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## KNOWLEDGE TRANSFER ON ORGANIC PRODUCTION FOR SUSTAINABLE AND ECOLOGICAL AGRICULTURE IN SERBIA

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**Abstract:** The transfer of scientific knowledge in the field of organic production is a prerequisite for the development of sustainable and environmentally friendly agriculture, particularly in countries where this type of production is still emerging. This study aims to provide a comprehensive overview of the results of agricultural advisor training in organic production from 2019, as well as the methods used to transfer acquired knowledge from advisors to agricultural producers during the period 2020-2024. The analysis of advisor training data included both quantitative and qualitative indicators, enabling assessment of the scope and dynamics, content and quality of the training, as well as knowledge improvement and evaluation of applicability. The analysis of subsequent knowledge transfer from advisors to producers included quantitative indicators, such as the number of advisory educational activities conducted and the number of participating producers. The results of the advisor training show a high level of participant satisfaction (average score 4.65 out of 5), significant improvement in participants' knowledge (38.38%), and a high level of practical applicability of the training (average score 4.87 out of 5), confirming the relevance of the content and the adequacy of the educational methods used. The results of knowledge transfer from advisors to producers indicate a systematic and diverse approach to training - lectures, workshops, panel discussions, winter schools, and demonstration farms - as well as active producer participation, evidenced by a total of 19,895 participants. Based on the results of the study, it can be concluded that agricultural advisor training has strengthened the capacities of the advisory service and, in a broader context, has enhanced the efficiency of scientific knowledge transfer to producers, representing an important foundation for the long-term development of organic, sustainable, and environmentally friendly agriculture in Serbia.

**Keywords:** Education, Advisors, Producers, Transfer of scientific knowledge, Organic production

### INTRODUCTION

Contemporary challenges in agricultural production highlight the need for transformations aimed at improving sustainable practices, while simultaneously considering the environmental, economic, and social dimensions of sustainability (Boroš et al., 2024). The link between modern agriculture and the sustainability of agricultural systems, based on the smart use of renewable resources and the regeneration of resources, is also emphasized by Kovačević et al. (2020). These authors point to the existence of various agricultural pathways, ranging from conventional production, through integrated systems, to approaches grounded in strictly ecological principles of cultivation, such as organic and biodynamic farming. Long-term experimental research comparing organic and

conventional cropping systems shows that organic approaches reduce the use of pesticides and mineral fertilizers, improve soil health, biodiversity, and nitrogen-use efficiency, while yields can reach up to 85% of those achieved under conventional systems (Krause et al., 2024). Organic production is increasingly recognized as an important instrument for sustainable rural development and ecosystem protection (IFOAM, 2022), and according to Clark (2020), organic farming has experienced remarkable growth in recent decades, driven by increased societal interest in environmental protection and healthy diets.

Globally, the area under organic agriculture has shown continuous growth; however, its share of total agricultural land remains relatively low. Organic agriculture is practiced worldwide in 188 countries on more than 96 million hectares, involving over 4.5 million farmers. These figures clearly demonstrate the growing importance of organic production in the global market (Willer, 2024). Within the framework of the “Farm to Fork” strategy, the European Union has set an ambitious target of at least 25% of agricultural land under organic management by 2030 (European Commission, 2020). In this context, candidate countries, including the Republic of Serbia, face additional challenges related to the adaptation of production systems, institutional support, and the development of knowledge and competencies among all actors in the organic production value chain.

In Serbia, organic agriculture is undergoing gradual development and has shown growth over the past decade (Simić et al., 2025). This sector is regulated by the Law on Organic Production and has been recognized as an important area in both the previous Strategy of Agriculture and Rural Development of the Republic of Serbia (2014-2024) and the Draft Strategy of Agriculture and Rural Development (2025-2034). In 2022, organic crop production in Serbia was established on 25.035 ha, of which 16.712 ha were arable land and 8.323 ha were meadows and pastures (RSZ, 2023).

Successful organic production requires efficient knowledge transfer and application. Key challenges include adapting expert knowledge to local conditions, strengthening the role of advisory services, and better integrating sustainability and agroecological principles (Milardo, 2025). Agricultural advisors play a crucial role in this process, serving as the direct link between research institutions and agricultural producers (Tolimir et al., 2025a). Their ongoing education across various fields of modern agriculture, including organic production, is essential for the effective implementation of contemporary agroecological practices, proper management of conversion processes, compliance with certification requirements, and overall improvement of production sustainability (Rivera and Qamar, 2003; Röling, 2009).

In Serbia, with the aim of strengthening the competencies of agricultural advisors, a continuous education system has been established, defined by the Regulation on the Medium-Term Programme for the Development of Agricultural Advisory Services for the period 2021-2025, and, at the annual level, by the Regulation on the Annual Programme for the Development of Agricultural Advisory Services, for example for 2024 (Regulation, 2024). Within the advisory system, the knowledge transfer process begins with transferring knowledge from knowledge creators (faculties, research institutes, ministries) to advisors through training activities based on the “train-the-trainer” principle. The next step is transferring the acquired knowledge from advisors to producers, as end users, through individual and group advisory methods.

Many authors have emphasised that continuous professional development and capacity building of advisors are prerequisites for their effective performance and ability to respond to the complex demands of modern agricultural production and current trends in agriculture (Leeuwis and van den Ban, 2004; Stanković et al., 2015; Tolimir et al., 2025b; Simić et al., 2025b). In European Union countries, the importance of education is recognised and defined by EU Regulation No. 1305/2013, which states that, to increase the quality and effectiveness of advisory services, a minimum level of professional competence and regular training of advisors must be ensured. Experiences from Poland indicate that advisory services play a significant role in this process; however, their capacities are often limited by a lack of specialised staff and adequate institutional support (Śpiewak and Jasiński, 2019). A good example of improving practical knowledge transfer is the BioRegio Betriebsnetz (BRB) network in Bavaria, which brings together experienced organic farmers and enables them, with institutional support and minimal administrative burden, to serve as examples of good practice and complement the work of existing advisory services (Hinzpeter, 2025).

The aim of this paper is to present the effects of agricultural advisor training conducted from 2019 to 2024, as well as the scope and forms of subsequent knowledge transfer to producers through advisory and educational activities, and to highlight the importance of advisory work in supporting the development of organic production and sustainable agriculture in the Republic of Serbia.

## **MATERIAL AND METHODS**

The study focuses on the analysis of data related to the training of advisors of the Agricultural Extension and Expert Services of the Republic of Serbia (PSSS), responsible for activities in the fields of crop production, livestock production, fruit growing, and plant protection, during the period from 2019 to 2024. Within this period, training programmes for advisors in organic agriculture, implemented according to the “train-the-trainers” principle, were conducted in 2019, 2021, and 2022. Based on the knowledge acquired through advisor training, training programmes for producers were continuously implemented from 2020 to 2024. The training of both advisors and producers was carried out in accordance with the Regulations on the Annual Programme for the Development of Agricultural Advisory Services for the period covered by the study, i.e., from 2019 to 2024. Quantitative data on advisor training was collected from the Annual Reports on the Implementation of Advisor Training within the PSSS, recording the number of training events in organic production, the field of specialization, and the number of participants per training session. Qualitative and quantitative indicators of advisor training were determined through a questionnaire survey of participants (n=341), conducted after each training event (13 in total). Responses were recorded using a five-point Likert scale, from 1 (lowest) to 5 (highest). The questionnaire included the following questions: (1) How do you assess the lecture? (2) How do you assess the educational materials? (3) How do you assess the applicability of the knowledge acquired during the training? (4) How do you assess the training as a whole? Knowledge improvement was evaluated using a self-assessment test, in which participants were asked before the training: “How do you assess your level of knowledge before the training?” and after the training: “How do you assess your level of knowledge after the training?”. Knowledge improvement was expressed as a percentage and calculated as the relative difference between the initial and final self-assessment scores.

Quantitative data on producer education (number of advisory educational activities and number of participating producers), categorized by year of implementation, were collected from the Annual Reports on the Implementation of Advisory Activities – educational activities focused on organic production (lectures, panel discussions, workshops, demonstration farms, and winter schools). Standard data analysis methods were applied using Microsoft Excel.

**RESULTS AND DISCUSSION**

Table 1 presents the results related to the quantitative indicators of advisor training, showing the number of training modules conducted by advisor specialization and by year.

Table 1. Number of Trainings in Organic Production - Quantitative Indicators

Quantitative Training Parameters	Advisor Specialization							
	Crop Production			Animal Husbandry	Fruit Growing			Total
	Year of Education							
	2019	2021	2022*	2022	2019	2021	2022*	2019-2022
Number of Training Days	1	2	3	2	1	2	2	13
Number of Participants	23	54	98	32	23	49	62	341

\* The training in 2022 also included advisors from the field of plant protection

The data in Table 1 show a gradual strengthening of educational activities for agricultural advisors, both in the number of training days delivered and in the number of participants and areas of specialization covered. Between 2019 and 2022, a total of 13 training days were held, reflecting ongoing professional support for advisors. The focus of the training topics gradually shifted from administrative to technological aspects of organic production. In the first training year (2019), the content was mainly oriented towards certification procedures, reflecting the need for advisors to acquire basic knowledge of the regulatory framework and administrative requirements of organic production. This thematic focus represents a necessary starting point for advisory work with producers considering entry into the organic production system. Subsequent training activities focused on improving standards in primary vegetable and fruit production (2021), followed by a series of trainings in 2022 addressing technologies for organic livestock production, arable-vegetable systems, and fruit and viticulture production.

The training targeted three key specializations - crop production, animal husbandry, and fruit growing with a noticeable increase in participant numbers over time, particularly in 2022, when advisors specializing in plant protection were also included. This trend indicates a growing need for an interdisciplinary approach to organic production, which is especially important given the complexity of organic farming systems that require coordinated input from multiple areas of expertise.

All advisor training activities aimed to strengthen professional capacities for transferring knowledge related to organic production. Enhancing advisors’ competencies within

specific fields is a key prerequisite for effective knowledge transfer to producers and, indirectly, for increasing the adoption of organic production in Serbia. The importance of knowledge transfer in agriculture is also emphasized by Tolimir et al. (2025a), who note that agriculture in Serbia faces rapid technological change, climate-related challenges, and increasing demands for sustainable production, all of which require new learning approaches and the development of a modern knowledge base. These authors particularly highlight the role of agricultural advisory services within the Agricultural Knowledge and Innovation System (AKIS) as key intermediaries between science and practice. In the context of organic and ecological agriculture, continuous education of advisors and producers forms the foundation for effective knowledge transfer and contributes to the sustainable development of agriculture and rural areas in Serbia.

Furthermore, Gerster et al. (2024) point out that agricultural extension and advisory services (EAS) play an important role in strengthening farmers' capacities to cope with climate change and in developing sustainable production systems. These authors emphasise that viewing EAS within the AKIS framework enables more effective integration of knowledge, research, and practice, which is particularly relevant for the development of organic and ecological agriculture.

Research in EU countries shows that the Agricultural Knowledge and Innovation System (AKIS) is crucial for the modernization and sustainability of agriculture. Together with the Farm Advisory System (FAS), AKIS facilitates knowledge transfer, innovation uptake, and the exchange of experience, thereby contributing to more competitive and environmentally friendly production models (Kountios et al., 2024). Studies have shown that countries with well-developed advisory systems are more effective in promoting sustainable practices, and that continuous education of advisors and farmers forms the basis for efficient knowledge transfer and capacity building for innovation adoption. Consequently, AKIS is considered a key instrument for advancing sustainable agriculture and strengthening rural communities.

Table 2 presents data on the assessment of lecture quality, the relevance of educational materials, and the applicability of the training activities. High average scores for lectures (4.65), educational materials (4.75), and training overall (4.74) indicate that the trainings were well designed and relevant in content, that is, aligned with the needs of advisors in their work with agricultural producers. A particularly important result is the high rating of the practical applicability of the trainings, which can be linked to research showing that the practical orientation of educational activities is a key factor for successful knowledge acquisition and its application at the farm level (Röling, 2009; Rivera and Qamar, 2003). Considering the specific characteristics of organic production where technological requirements, certification procedures, and agroecological principles are often complex, the competence of advisors is of great importance, and their role as intermediaries between science and practice becomes particularly significant.

Table 2. Evaluation of Education - Quality Parameters

Training Quality Parameters	Advisor Specialization						All specializations average	
	Crop Production		Animal Husbandry		Fruit Growing			
	Year of Education							
	2019	2021	2022	2022	2019	2021		2022
<b>Lecture rating</b>	4.20	4.75	4.88	4.95	4.20	4.71	4.85	4.65
<b>Educational materials rating</b>	4.55	4.78	4.88	4.90	4.55	4.77	4.85	4.75
<b>Training applicability rating</b>	4.86	4.88	4.97	4.95	4.84	4.74	4.88	4.87
<b>Overall training rating</b>	4.56	4.77	4.87	4.89	4.56	4.68	4.83	4.74

Table 3 presents the effects of advisor training in terms of knowledge improvement, based on a comparison of pre- and post-test results for all training sessions. The results indicate that the training led to clear and measurable improvements in the knowledge levels of agricultural advisors across all specializations. Overall, the average improvement in knowledge related to organic production was 38.38%, with an average pre-test score of 2.94 and a post-test score of 4.06. Based on the results achieved, it can be concluded that the implemented training programmes had a significant positive effect on improving the professional competencies of agricultural advisors, thereby creating prerequisites for the dissemination of acquired knowledge through its practical application in advisory work.

Table 3. Effects of Educations of Advisors

Year	Pre test	Post test	Knowledge Improvement (%)
<b>Crop Production</b>			
<b>2019</b>	2.90	4.0	37.93
<b>2021</b>	3.10	4.04	30.32
<b>2022</b>	2.80	4.10	46.43
<b>Animal Husbandry</b>			
<b>2022</b>	2.86	3.96	38.46
<b>Fruit Growing</b>			
<b>2019</b>	2.90	4.00	37.93
<b>2021</b>	2.96	4.15	40.20
<b>2022</b>	3.04	4.20	38.16
<b>Average</b>	2.94	4.06	38.38

Increasing the knowledge level of advisors enhances the quality of advisory services and enables more effective transfer of the principles of organic and sustainable production to the farm level. This is especially important in countries such as Serbia, where organic agriculture is still developing. More broadly, the results confirm that investment in advisor training is a prerequisite for achieving goals in the development of organic agriculture and

for transitioning to sustainable and environmentally friendly production systems. This further supports the view that knowledge is a fundamental resource for sustainable agriculture and long-term rural development (European Commission, 2020; FAO, 2018). Table 4 shows the results related to knowledge transfer from advisors to producers. Between 2019 and 2024, a total of 566 educational activities were conducted, involving 19,895 producers, demonstrating both the significant scale and continuity of advisory and educational work. Although there were fluctuations in the number of training activities per year, their ongoing implementation clearly reflects the existence of a stable institutional advisory framework in Serbia, which has enabled the systematic dissemination of both theoretical and practical knowledge in organic production.

Table 4. Knowledge Transfer from Advisors to Producers

Year	Number of realised activities				Number of Participants			
	Lectures and Panel Discussions	Workshop	Winter School	Total	Lectures and Panel Discussions	Workshop	Winter School	Total
<b>2019</b>	62	11	23	96	911	80	3112	4103
<b>2020</b>	52	11	22	85	705	66	2686	3457
<b>2021</b>	63	15	22	100	712	96	2477	3285
<b>2022</b>	92	12	22	126	1198	90	2427	3715
<b>2023</b>	64	6	22	92	900	31	2781	3712
<b>2024</b>	50	9	8	67	556	87	980	1623
<b>Total</b>	383	64	119	566	4982	450	14463	19895

According to Petrović et al. (2014), the development of organic agriculture and livestock production worldwide, in Europe, and in Serbia depends on the implementation of standards, legal regulations, and institutional support. Educational activities enable farmers to adopt organic farming practices, thereby reducing the negative impacts of intensive industrial agriculture, such as soil degradation, loss of biodiversity, and the presence of chemical residues in products. Alawa et al. (2020) emphasize the role of advisory services, noting that the integration of university-level agricultural education and advisory institutions, supported by appropriate policy initiatives, contributes to sustainable agricultural development and ecological sustainability.

Regarding the number of activities conducted, lectures and panel discussions predominate with 383 events, while winter schools (119) and workshops (64) account for a smaller share. However, when analyzed by the number of participants, winter schools contribute most significantly, with a total of 14,463 participants, highlighting their importance as an educational format. Lectures and panel discussions gathered 4,982 participants, while workshops were attended by 450 participants, which is expected given their practical and typically limited nature. It is important to note that combining theoretical and practical forms of education proved particularly significant for knowledge transfer, as it allows complementary interactions among different types of educational activities. Through lectures, panel discussions, and winter schools, a broader reach of producers was achieved, providing the transfer of fundamental knowledge on the principles of organic production, certification, and regulatory requirements. This approach is especially important in

countries where organic production is still developing, as informing producers forms the basis for decisions regarding entry into the system (Milardo, 2025).

At the same time, through workshops and activities conducted on demonstration farms, producers had the opportunity to observe the direct application of theoretical knowledge in practice, facilitating better understanding of recommended technologies and measures, and their faster and more successful adoption at the farm level. The importance of combining different forms of knowledge transfer in working with farmers has been highlighted by Cawley et al. (2023), who note that the greatest effects of knowledge transfer at the farm level are achieved by combining group and individual activities based on relevant and practically oriented content. The authors emphasise that trust among farmers, advisors, and institutions, as well as peer-to-peer learning among farmers - which in this study was represented through demonstration farms are key factors for the successful application of acquired knowledge and for achieving positive production outcomes.

Shūmane et al. (2018) underline that the integration of farmers' informal knowledge with formal knowledge systems enables the creation of more resilient and sustainable agricultural practices. Networking among farmers and multidisciplinary interactions during educational activities contribute to greater applicability of acquired knowledge and strengthen local capacities for innovation in agriculture. Simić et al. (2025) highlight that organic agriculture is an intensive and complex system, in which continuous transfer of scientific and technical information is essential for introducing innovative and sustainable solutions, particularly in plant protection and production management. These authors stress that the exchange of practical knowledge and the strengthening of ecological awareness among producers contribute to the reduction of harmful inputs, conservation of natural resources, and the development of effective agricultural knowledge and innovation systems.

## CONCLUSION

The results of the research confirm that the education of agricultural advisors represents an important mechanism for the transfer of scientific knowledge in the field of organic production. The education of advisors, aimed at strengthening their competencies, was adequately designed and aligned with the modern requirements of organic production and the needs of producers, as evidenced by high ratings of quality and relevance, a significant increase in advisors' knowledge levels, and high ratings for the applicability of the acquired knowledge in practice. In the subsequent transfer of knowledge from advisors to producers, the combination of different educational formats proved to be an effective approach: lectures and winter schools enabled broad participant coverage, while workshops and demonstration activities on pilot farms contributed significantly to practical learning and knowledge application.

Further improvement of the agricultural advisory education system, accompanied by continuous adaptation of educational content to practical needs and strengthened cooperation among research institutions, advisory services, and producers, represents an important prerequisite for the long-term development of organic, sustainable, and environmentally friendly agriculture in the Republic of Serbia.

The results of this study open up space for future research, including long-term monitoring of the effects of advisor education on the adoption of production practices by producers, as well as on economic outcomes and environmental impacts. In addition, future research could focus on analyzing differences in the effectiveness of specific educational formats, regional specificities in knowledge transfer to producers, and the use of digital tools and modern information and communication technologies in advisory services.

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