
H:	Transportation and storage	34.4	31.7	37.3	42	47.8
I:	Accommodation and food service activities	42.6	46.2	30.8	44.8	56.4
J:	Information and communication	53.7	47.6	40.2	61.3	59.2
K:	Financial and insurance activities	72.1	36.3	38.1	32.8	44.8
L:	Real estate activities	24.4	29.9	8.5	41.6	39.3
M:	Professional, scientific, and technical activities	50.6	37.5	47.3	48.7	57.6
N:	Administrative and support service activities	37.7	43.4	53.1	40.7	45.9
Q:	Human health and social work activities	0.0	0.0	0.0	0	-
R:	Arts, entertainment, and recreation	0.0	0.0	0.0	0	-

Source: The Statistical Office of the Republic of Serbia, the authors' calculation.

During the selected period, the following sectors were the most innovative in the Serbian economy: information and communications and the manufacturing industry, so this can be interpreted as a driver of innovation in the agriculture, forestry and fishing sector, especially since the largest number of innovations was marked as process innovations (Table 3). There are studies that indicate that there is a causality between a low level of innovation and the implementation of information and communication technologies (ICT) in the agri-food industry. The implementation of ICT has an effect not only on companies but also on the relationships which companies establish with other stakeholders (Aibar-Guzmán et al., 2022; Domenech et al., 2014; Martinez-Gomez et al., 2022; Rudgard et al., 2011). However, after this leap, it is a worrying fact that in the last part of this analysed period this sector is again the least innovative in terms of the indicators of innovation activities.

Table 3. *Innovative business entities in agriculture by innovation types*

Agriculture, Forestry and Fishing	Innovators								Non-innovators %
	Total		Product/ service		Production process		Innovation failures or ongoing innovations		
	Number	%	Number	%	Number	%	Number	%	
2018- 2020	145	34.7	50	12.0	133	31.8	11	2.6	65.3
2016- 2018	216	49.3	122	27.9	184	42,0	7	1.6	51.7
2014- 2016	177	41,9	136	32.2	138	32.7	97	23.0	58.1
2012 -2014	109	22.9	89	18.7	81	17.0	61	12.8	77.1
2010- 2012	154	30.3	88	17.3	145	28.5	79	15.5	69.7

Source: Statistical Office of the Republic of Serbia, the authors' calculation.

The data presented in Table 3 display that the agricultural enterprises in Serbia, in the period 2010-2020, were mostly focused on process innovation. This type of innovation implies the activities regarding the introduction of a new or significantly improved method of production and distribution and thus affects the increase in efficiency through the reduction of unit costs of production and delivery. Some authors believe that process innovation is ore related to the companies in mature phases of the life cycle that build competitiveness based on costs, not on differentiation (Dess et al., 2008).

As for organic production in Serbia, it is evident that it has exceptional opportunities for progress, which is recognized as a development niche. Accordingly, as a result of various government incentives, especially by the Ministry of Agriculture, Forestry and Water Management, there was an increase in cultivable areas for organic production (Simić, 2021) (Table 4). Certain authors pinpoint the necessity of regional diversification regarding the promotion of organic agriculture (Reddy et al., 2022), so it is important to determine the direction for undertaking some future institutional activities.

Table 4. *Organic agriculture land in Serbia*

Year	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Organic Agriculture Land (ha)	5.855	6.335	6.340	8.228	9.548	15.298	14.358	13.432	19.254	21.265
Cultivable area (ha)	2.784	3.007	5.364	5.355	7.999	13.398	12.929	11.875	13.723	15.915
Meadows and pastures (ha)	3.071	3.327	976	2.873	1.549	1.900	1.429	1.548	5.531	5.350

Source: Organic production in Serbia 2020, Simić (2021) based on the data from the Ministry of Agriculture, Forestry and Water Management

Conclusion

The paper shows that the innovative potential of the companies in the agricultural sector in Serbia can be a significant factor in improving economic development, especially when it comes to developing countries as it is the case with Serbia. Bearing in mind the specific features of the sector, the paper indicates that institutional support is crucial for the improvement of this sector, which is still weak even globally (Table 1). Authors (Đuričin et al., 2022) showed in their research that there is positive relation between the efficiency of national innovation policy programs and project financing, in Sebia.

Over the last few years, the importance of this type of support has been recognized in Serbia through numerous policies and programmes whose effects will be seen in the future, which can be the subject of a future research.

An overview of the organic production is also presented, as one of the ways of improving the innovation potential of the agricultural sector in Serbia. The importance of this method of production has been noticed at the institutional level and various incentive measures have been defined whose effects can be interpreted as positive ones if the increase in cultivable areas is taken into account (Table 4). Nevertheless, this is only one of the indicators of the evaluation of the development of organic production in Serbia, a deeper analysis would require monitoring of additional indicators that would relate to the evaluation of the share of income from this activity, as well as the analysis of the environmental, economic, and social aspects of the improvement of the agricultural production because, as it is stated in the paper, it is impossible to observe the activities in the agricultural production sector outside the context of green economy and sustainable development.

The analysis, conducted in the paper, undoubtedly shows that the area of innovation and innovative activities is a basis for monitoring the innovation potential of the agricultural companies from different research perspectives. This enables the mobilization of the resources for undetaking a set of activities aimed at increasing and improving the importance of this sector for economic development.

Literature

1. Aibar-Guzmán, B., García-Sánchez, I.-M., Aibar-Guzmán, C., & Hussain, N. (2022). Sustainable product innovation in agri-food industry: Do ownership structure and capital structure matter? *Journal of Innovation & Knowledge*, *7*(1), 100160. https://doi.org/10.1016/j.jik.2021.100160
2. Akhmetshina, L., Pokrovskaya, T., & Semernin, D. (2018). Organic agriculture and sustainable development of the agrarian sector of regions in the context of "green" economy. *MATEC Web of Conferences*, *193*, 05047. https://doi.org/10.1051/matecconf/201819305047
3. Brychan, T. (2002). A Strategic Overview of the Importance of Innovation for Agrifood SMEs in Wales. In T. Brychan, S. Al-Hasan, & A. Sparkes (Eds.), *Innovation and Knowledge Transfer in the Welsh Agri-food Industry*. University of Glamorgan.
4. Cornell University, INSEAD, & WIPO. (2017). *The Global Innovation Index 2017: Innovation Feeding the World*.
5. Dess, G. D., Lumpkin, G. T., & Eisner, A. B. (2008). Creating effective organizational designs. In *Strategic Management: Creating Competitive Advantages*.
6. Domenech, J., Martinez-Gomez, V., & Mas-Verdú, F. (2014). Location and adoption of ICT innovations in the agri-food industry. *Applied Economics Letters*, *21*(6), 421–424. https://doi.org/10.1080/13504851.2013.864032
7. Drucker, P. (2020). *The Essential Drucker*. Routledge. https://doi.org/10.4324/9780429347979
8. Đuričin, S., Beraha, I., Jovanović, O., Mosurović Ružičić, M., Lazarević-Moravčević, M., & Paunović, M. (2022). The Efficiency of National Innovation Policy Programs: The Case of Serbia. *Sustainability*, *14*(14), 8483. https://doi.org/10.3390/su14148483

9. Đurić, K., Ivanišević, D., Jahić, M., & Prodanović, R. (2021). Mere agrarne politike u funkciji održivog ruralnog razvoja Republike Srbije. *Ecologica, 28*(102), 264–270. https://doi.org/10.18485/ecologica.2021.28.102.18

10. Freeman, C. (1982). *The Economics of Industrial Innovation*. London: Frances Printer Publishers.

11. Jovanović, O. (2021). *The role of subsidies in the development of SMEs in Agro-food system in Serbia* [Univerzitet u Beogradu]. https://nardus.mpn.gov.rs/bitstream/handle/123456789/19051/Disertacija_12218.pdf?sequence=1&isAllowed=y

12. Jovanović, O., Lazarević-Moravčević, M., & Đuričin, S. (2018). Organska poljoprivreda u funkciji održivog razvoja Republike Srbije. *Ecologica: Naučno-Stručni i Informativni Časopis*, *25*(91), 722–726.

13. Karuppiah, K., Sankaranarayanan, B., Ali, S. M., AlArjani, A., & Mohamed, A. (2022). Causality analytics among key factors for green economy practices: Implications for sustainable development goals. *Frontiers in Environmental Science*, *10*. https://doi.org/10.3389/fenvs.2022.933657

14. Martinez-Gomez, V., Domenech, J., & Mas-Verdú, F. (2022). Adoption of ICT innovations in the agri-food sector: An analysis of French and Spanish industries. In *Innovation Strategies in the Food Industry* (pp. 229–238). Elsevier. https://doi.org/10.1016/B978-0-323-85203-6.00020-7

15. Mosurović-Ružičić, M., Kutlača, Đ., Stanišić, N., & Semenčenko, D. (2018). Perspectives of innovation in Serbian firms: Empirical evidence from agro-food and software industry. *Economics of Agriculture, 65*(3), 1171–1191. https://doi.org/10.5937/ekopolj1803171m

16. Musvoto, C., Nortje, K., Nahman, A., & Stafford, W. (2018). *Green Economy Implementation in the Agriculture Sector*. Springer International Publishing. https://doi.org/10.1007/978-3-030-01809-2

17. OECD/Eurostat. (2018). Oslo Manual 2018: Guidelines for Collecting, Reporting and Using Data on Innovation. In *Handbook of Innovation Indicators and Measurement*. https://doi.org/10.1787/9789264304604-en

18. Pavlova, G., Bezus, R., Masliaieva, O., & Didur, K. (2018). Conceptual basis for innovative potential of agricultural production implementation. *Academy of Entrepreneurship Journal, 24*(2), 1–6.

19. Reddy, A. A., Melts, I., Mohan, G., Rani, C. R., Pawar, V., Singh, V., Choubey, M., Vashishtha, T., Suresh, A., & Bhattarai, M. (2022). Economic Impact of Organic Agriculture: Evidence from a Pan-India Survey. *Sustainability*, *14*(22), 15057. https://doi.org/10.3390/su142215057

20. Rohne Till, E. (2022). The Role of Agriculture in Economic Development. In *Agriculture for Economic Development in Africa* (pp. 9–17). Springer International Publishing. https://doi.org/10.1007/978-3-031-07901-6_2

21. Rudgard, S., Ballantyne, P. ., Castello, R., Del, Edge, P., Hani, M., Maru, A., Morras, E., Nichterlein, K., Porcari, E., & Treinen, S. (2011). ICTs as enablers of agricultural innovation systems. In *ICT in Agriculture e-sourcebook*.

22. Ružičić Mosurović, M., & Kutlača, Đ. (2019). Statistical Monitoring of Innovation Capacities of the Serbian Firms as Decision-Making Tool. *Economic Analysis*, *49*(2), 74–84. https://doi.org/10.2991/seneet-19.2019.32

23. Simić, I. (2021). *Organska proizvodnja u Srbiji 2020*. Nacionalno udruženje za razvoj organske proizvodnje Serbia Organika.

24. Statistical Office of the Republic of Serbia. (n.d.). *Science, technology and innovation indicators*. https://www.stat.gov.rs/oblasti/nauka-tehnologija-i-inovacije/

25. Tomaš Simin, M., & Janković, D. (2014). Applicability of Diffusion of Innovation Theory in Organic Agriculture. *Economics of Agriculture*, *2*, 507–529. https://doi.org/10.22004/ag.econ.175298

26. Tomaš Simin, M., Pejanović, R., & Glavaš-Trbić, D. (2016). Organska poljoprivreda kao "nova-stara" tehnologija. *XXII Skup Trendovi Razvoja: "Nove Tehnologije u Nastavi" , Zlatibor*, 1–6.

27. United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. United Nations.

28. Water, M. of A. F. and. (n.d.). *Ministry of Agriculture, Forestry and Water Management*. http://www.minpolj.gov.rs/?script=lat

29. Willer, H., Travniček, J., Meier, C., & Schlatter, B. (2021). *The World of Organic Agriculture Statistic and Emerging Trends 2021*. Bon: Research Institute of Organic Agriculture FiBL, and IFOAM- Organics International. https://www.organic-world.net/yearbook/yearbook-2021.html

PRINCIPLES OF SUSTAINABLE AGRICULTURE AS A TOOL FOR THE IMPROVEMENT OF RURAL AREA LIFE QUALITY IN THE REPUBLIC OF SERBIA

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Abstract

Agriculture is one of the main anthropogenic activities that has strong footprint on natural resources. The concept of sustainable development and non-linear economic models are developed with aim to reduce the negative impact on ecosystem produced by agriculture. Official EU institutions have recognized the importance of circular economy and sustainable agriculture for rural areas development. The one of the first steps is certainly the assessment of the development potential of the locally specific ecological, recreational and cultural environment. Natural and built environmental amenities represent locally specific resources that make rural areas attractive for living, vacationing and new business initiatives. Two theoretical models based on the identification of factors that influence the decisions of individuals and employers regarding the choice of location for living and working, as well as spatial differences in terms of economic development are analyzed in the present study. Further, recommendations were proposed as one of the possible determinants for the future approach in planning and implementation of the development of rural areas in the Republic of Serbia. Principles of sustainable agriculture and the circular economy concept implementation, and the improvement of the life of the population in rural areas are recognized as creating determines of the rural development policy in the future.

Key words: *sustainable agriculture, outdoor amenities, rural areas, circular economy*

Introduction

Anthropogenic activity significantly comprises to environment pollution, especially from the second half of XX century (Mayers et al. 2017). The main

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factors related to increased negative impact include exponential growth in water consummation, transportation, fertilizer utilization, paper and plastic production and primary energy use. Additionally, anthropogenic impact could be measured in natural system degradation and denaturation (carbon dioxide emission, terrestrial and marine biosphere degradation, ocean acidification and tropical forest loses), (Mayers et al., 2017).

Steffen et al. (2015) in their study elaborated human population as dominant force that shapes biophysical conditions on Earth and defined it as the great acceleration theory. Considering listed changes in nature and suggested factors in their study, it could be concluded that agriculture is one of the major human activities that changes natural resources. On annual world level for nutrition needs humans utilize 40% of land for farming (animal breading and crop cultivation), half of water resources for irrigation, 90% of fish fond, cut 7-11 km^2 of forests and 60% of river barrier by dams (Steffen et al., 2015).

The concept of sustainable development and non-linear models of the economy, the circular economy, but now also the circular bioeconomy, are possible approaches for reduction of the anthropogenic impact on the Earth and protection natural resources for new generations. It is particularly important to emphasize the significance of these approaches for the development of rural areas, which is also recognized by the European Network for Rural Development, the European Agricultural Fund for Rural Development and the European Commission (Fund et al., 2018; Projects Brochures the European Agricultural Fund for Rural Development Bioeconomy, 2019; Stegmann et al., 2020). Additionally, in developed economies, natural and built environmental amenities represent locally specific resources that make rural areas attractive for living, vacationing and new business initiatives that are strongly linked to a specific rural area.

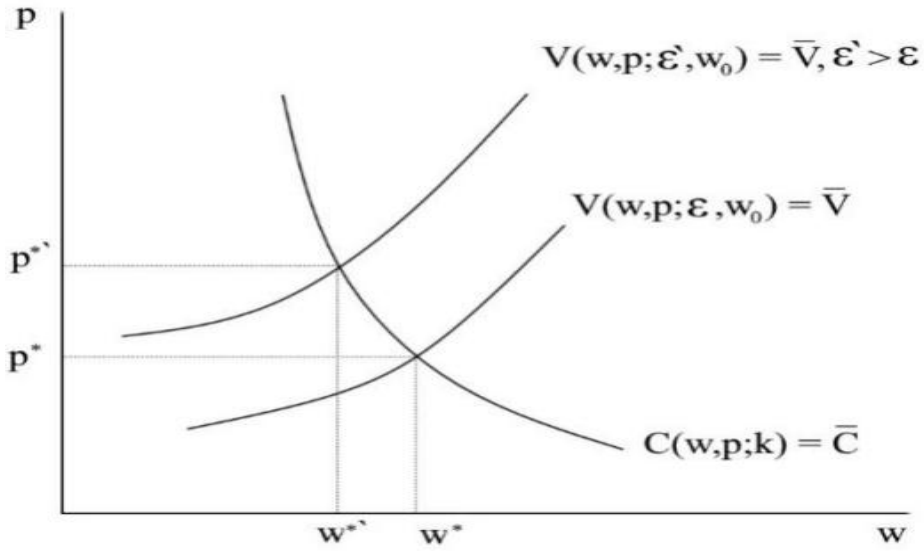
Outdoor amenities and life quality of population in rural areas

Many empirical studies in the field of rural development focus on the analysis of the impact that different factors such as outdoor amenities, the availability of human capital and geographic position can have on spatial differences regarding the average per capita income, the average housing price and the unemployment rate (Roback, 1982; Blanchflower and Oswald, 1995; Wu and Gopinath, 2008; Hand et al., 2008). The specific *"quality of rural environment"* which makes a certain rural area suitable for life and leisure is defined as outdoor amenities of

rural areas (Josipović, 2017). Pleasant climate (temperature, number of sunny days, humidity) and a rich natural landscape (biodiversity and environmental protection, abundant water and forest resources, diverse topography) represent natural amenities of rural areas. In addition to natural amenities, outdoor amenities of rural areas refer to build amenities such as modern road network and infrastructure related to the offer of various recreational activities.

Wu and Gopinath (2008) developed a theoretical model with a view to: identifying the factors that affect the decisions individuals or employers make regarding the choice of work and life location, analyzing the connection between the decisions individuals and employers make and looking at potential effects of their decisions on spatial differences in terms of economic development. The model is based on Roback theoretical model (1982) and it starts from the premise that an individual chooses a location which can provide him maximum utility. The individual utility function represents maximum utility that can be achieved based on the given income (w), housing price (p), availability of outdoor amenities (Ɛ) and other individual earnings besides income (w_0). The individual utility function which can be expressed in the following way V (w, p; Ɛ, w_0) is shown in graph 1.

Graph 1. *The connection between the decisions of households and enterprises regarding location*



Source: Wu and Gopinath, 2008, pp 394.

The individual utility function has a positive slope because it starts from the premise that for the given level of outdoor amenities, areas characterized by a higher income are also characterized by higher housing prices to equalize utility at all locations, i.e., to achieve a balance. An individual chooses a location to maximize overall utility V (w, p; Ɛ, w_0) considering *trade-off* between income (w), housing price (p) and outdoor amenities (Ɛ). It follows that the income level, and the housing prices need to be adjusted to equalize utility at all locations, i.e.:

$V(w, p; \varepsilon, w_0) = \bar{V}$, where $\bar{V}$ represents the utility level at a national level.

According to this theoretical model, an employer chooses a location with minimize total cost considering *trade-off* between the input price, accumulated human and physical capital and transport costs (Wu and Gopinath, 2008). An employer will choose the best combination of work force (l) and capital (κ) so as to minimize total production cost. Graph 1 shows iso-cost curve which can be expressed in the following way: C (w,p,k). It has a negative slope because it is based on the premise that for the given level of accumulated capital, the location with higher workforce expenses must have lower housing prices so as to achieve a balance, i.e. to equalize total expenses at all locations. The income level and housing prices need to be adjusted to equalize expenses at all locations, i.e.: $C(w, p; k) = \bar{C}$, where $\bar{C}$ represents a constant determined by the existing production technologies.

According to the developed model, in two rural areas characterized by the same level of accumulated capital, but different levels of outdoor amenities, we can conclude the following (Graph 1): 1. The utility function of an individual who lives in a rural area with greater outdoor amenities exceeds the utility function of an individual who lives in a rural area with lesser outdoor amenities because for the given income level the average housing price in a rural area with greater amenities must be higher so as to equalize the utility at both locations; 2. In equilibrium, the average housing price is higher and the income is lower in a rural area with greater outdoor amenities because individuals accept a lower income and higher housing prices in order to live in an area characterized by greater outdoor amenities.

In order to analyze interdependence of outdoor amenities, income level, housing prices and unemployment rate Blanchflower and Oswald (1995) developed a theoretical model. This model is based on the following premise: population

in areas with high outdoor amenities is ready to accept a lower income and higher housing prices compared to areas with lower outdoor amenities. In other words, people are ready to live in these areas even if they are characterized by a higher unemployment rate than areas with low outdoor amenities.

Starting from the abovementioned theoretical models, in their empirical studies many authors have confirmed the hypothesis that if population highly appreciates the possibility of living in areas with high outdoor amenities, they are ready to stay there despite the risk of being out of work for a certain period of time (Blanchflower and Oswald, 1995; Deller and Tsai, 1999; Deller, 2009). Also, many empirical studies conducted so far contribute to understanding the ways in which outdoor amenities (natural amenities, availability of recreational activities and the development level of rural infrastructure) can affect socio-economic growth and the development of rural areas (Deller et al., 2001; Hand et al., 2008; Deller, 2009).

Principles of sustainable agriculture

Producing enough food for the population is the main goal of all governments in the world (Mayers et al., 2017). The increase in population on the planet has led to intensive occupation of land, as well as increased use of water resources, for the purpose of cultivating crops and animals. Beside consummation of natural resources (soil and water), agriculture production pollutes environment by extensional application chemical products (fertilizers and pesticides), which accumulates and circulates through ecosystem (belong to POPs – Persistan Organic Pollutants compounds), often entering the food chain and has great negative impact to ecosystem (Mateo-Sagasta et al., 2017; Sun et al., 2018).Everything mentioned indicates the importance of transition to the principles of sustainable agriculture, which primarily aim to ensure ecosystem homeostasis, preserve and/or renature and restore natural resources and use them rationally and efficiently for the production. In addition, principles of sustainability refer to the improvement of rural areas and the reduction of their inhabitants resilience to climate changes and market changes (FAO and post – 2015 development agenda).

It is estimated that by 2025, the number of inhabitants on the planet will be around 8.5 billion, and that over 80% of the world's total population of billions will live in developing countries. This raises the question of how agriculture will be able to respond to increased needs, given the already existing load of

natural resources and the problem of environmental pollution. To overcome this challenge, it is necessary to create conditions for the implementation of the sustainable agriculture principles and rural development, which will first of all enable sufficient production, but also food safety.In order to achieve this, it is necessary to harmonize policies at the local and national level related to agriculture, the environment and macroeconomics. This process requires a series of activities such as education and development of new technologies, food availability to vulnerable groups, adequate level of market production, increase of employment and poverty rate reduction, rational management of natural resources and environmental protection (Agenda 21, Chapter 14, Section II Conservation & management of resources for development Chapter 14 Promoting Sustainable Agriculture & Rural Development). All the mentioned activities indicate the necessary cooperation of various institutions, as well as the connection of science and economy.

The comparative advantage of the rural areas of Serbia is a variety of outdoor amenities, such as: a pleasant climate, different topography, rich forest and water resources, developed traffic infrastructure and a rich offer of recreational activities that provide the opportunity for housing, rest and recreation in a pleasant environment (Josipović & Kokeza, 2021). The one of the first step on the path to sustainable rural development of the Republic of Serbia is certainly the assessment of the development potential of the locally specific ecological, recreational and cultural environment.

Guidelines for sustainable development of rural areas in the Republic Serbia

The demographic structure of the population of rural areas in the Republic of Serbia is unfavorable and the rural exodus is increasingly pronounced as a consequence of negative natural growth and population departure to urban areas and abroad. Improvement of agricultural production competitiveness, diversification of rural economy and improvement of rural area life quality require the application of an endogenous, holistic and decentralized approach in planning and realization of rural development in Serbia. This approach is based on rich, locally specific resources and is directed towards preservation and promotion of rural ecological, cultural and social values (such as clean air, rich natural landscape, possibilities for organic food, rural culture and tradition, etc.). What is more, this approach encourages mutual activities, forming networks and partnerships among individuals, organizations and institutions at a local level.

Rural development planning in Serbia requires mapping rural areas from the perspective of available natural and total outdoor amenities. The classification of rural areas in Serbia from the perspective of natural and total outdoor amenities based on relevant amenities indicators from 2019 is shown in Table1.

Starting from the methodology for evaluation of economic value of outdoor amenities in rural areas applied in empirical research (Beale and Johnson, 1998; McGranahan, 1999; Deller et al., 2001; Glaeser et al., 2001; McGranahan, 2008; McGranahan et al., 2010), first classifications of rural areas in Serbia were developed considering natural and total outdoor amenities (Josipović, 2018; Rikalović i Josipović, 2019; Josipović et. al., 2021; Drobnjaković et al., 2022). Two groups of indicators were used to assess outdoor amenities of rural areas in Serbia:

1. *Natural amenities indicators* (average temperature in January; topographic scale; available water and forest resources) and
2. *Built amenities indicators* (percentage of people employed in art, entertainment and recreation industry; infrastructure development level).

Endogenous development of rural areas rich in outdoor amenities is based on the development focused on starting entrepreneurial initiatives, especially in industries such as: organic production, production of traditional agricultural products, rural tourism (winter, recreational, wellness, eco, etc.), activities related to culture and art.

Sustainable rural development of Serbia is based on promoting economy that uses rural resources more efficiently, which is greener and more competitive. The most important guidelines for raising value of local developmental potential, improving rural economic performances and creating competitive rural economy are the following: Providing appropriate business environment and forming local institutions which support business initiatives; Improvement and development of rural infrastructure and wider application of information and communication technologies; Improvement of knowledge and skills, development of innovations and application of green technologies; Encouraging diversification of rural economy, development of local markets, creating more jobs and restructuring agriculture; Closer cooperation among public, private and civil sector.

Table 1. *Classification of rural areas in Serbia according to the natural amenities and outdoor amenities*

Region	Rural area	Natural amenities		Outdoor amenities	
		Natural amenity index	Rank	Outdoor amenity index	Rank
Vojvodina Region	West Bačka	-1,4396	Low	-3,4577	Low
	South Banat	-0,8004	Intermediate	-2,0163	Intermediate
	South Bačka	-0,4208	Intermediate	1,4983	Intermediate
	North Banat	-2,0538	Low	-4,3851	Low
	North Bačka	-0,3926	Intermediate	-1,6137	Intermediate
	Central Banat	-0,9130	Intermediate	-3,7019	Low
	Srem	-1,1209	Low	-2,0883	Low
Šumadija and West Serbia Region	Zlatibor	-1,4074	Low	3,1175	High
	Kolubara	0,5592	Intermediate	-0,0781	Intermediate
	Mačva	-2,7326	Low	-2,7750	Low
	Moravica	0,3925	Intermediate	0,6107	Intermediate
	Pomoravlje	0,2240	Intermediate	1,1312	Intermediate
	Rasina	0,8795	High	2,0190	Intermediate
	Raška	2,5536	High	3,3341	High
	Šumadijska	-0,1786	Intermediate	0,9757	Intermediate
South and East Serbia Region	Borska	2,4242	High	2,3492	High
	Braničevo	1,8393	High	2,3105	High
	Zaječar	-0,0146	Intermediate	0,1658	Intermediate
	Jablanica	-0,5859	Intermediate	-1,0204	Intermediate
	Nišava	1,5117	High	2,1895	High
	Pirot	0,6481	Intermediate	0,2910	Intermediate
	Podunavlje	-1,4452	Low	-3,5506	Low
	Pčinja	2,2409	High	3,4798	High
	Toplica	0,2325	Intermediate	1,2146	Intermediate

Source: Josipović et al., 2021.

Conclusion

Principles of sustainable agriculture and the circular economy concept implementation and the improvement of the life quality of the population in rural areas appear as the determinants of the creation of the rural development policy of the Republic of Serbia in the future. As a developing country, Serbia is at the beginning of the process of the rural economy transition towards a new model of development, which is defined in the literature as a model of rural industrialization. In order to foster the reverse migration flow of population

from urban to rural areas, it is necessary to create an appropriate institutional and stimulating business environment. Its role is reflected in: Strengthening the competitiveness and efficiency of the agricultural sector; Ensuring income stability and security of employees in agriculture and activities related to agriculture; Management of rural outdoor amenities in accordance with the principles of sustainable development; Improvement of social capital and rural infrastructure. Also, in order to improve the rural environmental amenities, it is necessary to adopt appropriate measures aimed at environmental protection, biodiversity preservation and sustainable use of national natural resources.

Literature

1. Blanchflower, D. G., & Oswald, A. J. (1995). *An introduction to the wage curve*. Journal of economic perspectives, 9(3), 153-167.
2. Deller, S. C., Tsai, T. H., Marcouiller, D. W., & English, D. B. (2001). *The role of amenities and quality of life in rural economic growth*. American journal of agricultural economics, 83(2), 352-365.
3. Deller, S. (2009). *Wages, rent, unemployment and amenities*. Journal of Regional Analysis & Policy, *39*(2), 141-154.
4. Drobnjaković, M., Stojanović, Ž., &Josipović, S. (2022). *Rural Areas and Rural Economy in Serbia*. In The Geography of Serbia (pp. 289-303). Springer, Cham.
5. Food and Agriculture Organization of the United Nations, Sustainable development goals, https://www.fao.org/sustainable-development-goals/overview/fao-and-the-2030-agenda-for-sustainable-development/sustainable-agriculture/en/, [Accessed December 9, 2022]
6. Fund, C., El-Chichakli, B., & Patermann, C. (2018). Bioeconomy Policy (Part III): Update Report of National Strategies Around the World. Berlin. Projects Brochures the European Agricultural Fund for Rural Development Bioeconomy, 2019, 1-32.
7. Hand, M. S., Thacher, J. A., McCollum, D. W., &Berrens, R. P. (2008). *Intra-regional amenities, wages, and home prices: the role of forests in the Southwest*. Land Economics, 84(4), 635-651.
8. Josipović, S.& Kokeza, G. (2021). *Socio-ekonomska uloga domaćih pogodnosti ambijenta pre i za vreme pandemije COVID-19*, Ekonomski vidici, Društvo Ekonomista Beograda, *26*(1-2), 189-210. UDK-33. ISSN 0354-9135.

9. Josipovic, S., Stojanovic, Ž., Dragutinovic Mitrovic, R. & Kokeza, G. (2021). *Modelling and measuring outdoor amenities*, 179th EAAE Seminar, Food Policy Modelling as an Effective and Expeditious Response to Today's Urgent Issues, Abstracts Book, 42, Mediterranean Agronomic Institute of Chania (MAICh)

10. Josipović, S. (2018). Погодности амбијента, предузетништво и рурални развој Србије. *Универзитет* у *Београду*, Ekonomski fakultet.

11. Josipović, S. (2017). *Prirodne pogodnosti I klasifikacija ruralnih oblasti*. Ekonomski vidici, *22*(2-3), 149-160.

12. Mateo-Sagsta, J., Marjani Zadeh, S. & Turral, H. (2017) Executive Summary - Water pollution from agriculture: a global review. Food and Agriculture Organisation of the United Nations (FAO), Rome and International Water Management Institute (IWMI), Colombo.

13. Myers, S. S. (2017). Planetary health: protecting human health on a rapidly changing planet. *The Lancet*,390*(10114), 2860–2868.*

14. Ondiko, J.H., Karanja, A.M. & Ombogo, O. (2022). A Review of the Anthropogenic Effects of Climate Change on the Physical and Social Environment. *Open Access Library Journal*, 9: e7751

15. Paul Stegmann,Marc Londo,Martin Junginger, The circular bioeconomy: Its elements and role in European bioeconomy clustersResources, Conservation & Recycling: XVolume 6, May 2020, 100029

16. Projects Brochures the European Agricultural Fund for Rural Development Bioeconomy, 2019, 1-32.

17. Rikalović, G., & Josipović, S. (2018). *The mapping of rural Serbia according to the index of natural amenities*. Zbornik Matice srpske za drustvene nauke, (166), 249-261.

18. Roback, J. (1982). *Wages, rents, and the quality of life*. Journal of political Economy, 90(6), 1257-1278.

19. Sun, S., Sidhu, V., Rong, Y. & Zheng, Y. (2018). Pesticide Pollution in Agricultural Soils and Sustainable Remediation Methods: a Review. *Current Pollution Report,* 4, 240–250.

20. Steffen, W, Broadgate, W., Deutsch, L., Gaffney, O. & Ludwig, C. (2015). The trajectory of the Anthropocene: the great acceleration. *Anthropocene Review*, 2, 81–98.

21. Steffen, W., Richardson, K., Rockstrom, J., Cornell, S. E., Fetzer, I., Bennett, E. M., et al. (2015). Planetary boundaries: Guiding human development on a changing planet. *Science,* 347*(6223), 1259855–1259855.*

22. Stegmann, P., Londo, M. &Junginger, M. (2020) The circular bioeconomy: Its elements and role in European bioeconomy clusters, Resources, Conservation & Recucling, 10 *(6),* 100029.

23. UN Department of Economic and Social Affairs, Division for Sustainable Development, Agenda 21, Chapter 14, Section II Conservation & management of resources for development Chapter 14 Promoting Sustainable Agriculture & Rural Development. https://www.un.org/esa/dsd/agenda21/res_agenda21_14.shtml, [Accessed December 9, 2022].

24. Wu, J., & Gopinath, M. (2008). *What causes spatial variations in economic development in the United States?*. American Journal of Agricultural Economics, 90(2), 392-408.

PLACE OF NATURE-BASED TOURISM IN ECOSYSTEM SERVICES VALUATION IN RURAL LANDSCAPE

Milica Luković[1], *Danijela Pantović*[2]

Abstract

Ecosystem services (ES) are the subjects of number of studies in recent ten years. There were many attempts to valuate ecosystem services from ecological, social and economic aspects. The fact is there are limited numbers of studies focused on the place of tourism as a part of cultural ecosystem services in the frame of rural surrounding. The research includes perception of different interest groups (local inhabitants, stakeholders and students) on ES in selected rural areas. The aim of this paper is to identify the most important ES using priority ranking analysis and range of variance between researched groups. The results show that in local inhabitant's perception provisioning ES are still major driving force of rural economy. Cultural ES is finding its place in perception of stakeholders and students. In the range of cultural ES categories, nature-based tourism was recognized as one of important factors of development. The conclusion of the paper indicates the necessity of including cultural ES in the analysis and assesses the need to map places of exceptional cultural value. In addition, the need to use the ES framework for identifying the economic benefits of cultural and natural resources are emphasized.

Key words: *ecosystem services, rural landscape, nature-based tourism*

Introduction

Ecosystem services represent a range of goods and services from nature which has benefits for local people and communities. The EU 2020 Biodiversity Strategy besides comprehensive information referring to the status of biological diversity and ecosystems highlighted the necessity of establishing of capacity to monitor ecosystem services (Maes et al., 2013). A decade in the past efforts

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have been made to gather scientific information and practical knowledge for the best use, operation, decision policy and management of ecosystems and their services across Europe and wider. In that context, several systems of classification ecosystem services were made. The most used classification system proposed by Millennium Ecosystem Assessment (MEA, 2005) work and The Economics of Ecosystems and Biodiversity (TEEB, 2010) and recognizing for categories with sub-categories (1. Supporting ES; 2. Regulating ES; 3. Provisioning ES; 4. Cultural ES). According to Plieninger et al., 2013 knowledge and information on biodiversity and ecosystem services are crucial for the local economy, small biodiversity businesses, employment, and human well-being. There is a range of differences in ecosystem services perception and evaluation. Providing ES (e.g. food, water, fuel) are often the focus of the local community as direct benefits from nature with stronger linkages to human well-being than other ecosystem services categories, while supporting or regulating ES are not enough recognized out of the scientific field. A specific category of ecosystem services is cultural services that represent more nonmaterial than material benefits that could be obtained from nature and put into the function of well-being (Cheng et al., 2019). Cultural ecosystem services people realize through "spiritual enrichment, cognitive development, reflection, recreation and aesthetic experiences" (Hernández-Morcillo et al., 2013, p. 435; MEA, 2005).

Rural areas cover 70% of the total territory which gives a diversity of landscapes and ecosystem services. Assessment and evaluation of ecosystem services are essential for local sustainable development in the increasing trend of depopulation and degradation of nature (Fernández Martínez et al., 2020). Recent studies indicate a problem of poverty in rural areas and a lack of basic infrastructure, access to new technologies, education, and knowledge exchange to improve their economy. The natural advantage of rural areas lies in their natural capacity to use biodiversity at the level of genes (e.g. wild and autochthonous varieties), species (e.g. wild edible plants, mushrooms) and ecosystems (e.g. forest, meadows, rivers). The economy was not oriented to biodiversity business and ecosystem marketplace (Bishop et al., 2009). Ecosystem services could reduce rural poverty through the new biodiversity business models which include eco-friendly energy, authentic food, and a range of cultural services (e.g. recreation, landscape aesthetic, spiritual). Biodiversity business has added-value for rural entrepreneurship and employment. Nature-based tourism, among other conventional rural businesses, depends on ecosystem services (Luković and Kostić, 2022). The studies indicate that new bio prospecting compounds of biodiversity business are genes and wild species, and they are estimated to the worth US$500 million

in the next 20 years (up to 2050). As well as, the recent report on ecotourism (e.g. sport, recreation, hunting and fishing) already follow a growing trend of expanding at a rate of about 30% per year compared to 9% for conventional tourism.

Despite attempts to valorize cultural ES, there is still a lack of empirical evidence regarding the value of cultural ES and promotion of its role in the green economy, investing base in natural assets, as well as economic, social and environmental benefits (Le Blanc, 2011). This study intends to apply a frequent citation report for assessing the ecosystem services that local people perceive as economically important or enjoy and to find out where the place of nature-based tourism is in their perception with a range of ecosystem services with the accent to cultural ones.

Material and methods

Study area

The study was performed in six villages/rural areas along the geographic gradient, respecting a range of altitudes (0-300m; 300-600m; 600-1500m). Researched sites located from Pannonian plane (Šumarak and Novo Miloševo), across hilly Sumadia (group of villages under the Rudnik mountain- Ramaća and Stargari) to western mountain villages in Serbia- Rudno on Radočelo and Devići on Golija mountain (Figure 1). The researched sites include populated rural settlements.

Figure 1. *The map of researched sites*

Study design and method

Our study applied a combination of different ecosystem services categories/sub-categories according to Millennium assessment aims (MEA 2005), TEEB classification (TEEB, 2010) and Plieninger et al., 2013 for ecosystem services assessment through local settlements perception and knowledge. Extracted ecosystem services sub-categories include spiritual and religious values, sense of place, aesthetic values, social relationship, cultural heritage/ diversity, recreation and ecotourism, walking, bird watching, herbal tours, gathering wild products, bicycling, hunting, knowledge systems and educational values. Semi-structured interviews were conducted with local community representatives with the frequency of mentioning each category without our suggestion. The total number of respondents was 67. As well as, a pre-test was performed, discussed, and refined with students in their final year of studies at the Faculty of hotel management and Tourism.

The relative Frequency of Citation (RFC) index represents the number how many times one sub-category is mentioned by respondents. This parameter was determined for each sub-category as the ratio of respondents who cited a sub-category to the total number of respondents.

$$RFC = \frac{FC}{N}$$

Mentioned ES sub-categories grouped into one of four main categories.

Results and discussion

The respondents included in the research had the opportunity to express subjective attitudes referring to important ecosystem services. The obtained results were gathered and classified into adequate categories. The results show that local respondents in general recognize, value and appreciate provisioning ES with an average RFC index 0.86 and cultural asset of services (0,71), while supporting ecological processes (RFC- 0.36) is not in the focus (Table 1).

Table 1. *Frequency of citation ecosystem services categories by local respondents*

Ecosystem services (ES)	RFC					
	S1	**S2**	**S3**	**S4**	**S5**	**S6**
Supporting ES (e.g. biogeochemical cycles, biodiversity, food chain)	0.36	0.29	0.10	0.05	0.12	0.17
Regulating ES (e.g. air/water regulating, pollination, climate regulating, erosion prevention)	0.41	0.51	0.37	0.30	0.61	0.63
Provisioning ES (e.g. food, water, fuel, biomass, medicinal resources)	0.82	0.87	0.79	0.81	0.91	0.94
Cultural ES (e.g. aesthetic and spiritual value, cultural and historical value, recreational value)	0.73	0.71	0.59	0.62	0.75	0.83

Source: author's calculation

Traditionally provisioning ES is the most appreciated by local communities which have direct economic and well-being benefits from natural resources such as crops, fodder, pastures, firewood, cattle breeds and a variety of value-added products like milk, cheese, and meat (Garrido et al., 2017). In rural surroundings resources like wild edible berries, plants and fruits from provisioning ES spectra also play a crucial role in agro-pastoral business and well-being lifestyles and thus provide a growing market linked with tourism (Mansfield & Potočnik Topler, 2021). Cultural ES is ranked as the second most valued which confirms other studies that highlighted recreation, rural tourism, eco-tourism activities, and traditional knowledge as highly appreciated by locals (Oteros-Rozas et al., 2014). The possible reason for local respondents' high perception of cultural ES lies in the fact that in the last several years, in Europe as well as in Serbia, there is an evident trend in increasing demands for rural services (Luković et al, 2022).

Special attention was paid to cultural ES to find out how is valued nature-based tourism in locals' perception. From four main ecosystem services categories, it was extracted cultural assets with sub-categories which were especially valued. The results show that the diversity of perceptions is based on geographical and cultural-historical background. The most valued cultural sub-categories were ecotourism and recreational activities (RFC- 0,74), cultural heritage/diversity (RFC- 0,71) and aesthetic values (RFC- 0,66). The knowledge system and education are not highly ranked in locals' perception even though there is interest in traditional knowledge and practices transfer.

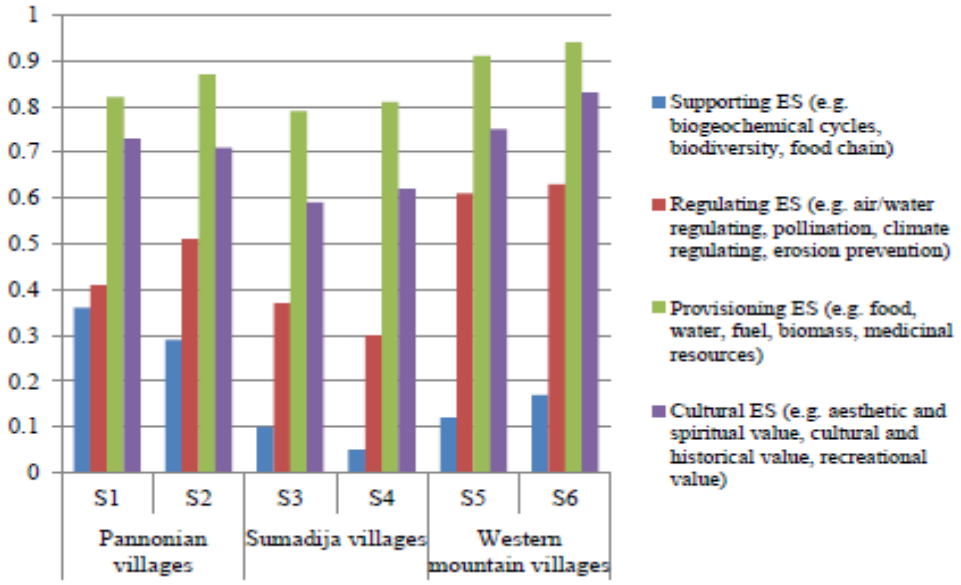
Table 2. *Frequency of citation sub-categories within cultural ecosystem services by local respondents.*

Cultural ES	RFC					
	S1	**S2**	**S3**	**S4**	**S5**	**S6**
Spiritual and religious values	0,51	0,50	0,69	0,65	0,70	0,68
Sence of place	0,48	0,39	0,60	0,64	0,67	0,67
Aesthetic values	0,61	0,51	0,62	0,67	0,75	0,71
Social relationship	0,60	0,62	0,58	0,50	0,62	0,63
Cultural heritage/diversity	0,70	0,63	0,63	0,70	0,79	0,80
Recreation and ecotourism activities	0,65	0,69	0,58	0,71	0,90	0,92
• Walking	0,65	0,64	0,59	0,48	0,89	0,84
• Bird watching	0,70	0,75	0,38	0,42	0,65	0,70
• Herbal tours	0,50	0,70	0,50	0,49	0,82	0,85
• Gathering wild products	0,42	0,50	0,71	0,68	0,90	0,95
• Bicycling	0,80	0,71	0,30	0,48	0,60	0,59
• Hunting	0,65	0,60	0,70	0,75	0,64	0,68
• Fishing	0,75	0,72	0,49	0,40	0,70	0,72
Knowledge systems andeducational values	0,55	0,45	0,30	0,38	0,50	0,58

Source: author's calculation

Local people's perception of cultural ecosystem services at the level of communities was discussed in different studies and their findings confirm that local respondents appreciate diverse cultural services and their multiple roles at the local level for individual and community well-being. Opposite to our results, according to Plieninger et al., 2013 indicate that half of the respondents identified sites of particular aesthetic values, social relations, or educational values. The reason could be under-appreciated cultural ES compared to other more easily quantifiable ecosystem services such as provisioning ones (Norton et al., 2012). Ten years after this research and under the pressure of Covid-19 over-look of rural ecosystems services changed perception. Some results show an increased demand for rural, natural, untouched areas with the capacity to offer local authenticity experience through the bio-cultural heritage (Luković and Nićiforović, 2021). Recent studies more paid attention to recreation and ecotourism, as well as aesthetic values, and were evaluated more often than other sub-categories. The positive perception of cultural ecosystem services is strong correlation with the well-being of people and communities, especially in developing countries where people are more dependent upon other types of ecosystem services than supporting one (Hernández-Morcillo et al., 2013).

Figure 2. *Comparative analysis in main ecosystem services perception*



Source: author's calculation

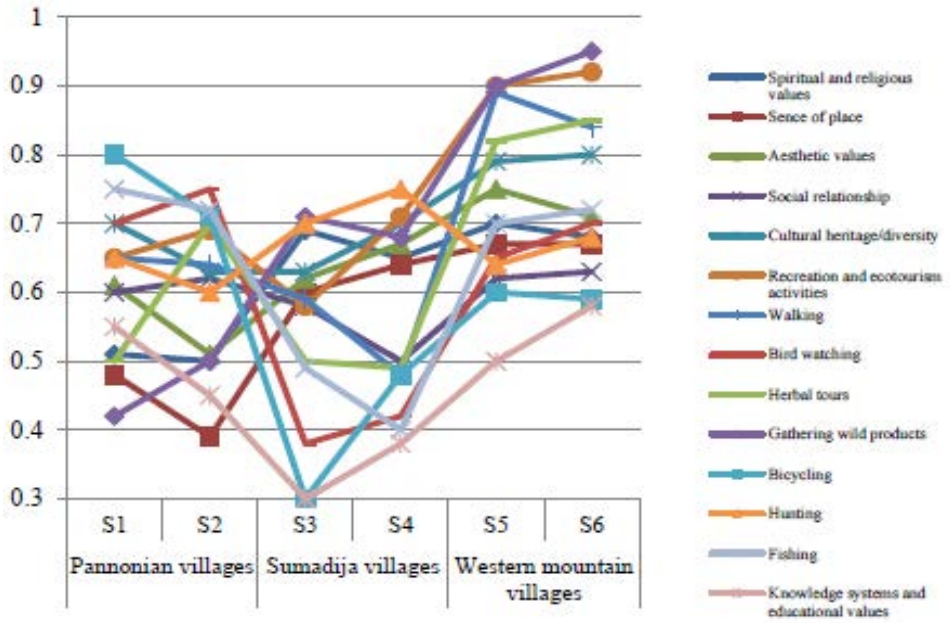
Comparative analysis show clear differences between Pannonia, Sumadia and western mountain villages in perception of the main categories of ecosystem services (Figure 2). Provisioning ES are the most appreciated by respondent along the geographic gradient and with special importance for western mountain villages who highlighted firewood, pastures and cattles. Even though low level of valuation, the significant variations could be seen in supporting ES perception. For example, pannonian respondents highly valued basic ecological processes. Cultural ES follow provisioning as the second important and the greatest significance has to western mountain villages, especially Golija mountain.

Apart from the above, it can be observed that in all investigated regions, the cultural values of the ecosystem have a high perception. Cultural and historical values are especially important. When the epithet WHS (World heritage site) is added to that, the concept and experiences of visitors at such locations are highly positioned (Poria et al., 2013). Individually, precisely because of the WHS location, Western mountain villages have the dominantly highest cultural value.

Locals in mountain regions were most acknowledged in provisioning ES, where livestock grazing was considered a fundamental practice for social well-being

(Garrido et al., 2017). Some studies indicate (e.g. Carmona et al., 2013) that many respondents valued cultural ecosystem services not only from the aspects of biophysical or economic approaches but then from their sense and special relationship to tradition and culture. Some of the areas researched in this study are under the protection status with a limited range of activities which capitalize on cultural ES as an added value to sustainable rural development and powerful mechanisms in nature conservation and biodiversity business (Daniel et al., 2012).

Figure 3. *The place of nature-based tourism activities in the perception of local respondents*



Source: author's calculation

Figure 3 shows the place of nature-based tourist activities, according to the perceptions of the local population. Looking at rural regions, based on Figure 3, it is noticeable that Bicycling, Fishing and Bird watching dominate in Pannonian villages. On the contrary, local residents in Sumadija villages gave the highest rating to Hunting and Recreation and ecotourism activities. The lowest rating was recorded precisely in these villages, when it comes to cycling, in contrast to the previous geographical area. In the end, as expected, spiritual and religious values, as well as recreation and ecotourism activities, received the highest value in Western mountain villages.

Conclusion

Rural areas with diverse landscapes provide a wide range of benefits to the local community through ecosystem services. Results of this study and previous research confirm that provisioning ecosystem services are the most appreciated giving direct economic benefit. Cultural services asset, as well as high, ranked and valued by locals and recognized as possible source of income, highlighting nature-based activities, cultural heritage and aesthetic sense of place as the most important. Awareness about the positive impact of tourism for biodiversity business and ecosystem marketplace in rural areas through the revealing of traditional knowledge and practices, old recipes-food tourism, herbal tours and finally rational exploitation of biological diversity capacity. Cultural services together with provisioning services could be vital for future sustainable rural development from economic aspects, as well as from the aspect of land use and management. This study was limited to several villages along the geographical gradient and should be spread on a large scale. Positive outputs suggesting to the stronger promotion and raising of awareness about cultural ecosystem potential as generators of economic diversification, nature conservation and preservation of a cultural, historical, and traditional sense of place.

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Literature

1. Bishop, J., Kapila S., Hicks, F., Mitchell P. & Vorhies F. (2009). *Building Biodiversity Business*. World Conservation Union; 2nd ed. Edition, p.159
2. Carmona, C.P., Azcárate, F.M., Oteros-Rozas, E., González, J.A. & Peco, B., (2013). Assessing the effects of seasonal grazing on holm oak regeneration: implications for the conservation of Mediterranean dehesas. *Biol. Conserv. 159*, 240–247.

3. Cheng, X., Van Damme, S., Li, L., & Uyttenhove, P. (2019). Evaluation of cultural ecosystem services: A review of methods. *Ecosystem Services, 37,* 100925. doi:10.1016/j.ecoser.2019.10092

4. Daniel, T.C., Muhar, A., Arnberger, A., Aznar, O., Boyd, J.W., Chan, K.M.A., et al., & von der Dunk, A. (2012). Contributions of cultural services to the ecosystem services agenda. *Proceedings of the National Academy of Sciences of the United States of America, 109*, 8812–8819.

5. Fernández Martínez, P., de Castro-Pardo, M., Barroso, V. M., & Azevedo, J. C. (2020). Assessing Sustainable Rural Development Based on Ecosystem Services Vulnerability. *Land, 9*(7), 222. doi:10.3390/land9070222

6. Garrido, P., Elbakidze, M., Angelstam, P., Plieninger, T., Pulido, F., & Moreno, G. (2017). Stakeholder perspectives of wood-pasture ecosystem services: A case study from Iberian dehesas. *Land Use Policy, 60,* 324–333. doi:10.1016/j.landusepol.2016.1

7. Hernández-Morcillo, M., Plieninger, T., & Bieling, C. (2013). An empirical review of cultural ecosystem service indicators. *Ecological Indicators, 29,* 434–444. doi:10.1016/j.ecolind.2013.01.0

8. Le Blanc, D. (2011). Special issue on green economy and sustainable development. *Nat. Resour. Forum,* 35 (3), 151–154.

9. Luković, M. & Kostić, M. (2022). Quantification of main nature-based resources in rural tourism areas. Sustainable agriculture and rural development. Conference paper, 309-320.

10. Luković, M. & Nićiforović, J. (2022). Nature and natural food products in future tourists perspective. The future of tourism, The Seventh International Scientific Conference (TISC).

11. Luković, M., Pantović, D., Riznić, D., Lakićević, M. & Milutinović S. (2022). Place of biocultural heritage in post Covid-19 tourism destination choice. *Ecologica. 29*(107), 413-419

12. Luković, M. & Nićiforović, J. (2021). Increased demands for natural immuno- boosters in selected tourism areas. *Tourism International Scientific Conference Vrnjačka Banja - TISC, 6*(1), 366-381.

13. Mansfield, C. & Potočnik Topler, J. (2021). Building the Ethnopôle: Eliciting and sharing ethnobotanical knowledge in tourism development. *Annales Ser. hist. sociol.*, *31*(2), 197–208.

14. Maes J, Teller A, Erhard M, Liquete C, Braat L, Berry P, et al., & Bidoglio G (2013). *Mapping and Assessment of Ecosystems and their Services. An analytical framework for ecosystem assessments under action 5 of the EU biodiversity strategy to 2020*. Publications office of the European Union, Luxembourg.

15. MEA, (2005). Millenium Ecosystem Assessment Ecosystems and Human Well-being: Synthesis Report. Island Press.

16. Norton, L.R., Inwood, H., Crowe, A. & Bakers, A., (2012). Trialling a method to quantify the 'cultural services' of the English landscape using countryside survey data. *Land Use Policy,* 29(2), 449–455

17. Oteros-Rozas, E., Martín-López, B., González, J., Plieninger, T., López, C. & Montes, C. (2014). Socio-cultural valuation of ecosystem services in a transhumance social-ecological network. *Reg. Environ. Change, 14*, 1269–1289.

18. Poria, Y., Reichel, A., & Cohen, R. (2013). Tourists perceptions of World Heritage Site and its designation. *Tourism management*, *35*, 272-274.

19. Plieninger, T., Dijks, S., Oteros-Rozas, E., & Bieling, C. (2013). Assessing, mapping, and quantifying cultural ecosystem services at community level. *Land Use Policy,* 33, 118–129. doi:10.1016/j.landusepol.2012.1

20. TEEB, (2010). The Economics of Ecosystems and Biodiversity: Ecological and Economic Foundations. Earthscan, London.

TRENDS OF TRADE INDICATORS OF POTATOES IN BOSNIA AND HERZEGOVINA

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Abstract

In the paper, the movement of foreign trade indicators of potatoes in Bosnia and Herzegovina was analyzed using a quantitative research method, and thus an attempt was made to determine possible changes that occurred in the analyzed ten-year period, and to predict their movement in the future. The results showed that Bosnia and Herzegovina had a negative foreign trade balance when it comes to this vegetable, which is 16,150 tons. Imports, both in terms of quantity and price, have a slight tendency to increase in the coming period, while exports have a recorded tendency to decrease when it comes to quantities, and a slight upward trend in prices. Relatively unstable movements can be observed for both indicators in the observed ten-year period. According to the established linear trend, the quantitative import and export of potatoes will remain below the achieved ten-year average in the following period, while the price and foreign trade parameters are above it. On average, in the analyzed period, the largest import of potatoes was from the Netherlands, while the largest export was to Croatia.

Key words: *Potatoes, trends, import, export, Bosnia and Herzegovina*

Introduction

Given its nutritional importance, potatoes are today the main vegetable species in many countries. Potatoes are of great economic importance in less developed countries as well as in economically developed countries. (Puškarić, 2007) According to Vlahović (2003), 85 different industries use potatoes as a raw material from which more than a thousand products are obtained.

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In Bosnia and Herzegovina, potatoes are one of the most common vegetables, both in terms of sown areas and produced quantities. Namely, the sown areas of these vegetables last year were 33,560 ha, while the produced quantity was at the level of 339,727 tons. Such produced quantity ranks them in the first place in terms of production, behind which are the production of other vegetable crops such as cabbage (68,927 tons), tomatoes (52,892 tons), peppers (41,230 tons), etc. (BiH Statistics Agency, 2021). According to FAOSTAT data, the largest areas under potatoes are in Asia, almost half (49.7%), and the country that produced the most of this vegetable in 2020 was China with a production of 78,183,874 tons. It was immediately followed by countries such as India (51,300,000 tons), Ukraine (20,837,990 tons) and others.

The author's earlier research focused on the quantitative analysis of vegetable production itself (Mutavdžić, 2010; Novković et al., 2010; Lazić, 2014; Ivanišević, 2015; Ubiparip et al., 2016; Tarnowska and Kowalska, 2018; Ivanišević et al., 2018; Mihajlović, 2019). In their research, Hossain and Abdulla (2016) forecast the production of potatoes in Bangladesh until 2023, while Nedeljković and Vujić (2020) forecast the production, area and yield of potatoes in Bosnia and Herzegovina.

As stated by Nedeljković (2022), it is necessary to support the development of vegetable production, as an intensive branch of agriculture, and to somewhat reduce the extensiveness and current dominance of cereals in domestic production, considering the constant increase in demand for food on the world market.

Accordingly, Bijelić (2011) believes that financial instruments for the promotion of foreign trade include all forms of financial support of a country to its exporters in order to increase exports and increase sales abroad.

Taking into account the above, the subject of the work would be the analysis of the movement of foreign trade parameters of potatoes in Bosnia and Herzegovina with the aim of creating an adequate forecasting model of the mentioned indicators, which would also determine any changes that occurred in the analyzed period. Thus, the results of the research could be used for the purpose of making some of the strategic decisions that would concern this vegetable production.

Method and data sources

For data sources, we used the statistical database of the International Trade Center (ITC) as well as data from the BiH Agency for Statistics and the Food and Agriculture Organization (FAOSTAT). The period of analyzed foreign trade parameters of potatoes was from 2012 to 2021, and for this purpose we used the standard instrument of descriptive statistics (average, interval of variation, rate of change, coefficient of variation). Predictions (tendencies) are shown through the calculated rate of change, as well as by applying the appropriate trend line. The obtained results are presented tabularly and graphically.

Results

In the analyzed ten-year period, the average imported amount was almost 19,413 tons, while the exported amount was at the level of over 3,262 tons, which is only 16.80% of the imported amount of potatoes. The maximum import of 29,292 tons was achieved in 2015, while the maximum export was in 2017. Quantitatively, both import and export had a relatively unstable trend in the analyzed period expressed by the coefficient of variation, with the imported quantities of potatoes having a slight, so to speak insignificant tendency to increase, while the exported quantities of these vegetables show a slight tendency to decrease. (table 1)

Also, the following table 1 shows the movement of prices in the observed period. Namely, the average import price of potatoes was slightly higher than 339 euros/t, and the export price was 298 euros/t. Import and export prices reached their maximum in 2019. In contrast to the quantity, the price of potatoes for both imports and exports shows a slight tendency to increase as measured by the rate of change. The prices of foreign trade parameters of potatoes had a relatively unstable movement, which was particularly pronounced in the case of exports (cv=24.65%).

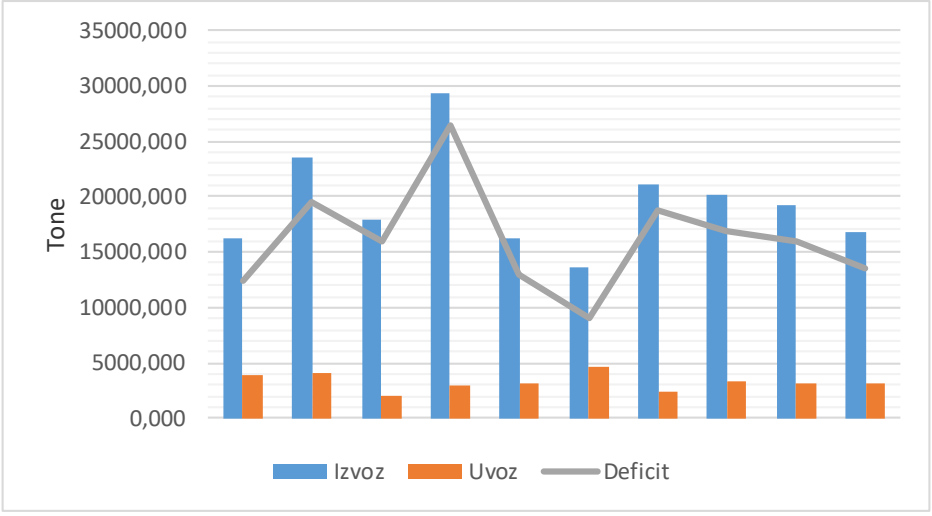
Table 1. *Dynamics of foreign trade parameters of potatoes in BiH (2012-2021)*

Parameters	Import		Export	
	Quantities (t)	Price (evro/t)	Quantities (t)	Price (evro/t)
Average (t)	19.412,900	339,300	3.262,700	298,800
Minimum (t)	13.566,000	246,000	2.066,000	153,000
Maksimum (t)	29.292,000	449,000	4.571,000	405,000
Coefficient of variation cv (%)	23,15	16,05	23,46	24,65
Rate of change r (%)	0,26	0,91	-2,60	1,75

Source: author's calculation based on ITC data

The quantitative deficit of foreign trade indicators is visually shown in the following graph 1. The average value of the foreign trade deficit in the analyzed period was 16,150.20 tons, and it reached its highest value in 2015, while the lowest was in 2017. The reason for such movement is certainly the amount of import and export of these vegetables in those years in Bosnia and Herzegovina.

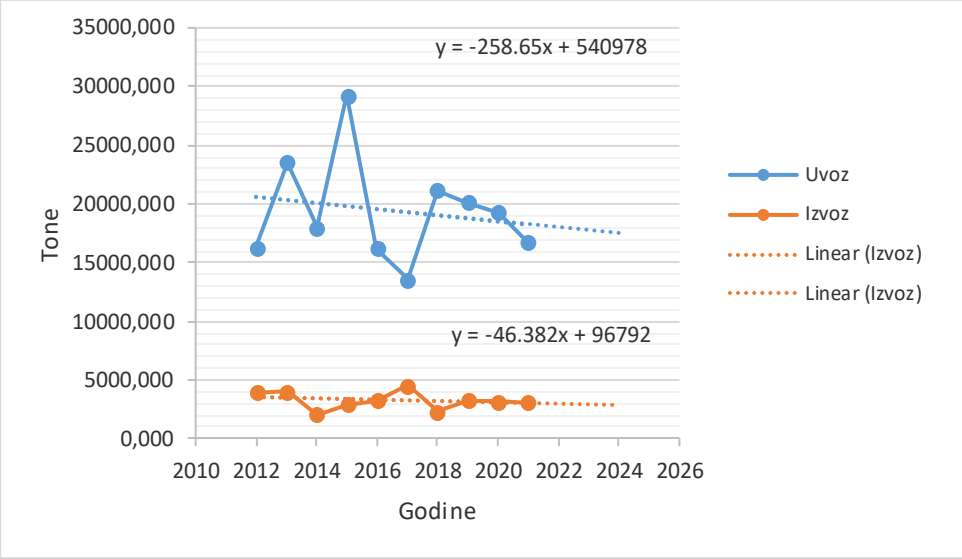
Graph 1. *Movement of foreign trade deficit of potatoes in BiH (2012-2021)*



Source: Calculation of the author based on the data

In the following graph 2, we can see the trends of import and export of potatoes in the future period, which according to the obtained linear trend formula show us that in the next year, the import of potatoes in BiH would be at the level of 17,987.70 tons, and the export at the level of 3007,596 tons. This shows that the export of this vegetable from BiH would still be below its average level for the analyzed ten-year period.

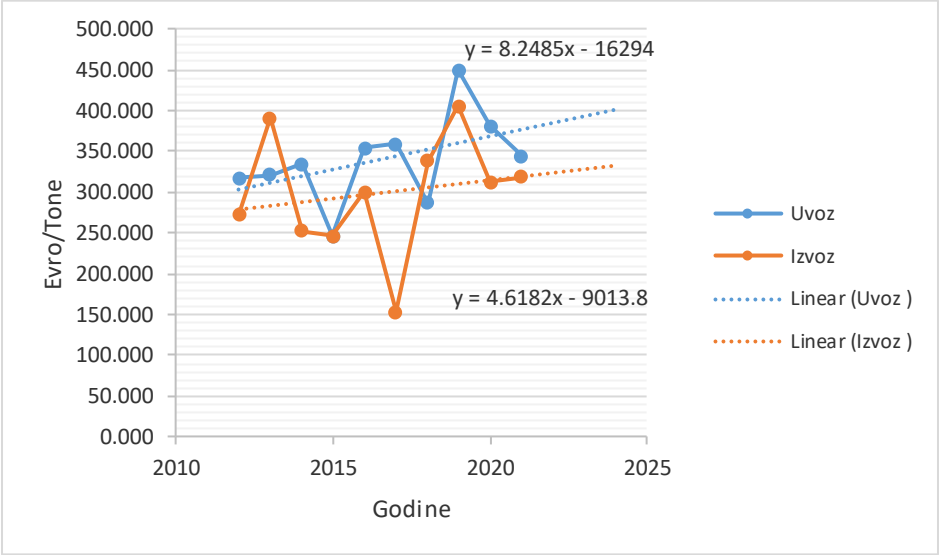
Graph 2. *Trend and forecast of import and export of potatoes in Bosnia and Herzegovina (T).*



Source: Calculation of the author based on the data

The following graph 3 gives a visual representation of the movement and price forecast of foreign trade indicators of potatoes in Bosnia and Herzegovina. The trend line shows price growth in the future period, both for imports and exports. According to the linear trend formula, we can expect the import price of potatoes in BiH in the next year to be at the level of 384.46 euros/ton, while the export price would be 324.20 euros/ton. It certainly exceeds the average prices in the observed period.

Graph 3. *Trend and forecast of import and export of potatoes in Bosnia and Herzegovina (Euro/t)*



Source: Calculation of the author based on the data

From the data in the following table 2, we see that the largest import of potatoes for the analyzed period of BiH is from the Netherlands, in the amount of 7,507.8 tons, which in the total structure of imports would amount to more than one third of the entire import. It is immediately followed by Germany, as well as countries such as Egypt and Belgium, where this import is significantly lower compared to the first two mentioned countries. As for the export of potatoes, it dominates neighboring Croatia with a share in the export structure of 34.61%, i.e. 1,129.3 tons. It is followed by Montenegro and Norway.

Table 2. *Structure of import and export of potatoes in BiH (2012-2021)*

No.	Country	Average value (t)	Share structure (%)
IMPORT			
1	Netherlands	7.507,80	38,67
2	Germany	3.448,30	17,76
3	Egypt	1.352,90	6,97
4	Belgium	863,90	4,45
5	Denmark	358,30	1,85

No.	Country	Average value (t)	Share structure (%)
EXPORT			
1	Croatia	1.129,30	34,61
2	Montenegro	932,90	28,59
3	Norveška	396,50	12,15

Source: Calculation of the author based on the data

Conclusion

On the basis of what was previously stated in the paper, we can conclude the following:

Potatoes are among the most common vegetables in Bosnia and Herzegovina, with a production of about 340,000 tons. In addition, Bosnia and Herzegovina is an import-dependent country when it comes to this type of vegetable.

On average, in the previous ten-year period, 3,262,700 tons were exported at a price of 298.8 euros/t, and 19,412,900 tons were imported at a price of 339.3 euros/t, which resulted in an average deficit of 16,150 tons.

In the coming period, a slight growth trend in potato imports is expected, when it comes to both the quantity and realized price, while a quantitative decline in imports and a very modest price growth trend is expected.

The country from which the most potatoes were imported into BiH was the Netherlands, while the country to which the most potatoes were exported was Montenegro.

Research can be useful in making rational strategic decisions at the state level when it comes to this part of vegetable production, which would concern the improvement of its foreign trade position.

Literature

1. Bijelić, P. (2011). Marketinški instrumenti promocije spoljne trgovine, Časopis za marketing teoriju i praksu Marketing, Beograd, 4(2), 268-275.
2. Hossain, M.M., Abdulla, F. (2015). On the production behaviors and forecasting the tomatoes production in Bangladesh, Journal of Agricultural Economics and Development, 4(5), pp. 66-74.

3. Ivanišević D. (2015). Predviđanje proizvodno-ekonomskih parametara u povrtarstvu u Srbiji, Doktorska disertacija, Poljoprivredni fakultet, Univerzitet Novi Sad.
4. Ivanišević, D., Prodanović, R., Stajić Dunja (2018). Ekonomika proizvodnje paradajza u zavisnosti od načina nabavke rasada, Ekonomija teorija i praksa, Fakultet za ekonomiju i inženjerski menadžment Univerziteta Privredna akademija u Novom Sadu, god.11, br. 3, str. 39-51.
5. Lazić, D. (2014). Analiza i predviđanje proizvodnje povrća u zemljama EU-master rad, Poljoprivredni fakultet, Univerzitet Novi Sad.
6. Mihajlović Šumadijka (2019). Razvoj proizvodnje povrća u Vojvodini, Doktorska disertacija, Poljoprivredni fakultet, Univerzitet u Novom Sadu.
7. Mutavdžić Beba (2010). Analiza i predviđanje proizvodno-ekonomskih parametara u poljoprivredi Vojvodine-doktorska disertacija, Beogradski univerzitet, Poljoprivredni fakultet, Zemun
8. Nedeljković, M. (2022). Kretanje spoljno-trgovinskih parametara paradajza u Bosni i Hercegovini, Agroekonomika, br. 94, Departman za ekonomiku poljoprivrede i sociologiju sela, Poljoprivredni fakultet, Univerzitet Novi Sad.
9. Nedeljković, M., Vujić, J. (2020). Predviđanje proizvodnje, površina i prinosa krompira u Bosni i Hercegovini, Ekonomija, teorija i praksa, god. XIII, br. 2, str. 1-12, Fakultet za ekonomiju i inženjerski menadžment, Novi Sad.
10. Novković, N., Mutavdžić Beba, Šomođi, Š. (2010). Modeli za predviđanje u povrtarstvu, Škola biznisa, Viša poslovna škola Novi Sad, br. 3/2010, str. 41-49.
11. Puškarić, A. (2007). Stanje i tendencije tržišta krompira u Republici Srbiji, Monografija, Institut za ekonomiku poljoprivrede Beograd, str. 7.
12. Tarnowska Agnieszka, Kowalska Anna (2018): Production and Foreign Trade in Vegetables in Poland, Proceedings of the 2018 International Conference „Economic Science for Rural Development“, No 47, 9-11 May 2018, Jelgava, Latvia, pp. 499-507.

13. Ubiparip Dragana, Radovanović Maja, Novković, N., Ostojić, A. (2016). Analiza i predviđanje izvoza paradajza iz Republike Srbije, Agroekonomika, br. 69, Departman za ekonomiku poljoprivrede i sociologiju sela, Poljoprivredni fakultet, Univerzitet Novi Sad.

14. Vlahović, B. (2003). Tržište poljoprivredno-prehrambenih proizvoda-specijalni deo-knjiga II, Poljoprivredni fakultet, Novi Sad, str. 8.

Internet sources:

15. https://www.fao.org/faostat/en/#data/QCL/visualize (Accessed: 25.10.2022)

16. https://bhas.gov.ba/data/Publikacije/Saopstenja/2022/AGR_18_2021_Y1_1_BS.pdf (Accessed: 15.10.2022)

17. https://www.trademap.org/Country_SelProductCountry_TS.aspx?nvpm (Accessed: 10.10.2022)

SMART (TOURIST) CONCEPT IN RURAL AND VITICULTURAL AREA. STUDY CASE: NEGOTIN WINEGROWING REGION

Radmila Jovanović[1], *Predrag Vuković*[2], *Jean Andrei Vasile*[3]

Abstract

The wine growing region of Negotin, as well as the rest of Serbia's wine growing areas, is mostly linked to rural areas. Also, in developed countries, wine tourism stands out as a product of rural tourism. Although most wineries are still in the initial phase of using innovative and smart technologies, most wineries in Serbia invest great efforts and increase the attractiveness of wine tourism through the provision of smart tourist services.

In the article, an assessment of the area and settlements of the wine growing region of Nekgotin was carried out, where there would be the greatest potential for development into smart destinations: smart villages and smart wine-growing destinations. In the analysis and evaluation, the concept of smart tourist destinations was defined as 6A (attractions, accessibility, contents, available packages, activities, auxiliary services) with the use of Geographic Information System (GIS) and Analytical Hierarchy Process (AHP). The results show that the wine growing region of Negotin has potential for the development of wine growing districts as smart tourist destinations - the city of Kladovo. The other areas of this wine growing region present an extremely poor zone of potential with a total frequency of 84.01%.

By investing, educating and investing additional efforts of the local community and the state, the other areas of the Negotinska Krajina wine-growing region would have great opportunities for development, especially due to the long history and tradition of the development of wine and viticulture in this area.

Key words: *smart villages, (smart wine) destinations, wine growing region, smart concepts 6A, information technologies*

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Introduce

The concept of "smart village" is a new concept that refers to the development of rural areas and communities from existing, traditional elements and their improvement with digital, telecommunication technologies and social innovations, using knowledge in the same. The application of this concept and the development of digital technologies can improve the quality of life, raise the standard of living, better use of resources, reduce the impact on the environment, create new opportunities for the marketing of various rural products and most importantly - promote demographic balance.

The wine growing regions of Serbia are mostly linked to rural areas, where, especially in developed countries, wine tourism is highlighted as a product of rural tourism. Most wineries in Serbia also try to be innovative by marketing new technologies and attractiveness in wine tourism and by providing smart tourist services.

The aim of this article, in addition to the promotion of wine and rural tourism, the landscape of the Negotin wine region, ecological sustainability through the introduction of new technologies, is to assess and identify the area of the Negotin wine region. That is, which part of the wine growing and rural area would have good opportunities for the development of smart tourism in the wine growing region of Negotin.

According to Tran et al. (2017), Buhalis (2000) and Gozdegul et al. (2019) and based on the current conditions and state of development of (wine) tourism in the wine growing region of Negotin, the methodology was adapted and modified for this project.

Through comparative analysis and assessment, the concept of smart tourist destinations will be defined and analyzed through the 6A (attractions, accessibility, amenities, available packages, activities, ancillary services) and the use of Geographical Information System (GIS) and Analytical Hierarchy Process (AHP).

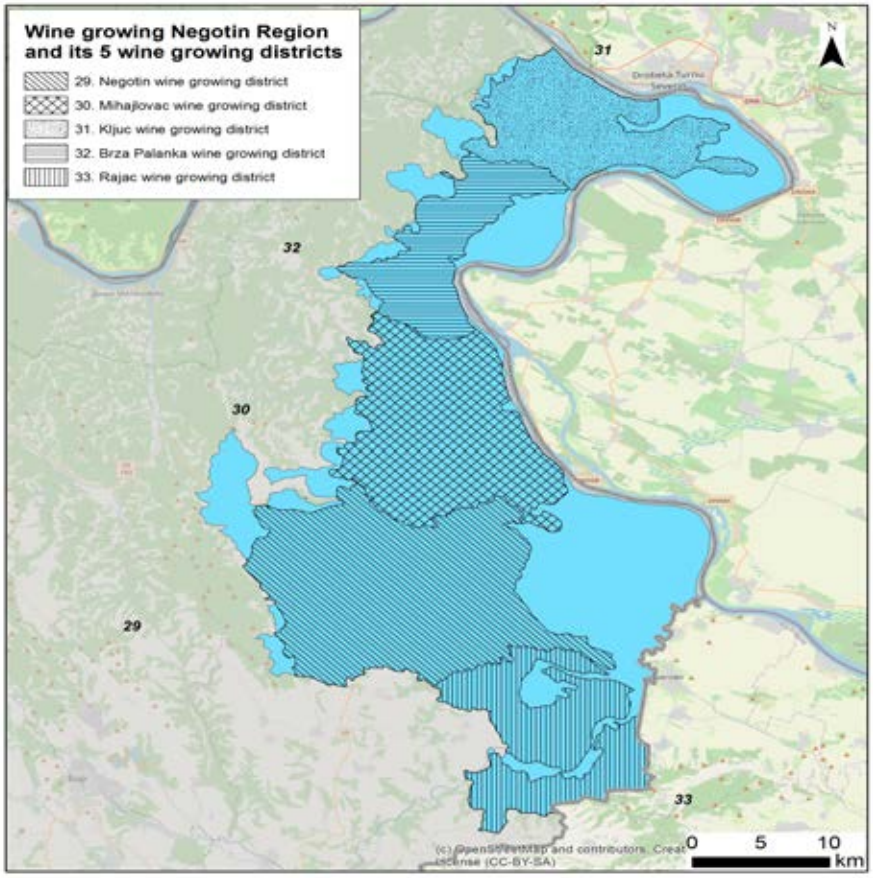
Study area

Wine groving Region of Negotin belongs to the eastern part of the Central Serbia wine growing unit. It stretches along the Danube, from Sip to the three-border Serbian-Romanian-Bulgarian border. In the east, it reaches the border with Bulgaria, while the southern border is formed by the headwaters

of the Sikol and Čubran rivers, left tributaries of the Timok. The area belongs to the Bor District (22°13'30'' and 22°46'30'' eastern longitude, 44°2' and 44°39' northern latitudes). Wine growing region of Negotin has 5 wine growing districts: Ključ (123.42 km², municipality of Kladovo), Brza Palanka (95.13 km², municipality of Kladovo), Mihajlovac (196.67 km², municipality of Negotin), wine growing district of Negotin (279.42 km², municipality of Negotin) and Rogljevo-Rajac (134.74 km², municipality of Negotin).

The main road routes go through Negotin, Belgrade - Požarevac - Majdanpek - Negotin and Niš - Zaječar - Negotin. The only railway route is Prahovo - Zaječar - Knjaževac - Niš.

Figure 1. *Geographical location of wine growing districts in the Negotin wine growing region*



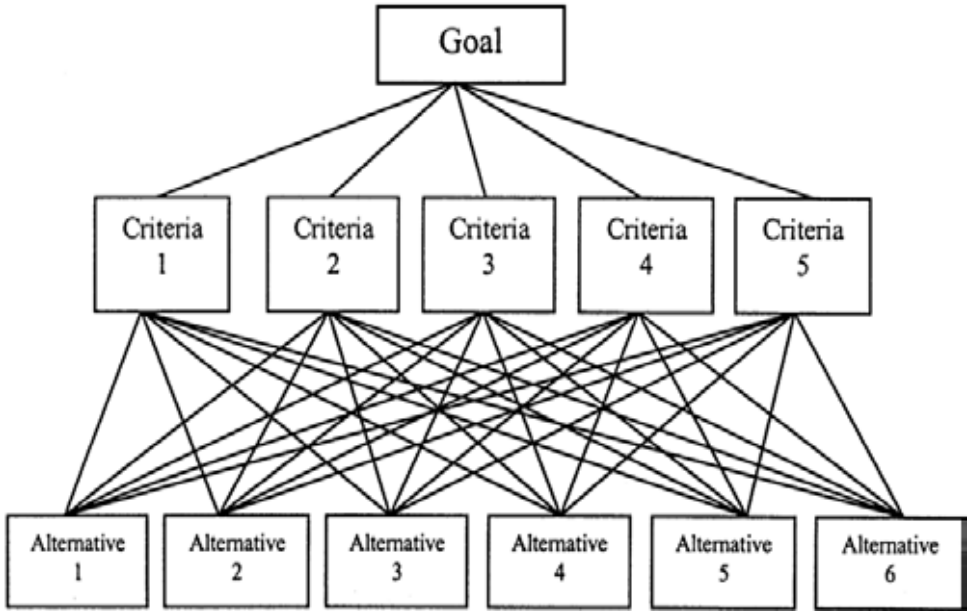
Source: Elaborated by authors.

Methodology

Analytical-hierarchical process (AHP method) is being used for potential evaluation. The analytical hierarchy process was introduced by Thomas Saaty (1980) for complex decision making. The AHP method helps in looking at the subjective and objective aspects of a decision, reducing complex decisions, comparing pairs and synthesizing the results. The AHP method is known as a level analysis method that seeks to decompose problems into a branched structure and establish a level of class structure, with mutual influence, allowing more accurate decisions on complex issues (Crouch, Ritchie, 2005).

This method allows comparing two items of each level with different measurements and setting up pairwise comparison matrices to calculate a vector, which represents the priority of significant elements at a certain level of structure (Saaty, 2008).

Figure 2. *Example of a hierarchical model in AHP*



Source: Saaty (1980)

For research purposes, the AHP method is implemented within GIS, and defines weights (importances) for the selected criteria (Al-shabeeb, 2016), including effective visualization of the output.

Results and conclusion

Based on Jakšić et al., (2015), a total of 56 wines with geographical origin (referred to the wine label)[4] were registered in: Negotin wine growing district (15), Mihajlovac (18), Ključ (2) and Rajac-Rogljevo wine growing district (21).

In Negotin wine growing region there are a total of 69 settlements. However, only those where grapes are produced are included in this analysis. In the paper, 5 categories are distinguished that define the potential: very poor category, poor category, moderate category, good category and very good category. The fifth category, very good category, is not present for this vineyard area. It is dominant in wine-growing regions that have very well developed all the elements of model 6A. The largest areas are in the first and second categories: poor category with a share of 44.76% and very poor category with a total share of 39.25%. The smallest share has areas in the moderate category category with 15.07% and good category with 0.9%. Spatially, it includes the following settlements.

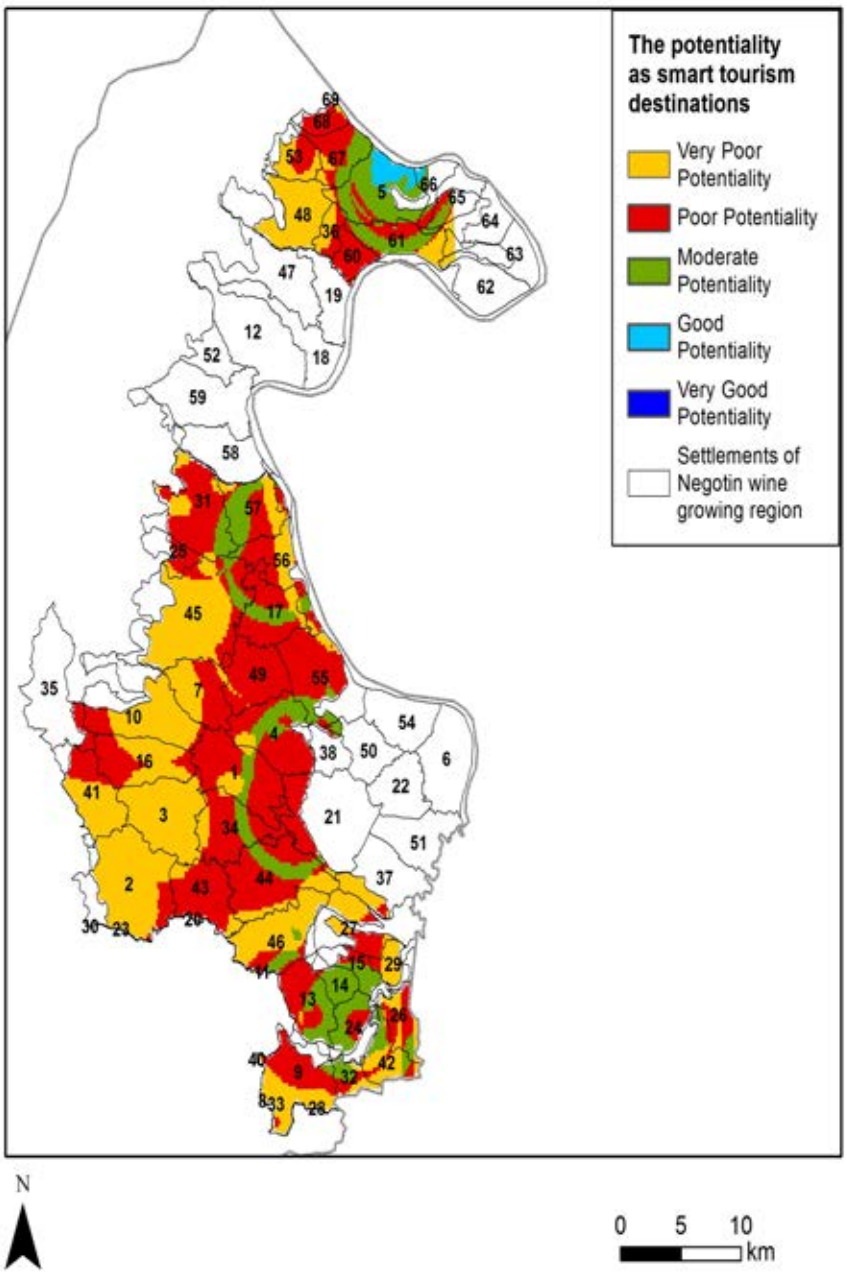
Very Poor Category is registered in the settlements: Sikole, Tranjane, Šarkamen, Jabukovac, Štubik, Rečka and Podvrška.

Poor Category is registered in settlements: Urovica, Slatina, Mala Kamenica, Dupljane, Dušanovac, Vidrovac, Jasenica, Karbulovo, Brestovac, Čubra, Bracevac, Davidovac, Milutinovac,

Moderate Category is registered in settlements: Kladovo, Smedovac, Rogljevo, Rajac, Crnomasnica Good Category is registered only in Kladovo settlement.

4 According to the same authors (2015), these wines are produced in a total of 11 wineries: Ključ wine growing district (1), Rajac-Rogljeo wine growing district (6), Mihajlovac wine growing district (2) and Negotin wine growing district (2).

Figure 3. *Potential Map for smart tourist destinations in Negotin wine growing region*



Source: Elaborated by authors

The settlements of Negotin wine growing region

1.	Jasenica	24.	Rajac	47.	Velika Kamenica
2.	Sikole	25.	Vratna	48.	Podvrška
3.	Trnjane	26.	Kovilovo	49.	Dupljane
4.	Vidrovac	27.	Mokranje	50.	Samarinovac
5.	Kladovo	28.	Šipikovo	51.	Bukovče
6.	Radujevac	29.	Veljkovo	52.	Reka
7.	Malajnica	30.	Glogovica	53.	Manastirica
8.	Veliki Jasenovac	31.	Urovica	54.	Prahovo
9.	Braćevac	32.	Crnomasnica	55.	Dušanovac
10.	Štubik	33.	Mali Jasenovac	56.	Mihajlovac
11.	Klenovac	34.	Karbulovo	57.	Slatina
12.	Grabovica	35.	Plavna	58.	Kupuzište
13.	Tamnič	36.	Rečica	59.	Brza Palanka
14.	Smedovac	37.	Kobišnica	60.	Milutinovac
15.	Rogljevo	38.	Miloševo	61.	Vajuga
16.	Šarkamen	39.	Tabakovac	62.	Korbovo
17.	Mala Kamenica	40.	Brusnik	63.	Rtkovo
18.	Ljubičevac	41.	Popovica	64.	Velika Vrbica
19.	Velesnica	42.	Aleksandrovac	65.	Mala Vrbica
20.	Metriš	43.	Brestovac	66.	Kostol
21.	Negotin	44.	Čubra	67.	Kladušnica
22.	Srbovo	45.	Jabukovac	68.	Davidovac
23.	Salaš	46.	Rečka	69.	Novi Sip

Through this project, the initiation and implementation of “smart villages” builds on the existing resources by further improving them by finding new opportunities for survival and development.

Numerous advantages and the improvement of rural areas can contribute to the development of wine tourism in wine growing region of Negotin through the application of digital technology: by improving the production process, increasing the number of tourists, introducing wine products to end users, increasing supply and demand. As well as further development directions - provision of intelligent platforms for gathering and distributing information among key stakeholders, efficiency and effectiveness of tourism resource

allocation and integration of tourism suppliers to ensure that tourism revenues are evenly distributed within the local community.

The change of traditional management structures through information technology in the field of rural development is a prerequisite for effective social-economic transformation of rural areas.

It is important to emphasize that the model of "smart villages" in Serbia and in the wine-growing region of Negotin, is still in its initial phase and that the further focus of the research is related on:

1. For the development of small wineries, households and farms engaged in viticulture and winemaking, producing various viticultural products: wines, compotes, sweets, grape seed oils, home-made juices, aromatic and medicinal molasses, as well as other specialized grape products and vines.
2. Connecting local communities and producers for product marketing
3. Product placement on the premises and local markets (e.g. the closest cities),
4. Education for the application of digital technology,
5. Organization of public transport,
6. Establishing a private-public partnership
7. Starting local initiatives, support for the establishment of wine cooperatives,
8. Development and branding of wine events and traditions, authentic to the village, etc.

Conclusion

Wine tourism has been expanding in the Republic of Serbia in recent years. It is complementary with event tourism and rural tourism. The income that the destination generates comes from the sale of wine itself, as well as from all other expenses that tourists have during their stay in the destination during their staying. It is also complementary in development with agriculture, trade, development of economic and cultural activities, etc. The assessment is that its development leaves positive multiplied effects on the tourism destination where it is developed.

The Negotin region has a long tradition of wine development and viticulture. The assessment is that with the development of wine tourism, the development of overall tourism would be enhanced, and the effects of the development of tourism would be multiplied on the development of other economic branches. In general, it means agriculture, trade, construction branches, transport, etc. These positive impacts would also be damaged in non-economic activities, because wine tourism is complementary to event tourism, which in turn is complementary to cultural activities in the tourist destination. Based on this, it can be seen that the development of tourism would actually be an incentive for the development of the entire Negotin region, which for many years was unfairly neglected in the overall economic development of the country. In this sense, it is necessary to invest in marketing activities in order to connect supply and demand with these types of tourism.

Literature

1. Saaty, T.L. (1980). *The Analytic Hierarchy Process*. New York: McGraw Hill.
2. Saaty, T.L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences*, 1(1), pp. 83–98.
3. Al-shabeeb, A.R. (2016). The Use of AHP within GIS in Selecting Potential Sites for Water Harvesting Sites in the Azraq Basin-Jordan, *Journal of Geographic Information System,* 8, 73-88.
4. Crouch, G.I. and Ritchie, J. B. (2005). Application of the analytic hierarchy process to tourism choice and decision making. A review and illustration applied to destination competitiveness. *Tourism Analysis*. 10(1), 17–25.
5. Tran, M.H., Huertas, A. and Moreno, A. (2017). (SA)6: A New Framework For The Analysis Of Smart Tourism Destinations. *Actas del Seminario Internacional Destinos Turísticos Inteligentes: nuevos horizontes en la investigación y gestión del turismo,* 190-214. DOI: 10.14198/Destinos-Turisticos-Inteligentes.2017.09.
6. Gozdegul, B., Dogan, O., and Al-Turjman, F. (2019). Smart Tourism Destination in Smart Cities Paradigm: A Model for Antalya. In Al-Turjman, F. (editor), *Artificial Intelligence in IoT,* 63-92. Springer.
7. Buhalis, D. (2000). Marketing the competitive destination of the future. *Tourism Management,* 21(1), 97–116.
8. Јакшић, Д., Иванишевић, Д., Ђокић, В., Тепавац-Брбаклић, М. (2015). *Вински атлас Србије*. Београд: Републички завод за статистику.

QUALITY OF LIFE IN ROMANIA IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT

Raluca Ignat[1], *Valentin Lazăr*[2], *Daniela Zănescu*[3], *Monica Triculescu*[4]

Abstract

Quality of life is a concept of modern society. Societal evolution requires the permanent change of methods and tools for analysing living conditions, living standards and living demands of each individual, but also of groups, in general. Regardless of the need for development of the group or community, it is the individual's claim to life that determines progress. Why? Because the common, ordinary individual is the one who does extraordinary things because he wants his own good, first and foremost. The main purpose is to provide an insight of the quality of life in Romania in the context of sustainable development. Based on the current situation, the paper aims at drawing the best solutions for improving quality of life based on the three pillars. Education based solution is the most appropriate in order the reach some of the pillars' objectives both with solution-based investments for others.

Key words: *quality of life, sustainable development, education, Romania*

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Introduction

Societal evolution requires the permanent change of methods and tools for analysing living conditions, living standards and living demands of each individual, but also of groups, in general. Regardless of the need for development of the group or community, it is the individual's claim to life that determines progress (Ignat, R, 2013). Why? Because the common, ordinary individual is the one who does extraordinary things because he wants his own good, first and foremost. The main purpose of this paper is to provide an insight of the quality of life in Romania in the context of sustainable development. Based on the current situation of the main components of quality of life, the paper aims at drawing the best solutions for improving quality of life based on the three pillars: economic, social and environment. The paper has an added value offered by its very pragmatic approach that is quite suitable for public policy decisions. Conclusion is that education-based solution is the most appropriate in order the reach some of the pillars' objectives both with investments-based solution for others.

Literature review

The ideas of the quality of life concept, for the first time, were grounded in the research of scholars Gregory King, Fracois Quesnay, Antoine-Laurent Lavoisier, Joseph-Louis Lagrange, Alfred Marshall and others. They analysed some components of the quality of life, without giving it a concrete definition.

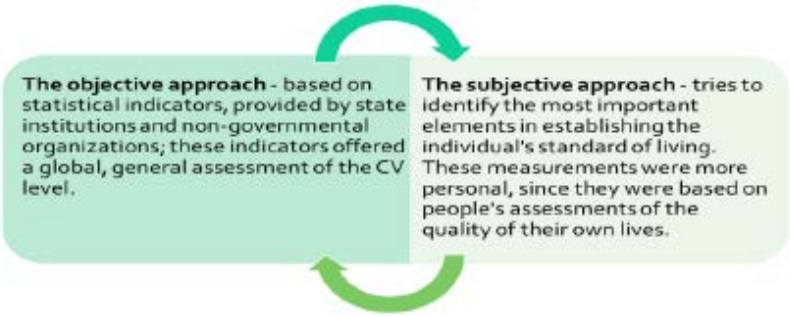
An important contribution to the studied problem belongs to Alfred Marshall which, in one of his most important works, "Principles of Economy" (1890), comes up with his theoretical approach that refers to the role of the state in regulating the well-being of the people by the influence of fiscal instruments upon consume surplus and producers.

Elton Mayo (1930) run several experiments and the accomplished results proved that people can be motivated by social needs, that is precisely why the social force of the members of a group is more important than effective control through management.

As Iuliana Precupetu has written, Schlesinger treated the quality of life category from socio-psychological positions, while the American professor J.K. Galbraith, in his most recent work "The Good Society - The Humane Agenda" (1996) or "The perfect society" (1997), generated the quality of life concept, in relation to the human need to recognize the dominance of economic goals and not allow

them to have an inadequate monopoly over life, to the detriment of other goals: "what matters is not the quantity of our goods, but the quality of life". Galbraith, both Americans (1967). Through this, J.K. Galbraith, for the first time in economic thought, brought the economic aspect to the social aspect of CV closer.

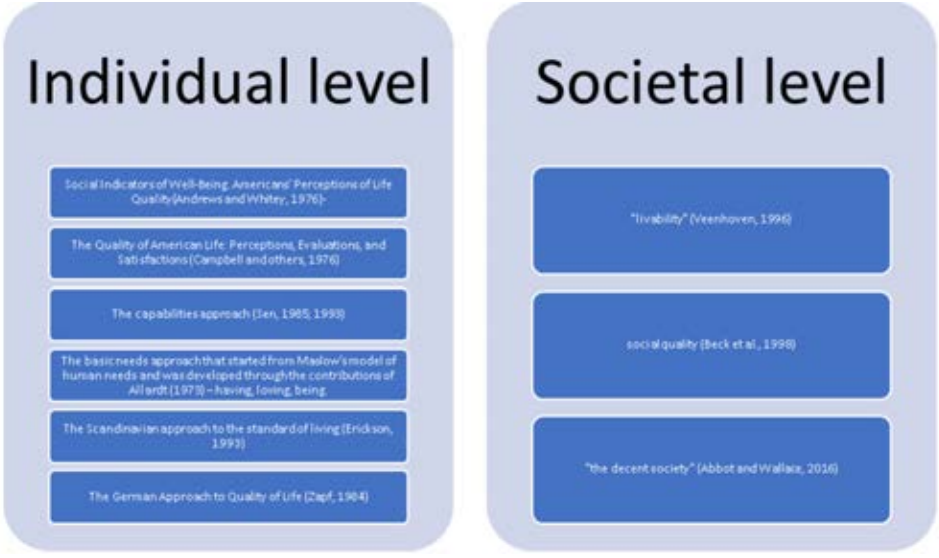
Figure 1. *The objective and subjective approaches of quality of life.*



Source: authors' preparation based on literature.

The quality of live may be also approached both at individual and societal level, as the two dimensions works together in offering the whole. The evolution of the concept may be synthetized as follows:

Figure 2. *The individual and societal dimension of quality of life.*



Source: authors' preparation based on literature

The Stiglitz report on quality of life (Anghelache et all, 2017) just had revolution the paradigm and considered for the first time the three pillars in the quality of life, the "traditional" approach in sociology of objective and subjective indicators, of capabilities and the approach to welfare economics and fair allocations. This was the beginning of changing the way of bearing in mind quality of life, both by theoreticians and politicians.

The methodological part of the quality of life involves several indicator systems that known a constant improvement over the years, according to the concept evolution (Precupetu et all, 2018). There is the European System of the Social Indicators that involves 13 themes for indicators. This is a quite complex system and involves both objective, as income, health, housing, environment, and subjective approaches, as total life satisfaction, and both individual, as educational and vocational training, income, and societal levels, as consumption patterns. There are other indicators systems that are being used in different countries or studies, such as Calvert-Henderson Quality of Life Indicators, an eight dimensions system that implies the three pillars, social, economic and environment. On the same path there are (Precupetu, I) the Stiglitz indicators system, Basic and Advanced QUALITY OF LIFE Indexes, Netherlands Living Conditions Index) was initiated for the Netherlands in 1974 by the Planning Office Cultural and Social, Producing annual reports, World Health Organization Quality of Life WHOQUALITY OF LIFE created by the World Health Organization that includes six dimensions of quality of life, Happy Life Expectancy Scale: the degree to which people live happily in a certain country, OECD Better life Index. At the European level, a very complex system was developed in order to offer a comprehensive view upon the quality of life. The subjective dimension is obviously considered, as several indicators gather data about the citizens expectations and experiences. This subjective approach represents a very suitable starting point for discussing the future public policies for Europe. The objective dimension in well determined for all pillar, as the system covers from individual to societal data regarding living conditions, production and economy functioning, health, leisure and social interactions, natural and living environment.

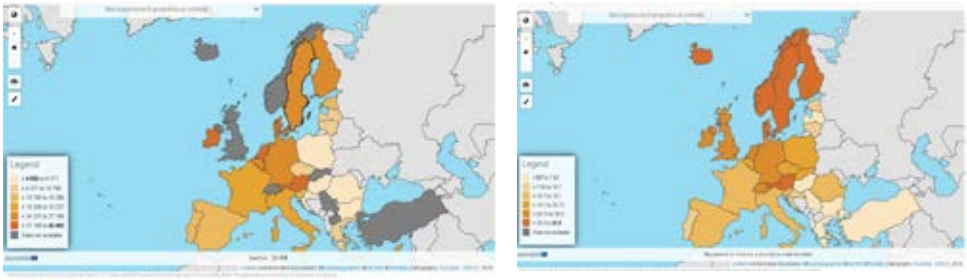
Analysis and results

In order to better understand the current situation of the quality of life in Romania, a comparative analysis within European continent was run. Based on Eurostat data a mapping of the quality of life was elaborated. The main

purpose was to identify the highest peaks and the lowest grounds of the several indicators of quality of life, in order to be able to understand what would be the most suitable direction for Romania's development of quality of life. Therefore, for each category of indicator within the Eurostat quality of life indicator system one indicator was chosen and a map was made. This tactic provided a synthetic picture of the current situation in comparison.

For the material and living conditions, mean and median income by age and sex was chose as first indicator to be analysed, as it is, in our point of view, the main indicator that implies the economic pillar at individual level and it encompasses the first and vital base for the future quality of life of each individual.

Figure 3. *Mean and median income by age and sex - EU-SILC and ECHP surveys (online data code: ILC_DI03) and Percentage of the population rating their satisfaction as high, medium or low by domain, sex, age and educational attainment level*



Source: Eurostat

As seen above, Romania should improve the income policy, as it is placed at the end of the Mean and median income by age and sex, especially with the economic growth that the country has known in the last several years.

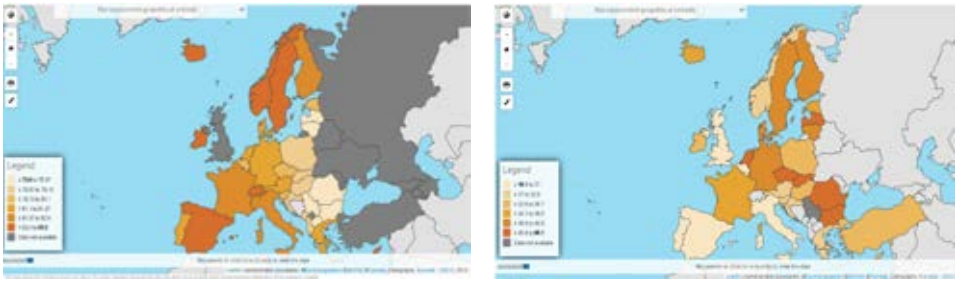
Then, Percentage of the population rating their satisfaction as high, medium or low by domain, sex, age and educational attainment level was chose as second indicator to be analysed, as it implies not only the very objective situation of the living condition, but the citizens perspective towards his own situation. In this case, Romania is in the middle of the list, which implies that Romanian seem to be relatively satisfied by their living situation.

Figure 4. *Unemployment rates by sex, age and educational attainment level (%) (online data code: LFSA_URGAED) and Low-wage earners as a proportion of all employees (excluding apprentices) by age and Average number of usual weekly hours of work in main job, by sex, age, professional status, full-time/part-time and economic activity (from 2008 onwards, NACE Rev. 2)*

Source: Eurostat

For the productive and other main activity, unemployment rates by sex, age and educational attainment level revels that Romania is situated at the middle of the lists within the European countries, probably because Romania is one of the most attractive destinations for investments in the last decade and those offered jobs and urban areas. Yes, when analysing it together with the second indicator, it will be observed that the Low-wage earners as a proportion of all employees is very high, which means that although there are relatively enough jobs, there are not well paid. Moreover, the low wages are for the highest Average number of usual weekly hours of work in main job, by sex, age, professional status, full-time/part-time and economic activity within all European countries. And this implies that not only the earners are poorly paid, but they work the most for these salaries. For sure, this is not only a matter of employees' efficiency, but a matter of a dishonest harmonisation between number of working hours, average hourly salary and results. And this is possibly to be one of the attractions for the investments. And this is not a sustainable base neither for the durable development of Romania, nor for quality of life.

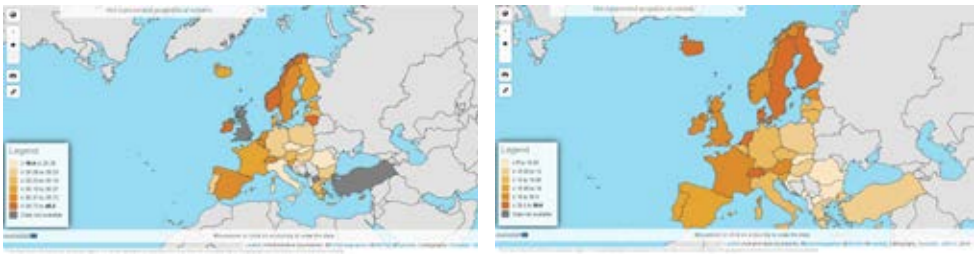
Figure 5. *Life expectancy by age and sex and Daily consumption of fruit and vegetables by sex, age and educational attainment level.*



Source: Eurostat

For Health, Life expectancy by age and sex shows that Romania is at the end of the countries list, with a poor life expectancy. Also, when considering food and nutrition as conditions for a long and healthy life, Romanians do consume fruits and vegetables. This, at a glance, may suggest that others are the causes of the low life expectancy. Obviously, a future and deeper analysis needed to be run for this dimension of the quality of life.

Figure 6. *Population by educational attainment level, sex and age (%) and Participation rate in education and training (last 4 weeks) by sex, age and educational attainment level.*



Source: Eurostat

Education is an important component of the quality of life as education is the base of the future development, of the skills and predictions of all society's members and behavior. It is the lawn for a better life, better understanding of everything and should have performing results. The percent of the population which had attended to formal education is placing Romania at the end of the countries list. Probably because Romania lost within the last decade almost 1.000.000 citizens (RPL 2021) that left their country for other European

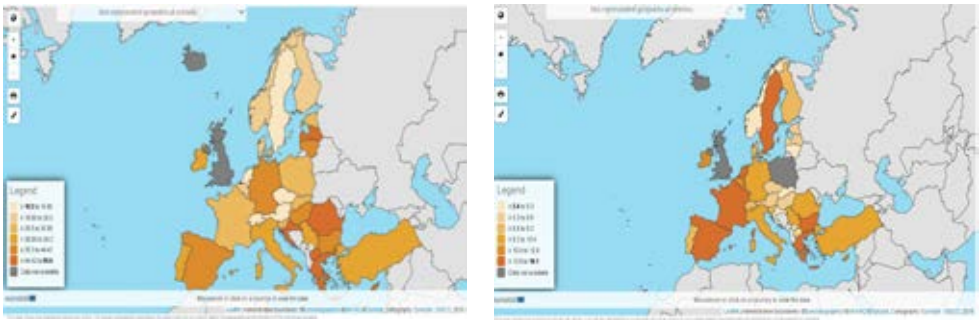
destinations. Their children are not well supervised and most probably they abandoned school. Moreover, when we consider this information together with the number of children and young persons at the edge of the poverty, we may easily understand this low percentage of the population by educational attainment level, sex and age. And yet, those who are educated and trained, do not attend so much educational programs frequently, as shown by participation rate in education and training (last 4 weeks) by sex, age and educational attainment level.

Figure 7. *Participation in any cultural or sport activities in the last 12 months by income quintile, household type and degree of urbanisation and Percentage of the population rating their satisfaction as high, medium or low by domain, sex, age and educational attainment level*

Source: Eurostat

Considering for analysis Leisure and social interactions, there is no Participation in any cultural or sport activities in the last 12 months by income quintile and this may be interpreted as few incomes allocated for social life of Romanians comparison with other nationalities within European Union. Percentage of the population rating their satisfaction as high, medium or low by domain, sex, age and educational attainment level revels that a small part of the population consider itself as being satisfied in relation with life in general. This subjective indicator is probably the most expressive in relation with quality of life, as the individual satisfaction may do the difference, according to Mayo interpretation.

Figure 8. *Inability to face unexpected financial expenses - EU-SILC survey and Crime, violence or vandalism in the area - EU-SILC survey.*



Source: Eurostat

When analyzing Economic security and physical safety there is another subjective we conclude that Romanians have great inability to face unexpected financial expenses compared to the rest of the European citizens. If we take into consideration interpretation this indicator and those regarding low-wage earners as a proportion of all employees and average number of usual weekly hours of work in main job, by sex, age, professional status, full-time/part-time and economic activity it is absolutely obviously that Romanians' quality of life is very much affected al the economic pillar. And there are necessary investments and public policies. And, for all, education-based solution are compulsory, as education will provide more performant workers, more efficient and, then, better payed.

Conclusion

The concept of quality of life and well-being, in the context of the sustainable development, were no longer oriented towards the socialist way of life.

The quality of life concept had become widespread and was no longer built on the basis of contradictions, for example, "quantity versus quality" or "economy versus ecology ".

Hopes and illusions related to a society in which rigorous planning and control are used to ensure quality of life have disappeared.

For Romania, the centralized economy was no longer the prominent model, various other administration systems took shape: the market, the state, associations, families and small social groups.

Romania is gathering more and more economic assessments, but, is still facing challenges in the domains like poverty, social inclusion, natural environment and not only.

Europe is looking forward to asses a high level of quality of life and its public policies are aiming to quality of life conditions, especially in a sustainable based orientation.

Literature

1. Alfred Marshall (1980), *Principles of Economics*, McMaster University Archive for the History of Economic Thought, https://EconPapers.repec.org/RePEc:hay:hetboo:marshall1890, accessed on 15th of November 2022
2. Elton Mayo (1930), *Human problems of an industrial civilization*, accessed at https://www.bl.uk/people/elton-mayo on 15th of November 2022
3. Iuliana Precupetu, *Indicatori și indici ai calității vieții*, accesed on 16 th of November 2022 at http://www.ince.ro/Evenimente/8_aprilie_2019_I_Preucupetu_ICCV_Indicatori_si_indici_ai_calitatii_vietii.pdf
4. Institutul de Cercetare a Calităţii Vieţii (2018), Calitatea vieţii în România în context European, Institutul de Cercetare a Calităţii Vieţii, 2018, Raport de cercetare, accessed on 16th of Nobvember 2022 at https://www.iccv.ro/wp-content/uploads/2018/03/Raport-Calitatea-Vietii.pdf
5. Anghelache Constantin, Manole Alexandru Lucian, Anghel Madalina Gabriela, Lilea Florin Paul Costea, Bunea Mariana (2017), *Analysis models of the life quality standard in Romania*, Revista Română de Statistică - Supliment nr. 5 / 2017, accesed on 16th of November 2022 at https://www.revistadestatistica.ro/supliment/wp-content/uploads/2017/05/RRSS_05_A01_en.pdf
6. Ignat Raluca (2013) *Calitatea vietiii in Romania rurala. Nevoie sau de la vitalitate la performanta economica?*, Editura ASE, Bucureşti, 2013, ISBN 978-606-505-700-5, 2012, Suport CD
7. National Institute os Statistics (2022), *First Provisional Data for the Census of Population and Housing*, round 2021, accessed on 16th of November at https://insse.ro/cms/sites/default/files/com_presa/com_pdf/cp-date-provizorii-rpl2021.pdf
8. Eurostat, *Quality of life,* accessed on 18th of November 2022, https://ec.europa.eu/eurostat/web/quality-of-life

THE RISKINESS OF FEED GRAIN PRODUCTION – AN EXAMPLE OF SERBIAN FAMILY FARMS[1]

Sanjin Ivanović[2], *Saša Todorović*[3]

Abstract

Feed grain production is exposed to many risks which, in general, can be referred to as internal and external risks. As a result, a significant variation in the profitability of different feed grain could appear due to risk exposure. The riskiness of feed grain production is transferred to livestock breeding (because of the high participation of feed costs in total costs of livestock production) influencing in such a way its economic efficiency. Therefore, the goal of this research is to analyze the profitability of feed grain production in the risky environment. The analysis was based on data originating from Serbian family farms dealing with feed grain production. The results indicate the way farmers make their business decisions in risky circumstances, providing better insight and understanding of farmers' behavior.

Key words: *risk, costs, production value, feed grains, livestock production*

Introduction

Agricultural production is exposed to many risks (Huirne, 2003). Risk can be defined as the possibility of adverse outcomes due to uncertainty and imperfect knowledge in decision making. There are five general types of risk in agriculture (production risk, price or market risk, financial risk, institutional risk, and human or personal risk) (Harwood et al., 1999; Hardaker et al., 2004). Similarly, Ivanović and Marković (2018) described risks in agriculture as internal (related to the farm) and external (related to the business

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environment) risks. The nature of risk varies significantly from crop to crop. Multiple types of agricultural risks are likely to occur simultaneously. Feed grain producers simultaneously cope with and manage multiple risks that can have compounding effects (Van Winsen et al., 2013; Wauters et al., 2014). Due to risk exposure, significant variation in profitability of different crops could appear.

Riskiness of feed grain production is transferred to livestock breeding – because of a high participation of feed costs in total costs of livestock production. Feed costs are the most important in milk production (Hemme et al., 2014) and in intensive poultry production systems (Donohue and Cunningham, 2009). Research conducted by Ivanović (2013) indicated that in pig fattening and cattle fattening production feed expenses are highly important. Jeločnik et al. (2021) determined that feed costs are the most important within variable costs of cattle fattening, pig fattening, cow milk production, poultry production, sheep and goat production. Similarily, according to Ivanović (2018), feed costs dominate within total costs of goat, sheep and cow-calf production systems.

Therefore, the goal of this research is to analyze the profitability of feed grain production in a risky environment. The attention was paid primarily to the maize and barley production (winter barley for animal feed).

Materials and methods

To perform the analysis, the authors used data from their database[4], which, among others, include family farms which perform feed grain production (specifically maize and barley production). Based on the available data, the authors created a model of the family farm, situated in lowland region, cultivating 49 ha of arable land. The model of the farm assumes that 53.67% of land is owned by the farm (26.3 ha) while 46.33% of land is rented (22.7 ha). Production is primarily directed towards maize production, which participate in sowing structure with 49.88% (24.44 ha) while barley production is less important, participating in sowing structure with 21.84% (there are 10.70 ha of barley). Altogether, maize and barley production cover 71.72% of arable land, while the farm also produces some other crops (primarily sunflower and winter wheat). The analysis performed in the paper is based on data cover-

4 The database has been created as a result of an annual survey on a representative sample of farms in the Autonomous Province of Vojvodina.

ing the 10-year-period (from production year 2011/2012 to production year 2020/2021). Availability of these data enabled the authors to determine a number of parameters and indicators describing not only economic effects of maize and barley production, but also the riskiness of these enterprises.

Besides, the authors used official statistical data published by the Serbian Statistical Office (SORS, 2022). These data are primarily related to maize and barley yields and prices at the national level during the observed period (from 2012 to 2021). Fluctuations of yields and prices of maize and barley can have a strong influence on the level of profit. Therefore, a correlation between prices as well as the yield-price correlations at the aggregated level (national level) for the observed period was estimated using Pearson correlation.

Apart from that, the authors performed an enterprise budgeting for maize and barley production. Such an analysis considered the value of production, the level of subsidies, the costs of production, the opportunity costs of own factors (family labor, own land and own capital) and, consequently, the level of profit. The calculation of profit was based on the economic theory (Gogić, 2014) according to which the profit is equal to the total revenue minus the total costs as follows:

$$P = TR - TC$$

where: *P* - profit, *TR* - total revenue, and *TC* - total costs.

Two types of profit are calculated in the paper – financial and economic profit. While financial profit considers only the production costs, economic profit takes into account the opportunity costs as well. At the same time, both types of profit are calculated with and without subsidies. Accordingly, the authors calculated the following profit indicators:

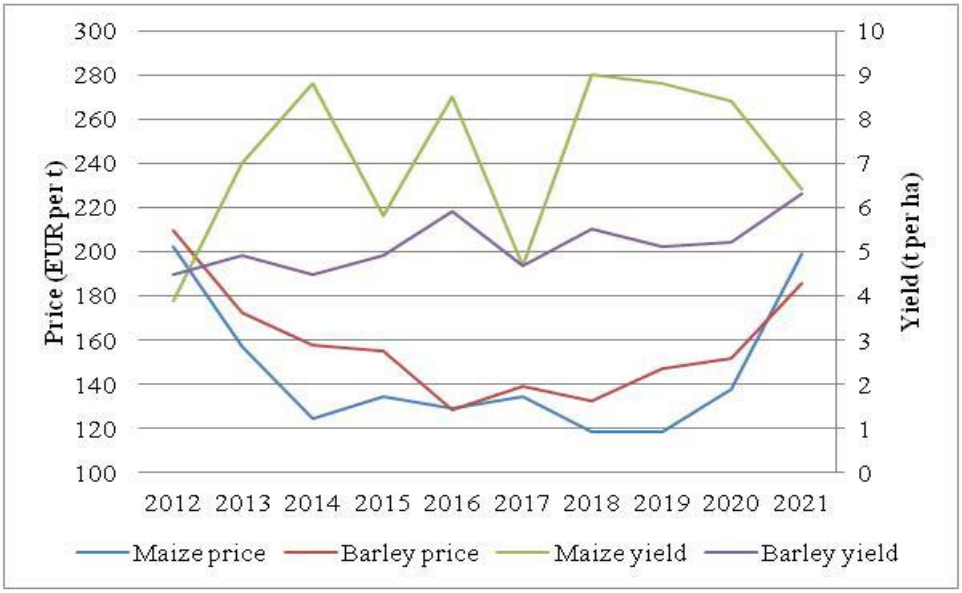
- Financial profit with subsidies,
- Financial profit without subsidies,
- Economic profit with subsidies and
- Economic profit without subsidies.

When it comes to the riskiness of maize and barley production, the following risk indicators are used in the paper – standard deviation, coefficient of variation, probability of achieving positive financial and economic profit.

Results and discussion

Maize and barley prices varied over the observed period in the same direction whereby they reached the highest levels in 2012 and 2021 (Figure 1).

Figure 1. *Feed grains yields and prices on family farms in the Republic of Serbia for the period 2012-2021.*



Source: SORS, 2022

Accordingly, it was determined that the correlation between maize price and barley price is strong and positive (0.90). However, the price of maize varied more than the price of barley (coefficient of variation for maize was 0.21, while it was 0.16 for barley). Having the above mentioned in mind, if market price is used to determine feed costs (the cost of maize and barley) in livestock production, maize proves to be more risky comparing to barley. Therefore, higher participation of barley in animal feed could make feed costs in animal production more stable and less susceptible to price variations.

When it comes to yields (Figure 1), the variation of maize yield was higher comparing to the changes of barley yield (coefficient of variation for maize was 0.26, while it was 0.12 for barley). The analysis also revealed moderate and negative correlation between yield and the price of maize (-0.66) while the correlation between barley yield and price was negative but very weak (-0.20).

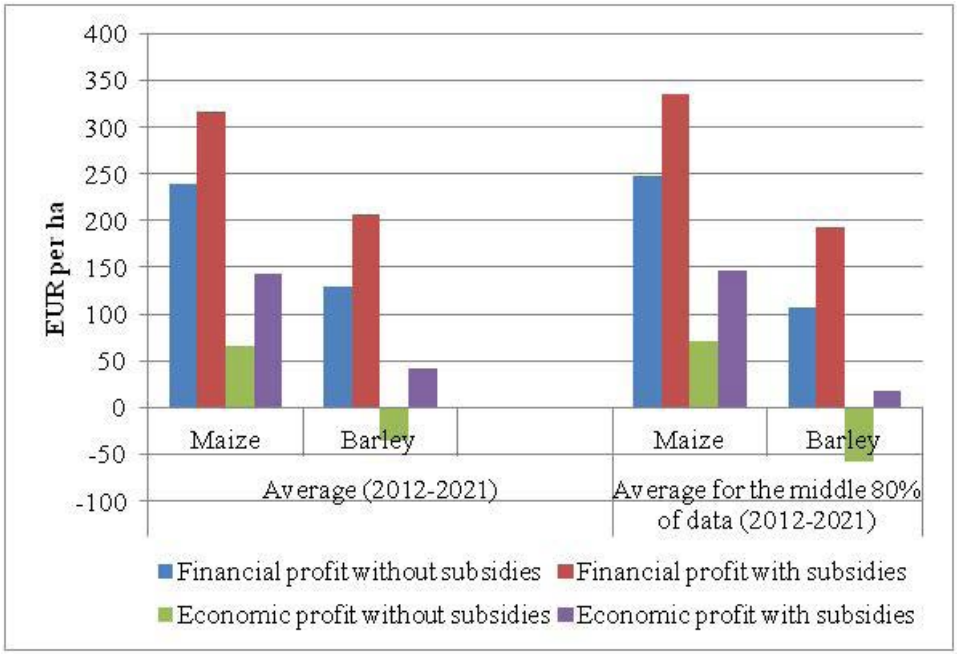
Within this research, the profit in maize and barley production is analyzed in two ways. The first analysis assumes an average level of profit for the period 2012 – 2021. The second analysis is performed for middle 80% of data covering the same period – which means that 10% of the highest profits and 10% of the lowest profits are not taken into account (Figure 2). Having in mind that the 10-year-period is covered, the second analysis does not consider the data from two production years. At the same time, both analyses use the same indicators – financial profit without subsidies, financial profit with subsidies, economic profit without subsidies and economic profit with subsidies.

Results of the first analysis indicate a favorable position of maize production in comparison to barley production. In other words, maize production achieved higher profits comparing to barley production. At the same time, maize production recorded positive financial and economic profits (with and without subsidies), while barley production has negative economic profit without subsidies. Negative economic profit without subsidies for barley production indicates that barley production cannot cover its costs when opportunity costs are included in the calculation (and therefore creates a loss). It can be clearly seen that, when budget transfers are subtracted, the profitability of the observed enterprises decreases significantly, which indicates the importance of subsidies for the profitability of the observed enterprises.

The second analysis (covering middle 80% of data) revealed a similar pattern – barley production resulted in a negative economic profit without subsidies, which is even less favorable. Nevertheless, financial profit for maize (with and without subsidies) is slightly higher than in the first analysis, while financial profit for barley production worsened.

On the other hand, it should be borne in mind that the extreme weather events (such as droughts and floods) are increasingly common in the Republic of Serbia (FAO, 2020) which significantly affects farm economic performance (Todorović et al., 2021). Therefore, the profit calculated for the entire period (2012-2021) should be considered as more realistic comparing to the profit determined on the basis of 80% of data (which implies an exclusion of the lowest and the highest profit values).

Figure 2. *Comparing average profits and average profits for the middle 80% of data for the feed grains for the period 2012-2021.*



Source: authors' calculation

Note: average for the middle 80% of data calculates ignoring the top and bottom 10%.

On the basis of the previous analysis, it could be concluded that (although maize production is riskier concerning yield and price variations) the level of maize average financial profit is higher comparing to the profit in barley production. The reasons for this should be sought in much stronger negative yield-price correlation for maize compared to barley production. The stronger negative correlation means an additional possibility to stabilize farmers' income. For instance, Ivanović and Todorović (2012) proved that under drought conditions (assuming that the drought is present at the global level) the rise in gross margin and profit can be achieved.

It is also possible to determine probabilities of achieving positive financial and economic profit (both of them with and without subsidies) (Table 1).

Table 1. *Probabilities of achieving positive financial and economic profit*

Profit indicators	Probability	
	Maize	Barley
Financial profit without subsidies	90%	100%
Financial profit with subsidies	90%	100%
Economic profit without subsidies	60%	20%
Economic profit with subsidies	80%	60%

Source: authors' calculation

The analysis indicated that farmers have a slightly higher probability of achieving a positive financial profit in barley production. Nevertheless, there is a higher probability of achieving the positive economic profit in maize production. Farmers producing maize have three times higher probability of achieving the positive economic profit without subsidies and slightly higher probability of achieving the positive economic profit with subsidies (comparing to barley production).

Discussion of production and opportunity costs offers an additional insight into the level of the above mentioned types of costs, as well as their variability (Table 2). Although average production costs and opportunity costs are somewhat higher for maize production, they have a lower level of variability (lower coefficient of variation for production and opportunity costs).

Table 2. *Analysis of production and opportunity costs*

Indicators	Production	
	Maize	Barley
Average cost of production (EUR per ha)	936.46	845.94
Standard deviation of production costs	105.74	108.52
Coefficient of variation of production cost	**0.11**	**0.13**
Average opportunity cost of production (EUR per ha)	172.47	164.90
Standard deviation of opportunity cost	87.09	86.15
Coefficient of variation of opportunity cost	**0.50**	**0.52**

Source: authors' calculation

Therefore, if maize and barley are used in livestock production as animal feed (and provided that feed cost is calculated on the basis of their production costs) a higher risk (higher cost variations) could be related to barley production.

Conclusion

Agricultural production has always been risky. Various types of risk could significantly influence farm economic performance. Having in mind that risks are transferred from crop to livestock production, it is necessary to understand how crop and livestock producers make decisions in such business environment.

The analysis has revealed that maize price is more variable than barley price, and maize yield tends to be more variable comparing to barley yield. At the same time, there is a lower probability of achieving positive financial profit in the maize production. Nevertheless, farmers are more oriented towards maize production, which could be caused by a higher level of average financial profit (related to negative yield-price correlation). Besides, maize production has lower coefficient of variation of costs.

On the other hand, the riskiness of livestock production (related to the feed costs) depends on the way in which feed costs are calculated. The results of this research provide an insight in the way crop and livestock farmers make their business decisions in risky business environment, enabling better understanding of their behavior.

Literature

1. Donohue, M., & Cunningham, D. L. (2009). Effects of grain and oilseed prices on the costs of US poultry production. *Journal of Applied Poultry Research,* 18(2):325–337. doi: 10.3382/japr.2008-00134
2. FAO, 2020. Smallholders and family farms in Serbia Country study report 2019. Budapest. doi: 10.4060/ca7449en
3. Gogić, P. (2014). Teorija troškova sa kalkulacijama u proizvodnji i preradi poljoprivrednih proizvoda. Poljoprivredni fakultet, Beograd – Zemun.
4. Hardaker, J. B., Huirne, R. B. M., Anderson, J. R., & Lien, G. (2004). Coping with Risk in Agriculture. CAB International, New York.
5. Harwood, J., Heifner, R., Coble, K., Perry, J., & Somwaru, A. (1999). Managing Risk in Farming: Concepts, Research, and Analysis. United States Department of Agriculture, Economic Research Service, Agricultural Economics Reports.
6. Hemme, T., Uddin, M. M., & Ndambi, O. A. (2014). Benchmarking cost of milk production in 46 countries. *Journal of Reviews on Global Economics,* 3:254-270.

7. Huirne, R. B. M. (2003). Strategy and risk in farming. *NJAS: Wageningen Journal of Life Sciences*, *50*(2):249-259. doi: 10.1016/S1573-5214(03)80010-6

8. Ivanović, L. (2018). Mogućnosti razvoja ekstenzivnih oblika stočarske proizvodnje u Srbiji. Doktorska disertacija. Poljoprivredni fakultet, Univerziteta u Novom Sadu.

9. Ivanović, S. (2013). Analiza investicija u stočarskoj proizvodnji. Monografija. Univerzitet u Beogradu, Poljoprivredni fakultet.

10. Ivanović, S., & Marković, T. (2018). Upravljanje investicijama u agrobiznisu. Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd – Zemun.

11. Ivanović, S., & Todorović, S. (2012). Effect of drought on production and market risk in crop production. In D. Cvijanović, J. Subić, A. Jean-Vasile (Eds.), *Thematic proceedings: Sustainable agriculture and rural development in terms of the Republic of Serbia strategic goals realization within the Danube region - Preservation of rural values* (pp. 1408-1425). Belgrade: Institute of agricultural economics, Belgrade.

12. Jeločnik, M., Subić, J., & Nastić, L. (2021). Upravljanje troškovima na poljoprivrednim gazdinstvima. Monografija. Institut za ekonomiku poljoprivrede, Beograd.

13. SORS, 2022. Statistical office of the Republic of Serbia, Belgrade, Serbia. https://data.stat.gov.rs/

14. Todorović. S., Ivanović, S., & Bogdanov, N. (2021). The influence of extreme weather events on farm economic performance – a case study from Serbia. *Italian Journal of Agrometeorology*, (1):51–62. doi: 10.36253/ijam-1073

15. Van Winsen, F., De Mey, Y., Lauwers, L., Van Passel, S., Vancauteren, M., & Wauters, E. (2013). Cognitive mapping: A method to elucidate and present farmers' risk perception. *Agricultural systems*, *122*:42-52. doi: 10.1016/j.agsy.2013.08.003

16. Wauters, E., Van Winsen, F., De Mey, Y., & Lauwers, L. (2014). Risk perception, attitudes towards risk and risk management: evidence and implications. *Agricultural Economics*, *60*(9):389-405. doi: 10.17221/176/2013-AGRICECON

YOUTH ENTREPRENEURSHIP IN AGRICULTURE

Slađana Vujičić[1], *Marija Lukić*[2], *Milivoje Ćosić*[3], *Biljana Prodanović*[4]

Abstract

Today, the main capital of societies is knowledge, skills and human resources. Also, entrepreneurship is recognized as one of the key drivers of the economic development of every country. The development of entrepreneurship in the agricultural sector represents one of the opportunities for strengthening agricultural enterprises, increasing the export of agricultural products, but also reducing unemployment, especially among young people. Young people today represent the driving force of society and their involvement in entrepreneurship, especially in the agricultural sector, would help them get a job and become financially independent.

The aim of the work is to examine the possibilities for the development of youth entrepreneurship in the agricultural sector and to point out the obstacles that threaten that development.

Key words: *youth, entrepreneurship, agriculture, unemployment*

Introduction

Today, entrepreneurship is recognized in the world as a tool for solving almost all economic problems. In addition to its role in employment, entrepreneurship fosters creativity as well as economic growth. Because of the benefits that entrepreneurship provides, many people, especially young people, are considering entrepreneurship as a viable career option where regular job opportunities fail. For young people, entrepreneurship is an alternative

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to meet their needs and earn a living. Namely, youth entrepreneurship reduces youth unemployment rates, improves innovation development and overall improves economic growth (Ćoćkalo et al, 2017; Manolova et al, 2019). For entrepreneurial organizations to be able to successfully develop the business strategy, it is necessary to provide optimal resources for unhindered growth, internal coherence, stability of organizational culture, and competitiveness in the market (Radovic Makrovic et al.,2021).

Young people in Serbia

Data from the National Employment Service show that the number of young people who are unemployed in May 2022 was 86,575, which represents a total of 19.20% of the total number of unemployed. Almost a fifth of the total unemployed in the Republic of Serbia are young people between the ages of 15 and 30. In relation to 2021, youth unemployment decreased by 28,958 young unemployed persons, i.e. by 25.06%. Since 2014, youth unemployment has fallen by 110,000 (Table 1).

Table 1. *Number of unemployed youth by age group (2014-2021)*

Year	The number of young unemployed	15-19 year	20-24 year	25- 29 year
2014.	196 260	20 666	77 484	98 110
2015.	183 602	19 242	72 973	91 387
2016.	171 245	17 765	66 919	86 561
2017.	146 843	14 472	56 569	75 802
2018.	123 686	12 934	46 654	64 098
2019.	114 679	10 979	43 690	60 010
2020.	104 702	10 711	38 902	55 702
2021.	115 533	13 844	44 295	57 394

Source: National Employment Service

However, the number of young people, aged 15-24, continues to decrease, by 10,500 in 2021, i.e. by 1.5%, compared to 2020 (Labor Force Survey, 2021).

Table 2. *Basic contingent workforce according to age groups 2020/2021.*

	2021	2020 (revised data)	Changes compared to the previous year	
		In the thousands	In the thousands	%
Population aged 15 and over	5.856,9	5.894,2	-37,3	-0,6
Active	3.201,2	3.076,0	25,3	4,1
Employed	2.848,8	2.776,7	72,1	2,6
Unemployed	352,4	299,2	53,2	17,8
Population outside the labor force	2.655,7	2.818,2	-162,5	-5,8
Young Population (15-24)	**694,8**	**705,3**	**-10,5**	**-1,5**
Active	231,5	197,3	34,1	17,3
Employed	170,3	142,7	27,6	19,3
Unemployed	61,2	54,6	6,6	12,0
Population outside the labor force	463,4	508,0	-44,6	-8,8

Source: Labour Force Survey,2021,Statistical Office of the Republic of Serbia

In the group of young population aged 15-24, there is a noticeable decrease in the population outside the labor force (-44,600) and an increase in the active population (+34,100). The number of employed young people, aged 15-24, in 2021 is higher by 27,600 (or 19.3%), and the number of unemployed by 6,600 (or 12.0%) compared to 2020. The employment rate of the young population in 2021 was 24.5%, which is 4.3 p. p. more than in 2020. The youth unemployment rate recorded a value of 26.4% and is 1.2 percent lower than last year. p. The rate of the population outside the labor force is lower by 5.3 p. p. and in 2021 it amounted to 66.7%.

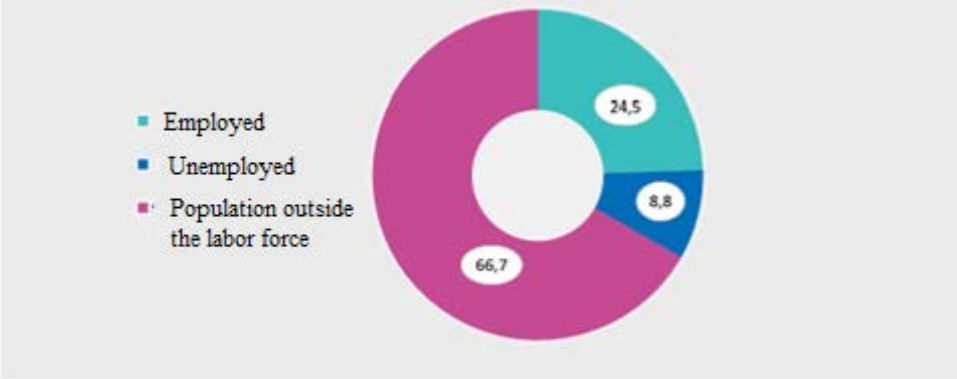
Table 3. *Population according to activity status, age groups, region and type of settlement, 2021*

Population by activity status, age groups, region and settlement type, 2021								
	Republic of Serbia							
	In total	Serbia North		South Serbia			Type of settlement	
		Belgrade region	Region of Vojvodina	Region of Sumadia and Western Serbia	Region of Southern and Eastern Serbia	Region of Kosovo and Metohije	Urban	The rest
Population aged 15 and over (in thousands)	**5856,9**	**1438,0**	**1569,6**	**1615,1**	**1234,2**	—	**3431,0**	**2425,9**
Active	3201,2	828,4	856,0	900,0	616,8	—	1863,1	1338,1
Employed	2848,8	755,2	774,5	786,4	532,7	—	1648,9	1199,9
Unemployed	352,4	73,2	81,5	113,6	84,1	—	214,2	138,2
Population outside the labor force	2655,7	609,6	713,6	715,1	617,4	—	1567,9	1087,8
Activity rate	54,7	57,6	54,5	55,7	50,0	—	54,3	55,2
Employment rate	48,6	52,5	49,3	48,7	43,2	—	48,1	49,5
Unemployment rate	11,0	8,8	9,5	12,6	13,6	—	11,5	10,3
Population rate outside the labor force	45,3	42,4	45,5	44,3	50,0	—	45,7	44,8
Young population (15-24)	**694,8**	**156,1**	**188,0**	**200,9**	**149,8**	—	**409,1**	**285,7**
Active	231,5	49,1	71,3	70,2	40,9	—	111,3	120,2
Employed	170,3	37,9	54,8	50,0	27,7	—	78,7	91,6
Unemployed	61,2	11,2	16,5	20,3	13,2	—	32,6	28,6
Population outside the labor force	463,4	107,0	116,6	130,7	109,0	—	297,8	165,5
Activity rate	33,3	31,4	37,9	34,9	27,3	—	27,2	42,1
Employment rate	24,5	24,3	**29,1**	24,9	**18,5**	—	19,2	32,1
Unemployment rate	26,4	**22,7**	23,2	28,9	**32,3**	—	29,3	23,8
Population rate outside the labor force	66,7	68,6	62,1	65,1	72,7	—	72,8	57,9

Source: Labour Force Survey,2021, Statistical Office of the Republic of Serbia

Observed by region, the highest youth unemployment rate (32.3%), along with the lowest employment rate (18.5%), was recorded in the Region of Southern and Eastern Serbia.

Graph 1. *Status of persons aged 15-24 in activity, 2021*



The lowest unemployment rate, at 22.7%, was recorded in the Belgrade region, while the highest employment rate, at 29.1%, was recorded in the Vojvodina region.

Youth entrepreneurship in agriculture

arly significant social role to feed the world's population, which is experiencing a steady increase. Thanks to the general social and technological progress, agriculture has experienced a dramatic productivity growth over the last 100 years, thus successfully fulfilling its role (Lapčević, Nikitović, 2019). The agricultural sector in the Republic of Serbia has a very high economic and social significance, since it has a substantial share in creating the gross domestic product and employing a large number of people (Milanović, Nikitović, Vujičić, 2020). Agricultural production provides great opportunities for the development of entrepreneurship. Vukotić (2003) states that the market represents the key information that is needed for the development of entrepreneurship in the field of agriculture, because only if the population of rural areas sees the possibility of earning through agriculture, and not just feeding their family, there is a chance for the development of entrepreneurship. The development of entrepreneurship is influenced by creativity and innovation, and it could be said that entrepreneurship can only develop if the young generation is given the opportunity to participate in its development. Young people can acquire entrepreneurial competences through various trainings or

educations. The fact is that the Republic of Serbia has agricultural resources that are not used sufficiently and can help in the further development of the entire economy so that the education of young people in agriculture would increase their ability to create and develop jobs in the field of agribusiness. In our country, agriculture is positioned as a very important potential in overall social and economic development, taking into account the quality and quantity of available resources, rich tradition and favorable geographical position (Marković, 2010, p. 273). Agriculture and rural development strategy of the Republic of Serbia for the period 2014–2024. emphasized that small family farms are an indispensable part of the rural economy and require special attention (Strategy of Agriculture and Rural Development of the Republic of Serbia 2014-2024). The same Strategy states that, "in addition to women, young people in the countryside also face high risks of being excluded from the labor market. Young people aged 15-24 are employed in non-agricultural sectors in only 21% of cases. Although even half of this age group is inactive people, what indicates the difficulties in accessing jobs is the significantly higher participation of the unemployed, which in this category, as well as in the next age category (25-34 years), amounts to only 15.5%".

Entrepreneurship in rural areas is considered a great employment potential, and residents of those areas see it as an instrument for improving their standard, while women see it as an opportunity for employment close to home, which enables independence, independence and reduces the need for social assistance (Gajić, 2014). However, there are frequent migrations of the young population from the countryside to the city. In addition to employment, there are a number of other structural factors that (depending on the local context of the rural environment) can have an impact on migration decisions: general socio-economic underdevelopment of the local environment, underdevelopment of infrastructure (transportation, utilities, telecommunications...), underdevelopment of services service, impossibility of transportation, remoteness, passivity in the local environment (aging population, lack of cultural and entertainment facilities, lack of perspective and lack of local dynamics...), greater exposure to natural disasters, etc. (Janković, Novakov, 2012). Planck, Ziche (1979) stated the so-called push and pull factors that influence the migration of young people from the countryside to the city (Table 4).

Table 4. *Reasons for rural-urban migration: push and pull factors*

Village (push factors) City (pull factors)	Village (push factors) City (pull factors)
Lack of (arable) land; (disguised) unemployment, lack of qualified jobs, low income and salary level, poor working conditions, inability to advance, social control and dependence, limited opportunities to start a family, limited possible education, unsatisfactory cultural offer, monotony and boredom, insufficiently rich offer of goods and services, inadequate public services, political isolation, low social status.	Better prospects for existence, greater offer of jobs, more diverse work opportunities, higher salary level, better opportunities for success, offer of easier work, better career prospects, anonymity, pluralism of behavior patterns, earning opportunities for women, better educational institutions, stimulating spiritual /intellectual atmosphere, diversity of behavior, better living conditions, diverse offer of goods and services, satisfactory public services, possibility of participation in political life, higher social status

Source: Planck, Ziche (1979)

Migrations of young people from rural areas are usually associated with migrations related to education (temporary migrations), that is, from a long-term perspective, employment, career, desire for an urban lifestyle, etc. (Janković, Novakov, 2012).

Empirical research

In order to investigate the possibilities for the development of youth entrepreneurship in the agricultural sector in the Republic of Serbia and the obstacles that threaten that development, empirical research was conducted through a survey questionnaire on a sample of 152 respondents in the period from April to June 2022. The research was conducted on the territory of the whole of Serbia, in rural areas. Questionnaires were distributed in written electronic form to respondents. The research conducted showed that of the total number of respondents who live in rural areas, the majority of young people (92%) live in households that own land. Of these, 68% have a registered farm. According to ownership, agricultural farms are largely registered to male relatives (father, brother, grandfather) and that is 59%, while only 14% are registered to female relatives (mother, grandmother, sister). 27% of farms were registered as young respondents from the sample.The research showed that the majority of young people work on the farm, on average 33% of them work and manage the whole farm or one part of it, and 24% help on the farm.

Table 5 shows the analysis of the results of the survey questions related to the factors that influence the possibility for the development of youth entrepreneurship in the agricultural sector. This analysis showed that young people highlighted the possibility of employment as the most important factor for the development of entrepreneurship in agriculture (Table 5).

Table 5: *Factors that influence the development of entrepreneurship in agriculture - respondents' answers in %*

Factors affecting the development of entrepreneurship in agriculture	Respondents' answers in % of the total number of respondents
Possibility of employment	66%
Education	24%
Association with other farmers	17%
Environment	28%
Availability of information on entrepreneurship in agriculture	45%

Young people cited the lack of financial resources as the main obstacle to the development of youth entrepreneurship in agriculture (Table 6).

Table 6: *Obstacles to the development of youth entrepreneurship in agriculture*

Obstacles to the development of entrepreneurship in agriculture	Respondents' answers in % of the total number of respondents
Lack of financial resources	83%
Unavailability of the market	45%
Insufficient information about incentives for agriculture	34%
Paperwork	28%
Labor shortage	45%

Conclusion

The Republic of Serbia is a country where agriculture plays an important role in both economic and social development. Agriculture is the basis of the entrepreneurship we have today. Entrepreneurship is inextricably linked with agricultural production in Serbia. As it has already been pointed out that entrepreneurship is the basis of creativity and innovation, we can say the same about agricultural entrepreneurship, but also add profitability and risk management of agricultural producers.

Possibilities for the development of youth entrepreneurship in agriculture are still in the initial phase. The conducted research showed that young people see an opportunity for employment in agriculture. In addition to employment as a factor that affects the development of entrepreneurship in agriculture, young people also see the availability of information about entrepreneurship in agriculture, the environment, education... However, young people recognized numerous obstacles to the development of youth entrepreneurship in agriculture, such as a lack of financial resources, insufficient information about incentives for agriculture as well as labor shortages.

Literature

1. Ćoćkalo, D., Đorđević, D., Nikolić, M., Stanisavljev, S., & Terek, E. (2017). Analysis of possibilities for improving entrepreneurial behaviour of young people: Research results in Central Banat district. Journal of Engineering Management and Competitiveness (JEMC), 7(2), 97-108. UDC: 005.961:005.914.3-053.91(497.113 Banat).
2. Gajić A. (2014) "Entrepreneurship as an economic force in the development of rural areas in Serbia", Trendovi u poslovanju,No. 3, volume 1/14.
3. Janković, D.,Novakov M. (2012). Employment in Agriculture and Life in Rural Areas? Migration Preferences of Agricultural Students. Thematic proceedings International scientific meeting "Sustainable agriculture and rural development in terms of the Republic of Serbia strategic goals' implementation within the Danube region – the preservation of rural values". Institute of Agricultural Economics, Belgrade. December 6-8, 2012, Tara.
4. Lapčević G., Nikitović Z. 2020. „Upravljanje ljudskim faktorom u poljoprivredi - motivacija i kontrola„ Trendovi u poslovanju, vol. 7, No. 2, pp. 57-67.
5. Manolova, T. S., Edelman, L. F., Shirokova, G., & Tsukanova, T. (2019). Youth entrepreneurship in emerging economies: can family support help navigate institutional voids? Journal of East-West Business, 1–33. doi:10.1080/10669868.2019.1624672.
6. Marković, I. (2010). Improvement of Serbian export competitiveness. Facta universitatis, Series: Economics and Organization, 7(3), 271–278.

7. Milanović M., Nikitović Z., Vujičić S. 2020. ,,The importance of the quality of the agricultural product for sustainable success of agricultural holding,, International Review, No. 3-4, pp. 105-112.
8. Planck, U.,J. Ziche (1979). Land-und Agrar-soziologie. Ulmer Verlag. Stuttgart.
9. Radović Marković M., Nikitović Z., Somborac B. Penjišević A., Vujičić S.(2021) ,,Integration of Gender Aspects into Development of Knowledge Management System in the Entrepreneurial Organizations in Serbia,, Journal of Women's Entrepreneurship & Education . 2022, Issue 1/2, p154-169. 16p.
10. Vukotić V.(2003): "Entrepreneurship in the field of agriculture or How to switch from the concept of population nutrition to the concept of business opportunities", http://www.vukotic.net/files/publikacije/1242824304_1709.pdf

IMPORTANCE OF BEEF IN THE DIET AND PRODUCTION IN THE REPUBLIC OF SERBIA[1]

Slavica Arsić[2]

Abstract

The main socio-economic goals of the development of meat production (beef and veal) and meat products are the satisfaction of the nutritional needs of the population, provision of raw materials for the food industry, the creation of necessary commodity food reserves and the necessity of exporting meat and meat products.

Beef meat (beef and veal) is considered to be the best quality meat with the most suitable nutritional properties; therefore the price of this type of meat is generally higher than the prices of other types of meat.

Meat is a high-quality food that is essential in the human diet, and which contains the most important nutrients: protein 12-25%, fat 1-20%, carbohydrates about 1%, as well as minerals (especially calcium and iron), and vitamins (riboflavin, thiamine, niacin). The importance of meat in the diet is supported by the statement that about half of the fatty acids in meat are unsaturated. Among them there are fatty acids with "long" chains, which are important in the diet of the elderly, because they are unable to synthesize them from fatty acids with "shorter" chains.

The paper also provides an analysis of the production and consumption of beef (beef and veal) for the observed period from 2012 to 2021 in the Republic of Serbia, during which period there is a certain cyclicality in production and consumption. The production of beef in the Republic of Serbia in the observed time period reached its highest physical volume in 2012. (82,000 t) after which it decreases until 2017 and 2019 (71,000 t) and in the following year there will be a slight increase to 75,000 t., at which level it has remained and there is no hint of stabilization or increase in beef production in the Republic of Serbia.

Key words: *beef, analysis, production.*

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Introduction

The basic parameter from which to start when analyzing the supply of cattle and beef production is the number of heads. The total number of cattle, as one of the potentials for beef production, and heifers that provide new heads for fattening, in the observed period from 2012 to 2021, is in permanent decline. The general crisis in animal husbandry did not bypass the cattle industry either. Inconsistency, initially the price of inputs and final products of cattle breeding, contributed to the decrease in the number of cattle. The average number of cattle in the Republic of Serbia, in the observed period from 2012 to 2021, was about 898 thousand head, with a tendency to decrease at an average annual rate of 5.8% (2.5-3%), which is shown in table 1. and in graph 1. Only in 2021, compared to the previous year, there is a decrease in the number of cattle by 3%.

Table 1. *The movement of the number of cattle in the Republic of Serbia and the calculation of the base and chain index, in thousands.*

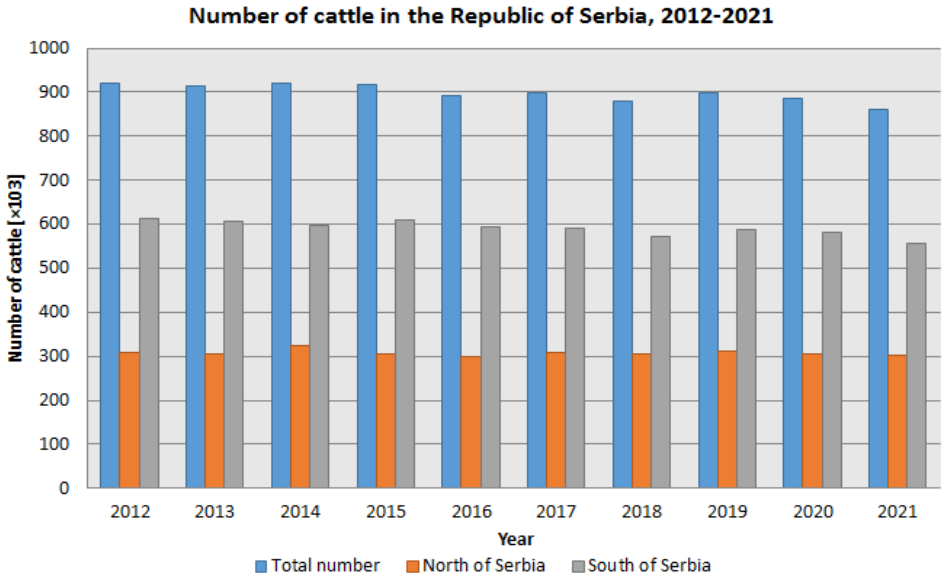
Republic Serbia - Total				Serbia North			Serbia South		
Year	**Cattle**	**Base index**	**Chain index**	**Cattle**	**Base index**	**Chain index**	**Cattle**	**Base index**	**Chain index**
2012	921			307			614		
2013	913	99.1	99.1	306	99.7	99.7	607	98.8	98.8
2014	920	99.9	99.9	323	105.2	105.5	597	97.2	98.3
2015	916	99.5	99.6	306	99.6	94.7	610	99.3	102.2
2016	893	97.0	97.5	299	97.4	97.7	594	96.7	97.4
2017	899	97.6	100.6	307	100.0	102.6	591	96.2	99.5
2018	878	97.6	97.6	305	99.4	99.5	573	97.0	96.9
2019	898	97.5	102.3	310	100.9	101.6	588	95.7	102.6
2020	886	96.2	98.6	306	99.7	98.7	580	94.5	98.6
2021	860	93.4	97.0	303	98.7	99.0	556	90.5	95.8
Aver-age	898			307			591	96.2	

*Source***:** SORS Statistical yearbooks from 2012 to 2021, Belgrade and author's calculation

The region of Serbia South has the largest number of heads, with an average of around 560,000 heads, which is 64.6% of the total number in the Republic of Serbia, while Serbia North participates with 35.3%. The north of Serbia has a smaller number of cattle, but in the observed period, it shows a slight increase, which is a consequence of the appearance of more organized farming units than in other areas of the Republic of Serbia and attempts to harmonize the potential of cattle production and installed processing capacities.

Beef meat (beef and veal) is considered to be the best quality meat with the most suitable nutritional properties, therefore the price of this type of meat is generally higher than the prices of other types of meat. Beef has excellent dietary properties, it is easily digestible, and 85-90% of it is used in the body (Lazarević et al., 1995).

Graph 1. *Research of author's according statistical data*



According to Gavrilov (2009), beef contains 123-310 calories (515-1298 KJ), 4-25 grams of fat (expressed per 100 grams of edible portion), and 19-21 grams of protein. Unlike beef, veal meat has better nutritional properties and contains 118-180 calories, is less fatty (3.1-11 grams of fat), and has a higher proportion of protein (19-22 grams), also per 100 grams of edible part.

Meat represents one of the most important foods, because it is the best source of high-quality proteins, and it contains all the necessary amino acids necessary for the construction of its own proteins. According to Ljubisavljević (1992), the energy value of meat depends mainly on its fat content, and if it is fattier, it has a higher energy value (table 2).

However, as a rule, fatty meat contains excess fat at the expense of protein, and protein is the most important component of meat. For these reasons, less fatty meat, with a lot of protein, is more valued, because using meat as an

energy source is very uneconomical, since energy from bread, sugar, oil, margarine, fat and other foods is much cheaper.

According to Čobić and Antov (2002), the examination of the demands of consumers of agricultural products in Germany showed that their primary concern is the safety of the origin of the product and in second place the healthy keeping of animals. The favorable price of the product was even in fifth place, built environment protection and care for the environment.

Table 2. *Ingredients and energy value of 100 grams of beef and veal meat*

Type of meat		Water gr.	Proteins gr.	Fat gr.	Energy value KJ
Beef	Leg ham	71,2	21,2	7,2	627,00
	Plate	67,6	20,8	9,8	714,78
	Flank	65,2	22,2	12,3	836,00
	Shoulder	69,5	20,8	9,3	698,06
Veal	Leg ham	75,4	22,3	0,8	401,28
	Plate	74,8	22,7	1,7	422,18
	Flank	72,0	22,8	3,5	514,14
	Shoulder	74,8	21,4	2,4	447,26

Source: Ljubisavljević, 1992.

Meat is a good source of "B" complex vitamins, but it is poor in fat-soluble vitamins. According to Lončiškar and Milojević (1987), in developed countries protein of animal origin accounts for about half of the total protein. For example, vitamin "B12" is excluded from animal products, as well as most other vitamins ("B2", "B6"), and about 80% of calcium and 70% of phosphorus also come from animal products. (S. Arsić, 210.)

Production of beef meat

Data on the amount of beef produced in the Republic of Serbia for the period from 2012 to 2021 are given in table 3 (SORS). Also, the calculated values of base and chain indices of meat production are given.

The base indices for the Republic of Serbia show the greatest trend of production decline, in 2013 by 14.6% compared to the previous base year of 2012. Production dropped from 82,000 tons of meat to 70,000 tons, which is 12,000 tons less than in 2013, and there is also a decrease in production in 2017 and 2019 compared to the base year by 7.3%.

According to the calculation of chain indices, which shows the movement of meat production, cyclical production can be achieved, because in some years there is a decrease and then a slight increase, the night decrease is in 2013, in 2013, in 2013. 14.6%), while in the rest of the observed period there is an increase or stagnation of production, the biggest drop is in 2017 of 7.8% and in 2019 of 6.6%.

Table 3. *Production of beef in the Republic of Serbia and calculation of base and chain index, in thousands of tons*

Republic Serbia				
Year	**Beef**	**Base index**	**Chain index**	**Meat consumption/ inhabitant**
2012	82	**Base year**		11.4
2013	70	85.4	85.4	9.7
2014	73	89.0	104.3	10.2
2015	77	93.9	105.5	10.7
2016	77	93.9	100.0	10.7
2017	71	92.7	92.2	9.9
2018	76	86.6	107.0	10.6
2019	71	92.7	93.4	9.9
2020	75	91.5	105.6	10.5
2021	75	91.5	100.0	10.5
Average	**75**	**90,8**	**99,3**	**10,4**

Source: Own calculation based on statistical data from statistical yearbooks for the analyzed period, SORS, Belgrade

The general conclusion, in relation to the base and chain indices, for the observed time period from 2012 to 2021, would be that there is a certain cyclicality in the movement of production, but that there is no hint of stabilization or increase in beef production in the Republic of Serbia.

Cycles have a very negative effect on the quality of cattle breeding in a country. The most vulnerable are small farms that completely abandon production in the period of contraction, and in the period of expansion including cattle of untested quality in breeding.

To achieve production growth, it is necessary to build a set of anti-cyclical measures and instruments, to mitigate the cycles that are inherent in livestock production. Primarily, we are referring to regulatory - intervention measures on the market, which would be calculated to eliminate market disturbances. The primary prerequisite is to reserve, both animal products and animal feed.

According to Ivanović (2018) the possibility of increasing the volume of beef production can be implemented by mass production in the cow-calf system. In this system, production is with a low level of investments and with the use of available natural resources, however, on the other hand, it is not economically justified without public subsidies, i.e. it is associated with a high level of investment risk.

Production of veal meat

In order to get a true picture of consumption, in addition to household consumption, the consumption of other large consumers (schools, hospitals, catering facilities, etc.) should be taken into account, but this is impossible due to the lack of statistical data.

The data presented in SEEDEV (2020) related to the production of beef meat produces about 50% for an unknown customer, 20% for own needs, and about 30% for an organized market chain.

Household member, was 10.4 kilograms, with notable cyclicality. In the last year, compared to the initial consumption, it was 0.9 kilograms less. The biggest drop in beef consumption was recorded in 2013, 2017, and 2019. The decrease in beef consumption was influenced by numerous factors, among which the most significant are: a decrease in consumer purchasing power, relatively high retail price, certain substitution with pork and beef, changes in market supply, consumer habits, tastes, etc.

The average consumption of beef in the observed period from 2012 to 2021 in the The consumption of livestock products from own production is very pronounced, and in recent years it has been increasing, which in itself is not a significant incentive to increase production.

There are significant differences in beef consumption by socio-economic household category. The highest consumption is in non-agricultural households, followed by mixed ones, and the lowest in agricultural households. The average consumption of beef (beef and veal) and meat products is 10.4 kilograms per inhabitant per year. It is five kilograms less than the European average per inhabitant. Serbia is in 17th place in Europe, ahead of Portugal and behind Great Britain. In the structure of meat consumption, in our country, it participates with 23% and is in second place after pork. Comparing the retail prices of beef with pork and poultry meat, it should be noted that this

type of meat is more expensive, on average by about 50% than pork, and even by 280% than chicken meat, which will still affect the lower consumption of this type of meat.

Data on the consumption of beef in the Republic of Serbia, for the period from 2012 to 2021, are given in table 3.

The general conclusion for the observed time period from 2012 to 2021 would be that there is a certain cyclicality in consumption, and that there is no hint of stabilizing and increasing the consumption of beef in the Republic of Serbia. In the observed period, the present serious economic crisis, led to a decrease in the purchasing power of consumers, as has already been established, there was a significant decrease in the consumption of this type of meat, and the export of beef as an important export item also decreased. In the coming period, we can, unfortunately, expect a further decrease in the consumption of beef meat due to the increase in the consumption of cheaper types of meat (primarily pork and poultry meat), as well as the consequence of the high share of imported quantities of other types of meat and meat products.

Conclusion

Despite favorable natural conditions, the Republic of Serbia has seen a decrease in the number of cattle (calves and calves) at an annual rate of 2-3% in the last decade. During the research period, the number of cattle is decreasing, which also results in reduced production. The production of beef in the Republic of Serbia in the observed period reached its highest physical volume in 2012. (82,000 t) after which it decreases until 2017 and 2019 (71,000 t) and in the following year there will be a slight increase to 75,000 t., at which level it has remained.

Beef consumption increases or decreases cyclically due to relatively high prices and declining living standards. Consumption of beef in the observed time amounted to 10.4 kilograms, and together, beef and meat products amounted to 12 kilograms. The level of the market price of beef (beef and veal) meat is of great importance for meat consumption (especially in conditions of low consumer income). An increase in the price of this product leads to greater or lesser demand and consumption of this product.

In the end, as a general conclusion, our agriculture, and with it the production of beef, is in a fairly independent position. And if we were to compare

that production with foreign-world production, then the ratings are even more negative. With new measures, the Government of the Republic of Serbia is trying to contribute to the improvement, which still requires a longer period.

Literature

1. Гаврилов Н. : *„Извештај говедарство"* , Београд 2009.
2. Лазаревић, Р., Лазаревић,Љ., Петровић, М., Алексић, С,, Мишчевић, Б,,: *„Стање и правци развоја говедарства",* IV Конгрес о храни: Сточарска производња, прерада, квалитет, промет, економика и заштита животне средине,Београд, 1995.
3. Љубисављевић, М,,: *„ Животне намирнице"*, Пољопривредни факултет, Београд,1992.
4. Лончишкар, Ф., Милојевић, М.,: *„ Научна достигнућа и трндови развоја у сточарству",* Храна и развој, Пољопривредни факултет Београд,1987.
5. Чобић, Т,, Антов, Г.,: *„Тов говеда",* Пољопривредни факултет Нови Сад, 2002.
6. Славица Арсић: „Значај маркентишког приступа у производњи јунећег меса и његова економска оправданост„ Магистарски рад, Пољопривредни факлтет, Универзитет у Приштини, Зубин поток, 2009.
7. Статистички годишњаци за одговарајуће године од 2012-2021. године, Република Србија – Републички завод за статистику, Београд
8. Секторска анализа производње и прераде меса у Републици Србији, за потребе ИПАТД 3 програмирања, сектор месо, SEEDEV, 2020.
9. Ивановић, Л. (2018): „Могућности развоја екстезивних облика сточарске производње у Србији„ Докторска дисертација, Пољопривредни факлтет, Универзитет у Новом Саду, Србија

STATE AND THE IMPORTANCE OF ORGANIC PRODUCTION TO HUMAN HEALTH

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Abstract

Sustainable resource management and environmental protection are the basis for ensuring long-term stability and quality of agricultural production on the global food market where organic production has a great chance. In this study, organic crop production in Serbia is analyzed in comparison with neighbouring countries, and the prospects for the development of organic crop production in our country are indicated by SWOT analysis. Trend of growth in value of organic production is recorded a continuous upward path, due to the increased awareness of people about the importance of consuming health-safe foods, produced in a certified system of organic agriculture. Organically produced plant derived food products have a higher nutritional value than conventional ones and lower level of contamination in organic crops, which is why the risk of diseases caused by contaminated food is significantly reduced. Main *benefits organic productions are health-safe products, economic profit/benefit, preserving the environment and health.*

Key words: *organic plant production, health-safe products, SWOT analysis*

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Introduction

Sufficiency quantity of nutrients is the basis of good health, productive lives and longevity for everyone. Nutrient availability to people is primarily determined by the output of food produced from agricultural systems. If agricultural systems fail to provide enough quantity of diverse food all the nutrients essential to human life, people will suffer, societies will deteriorate and national development efforts will stagnate. Importantly, plant foods provide most of the nutrients that feed the developing world. As a result of population pressures, many global food systems are not currently providing enough micronutrients to assure adequate micronutrient intakes for all people. This has resulted in an increasing prevalence of micronutrient deficiencies (e.g., iron deficiency, vitamin A deficiency, and iodine deficiency disorders) that now afflicts over three billion people globally, mostly women, infants and children in resource-poor developing countries (Welch, 2002).

Organic plant production rises due to the growing desire of people to consume healthy food. The modern trend in nutrition sets new requirements for the quality and health safety of food. Conventional agriculture due to the application of pesticides and fertilizers, led to the loss of individual plant and animal species, while organic farming is based on the principles of protection and preservation of plant and animal species and the environment. Organic production in the world records a growth trend. Organic production of agricultural and other products is based on the application of organic production methods at all stages of production and aims to reduce the use of chemicals and excludes the use of GMOs and products consisting of or derived from GMOs, as well as the use of ionizing radiation. Organic farming aims to produce safe high quality and high nutritional value food in an environmentally sustainable way, maintaining the genetic diversity of agro and ecosystem, preserving the environment, maintaining and improving soil fertility, reducing all forms of pollution, improving health and making profit (Popović, 2015; Popović et al., 2012a; 2012b; 2013a; 2013b; 2014; 2017; 2019; 2020; 2021; Stevanovic et al., 2018; Ikanović & Popović, 2020, Filipović et al., 2021; Zejak et al., 2022).

Organic agriculture is defined today in various ways, although some common principles exist for all of them - to not use synthetic fertilizers and chemical pesticides (Lotter, 2003). Some commonly used definitions of organic agriculture are the ones used by: FAO - “Organic farming is a holistic pro-

duction management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity", IFOAM - "Organic agriculture is a production system that sustains the health of soils ecosystems and people" (IFOAM *Annual Report 2007*), and USDA - "Organic farming is a production system that excludes the use of synthetically produced fertilizers, biocides, growth regulators, and livestock feed additives such as antibiotics and growth hormones" (IFOAM Annual Report, 2007; Ikanović & Popović, 2020). There is a general idea that organic farming contributes to improved human and environmental health.

Organic production and certification methods provide a safe product produced in accordance with the legislation governing the field of organic production. An organic product is a product produced and labelled in accordance with the law and legislation adopted pursuant to the law (Ikanović & Popović, 2020).

Potential benefits from organic production arise from improved: soil fertility, organic matter content and biological activity; better soil structure and reduced susceptibility to erosion; reduced pollution from nutrient leaching and pesticides; and improved plant and animal biodiversity (Kasperczyk & Knickel, 2006). The increase in organic market and production is evident in the world as and one might expect a continuous increase in the market share of organic products as well as in areas of organically certified land for organic production around the world (Johansson et al., 2014).

Quite a number of studies are available examining the impact on amounts of certain nutritional compounds of organic crop cultivation practices (Hussain et al., 2010; 2012). Studies have also been done (Benbrook et al., 2013) have focused on a more holistic and full understanding as to whether organic production influences public health.

This study aims to analyze organic production in Serbia and indicate the possibilities for its improvement.

Materials and Methods

This study is the analysis of the organic agriculture in the world and Serbia. The database was FAO 2022. A SWOT analysis was presented in order to indicate the possibilities for further improvement of organic production. The results shown were processed using descriptive statistics and presented in tabular and graphical forms.

Results and Discussion

Organic production in the world and in Yugoslavia ex countries

In 2020 in the world the total area under organic production covered 74.93 million hectares,organic share of area was 1.6%, export to EU and USA was 4,666,220 MT, and area growth by 4,1%, Table 1.

Table 1. *Organic agriculture area in world [ha], Organic area share of total farmland [%], Organic producers in the world, and Export to EU and USA, 2020.*

Country	Organic area [ha]	Organic share of area [%]	Numbers of organic producers	Growth 2019-2020 [%]	Export to EU and USA, MT
World	74,926,006	1.6	3,369,417	+4.1	4,666,220

Source: Research Institute of Organic Agriculture FiBL, 2022. www.fibl.org/fileadmin/documents/shop/1344-organic-world-2022.pdf

Table 2. *Organic agriculture area in Yugoslavia ex countries [ha], Organic area share of total farmland [%], Organic producers in the world, and Export to EU and USA, 2020.*

Country	Organic area [ha]	Organic share of area [%]	Numbers of organic producers *	Export to EU and USA, MT
Croatia	108,610	7.2	5,153	28
Slovenia	52,078	10.8	3,685	3
Serbia	19,317	0.6	439	15,847
Montenegro	4,823	1.9	423	56
North Macedonia	3,727	0.3	863	361
B&H	1,692	0.1	86	1,582

Source: FiBL survey 2022, based on data from governments, the private sector, and certifiers. For retail sales data: FiBLAMI- survey 2022, based on data from government bodies, the private sector and market research companies. Export data: Traces/European Commission and USDA. For detailed data sources, see annex, p.322 *Total number includes data for countries with less than three producers.

In the countries of the former Yugoslavia: Serbia, Montenegro, Bosnia and Herzegovina, Croatia, Slovenia and Macedonia, there is a growing trend of areas under organic production. Croatia had the largest area under organic production (108,610 ha), followed by Slovenia (52,078 ha), Serbia (19,317

ha), Montenegro (4,823 ha), North Macedonia (3,727 ha) and Bosnia & Herzegovina (1,692 ha), while the largest exporter was Serbia (15,847 MT), Table 2, Pictures 1 and 2. Numbers of organic producers amounted to Croatia (5,153), Slovenia (3,685), Serbia (439), Montenegro (423), North Macedonia (863) and Bosnia & Herzegovina (86), Table 2.

By continents, Oceania had the highest share of the total areas (47.92%), followed by Europe (22.82%), South America (13.27%), Asia (8.20%), North America (4.99%), and Africa (2.78%), while the EU is an important producer with a share of 19.84% (Zejak et al., 2022). In 2000, this type of agricultural production covered an area of 14.98 million ha worldwide. The largest areas were in Europe (4.58 mill. ha) and North America (4.58 mill. ha), followed by Oceania (3.92 mill. ha) and South America (3.81 mill. ha) – which is 15% of its arable land. Europe produces ¼ of the global organic production, and in 2010-2020, organic production areas increased by 70.49%. During the same period, a significant increase in such areas took place in Africa (94.65%), followed by the EU (83.69%), Latin America (18.80%), Asia (1.50%), while the decline in the areas was noted in North America (-1.68%). The areas under organic production in the world grew by 104.33%, but the areas remain small compared to the total global plant production and amount to 74.93 mill. ha in 2020, which is 1.5% of the total area (Zejak et al., 2022).

Organic agricultural production today is set as one of the priorities for the development of agriculture. The SWOT analysis is a sound tool and can also be very useful in a slightly less formal strategy formulation, Table 3.

Table 3. *The SWOT analysis of organic production*

Strengths	Opportunities	Weaknesses	Threats
Health safe product	Increased demand	Little subsidies from the state	Insufficient education of producers
Large supply organic product	Producers have higher income	More investments	Change in legislation
Market Position and incentives	Customer satisfaction	Small farms	Fuel price growth
Growing production.	Preservation human health.	Large workforce	Economic recession
Customer base	Market growth	Insufficient product supply	Insufficient market capacity
Organic brand recognition	Use of European funds	Small farms	Natural disasters

Source: Ikanović & Popović 2020; Zejak et al., 2022.

Figure 1. *Organic production area in Croatia, Slovenia, Serbia, Montenegro, North Macedonia and Bosnia & Herzegovina in 2020.*

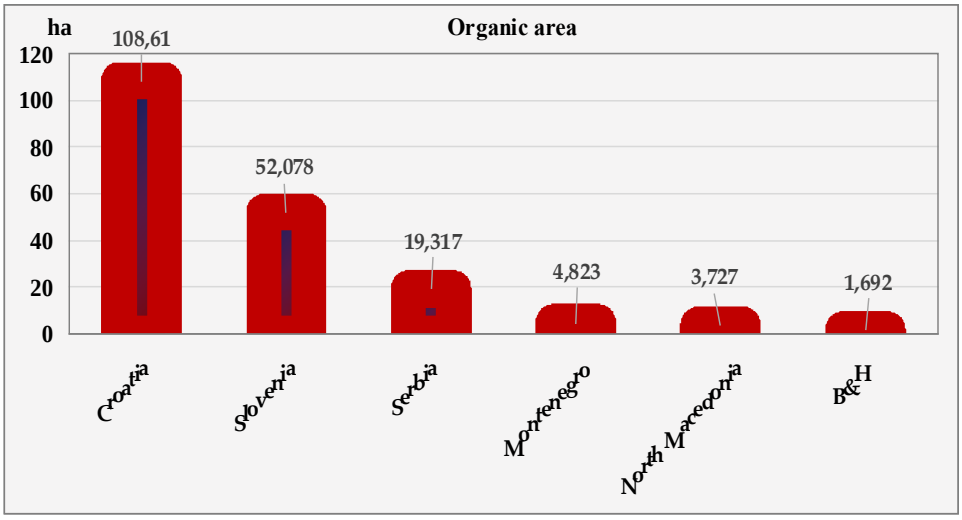
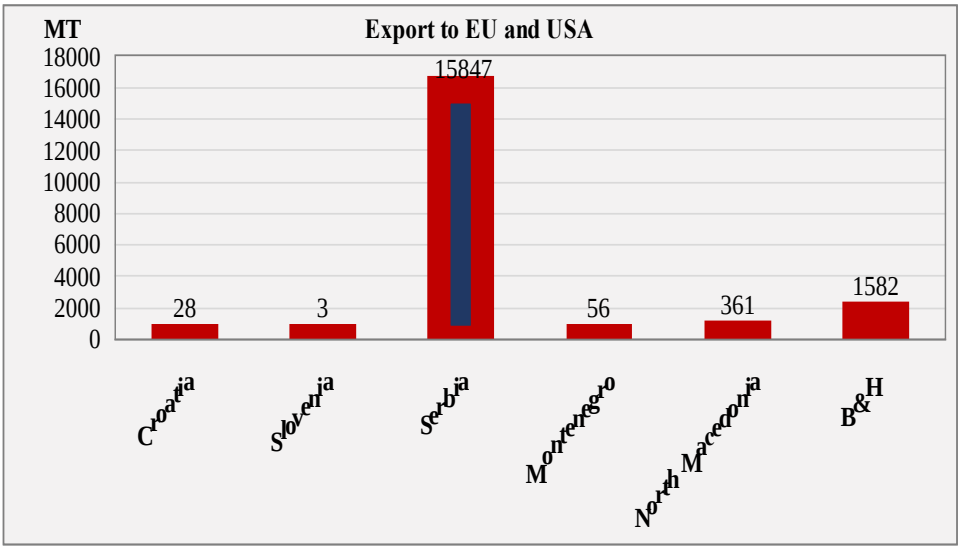


Figure 2. *Export to EU and USA from Croatia, Slovenia, Serbia, Montenegro, North Macedonia and Bosnia & Herzegovina in 2020.*



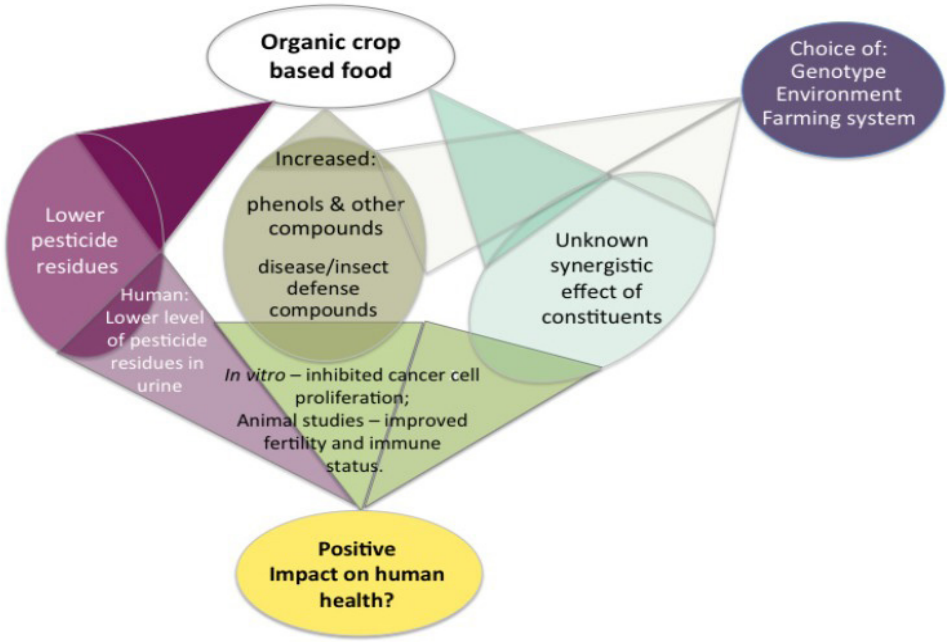
How Organically Produced Crops Contribute to Human Health?

Trought the world an increasing interest for food production in organic agriculture is seen and one key reason for this interest is the assumption that organic food consumption is beneficial to public health. Consumption of organic food seems to be positive from a public health point of view, and synergic effects between various constituents within the food are likely (Johansson et al., 2017).

Comparing the effects of organic and conventional production systems on chemical properties and phenolic compounds of two tomato types (standard and cherry) it was established that the higher level of bioactive compounds in organically produced tomato fruits compared to conventional ones. Tomato fruits contain a high level of antioxidants such as vitamin C, polyphenols (including flavonoids), and carotenoids (such as lycopene and β-carotene). The levels of carotenoids and phenolics are very variable and may be affected by ripeness, genotype and cultivation. Organic tomatoes presented a higher ratio of reducing sugars/organic acids, and contained significantly more total sugars, vitamin C and total flavonoids, 3-quercetin rutinoside, and myricetin in comparison with the conventional fruitage (Hallmann, 2012). Organically produced plant derived food products have a higher nutritional value, including antioxidants than conventional ones. Due to the fact that there is a lower level of contamination in organic crops, the risk of diseases caused by contaminated food is significantly reduced (Györéné et al., 2006).

The reasons for an eventual positive effect of consumption of food based on organic crop on public health are summarized in Figure 3.

Figure 3. *Proof of concept for interaction of different factors resulting in a possible positive impact on human health by organic crop based food.*



Source: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4025038/

Organic crops contain a significantly higher amount of certain antioxidants (vitamin C, polyphenols and flavonoids) and minerals, as well as have higher dry matter content than conventional ones. The products also have a lower level of pesticide residues, nitrate and some heavy metal (Györéné et al., 2006). The consumption of organic food, as well as regular and frequent consumption of organic products generally reduces the risk of overweight and obesity, both for women and men, as well as non-Hodgkin lymphoma in case of woman. Consumption of organic fruits and vegetables, as well as dairy products significantly reduces the risk of pre-eclampsia in pregnancy and eczema in infants. Positive effect on selected health problems probably results from a reduced amount of pesticide residues and an increased secondary plant metabolites intake which characterize organic food (Glibowski, 2020).

The uses of pesticides will increase the incidence of assorted cancers and therefore the risk of Parkinson unwellness [2].

Differences in the composition between organic and conventional crops are limited, such as a modestly higher content of phenolic compounds in organic fruit and vegetables, and likely also a lower content of cadmium in organic cereal crops. Organic dairy products, and perhaps also meats, have a higher content of omega-3 fatty acids compared to conventional products (Mie et al., 2017).

Besides the impact on public health through possible positive effects of consumption of organic food, public health might also be influenced through organic cultivation, for it effects the environment. The low amounts of pesticide residues and heavy metals reported in organically produced crops might be one part of bases for an anticancer effect of organic food (Johansson et al., 2014). Organic agricultures produce are good safety food system compared to conventional agriculture and lower impacts on the human, soil and atmosphere.

Conclusion

Agriculture have to find sustainable solutions to problem reduction of malnutrition with micronutrient which are alarming for human existence are needed. Organic production is ways in which plant nutritionists can contribute to preventing it in sustainable way. Organically produced plant derived food products have a higher nutritional value and antioxidants quantity than conventional ones but also a lower level of contamination in organic crops, which is why the risk of diseases caused by contaminated food is significantly reduced. That way produced plant foods will provide most of the nutrients that feed the developing world and will enable a healthy life for the human population.

Organic farming practices are designed to meet the following goals: Improve soil and water quality; Cut pollution; Provide safe, healthy places for farm animals (livestock) to live;

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Literature

1. Benbrook C., Zhao X., Yáñez J., Davies N., Andrews P. (2013): New Evidence Confirms the Nutritional Superiority of Plant-based Organic Foods. Available online: http://www.organic-center.org
2. Filipović V, Popović V, Ugrenović V, Popović S, Plećaš M, Raičević J, Terzić D (2021): Preparations based on medicinal plants usable in urban agriculture. 25th International Eco–Conference: 14th Environmental protection of urban and suburban settlements, Ecological movement of Novi Sad, Serbia, 22-24.9.2021. 344-351.
3. Glibowski P. 2020; Organic food and health. Rocz Panstw Zakl Hig. 71(2):131-136. doi: 10.32394/rpzh.2020.0110. PMID: 32519524.
4. Györéné KG, Varga A, Lugasi A. (2006): Az ökológiai (bio) és konvencionális termesztésu növényi élelmiszerek beltartalmának, táplálkozási értékének összehasonlítása [A comparison of chemical composition and nutritional value of organically and conventionally grown plant derived foods]. Orv Hetil. 2006 Oct 29; 147(43):2081-90. Hungarian. PMID: 17297755.
5. Hallmann E. (2012): The influence of organic and conventional cultivation systems on the nutritional value and content of bioactive compounds in selected tomato types. J Sci Food Agric. 92(14):2840-8. doi: 10.1002/jsfa.5617. Epub 2012 Feb 20. PMID: 22351383.
6. Hussain A., Larsson H., Kuktaite R., Johansson E. (2010): Mineral composition of organically grown wheat genotypes: Contribution to daily minerals intake. *Int. J. Environ. Res. Public Health.* **7**:3442–3456. doi: 10.3390/ijerph7093442.
7. Hussain A., Larsson H., Olsson M.E., Kuktaite R., Grausgruber H., Johansson E. (2012): Is organically produced wheat a source of tocopherols and tocotrienols for health food? *Food Chem.* 132:1789–1795. doi: 10.1016/j.foodchem.2011.11.141.
8. IFOAM Annual Report (2007): International Federation of Organic Agriculture Movements (IFOAM) *IFOAM International Federation of Organic Agriculture Annual Report 2007.* International Federation of Organic Agriculture Movements; Bonn, Germany: 2007.

9. Ikanović J., Popović V. (2020): Organic plant production. Book. Faculty of Agriculture, Bijeljina, pp. 1-230.

10. Johansson E, Hussain A, Kuktaite R, Andersson SC, Olsson ME. (2014): Contribution of organically grown crops to human health. Int J Environ Res Public Health. doi: 10.3390/ijerph110403870. 11 (4):3870-93. https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4025038/

11. Lotter D. (2003): Organic agriculture. *J. Sustainable Agr.* **21**:59–128. doi: 10.1300/J064v21n04_06.

12. Mie A, Andersen HR, Gunnarsson S, Kahl J, Kesse-Guyot E, Rembiałkowska E, Quaglio G, Grandjean P. (2017): Human health implications of organic food and organic agriculture: a comprehensive review. Environ Health. Oct 27; 16(1):111. doi: 10.1186/s12940-017-0315-4. PMID: 29073935; PMCID: PMC5658984.

13. Popović V,Vidić M, Tatić M, Zdjelar G, Glamočlija Đ, Dozet G, Kostić M. (2012a). Influence of foliar nutrition on yield and quality of soybeans produced in organic production.Journal of Institute of PKB Agroekonomik, Belgrade, 18(1-2): 61-70.

14. Popović V, Sikora V, Glamočlija Đ, Červenski J, Vasić M, Gvozdanović Varga J, Maksimović L. (2012b). Effect of soil conditioner on yield and quality of organic soybean, III International Simposium Agrosym, 15-17.11.2012. Jahorina, 435-441. *DOI. 10.7251/AGSY1203435P*

15. Popovic V, Sikora V, Glamočlija Đ, Ikanović J, Filipović V, Tabaković M, Simić D (2013a): Influence of agro-ecological conditions and foliar fertilization on yield and yield components of buckwheat in conventional and organic cropping system. Biotechnology in Animal Husbandry,*29*, 3, 537-546, *https://doi.org/10.2298/BAH1303537P*

16. Popović V, Sikora V, Adamović D, Glamočlija Đ, Rajičić V, Ikanović J. (2013b): Influence of foliar fertilization on buckwheat yield and quality in organic cultivation system. Bulletin for Alternative Plant Species, 45(86): 55–58.

17. Popović V, Sikora V, Simić D, Zivanović Lj, Ugrenović V, Filipović V, Zejak D (2014): Effect of foliar fertilization on buckwheat productivity (*Fagorypum esculentum* Moench) in organic farming system. Journal of Institute of PKB Agroekonomik, 20 (1-2): 83-92.

18. Popović V (2015): The concept, classification and importance of biological resources in agriculture. (Ed) Milovanovic J, Đorđević S: Conservation and enhancement of biological resources in the service of ecoremediation. Monograph. Belgrade. 29-51. pp. 1-407.

19. Popović S, Grublješić Ž, Popović V, Filipović V (2017): Ecological and Economic Importance of Mulching Within the Urban Areas of Large Cities of the Republic of Serbia. New York, Biomed J Sci&Tech Res., 1(6): 1-4. https://doi.org/10.26717/BJSTR.2017.01.000503.

20. Popović V, Jovović Z, Mirecki N, Lakić Ž (2019): Organic production trend. *Book*. Ed. Filipovic, Ugrenovic. Organic production and biodiversity. Open days of biodiversity, Pančevo, pp. 3-32.

21. Popović D, Vitomir J, Jokić M, Arnautović I, Vrhovac D, Barović N, Vujinović K, Popović S (2020a): Implementation of internal audit in companies intending to operate on the principles of green economy in the Republic of Serbia. Agriculture and Forestry 66(2):93-98. https://doi.org/10.17707/AgricultForest.66.2.09

22. Popović V., Ljubičić N., Kostić M., Radulović M., Blagojević D., Ugrenović V., Popović D., Ivosević B. (2020b). Genotype x Environment Interaction for Wheat Yield Traits Suitable for Selection in Different Seed Priming Conditions. Plants-Basel. 9(12): 1804.

23. Popović D, Vitomir J, Tomaš-Miskin S, Davidov T, Popović S, Jovanović M, Aćimić Remiković M, Jovanović S (2021). Implementation of internal control with reference to the application of "IT" in companies operating on the principles of the green economy. Agriculture & Forestry 67(2):257-266. https://doi.org/10.17707/AgricultForest.67.2.19

24. Stevanovic A, Šarčević-Todosijević Lj, Bošković J, Popović V, Živanović Lj. (2019). Organic production, genetically modified organisms and biodiversity conservation - leading challenges in environmental protection. Scientific conference: Sustainable primary agricultural production in Serbia-state, opportunities, limitations and opportunities. BačkaTopola, pp.95-102.

25. USDA *Report* 1980. United States Department of Agriculture –USDA *Report and Recommendations on Organic Farming*. United States Department of Agriculture; Washington, DC, USA: 1980.

26. Welch, R.M. (2002). The impact of mineral nutrients in food crops on global human health. Plant and Soil. 247, 83–90. https://doi.org/10.1023/A:1021140122921

27. Zejak D., Popovic V.,Spalević V., Popovic D., Radojevic V., Sezai Ercisli, Glišić I. (2022): State and Economical Benefit of Organic Production: Fields Crops and Fruits in the World and Montenegro" Notulae Botanicae Horti Agrobotanici Cluj-Napoca. DOI: 10.15835/nbha50312815, 50, 3, 12815.

WOMEN'S ENTREPRENEURSHIP IN THE FUNCTION OF AGRICULTURAL DEVELOPMENT

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Abstract

The development of female entrepreneurship is one of the prerequisites for accelerated economic development in any economy. Due to the multiple role of women in agricultural production, female entrepreneurship in this activity is particularly significant. European agriculture and Serbian agriculture, in terms of female entrepreneurship, have similar characteristics. A small number of women are property owners and farmers, in Serbia - 19.5%, in the EU - 17%. In Serbia, women are mostly owners and managers of small family farms, and with the increase in the area of used agricultural land, their participation decreases. In the EU, it is the opposite, as almost 40% of women manage large farms (over 100 ha). The age structure of women in agriculture is very unfavorable. Less than 10% of female managers are under the age of 35, and almost ¼ of women in the EU are over 65. while in Serbia, the average age of female owners of agricultural holdings is 65 years. This indicates the necessity of measures to support and empower women's entrepreneurship in agriculture, and the benefits would be multiple.

Key words: *female entrepreneurship, agriculture, women managers*

Introduction

Entrepreneurship in general is the driver of both economic and overall social development of a country. In this sense, female entrepreneurship,economic

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empowerment of women and creation of equal opportunities for women and men in business are not only issues of gender equality, but are one of the basic prerequisites for accelerated economic development. The male part of the population mostly opts for business and entrepreneurship, so the dominance of male entrepreneurship is visible not only in underdeveloped and developing countries, but also in developed and rich economies. Specific characteristics of women - that they do not take unnecessary risks, that female leadership makes business more democratic, that they are more decisive, ambitious and long-term oriented, and as their access to finance is limited, they do more with less (Alesina et al. 2013) - they contribute to the fact that women-led businesses do much better than those headed by men, generate more revenue and create more jobs than those owned by men, the results are a study from 2018, which analyzed data from the US Census Bureau, Dow Jones and Harvard Business Review.

The number of women in management positions in Serbia is around 30%. Also, about 30% are women entrepreneurs, significantly more in urban areas than in rural areas, and the largest numbers of businesses started by women are micro-enterprises - up to 10 employees. (National strategy for gender equality).

Women in Serbia are more educated, but work in less paid jobs, it is harder for them to find a job, on average they have lower wages and pensions, they mainly deal with women's activities (personal services, tourism, catering, trade), female entrepreneurs mainly employ women, and they are much more engaged in unpaid jobs than men (with chores at home).

The agricultural sector in Serbia contributes significantly to the GDP (about 16%), and as the role of women is multiple both in crop and livestock production, agriculture is increasingly focused on women. The agricultural sector employs 80% of economically active women. This includes 33% of the agricultural workforce and 48% of self-employed farmers. (www.agromedia.rs)

In rural areas, opportunities for work are limited, women are not financially and socially independent, they have limited access to income and property, and they usually do not make any decisions on agricultural production. Houses in which women live in the countryside are owned by men in 88% of cases, they do not own land in 84% of cases and they almost do not own means for agricultural production. They mostly work as unpaid helping members of agricultural holdings, without health and pension insurance. A total of 12% of women do not have health insurance, and over 60% of women are not covered by pension insurance,

which is even more unfavorable for women in the status of support members of the household - even 93% do not pay pension insurance (National Strategy for Gender Equality). Because of this, they are exposed to a greater risk of poverty, and agriculture provides an opportunity to overcome these differences, to free women from these restrictions and ensure their existence. Women's dissatisfaction with the social status in the countryside and their subordinate position in relation to the opposite sex increases their interest in starting their own agribusiness and readiness for additional education. (Cvijanović et al., 2011).

About 8% of women farmers in the world do not have ownership rights over land, which is why women farmers cannot turn to banks for loans. Only 13% of women own agricultural land in Europe (www.agromedia.rs). Research by the Food and Agriculture Organization shows that equal access to productive resources for women and men could increase agricultural production by 2.5-4% in developing countries.

These unfavorable statistical data speak of the need to invest in the creation of systemic changes and the promotion of female entrepreneurship, greater support for female entrepreneurship, for women in rural areas, reducing discrimination on the labor market and during employment, encouraging dialogue about the importance of economic empowerment of women and the exchange of knowledge and information among women, and the benefits would be visible both at the level of individual companies and at the level of national economies.

Labor force and women in agriculture in Serbia

Human capital affects the development of the national economy by acting on production (through employment, activity, economic activity and inactivity) and consumption (through gender and age structure). In the Republic of Serbia, as well as in Europe, demographic aging is pronounced, with a tendency to age in the coming years as well. The age structure of the population is deteriorating, the supply of labor force is decreasing, the relationship between the economically active and economically inactive population is unfavorable, the health and pension systems are additionally burdened, which has a negative effect on the overall economic growth. (Babić et al., 2020)

The relationship between employment and unemployment, activity and inactivity, between urban and rural areas is also unfavorable. Higher rates of activity and employment, and lower rates of unemployment and inactivity are characteristic of urban areas. The increase in the level of activity and

employment in rural areas is often characterized by low productivity, limited opportunities to exercise social rights based on work and high hidden unemployment. Regarding activity and employment, a significant generational gap is visible, as the level of activity and employment of women and young people is significantly lower than the average of the total population. Women's activity and employment rates are significantly lower than men's (45.4% vs. 61.8% for the activity rate and 38.1% vs. 52.8% for the employment rate), while the inactivity rate is significantly higher (54.6% vs. 38.2%). Significant employment in rural areas is made up of employees as helping members of the household, and the largest share in this category is among rural women - more than 1/5 of employed women in rural areas are employed as helping members of the household. (RZS, 2018)

Table 1. *Number of family agricultural farms, owners of farms by gender and their average age in years of life, by region, 2012 and 2018.*

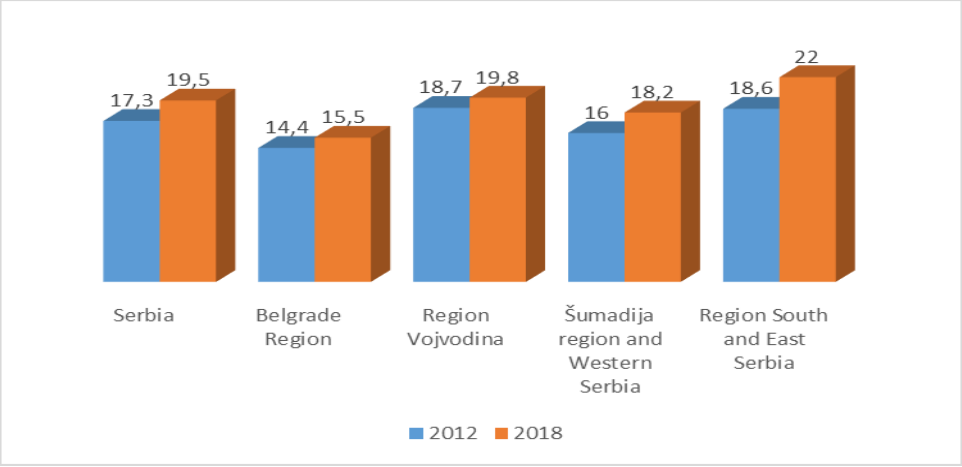
Year	Indicator	Serbia	Belgrade Region	Region Vojvodina	Šumadija region and Western Serbia	Region South and East Serbia
2012.	Number PPG	631.552	33.244	147.624	262.940	187.744
	Male	531.384	28.767	122.434	223.914	156.269
	Age	58	59	55	59	60
	Female	100.168	4.477	25.190	39.026	31.475
	Age	63	62	59	65	65
2018.	Number PPG	564.541	30.033	127.070	242.363	164.802
	Male	454.456	25.378	101.910	198.253	128.326
	Age	60	61	57	61	62
	Female	110.085	4.655	25.160	44.110	36.476
	Age	65	64	60	66	66

Source: RZS, Census of Agriculture 2012 and Survey on the structure of agricultural holdings, 2018.

Agricultural production in Serbia is almost entirely organized on family farms - 99.7%, while only 0.3% of agricultural production is organized by legal entities and entrepreneurs. The number of family agricultural farms in the observed period (2012-2018) tends to decrease, from 631,552 family agricultural farms in 2012 to 564,541 family agricultural farms in 2018, which is a decrease of 10.6%. The decline in the number of family farms is recorded in all observed regions in the Republic of Serbia, which is shown in the previous table.

Table 1 also shows the number of men and women holding family farms in the observed six-year period. We can see that men are dominant - holders of family agricultural farms in all regions, but there is also a visible tendency of increasing participation of women - holders of agricultural farms in 2018, compared to 2012, in all observed regions, and the most pronounced increase is in the region of southern and eastern Serbia, which is shown in graph 1.

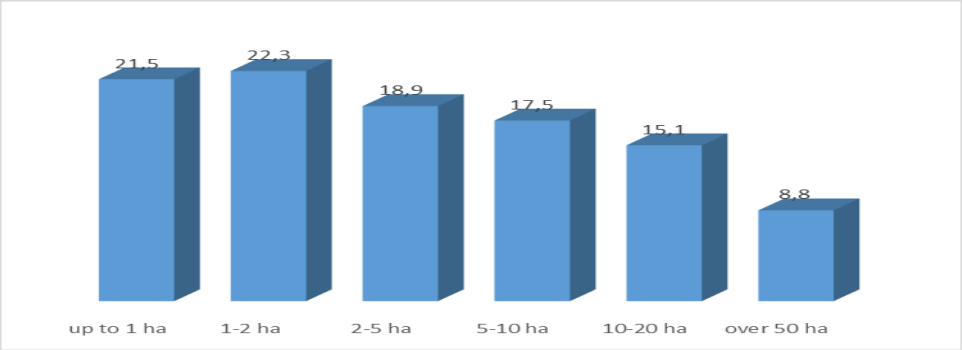
Graph 1. *Participation of women - owners of agricultural farms, 2012 and 2018*



Source: RZS, Census of Agriculture 2012 and Survey on the structure of agricultural holdings, 2018

As already mentioned, women entrepreneurs mostly start small and micro businesses. It is the same in agriculture. Although women make up the majority of the family workforce on farms of all sizes, they are mostly the holders of small farms, and with the increase in the area of used agricultural land, their participation decreases. (chart 2.)

Graph 2. *Participation of women - owners agricultural farms according to land size, 2018.*



Source: RZS, Census of Agriculture 2012 and Survey on the structure of agricultural holdings, 2018.

The tendency of the increase of the old population in the total population of Serbia has an impact on agriculture as well. The average age of owners of family farms (table 1) indicates a particularly high participation of farms whose owners are over 65 years old, especially in the Region of Eastern and Southern Serbia, and especially in the category of women - owners of family farms. Support in strengthening the position of women in agriculture is provided by the European pre-accession fund IPARD, through three accredited measures in Serbia: (www.ipard.co.rs, www.minpolj.gov.rs)

- Investments in physical property (equipment) of agricultural farms - women are allowed grants - up to 60% of the investment,
- Investments in the processing and marketing of agricultural products - in the area of wine production and processing of milk, meat, fruit and vegetables and eggs - women can achieve support in the amount of 50%,
- Diversification of agricultural holdings and development of rural tourism.

Women - farm managers in European Union countries

The number of women in agriculture in the European Union has been slowly increasing in recent years. Eurostat data for 2020 show that, on average, more than 17% of the EU is managed by women. However, there are significant differences between countries, from over 30% of female managers in the Netherlands to less than 10% in Denmark and Germany.

The fact that in the observed European economies, in the observed period, an increase in the participation of women in management positions, except in France and Slovakia, where a slight decline was recorded. A slight decrease in the number of managers is also noted in these economies. The opposite is happening in Greece - the total number of managers decreased by 37%, but the number of female managers increased by more than 10%.

Table 2. *Participation of women managers on farms in selected EU countries, 2016 and 2020, in millions*

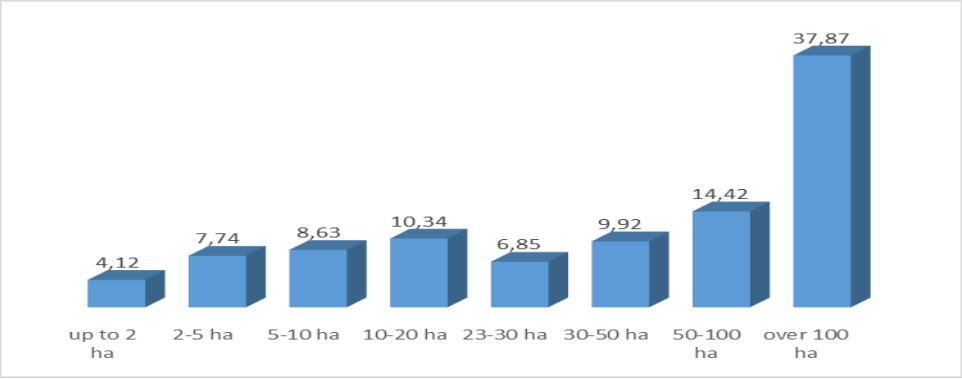
Country	Total number of managers		Number of female managers		% of female managers	
	2016.	2020.	2016.	2020.	2016.	2020.
EU-27	154,321	155,106	21,801	27,063	14,12	17,44
Belgium	1,354	1,368	0,158	0,164	11,67	11,98
Bulgaria	4,491	4,564	0,682	0,957	13,98	20,97
Czech Republic	3,455	3,492	0,224	0,463	6,48	13,26
Denmark	2,614	2,629	0,098	0,147	3,75	5,60
Germany	16,715	16,578	1,209	1,296	7,23	7,82
Greece	4,553	2,824	0,607	0,676	13,33	23,96
Spain	23,229	23,913	3,257	4,674	14,02	19,54
France	27,814	27,364	3,577	3,476	12,86	12,70
Italy	12,598	12,053	2,735	2,740	21,70	22,73
Hungary	4,670	4,921	0,757	0,845	16,20	17,17
Netherlands	1,796	1,817	0,534	0,609	29,73	33,51
Poland	14,405	14,750	2,485	4,055	17,25	27,50
Portugal	3,641	3,963	0,575	0,773	15,8	19,50
Slovenia	0,488	0,483	0,072	0,098	14,75	20,30
Slovakia	1,889	1,862	0,199	0,174	10,53	9,30

Source: Eurostat

European agriculture in general is dominated by an older population, and it is the same when it comes to female farmers - only 4.2% of female farmers are under the age of 35, and 42% of women working in agriculture are over 65, as opposed to only 29.2% of men (www.ec.europa.eu)

If we look at the size of arable land owned by the farm and the age of female managers, we will see that over 1/3 of women manage large farms (over 100 ha), and that almost ¾ of female managers are over 45 years old. There are very few young women managers - under 35, below 10%.

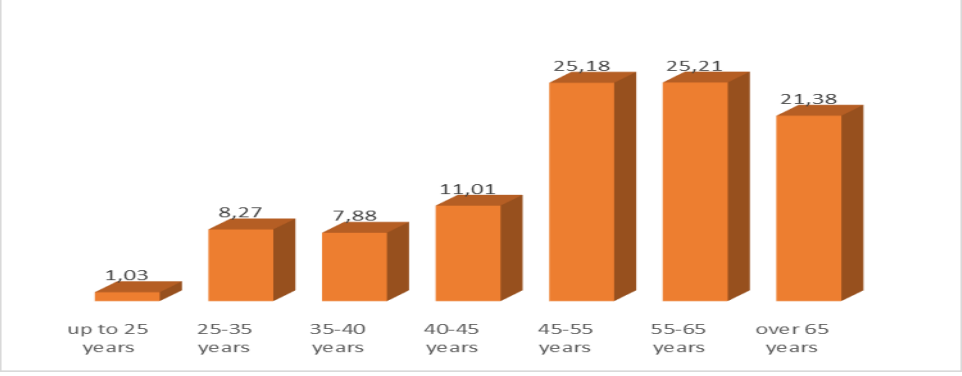
Graph 3. *Participation of female manager on EU farm, by size, 2020*



Source: Eurostat

Through various programs, the European Union supports young women who are interested in working in agriculture, helping them develop their individual rural development programs (investment in equipment and machinery, leasing land for organic production). The goal is not only to maintain gender balance, but to make rural areas competitive and desirable places to live for future generations.

Graph 4. *Participation of female managers on EU farms, by age, 2020.*



Source: Eurostat.

Empowerment of women is a complex and multidimensional concept, with an extremely important role in reducing poverty. Gender equality measures do not address issues that are important to women in agriculture. The Women's Empowerment in Agriculture Index (WEAI) measures the empowerment, action and inclusion of women in the agricultural sector and can be used to

assess the state of empowerment and gender parity in agriculture. This index consists of two sub-indexes. The first assesses the degree to which women are empowered in five domains in agriculture: (1) decisions about agricultural production, (2) access to and decision-making power over productive resources, (3) control over the use of income, (4) community leadership, and (5) distribution of time. The second sub-index (Gender Parity Index - GPI) reflects the percentage of women who are empowered or whose achievements are at least as high as the achievements of men in their households. (Alkire et al., 2013) The result of the WEAI index shows that women are disenfranchised in almost all areas, but men in agriculture generally have an advantage over women. The agricultural sector is basically a traditional (conservative) part of the economy. There is a great need to improve the empowerment of women engaged in agriculture, both at the local, regional and national levels. (Amber and Fakhar, 2019).

Conclusion

Although women make up 43% of the total workforce in agriculture, they face various forms of discrimination - ownership of land and livestock, equal wages, participation in decision-making bodies and access to credit and financial services. (www.fao.org) The current situation in the sector of small and medium-sized agricultural enterprises indicates the need for greater state financial support, free training that would enable better utilization of natural resources and support production based on modern ecological principles, as well as more significant support for the development of agricultural cooperatives, so that the needs can be more easily understood and problems of farmers and to provide them with adequate assistance based on that. (Pantić and Filimonović, 2013) In the EU, for female entrepreneurs from countries with modest and moderate rates of innovation (Bulgaria, Croatia, Cyprus, Czech Republic, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Portugal, Spain and Turkey) there is an entrepreneurial program for creating business solutions for specific challenges in agricultural production and food production. Programs are intended for women regardless of age, family situation and work experience. It only takes ideas and the will to acquire the necessary knowledge and confidence to start and develop a sustainable business. (www.eitfood.eu) All these programs, as well as instruments of state support, aim at more efficient use of the development potential of agriculture at all levels.

Literature

1. Alesina, A.F., Lotti, F., Mistrulli, P.E. (2013) "Do Women Pay More For Credit? Evidence From Italy", Journal of the European Economic Association, Vol. 11, pp. 45-66.
2. Alkire, S., Meinzen-Dick, R., Peterman, A., Quisumbing, A., Seymour, G., Vaz, A. (2013) The Women's Empowerment in Agriculture Index, OPHI working paper no. 58., ISSN 2040-8188 ISBN 978-1-907194-45-0
3. https://www.ophi.org.uk/wp-content/uploads/ophi-wp-58.pdf
4. Amber, Z., Fakhar, S. (2019) Women's Empowerment in Agriculture, International Journal of Advance Study and Research Work (2581-5997)/ Volume 2/Issue 5/May2019, DOI: 10.5281/zenodo.32192
5. https://www.researchgate.net/publication/341671768 Women's Empowerment in Agriculture
6. Babić V., Petrović M., Stanković Dj. Lj. & Kezić M. (2020) "Economic Structure Of The Population Of The Rasina District With The Specific Reference To The Employment In Agriculture", SJGS - Serbian Journal of Geosciences, Vol. 6 (2020) No. 1, Article 3 (p. 23-31), University of Nis, Faculty of Sciences and Mathematics, Department of Geography, ISSN 2466-3581, ISSN 2466-3549, COBISS.SR-ID 220219916 https://doi.org/10.18485/srbjgeosci.2020.6.1.3
7. Cvijanović, J. M., Vojnović, B., & Lazić, J. (2011). Research on women's interest in entrepreneurship in agribusiness. Agricultural Economics, 58(1), 67-79.
8. National strategy for gender equality for the period from 2016 to 2020 with the Action Plan for the period from 2016 to 2018 (Official Gazette of the RS, No. 4/2016)
9. https://www.mgsi.gov.rs/lat/dokumenti/nacionalna-strategija-za-rodnu-ravnopravnost-za-period-od-2016-do-2020-godine-sa-akcionim (25.11.2022.)
10. Pantić, O., Filimonović, D. (2013) Analysis of the development of small andmedium enterprises in the agro-food system of Serbia, Economic Science on the Crossroad, Institute of Economic Sciences, Belgrade
11. AGROMEDIA https://www.agromedia.rs/blog/agrokutak/medjunarodni-dan-zena-uloga-u-poljoprivredi/ (15.11.2022.)

12. IPARD - www.ipard.co.rs
13. EIT Food https://www.eitfood.eu/projects/ewa-empowering-women-in-agrifood-202 2 (20.11.2022.)
14. EUROSTAT - www.ec.europa.eu https://agriculture.ec.europa.eu/news/females-field-2021-03-08_en (18.11.2022.)
15. Main farm indicators by agricultural area, type and economic size of the farm, age and sex of manager/holder and NUTS 2 region[ef_m_farmang
16. https://appsso.eurostat.ec.europa.eu/nui/show.do?dataset=ef_m_farmang&lang=en (17.11.2022)
17. The Food and Agriculture Organization (FAO) – www.fao.org
18. www.fao.org/reduce-rural-poverty/our-work/women-in-agriculture/
19. Republic of Serbia - Ministry of Agriculture, Forestry and Water Management - sector for rural development, annual report on the implementation of ipard and programs for the period from 2018 to 2019- www.minpolj.gov.rs
20. http://uap.gov.rs/wp-content/uploads/2021/01/godishnji-izveshtaj-o-sprovodjenju-ipard-ii-programa-za-period-2018-2019-2.pdf
21. Republic Institute of Statistics (RZS) - www.stat.gov.rs
22. Census of agriculture in 2012 in the Republic of Serbia https://publikacije.stat.gov.rs/G2013/Pdf/G201314001.pdf (20.11.2022.)
23. Farm Structure Survey, 2018 – Structure, economic strength and marketing of farm products https://publikacije.stat.gov.rs/G2019/Pdf/G20196002.pdf (20.11.2022.)
24. Survey on the structure of agricultural holdings, 2018.
25. Labor force and work on agricultural farms - situation and trend https://publikacije.stat.gov.rs/G2019/Pdf/G20196006.pdf (20.11.2022.)

THE INFLUENCE OF NATIONAL PARKS ON SUSTAINABLE RURAL DEVELOPMENT IN THE MEMBER STATES OF THE EUROPEAN UNION

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Abstract

National parks, which are natural areas undisturbed by human exploitation, in addition to preserving biodiversity and scientific development, provide the opportunity to develop tourism, recreation and use of natural resources for the purpose of sustainable rural development of the local community. Rich biodiversity contributes to the development of tourism in national parks, and the ecosystem services it provides make development more sustainable. This overview paper presents several national parks in four EU countries: France (Cévennes), Norway (Brehamen; Rahamen), Hungary (Orseg), Spain (Galicia) and their impact on the sustainable development of rural areas in their immediate vicinity. National parks provide the opportunities for the development of rural tourism, catering, production and sale of food. With the increase in the number of tourists, there is a need for the construction of infrastructure, roads and accommodation facilities in rural areas, and also to educate and train staff from the rural community for jobs in the field of tourism. In addition to the economic importance, it is of exceptional cultural and spiritual importance because by presenting ethnic heritage to visitors, the tradition and culture of the given area is preserved. All the mentioned factors provide the possibility of employment, cessation of population migration from rural areas and economic growth and development, and the experiences of these practices from EU countries are also applicable in the Republic of Serbia.

Key words: *national parks, sustainable development, rural tourism.*

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Introduction

The highest growing branch of tourism in Europe for years has been Natural-Based Tourism (NBT) (Balmford et al. 2009). In this regard, the year 2020 has been declared the year of tourism and rural development by the United Nations World Tourism Organization (UNWTO). The increase in the number of tourists in national parks, nature parks and preserved natural resources located in the rural environment gives the possibility of economic development of rural regions through the development of complementary economic branches in addition to tourism and catering such as, construction, trade and sales, cultural and spiritual exchange, etc. In general, there is a mutually positive dependence between tourism and nature conservation, but there are also negative impacts of intensive tourism on the park itself and its biodiversity, such as the potential urbanization of nature parks due to the intensification of the construction of building facilities, catering facilities, and economic facilities, then the increased number of new residents, potential pollution of the environment due to excessive fluctuation of people, unintended land use (Törn et al. 2007). Therefore, it is necessary to create sub-coordination between the local government, the administration of the national park and the departments of the ministries in order to ensure both nature preservation and economic development. At the EU level, a positive trend of sub-coordination of the mentioned factors has been clearly observed (Kovács et al. 2021). The sustainable development of rural regions in the area of national parks can be encouraged by the development of tourism, but tourism in its classic form is not enough. It is necessary to look at the capacities of the national park and the needs of the local community, in order to provide a tourism development strategy together with complementary economic branches based exclusively on ecological principles in order to preserve nature and biodiversity (Mellon et al. 2016).

The intention of developing sustainable tourism and therefore sustainable development in the regions surrounding national parks is to eliminate the negative trend in rural areas that dates back to 1980s in Europe, which represents the departure of young population, the change in age structure, decline of agricultural production, reduction of economic activities, etc (Agarwal et al. 2009). Through analyzing the potential development opportunities of rural regions, sustainable tourism in the area of national parks emerges as the greatest opportunity. The importance of the protected nature area and its preservation is presented as a central point of sustainable development. Tourism in national parks attracts a certain profile of tourists who are interested in visiting pre-

served natural landscapes in their original state. A large percentage of guests are interested in ecotourism, and also in conservation tourism. (Buckley, R. 2009) In addition to the mentioned aspects, guests can be offered various adventurous content, activities such as hiking, paragliding, rafting, hunting and fishing tourism, etc.

Orseg National Park, Hungary

Orseg National Park is one of ten Hungarian national parks. It is located in the border area of Hungary with Slovenia and Austria. The national park was founded in 2002. During a long historical period, the area of today's Orseg National Park was a relatively economically undeveloped border area. The primary activity of the population was agriculture, dominantly animal husbandry. There was a constant permanent departure of the population, mostly the younger population, to the more developed regions of Hungary. With the accession of Hungary to the European Union, the borders between neighboring Slovenia and Austria were abolished, and thus the benefits that the border settlements had as such disappeared (Csapó, O. 2007).

Population migrations of greater intensity began in the period after the Second World War. The Orsega region had 11,457 inhabitants in 1949, and the number of inhabitants was 5,056 in 2010 https://www.ksh.hu/?lang=en The consequences are a change in the age structure of the population, a decrease in the number of agricultural households, a decrease in agricultural production and economic profits. The primary goal of the establishment of the national park, in ad dition to nature conservation, was the development of sustainable tourism with an aspect of rural tourism, agriculture, and all complementary economic branches that would promote the creation of new jobs, economic growth and reduce the departure of the younger population (Csapó, O. 2007).

A serious environmental problem arose as a result of the change in the structure of employees. The decrease in the percentage of the population engaged in animal husbandry from 70% in 1930 to 11.3% in 2010 drastically reduced the livestock, which resulted in a marked reduction in grazing. Without grazing, pasture degradation occurs, as woody vegetation spreads. The total number of cattle is 908, and the absolute majority of households own between one and three cattle on average. Increasing livestock production is imposed as an imperative in order to maintain the ecological stability of the national park (Csapó, O. 2007).

The development of tourism is significant, especially rural tourism in private accommodation. The number of tourists in private accommodation in 2002 and 2003 was 1,864 and 2,195 guests respectively, and that number in 2009 and 2010 was 7,145 and 6,010 guests respectively, which is three times more in comparison. The number of overnight stays in private accommodation in 2002 and 2003 was 7,832 and 7,039, respectively, and in 2009 and 2010, 21,443 and 21,508 overnight stays were recorded, which is almost three times more. https://www.ksh.hu/?lang=en 17.6% of the population is engaged in tourism in the area, and of that 52.2% rent private accommodation to guests. More than half of the population sees tourism as a distinct possibility for the development of the region (Beluszky P. and Sikos T. 2011).

A positive trend has been recorded in the purchase of houses and rural properties by the settled city population, who want to settle in a naturally healthy environment. The percentage of the immigrated urban population is 29.6%. This group consists of highly educated, well situated people who bring their capital and, in addition to the economic development of the region, influence cultural and technological progress (Baranyai et al. 2012).

The establishment of the national park, in addition to the protection and preservation of nature, also contributed to the growth of the economy, tourism and economy in general. Many projects to support the development of animal husbandry and farming have been successfully implemented under the auspices of the national park. Local farmers are provided with the opportunity of continuous training in order to carry out agricultural production according to ecological and sustainable principles. Ecological tourism is the primary goal of the national park administration, because in this way the beauties of nature unique to the Orsega area are presented. Further plans for the development of national tourism and tourism are the discovery and presentation of new tourist destinations in the region. Organizing organic agriculture and branding local food products would give local agricultural producers the opportunity for further economic progress.

In addition to the study on Orseg National Park, a study (Kovács et al. 2021) was conducted on several national parks in Hungary, with an analysis of biodiversity conservation, tourism development potential, ecology, and economic and cultural progress. Tests found results similar to Orseg National Park. There is a high potential for the development of ecotourism, sustainable rural tourism and thus rural development, but there are also clearly visible short-

comings. A positive trend of continuous growth in the number of guests over the years and the number of overnight stays has been observed. So, for example, In 2011, Koroš Maroš National Park had 16,276 guests, and in 2019, there would be 96,801 guests, which is six times more in comparison (Kovács et al. 2021). As a result, an economic profit was achieved for the local community and the economy. Which gives the possibility of further economic development of the rural region in the area of the national park. The main shortcomings are insufficiently built NBT infrastructure, poor interaction of tourism complementary economic branches, small percentage of foreign guests, small number of "highly attractive" tourist destinations, insufficient sub-coordination between local government, the national park and competent ministries. By using the development funds of the European Union, these shortcomings were partially remedied, but the biggest problem remains insufficiently built infrastructure.

National Parks of Spain

Tourism represents one of the most important economic branches of Spain, according to tourist visits and total earnings from tourism, Spain is in second place in the world ranking list (OMT: Madrid, Spain, 2018). A significant share in the total tourist offer of Spain is represented by 15 national parks of exceptional attraction and great diversity, which is the cause of multi-million guest visits per year (Cordente-Rodríguez et al. 2014). Spain records a trend of annual increase in the number of guests in national parks, from 9.53 million guests in 2012 to 15.44 million guests in 2017 www.miteco.gob.es/es/sistema/includes/errores/404.aspx

The current law governing national parks in Spain has been valid since 2014. The review of the law clearly shows two basic directions of action, the first is the preservation of natural entities and biodiversity, and the second is the economic and social development of the area of national parks. There are a number of factors that influence the sustainable development of the tourist destination and the economic development of rural areas in the area of the national park. The perception of the local rural population about the quality of life and social development in the rural areas of the national park is extremely important, because it affects the retention of residence in the countryside (Kim et al. 2013). The empowerment of the local community significantly affects the development and preservation of the cultural and natural heritage of the village (Olya et al. 2018).

A scientific study (Pérez-Calderón et al. 2020) analyzed the effects of public use of all fifteen Spanish national parks on the development of rural areas and tourism in their immediate surroundings. The aim of this study is to determine the impact of the perception of economic development on the perception of sustainability, social life and quality of life of residents in rural areas in the vicinity of national parks. The study examined the impact of national parks on the economic, social, economic and cultural development of rural areas over a period of ten years. For the purposes of the research, a questionnaire was prepared and sent electronically to local authorities in rural areas. The local authorities of each of the fifteen regions conducted a survey for their population. The research sample consisted of 169 villages located in the immediate vicinity of the economic and social influence of national parks. Answers to the survey were received for 75 of the 169 villages of the initial sample, or for 44.38%.

The results of the survey on the perception of the economic development of the inhabitants of the village are that the economic standard of the population has increased, the offer of tourist services to guests is greater and the number of tourist activities is greater, which in the opinion of the inhabitants has led to an increase in the number of tourists.

The perception of the social development of the inhabitants is that the migration of the population from the village has been prevented and that the tradition and culture of the local community has been preserved, which also represents a significant tourist attraction for visitors. Residents of the village negatively perceive social development from the point of view of behavior and habits of tourists, such as the creation of noise, the amount of waste generated, etc.

When it comes to the quality of life, the perception of the villagers is that the received subsidies resulted in progress in the construction of infrastructure, communication technologies, and efficient consumption of resources, application of environmental standards and overall a significant improvement in the quality of life. The perception of the population's global satisfaction with the impact of the national park was made and the research showed that the residents are satisfied with the created social and economic opportunities, as well as that the establishment of the national park enabled the traditions and customs of the local community to be maintained.

The study analyzed the perception of economic development, social development and quality of life. Looking at the overall results of the effects of public use

of national parks, it is clearly observed that the quality of life is directly conditioned by economic development, and the perception of social development is directly dependent on the quality of life.

National Parks Rheinheimen and Breheimen, Norway

The subject of the study (Hidle, K. 2019) is the examination of the impact of the Rheinheimen and Breheimen national parks in the rural municipality of Skjak, established in 2007 and 2009, on the sustainable development of the region. In the mountainous regions of Norway, a process of reduced population numbers due to economic migration over a longer period of time is characteristic (Arnesen et al., 2010). The same is the case with the mountain municipality of Sjak, whose population in January 2018 was 2,179, compared to 2,612 in 1990 https://www.ssb.no/en. Basic economic activities are forestry, agriculture, hunting and fishing. With the reduction of the number of agricultural products in the period from 1992 to 2015 by 33%. (Skjeggedal et al., 2015). The ownership of agricultural and mountain land and forest in the municipality is the joint property of all agricultural producers who jointly bought the land in 1789 from a private owner and today it is the largest non-state property in Norway

For this reason, opposition to the establishment of national parks was expressed among the population of the municipality of Skjak. Although national parks have been established for many years, there is still strong opposition from part of the population. (Skjeggedal et al., 2015). The situation is changing in a positive sense when it comes to the attitude of the population towards nature conservation, as evidenced by several projects of the local government and individuals aimed at nature conservation and economic development.

According to the Norwegian Law on Nature Conservation, the role of national parks is to protect natural landscapes and biodiversity specific to each region, so that each national park has its own decision-making rules on the conservation of natural resources (Hidle, K. 2019). A change was made by the Norwegian Nature Authority in 2013, with the aim of decentralizing decision-making and a dynamic approach to the management of national parks (Overvåg et al., 2016). The new national park management system in Norway includes a bottom-up system of local governments, regional authorities and relevant ministries. With the fact that there are still disagreements and conflicts between local governments and competent state ministries, despite the intention to achieve quality

cooperation. (Overvåg et al., 2016). The biggest objection to the previous management system was the greater influence of decision-making in the management of national parks by the state, that is, the competent ministry compared to the local government (Overvåg et al., 2016). The new way of managing national parks puts the protection of natural resources and biodiversity in the foreground and the economic development of the local rural community in the background, which caused a negative ratio of the population of the rural areas of the municipal national park. The absence of the possibility of the local rural population to use the resources of the mountain in a traditional way in the sense of engaging in forestry, agriculture and hunting without limiting norms imposed by the protection of natural resources, was a strong argument against the establishment of national parks. The attitude of the local community has changed significantly in a positive sense after the implementation of the Municipal Master Plan for the period 2011-2020. This plan implemented a number of projects of economic, cultural and spiritual importance for the region. Investments were made in local infrastructure, catering and tourist facilities in the municipality of Skjak itself, followed by projects in the conservation of natural resources and raising the awareness of the local population about the importance of national parks both for the local community and beyond. The traditional summer "Skjak Park Festival" has been opened, the purpose of which is to promote the tourist offer of national parks and attract nature-loving guests.

Through the synergy of the projects of the local government, state institutions and the national park with the aim of simultaneous preservation of natural resources and economic development of the region, positive progress was achieved in their implementation. The main task of implementing the mentioned projects was to prevent the migration of residents from the municipality of Skjak, which still exists, so there is still a need to continue work on projects that would lead to the cessation of emigration of residents and eventually sample the immigration of new residents to the region (Hidle, K. 2019).

Seven National Park, France

The Seven National Park is one of the eight French national parks, located in the southern continental part of France. It represents the Mediterranean agropastoral ecosystem. Due to its exceptional cultural and spiritual heritage and preserved natural landscapes of exceptional beauty, it is on the UNESCO list of world cultural heritage. The rural population of the region is engaged in agriculture, animal husbandry, forestry and beekeeping.

The study (Berriet-Solliec et al. 2018) presents an analysis of the management of the Seven National Park and rural areas in the surrounding area with the aim of achieving economic benefits through the use of public goods and quality ecosystem services aimed at preserving natural resources. As a result of the mutual synergy of the use of ecosystem services and public goods, a new term was defined that represents both of these concepts in one, namely "Environmentally and Socially Beneficial Outcomes - ESBOs" (Dwyer et al., 2016). Presented in a broader sense, the term "Ecological and social benefit" would represent the sustainable management of agroecosystems with the aim of: producing healthy food, sustainable amounts of energy, ensuring and maintaining high quality of water, air and soil, preserving biodiversity and natural landscapes, preserving cultural and spiritual heritage , possibility of recreation and treatment, improvement of rural life. (Maréchal et al. 2016)

During the implementation of the study, interviews were conducted with seven main stakeholders in the region, consisting of representatives of the local government, the national park administration, the association of regional farmers, the association of tourism professionals, the local higher education body and research body, and a decentralized state institution. The survey determined positive and negative factors in relation to ESBOs. Three negative factors were identified: climate change, the impact of the market and the consequences of using CAP funds of the European Union (CAP - The Common Agricultural Policy).

As a result of receiving subsidies from CAP funds, agricultural producers decide to convert natural mountain pastures into arable land. In this way, landscapes of previously preserved nature and soil become subject to the influence of pesticides and mineral fertilizers. Deep plowing has a negative impact on biodiversity, soil, landscape and also leads to the destruction of archeological remains that are characteristic of the national park area, such as old Neolithic graves, low walls from the ancient period, etc. Agricultural producers prefer to opt for agricultural subsidies rather than environmental payments for the preservation of cultural archaeological property on their properties due to the long and complex procedure of obtaining the necessary documentation.

The negative influence of the market economy and CAP funds is particularly evident in animal husbandry. The desire of farmers to make more money is changing the traditional way of herding in the region. Farmers stop taking cattle out for grazing and keep a larger number of cattle in barns, which causes

the spread of shrubby and woody species to part of the abandoned pastures, which leads to a change in the appearance of the natural landscape and thus the potential arrival of large game in areas where they did not live before, and the possibility of disrupting the agroecosystem. Climate change also has a negative impact on animal husbandry due to the frequent occurrence of drought over the years, therefore farmers are not able to provide the necessary amount of grass to feed the livestock. (Gautier, 2017) From the above, it can be seen that agricultural practices have changed in accordance with the impact of climate change and CAP funds.

Two positive factors were determined. The first is the immigration of the population from other parts of France to the area of the national park, and the second positive factor is the Seven National Park itself with its way of acting in practice. Due to the exceptional beauty of nature and good geographical location, there is a positive migration in the region. The arrival of a new population provides the opportunity to develop agriculture, tourism, and hospitality. New residents also bring capital, investment in infrastructure and economic development. The proximity of the big cities, Montpellier, Avignon, Nimes, two hours' drive away on average, provides the possibility of a constant influx of tourists and also the possibility of marketing the authentic products of the region on the market of the mentioned cities. The positive action of the Seven National Park is the preservation of natural resources, cultural and archaeological heritage under the protection of UNESCO and especially the implementation of the policy on sustainable tourism in protected areas.

Conclusion

According to the aforementioned studies, the establishment of national parks contributed to the preservation of protected areas of nature, biodiversity and partial economic progress of the rural regions where they are located. An extremely positive impact on the sustainable development of certain rural regions was made possible by the implementation of the policy on sustainable tourism in the protected area. The continuous growth of the number of tourists in the areas of national parks is a conscious trend. This is clearly confirmed by the particularly presented studies in Spain, France and Hungary. The development of tourism entails investment in the infrastructure of the local community. The European Union countries have the possibility of using funds for the development of rural regions, tourism and protected natural areas. The example of the Orseg National Park in Hungary shows that the use of funds for

the development of tourism has somewhat improved the tourist activity, but since there is no good cooperation between the local government, residents and state authorities on the capacities and possibilities for the implementation of projects, optimal results have not been achieved. In contrast to Hungary, a positive example of completed projects has been achieved in the sustainable development of rural regions of Spain's national parks. Practically, positive results were recorded in all parameters of development due to a good analysis of the situation on the ground, planning and successfully implemented sustainable development projects. There is a noticeable steady growth in the number of guests, higher earnings from tourism and economic progress. Citizens believe that their economic position and quality of life have improved. In this way, the negative migration of the population to other regions was prevented. One of the basic goals of sustainable development in rural regions is the intention to prevent the population from leaving rural areas. In addition to Spain, in the rural area of the French National Park Seven, the emigration of the domestic population has stopped due to economic progress, and there has been an immigration of the population from other parts of France. In contrast to the aforementioned two studies, in the Norwegian National Parks of Rheinheimen and Breheimen and Hungarian Orseg, negative population migrations continued. The reasons are different. With the establishment of the national park, the rural population of the Norwegian municipality of Skjak lost the possibility of traditional use of mountain resources, i.e. engaging in forestry, animal husbandry, hunting and fishing. These possibilities are significantly limited by the national park regulations. The possibility of reduced earnings of the rural population was a strong reason for the opposition of a part of the inhabitants of Skjak to the establishment of the national park, and in the first ten years of the national park, the income from sustainable tourism did not replace the income from the traditional use of mountain resources. Hungarian Orseg is traditionally a relatively poor border area and the development of rural and tourism in the national park is not sufficient to fully enable the economic perspective of all citizens, and negative migration is still present, despite the fact that a certain number of urban residents have permanently moved to the park area eager to live in areas of preserved nature.

Positive experiences of practices from EU countries are valuable because they are applicable in the Republic of Serbia as well. Rich biodiversity contributes significantly to the development of tourism in national parks, and the ecosystem services it provides make development more sustainable.

Literature

1. Agarwal, S.; Rahman, S.; Errington, A. (2009) *Measuring the determinants of relative economic performance of rural areas*. J. Rural Stud., 25, 309–321.
2. Arnesen, T., Overvåg, K., Glørsen, E., Schurman, C., & Riise, Ø. (2010). *Fjellområder og fjellkommuner i Sør-Norge. Definisjon, avgrensing og karakterisering [Mountain areas and mountain communes in South Norway. Definition, delineation and characterisation]. Report, 8*, 2010.
3. Balmford, A.; Beresford, J.; Green, J.; Naidoo, R.; Walpole, M.; Manica, A. (2009) *A Global Perspective on Trends in Nature-Based Tourism*. PLoS Biol., 7, e1000144.
4. Baranyai, O., Baranyai, G., Csapó, T., & Balogh, A. (2012). *Development opportunities in* Őrség *National Park.* Proceedings of University of West Hungary Savaria Campus, Natural Sciences. NYME Kiadó, Szombathely, 71-77.
5. Beluszky, P., & Sikos, TT. (2011). *Változó falvaink. Tizenkét falurajz Kercaszomortól Nyírkarászig*. Akadémia kiadó, Budapest.
6. Berriet-Solliec, M., Lataste, F., Lépicier, D., & Piguet, V. (2018). *Environmentally and socially beneficial outcomes produced by agro-pastoral systems in the Cévennes National Park (France).* Land Use Policy, 78, 739-747.
7. Buckley, R. (2009).*Ecotourism: Principles and Practices*; CABI: Brisbane, Australia
8. Cordente-Rodríguez, M.; Mondejar-Jimenez, J.A.; Villanueva-Alvaro, J.J. (2014). Sustainability of Nature: The Power of the Type of Visitors. E Environ. Mag. 13, 2437–2447.
9. Csapó, O. (2007). *Az* Őrségi *Nemzeti Park falvainak társadalmi-gazdasági helyzete. Csapó T.–Kocsis Zs.(szerk.): A kistelepülések helyzete és településföldrajza Magyarországon.* Savaria University Press, Szombathely, 136-144.
10. Dwyer, Janet C., Short, Christopher J., Berriet-Solliec, M, Gael-Lataste, F, Pham, H-V, Affleck, Melissa, Courtney, Paul and Déprès, C (2015) *Public Goods and Ecosystem Services from Agriculture and Forestry - a conceptual approach.* Project Report. Pegasus - Institute for European Environmental Policy.

11. Gautier, G. (2017). *Influence de la Politique agricole commune sur les pratiques pastorales des Causses et des Cévennes* (Doctoral dissertation, Rapport de thèse professionnelle pour le master PAPDD AgroParisTech. http://draaf. occitanie. agriculture. gouv. fr/IMG/pdf/rapport_gg_version_170703_cle011c56.pdf).

12. Hidle, K. (2019). *How national parks change a rural municipality's development strategies–The Skjåk case, Norway*. *Journal of Rural Studies*, *72*, 174-185.

13. Kim, K.; Uysal, M.; Sirgy, M.J. *How Does Tourism in a Community Impact the Quality of Life of Community Residents?* Tour. Manag. 2013, 36, 527–540.

14. Kovács, A. D., Gulyás, P., & Farkas, J. Z. (2021). *Tourism perspectives in national parks—A Hungarian case study from the aspects of rural development*. Sustainability, *13*(21), 12002.

15. Maréchal, Anne, Baldock, David, Hart, K., Dwyer, C., Short, C., Pérez-Soba, Marta., ... & Polman, N. B. P. (2016). *Synthesis report-The PEGASUS conceptual framework*. EU.

16. Mellon, V.; Bramwell, B. (2016) *Protected area policies and sustainable tourism: Influences, relationships and coevolution*. J. Sustain.Tour., 24, 1369–1386.

17. MITECO. Ministerio Para la Transición Económica. Datos de Visitantes a los Parques Nacionales (1996–2017). Available online: https://www.miteco.gob.es/es/red-parques-nacionales/la-red/gestion/visitasppnn_tcm30- 67283.pdf (accessed on 11 January 2020)

18. Overvåg, K., Skjeggedal, T., & Sandström, C. (2016). *Management of mountain areas in Norway and the persistence of local–national conflicts*. Journal of Environmental Planning and Management, *59*(7), 1186-1204.

19. Organización Mundial de Turismo. *Turismo, Comercio y La OMT [Comunicado de Prensa];* OMT: Madrid, Spain, 2018.

20. Olya, H.G.T.; Alipour, H.; Gavilyan, Y. *Different Voices from Community Groups to Support Sustainable Tourism Development at Iranian World Heritage Sites: Evidence from Bisotun*. J. Sustain. Tour. 2018, 26, 1728–1748.

21. Pérez-Calderón, E., Prieto-Ballester, J. M., Miguel-Barrado, V., & Milanés-Montero, P. (2020). *Perception of sustainability of Spanish national parks: Public use, tourism and rural development*. Sustainability, *12*(4), 1333.

22. Skjeggedal, T., Overvåg, K., & Riseth, J. Å. (2016). *Land-use planning in Norwegian mountain areas: Local development or nature protection?*. European Planning Studies, *24*(2), 344-363.

23. Törn, A.; Siikamäki, P.; Tolvanen, A.; Kauppila, P.; Rämet, J. (2007). *Local people, nature conservation, and tourism in northeastern Finland*. Ecol. Soc., 13, 8.

24. UNWTO. Recommendations on Tourism and Rural Development—*A Guide to Making Tourism an Effective Tool for Rural Development*; World Tourism Organization: Madrid, Spain, 2020.

25. https://www.ksh.hu/?lang=en (Hungarian central statistic office)

26. https://www.ssb.no/en (Statististk sentralbyra, Statistics Norway)

APPLICATION OF BLOCKCHAIN IN EU ORGANIC AGRICULTURE

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Abstract

In recent years Blockchain emerges as a promising technology for agriculture. Blockchain is applied in cryptocurrencies, but in recent years it has also been successfully implemented in the food supply chain. This paper aims to facilitate an understanding of the application of blockchain in organic agriculture. Within the EU where data records in the organic supply chain are in a paper form inaccessible to consumers, there are no uniform data records, etc. These structural shortcomings were the motive for analyzing blockchain as a solution to remove barriers in the supply chain. We rely on intensive literature research, consultations with organic farmers, retail chain representatives, organic products processors, organic certification bodies and experts in the field of production and marketing of organic foodstuff. The results show positive effects of applying blockchain to the organic food supply chain, such as strengthening organic production control systems, increasing consumer trust and reducing administrative and transaction costs.

Key words: *block-chain, digital agriculture, organic agriculture*

Introduction

This paper considers blockchain technology as a tool to improve transparency, traceability, and trust between participants in organic agriculture from producers/processors through to the final consumer, thus leading to the development of the domestic market. Blockchain can be a solution to the structural problems of organic agriculture, removing barriers in the supply chain.

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The most commonly used definition of organic agriculture is from the International Federation of Organic Agriculture Movements: "Organic agriculture is a production system that sustains the health of soils, ecosystems, and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation, and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved" (IFOAM, 2008).

Organic agriculture is increasing; a driving force is increased demand worldwide and in the EU (Kljajić et al., 2013; Kovačević, 2021). Added value products such as organic can significantly contribute to sustainable and profitable EU agriculture (Janković et al., 2018).

The main bottlenecks in EU organic agriculture found within this research are:

- All organic farmers and processors are obliged to keep records on production/processing. Aldo, all organic farming/processing is regulated under a single common EU legal framework - Regulation (EU) 2018/848 of 30 May 2018 on organic production and labelling of organic products, there is no single form for keeping records on production.
- Besides the difference in production record form, there is also a difference in format. Most of the production records are on paper, others in Excel, etc.

Consequences of difference in producers' records are that end consumers are not easily accessing the data on organic foodstuff, administrative costs for organic farmers are higher, consumers are lacking in confidence in organic foodstuff as the paper records on production are much easier to forge, and control system is less effective as the certification bodies and supervising institution are without real-time insight in organic production/processing having an additional effect on consumers mistrust in organic foodstuff and agrarian policy is less effective due to lack of real-time data on organic production. Our main aim is to analyze the effect of Blockchain applications on the above bottlenecks.

Blockchain technology emerged in recent decades as a decentralized digital database used firstly in cryptocurrencies. The 2008 white paper of the pseudonymous author Nakamoto, 'Bitcoin: A Peer-to-Peer Electronic Cash System', established the path for the development of Digital Ledger technologies and cryptocurrencies. Instead of relying on a centralized trusted par-

ty, a Blockchain is a digital transaction ledger, maintained by a network of participants. Individual transaction data files (blocks) are managed in a decentralized manner (Kamilaris et al., 2019). Every blockchain transaction is validated by all network nodes, which keep a collective eye on the blockchain data (Bano et al., 2017).

This research contributes to the literature by shedding light on an under-researched area of Blockchain application in organic agriculture. Also, according to our best knowledge, this is the first research to research the pros and cons of Blockchain application in organic agriculture, as well as to develop a concept for Blockchain application in the EU's organic sector.

Literature review

In recent years, blockchain technology has begun to be used for much more than cryptocurrencies and financial transactions (Tayeb and Lago, 2018). Its application in agriculture is increasing. The most common blockchain architecture in agriculture encompasses the following aspects (Tripoli & Schmidhuber, 2018):

1) Input suppliers as providers of information on the pesticides, fertilizers, and machinery used.
2) Agricultural producers generate information on the farm, farming practices, plant diseases/pests, weather conditions, and animal welfare/breeding.
3) Information on processing plants; i.e., processing methods, equipment, etc.
4) Information on transport and storage conditions.
5) Retailer information, including information on each foodstuff item; i.e., quality and quantity, expiration date, storage information, etc.
6) At the final stage, blockchain allows consumers to have all information associated with the product, from the producer and provider to the retail store, by simply scanning the QR code on the packaging.

One of the first applications of the blockchain in the food supply chain is by Walmart and Kroger. The application of Blockchain in the supply chain is expected to grow by 87% annually (Tribiset al., 2018; Chang et al., 2019). So far, 49 blockchain application initiatives have been identified in food supply chains (Kamilaris et al., 2019).

Blockchain is a promising technology for small farmers. AgriLedger has found an example of blockchain being used to increase trust among small cooperatives in Africa (AgriLedger, 2017). Another positive example is the blockchain B2B platform OlivaCoin, which reduces costs, increases transparency, and provides easier access to markets for the olive oil trade. Davcev et al. (2018) recognize the importance of blockchain in the agri-food chain in improving trust among small farmers and cooperatives, and online marketing and digitalization in the agricultural sector can also improve firms' efficiency (Medina-Viruelet et al., 2015).

According to the United Nations Food and Agriculture Organization (FAO), distributed ledger technologies can transform the global food system by introducing substantial efficiency gains along value chains and improving trust, transparency, and traceability (Tripoli and Schmidhuber, 2018).

To date, blockchain has not been implemented in organic agriculture, although governments worldwide are considering blockchain implementation at the national level. The proposal of the Agricultural Marketing Service of the U.S. Department of Agriculture to use blockchain for organic food supply chain traceability (USDA, 2020) is one of the first initiatives to do so.

According to the FAO, Blockchain has a fivefold effect (Tripoli and Schmidhuber, 2018):

1) A positive impact on food safety, quality, and sustainability.
2) Smart contracts enable secure real-time payments.
3) The transparent data generated in the Blockchain is easily accessible to consumers and other market participants.
4) By providing timely and accurate information, blockchain reduces information asymmetry among supply chain actors.
5) The real-time information and evidence enable better public policy.

According to Van Hilten et al. (2020), blockchain has the potential to improve organic food traceability. An example of Blockchain efficiency was found when tracking a package of mangoes from a retail outlet back to the producers this normally takes six and a half days, but with the Blockchain application, the tracking was instantaneous.

Kamble et al. (2020) investigate the effects of blockchain application in the agricultural supply chain by applying combined Interpretive Structural Modelling and Decision-Making Trial and Evaluation Laboratory methodology to evaluate causality between the blockchain enablers. The results show that traceability is the most significant reason for blockchain implementation in the agricultural supply chain, followed by suitability, immutability, and provenance.

An important positive effect of blockchain application in the food supply chain has also been found in Blockchain's smart contract, digital signature, and authentication, which support businesses through lower costs (Li et al. 2018). A smart contract is a digitized business arrangement, which is triggered automatically when certain criteria are met to validate and verify chain partners (Mistry et al., 2020.)

Material and methods

The methodology applied in this research relies on:

- Intensive literature research;
- Consultations with organic farmers;
- Consultations with retail chain representatives;
- Consultations with organic foodstuff processors;
- Consultations with organic certification bodies and supervising institution representatives;
- Consultations with experts in the field of production and marketing of organic foodstuff.

The main data sources are the Research Institute of Organic Agriculture (FiBL), Frick, and IFOAM Organic International

Discussion

This research has twofold goals, first to evaluate the pros and cons of the Blockchain application in organic agriculture and to develop a concept for the implementation of the Blockchain in EU organic agriculture. SWOT analyses are summarizing Straights, Weaknesses, Opportunities, and Treats in EU's Blockchain application in organic agriculture.

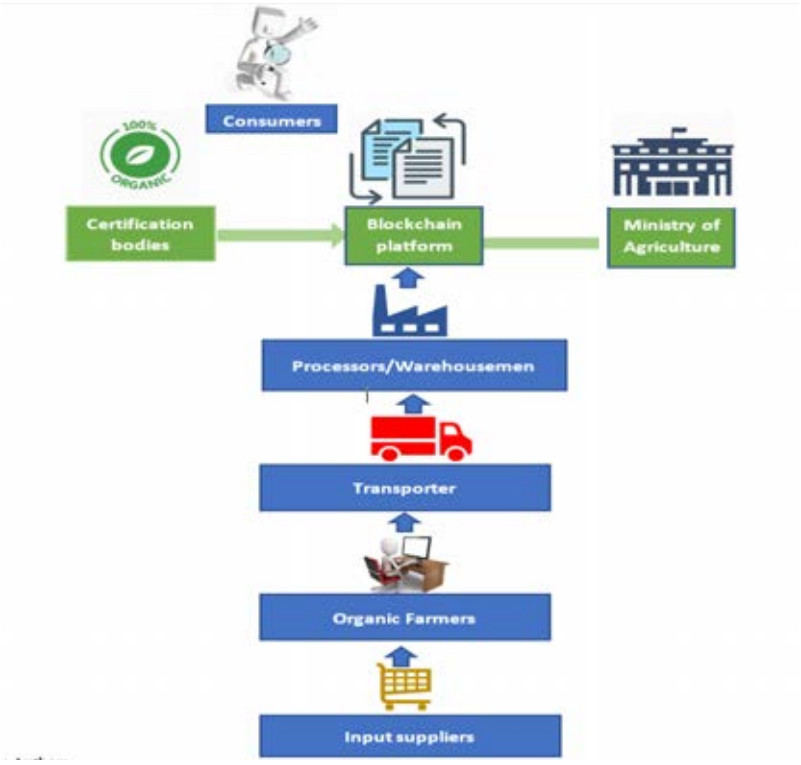
Table 1. *EU' Blockchain application in organic agriculture SWOT analyses*

Strengths	**Weakness**
• Possible positive Blockchain application effect on decreasing of the Organic foodstuff production; • Possible positive Blockchain application effect on transparency improving consumer trust and widening organic foodstuff market; • A positive impact on food safety, quality, and sustainability; • Smart contracts enable secure real-time payments; • The transparent data generated in the blockchain is easily accessible to consumers and other market participants; • Removal of trade barriers for organic foodstuff within EU due to common EU production/processing data records EU will start to "speak in the same language in organic agriculture"; • Improvement in controlling the organic production by real-time data access by certification bodies and supervising institutions. • Improvement in agrarian policy due to the real-time data access in organic production by agrarian policymakers.	• The complicated process for adoption and managing the common EU records on organic production/processing; • Blockchain technology is newly and complicated to introduce. Even if the Blockchain is adopted form part of stakeholders, uniform common EU records on production will have a tremendous effect and different data formats will still be able to use in a single value chain.
Opportunities	**Threats**
• Common EU rules for organic agriculture, Regulation (EU) 2018/848 of 30 May 2018 on organic production and labelling of organic products creates a legal field for introduction of the common EU production ledger in Blockchain; • Demand for organic foodstuff is increasing in the EU by approximately 10% annually.	• Significant use of energy for Blockchain;

Our second aim is to propose a common EU Blockchain concept in organic agriculture. Mail stone is to introduce a single common EU ledger for keeping the records in organic production. Currently, each organic certification body has its own ledger for records of organic production. Also, each organic certification body required a different data format. Our main assumption is as the Regulation (EU) 2018/848 defines common requirements for organic agriculture, it will be possible to introduce unique EU records on common requirements. Joint EU regulation or/and management body governing the common form of records for organic production/processing is foreseen.

Figure 1 presents the flow of blockchain applications in organic agriculture. The blockchain schema in this paper adds two participants to the existing common agriculture blockchains: organic production certification bodies and the institution in charge of organic agriculture supervision (most often the ministries of agriculture).

Figure 1. *The EU' Blockchain concept in organic agriculture*



Source: authors' presentation

The introduction of blockchain to organic agriculture would have a significant effect on both the supply chain and organic agriculture policy. Figure 1 shows how the supervisory institutions can monitor data on the production, processing, transport, and storage of organic products in real-time, thus also enabling evidence-based agricultural policy.

The application of blockchain will provide a unique and reliable digital data record at all stages of production, processing, transport, storage, and marketing of organic products. Customers will be able to get all relevant data on organic products of interest via a digital online platform. Thus, the system will encourage consumer confidence in organic products, which to date has been one of the main obstacles to organic food production. Increased consumer confidence in organic products will lead to increased demand, thus increasing production and leading to improved profitability in organic agriculture.

Conclusion

The new blockchain technology is based on a decentralized digital database, which when applied to the agricultural sector, and to organic agriculture, in particular, can establish trust between stakeholders and consumers through transparency and traceability. This paper is the first to investigate the economic sustainability of blockchain technology in organic agriculture. The pros of Blockchain application within EU organic agriculture are (1) reducing administrative costs, (2) improving sales conditions, (3) expanding the market, (4) improving the supply chain, and (5) improving payment efficiency and security. Blockchain technology could also be used to improve agrarian policy related to organic agriculture, as policymakers would be able to monitor the production, processing, transportation and storage of organic products and conduct evidence-based policies. Research on the economic effects of blockchain technology in organic agriculture should be ongoing.

Literature

1. Bano, S., A. Sonninol; M. Al-Bassam, S. Azouvi1, P. Mccorry, S. Meiklejohn and D. Danezis (2017) *Consensus in the Age of Blockchains*. arXiv preprint arXiv:1711.03936. University College London, United Kingdom, Available at: https://arxiv.org/pdf/1711.03936.pdf

2. Chang, Y., I. Eleftherios and S. Weidong (2019): *Blockchain in global supply chains and cross border trade: a critical synthesis of the state-of-the-art*, challenges and opportunities, International Journal of Production Research, 58(7): 2082-2099, DOI: 10.1080/00207543.2019.1651946

3. Davcev, D., L. Kocarev, A. Carbone, V. Stankovski and K. Mitreski (2018): *Blockchain-based Distributed Cloud/Fog Platform for IoT Supply Chain Management*. Eighth International Conference on Advances in Computing, Electronics and Electrical Technology (CEET), DOI:10.15224/978-1-63248-144-3-37

4. IFOAM (2008): *Organics International, Definition of Organic Agriculture*. Available at: https://www.ifoam.bio/en/organic-landmarks/definition-organic-agriculture

5. Janković, I., Jeločnik, M. and Zubović, J. (2018). *Possibilities for development of commodity exchange in Serbia*, Economics of agriculture 65(4), 1557-1571, DOI:10.5937/ekoPolj1804557J

6. Kamble, S., A. Gunasekaran and R. Sharma (2020): *Modeling the blockchain-enabled traceability in the agriculture supply chain*. International Journal of Information Management. Elsavier, Vol. 52, https://doi.org/10.1016/j.ijinfomgt.2019.05.023

7. Kljajić Nataša, Mijajlović Nada, Arsić Slavica (2013): *Organic production and its role in environmental protection,* Scientific Papers Series ,,Management, Economic Engineering in Agriculture and Rural Development, Volume 13, Issue 3/2013, pp. 17-25.

8. Kovačević Vlado (2021): *Analysis of current state and limiting factors for the development of organic sector in Serbia*, Western Balkan Journal of Agricultural Economics and Rural Development, vol. 3, br. 1, str. 23-33, DOI 10.22004/ag.econ.311335

9. Medina-Viruel M. J., E. Bernal-Jurado, A. Mozas-Moral, E. Moral-Pajares, D. Fernández-Uclés, (2015): *Efficiency of organic farming companies that operate in an online environment*, Custos Gronegócio Online, 11(4): 265–289

10. Mistry, I., S. Tanwar, S. Tyagi and N. Kumar (2020): *Blockchain for 5G-enabled iot for industrial automation: a systematic review, solutions, and challenges*. Mechanical Systems and Signal Processing, ScienceDirect,Vol.135, https://doi.org/10.1016/j.ymssp.2019.10638

11. Nakamoto, S. (2008): *Bitcoin: A peer-to-peer electronic cash system*, Available at: https://bitcoin.org/bitcoin.pdf

12. Regulation (EU) 2018/848 of 30 May 2018 on organic production and labelling of organic products

13. Tayeb, S. and F. C. Lago (2018): *Blockchain technology: between high hopes and challenging implications*, MENA Business Law Review, First quarter No1: 34-44.

14. Tribis, Y., A. El Bouchti and H. Bouayad (2018): *Supply Chain Management based on Blockchain: A Systematic Mapping Study*. MATEC Web of Conferences (EDP Sciences) 200, https://doi.org/10.1051/matecconf/201820000020

15. Tripoli, M. and J. SCHMIDHUBER (2018): *Emerging Opportunities for the Application of Blockchain in the Agri-food Industry*, FAO and ICTSD: Rome and Geneva. Licence: CC BY-NC-7, ISSN 1817-356X, Available at: http://www.fao.org/3/CA1335EN/ca1335en.pdf

16. United States Department of the Agriculture (USDA) 2020. US Department Of Agriculture To Explore Blockchain For Organic Food Traceability. Available at: https://www.ledgerinsights.com/us-department-of-agriculture-usda-blockchain-for-organic-food-traceability/

17. Van Hilten, M., G. Ongena and P. Ravesteijn (2020*): Blockchain for Organic Food Traceability: Case Studies on Drivers and Challenges*, Frontiers in Blockchain, 3:44, https://doi.org/10.3389/fbloc.2020.567175

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