



**INSTITUTE OF AGRICULTURAL ECONOMICS, BELGRADE, SERBIA**

# **SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT III**

*Thematic Proceedings*



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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, 15<sup>th</sup> December 2022.*

1. Behrang Manouchehrabadi, Lusine Aramyán, Coen van Wagenberg - **POLICY MAKING FOR REGRET AVERSE AGENTS . . . . . 1**
2. Georgi Georgiev, Nina Nenova, Daniela Valkova - **STUDY ON YIELD AND OIL OF F1 HYBRID COMBINATIONS OF OILSEED SUNFLOWER UNDER THE CONDITIONS OF SOUTH DOBRUDZHA . . . . . 21**
3. Georgiana Raluca Ladaru, Ionut Laurentiu Petre, Daniela Popa, Anton Theodor Dimitriu - **DETERMINANTS OF FARMERS' ASSOCIATION IN ROMANIA . . . . . 31**
4. Irina Shakhramanian, Anna Ivolga - **RURAL TOURISM AS AN APPROACH TO SUSTAINABLE RURAL DEVELOPMENT: CASE OF THE STAVROPOL REGION. . . . . 43**
5. Stefan Postolache, Pedro Sebastiao, Vitor Viegas, Jose Miguel Dias Pereira, Octavian Postolache - **IOT SMART SENSOR SYSTEM FOR SOIL CHARACTERISTICS MONITORING IN VINEYARD. . . . . 55**
6. Vasilii Erokhin - **RURAL REVITALIZATION: CHINA'S APPROACH TO SUSTAINING RURAL DEVELOPMENT . . 67**
7. Vesna Gantner, Danko Šinka, Vera Popović, Milivoje Ćosić, Tihana Sudarić, Ranko Gantner - **THE VARIABILITY OF MICROCLIMATE PARAMETERS IN DAIRY CATTLE FARM FACILITY . . . . . 77**
8. Victor Petcu, Gabriel Popescu, Ioana Claudia Todirica - **ADDING VALUE TO WINTER WHEAT CROP BY ORGANIC SEED PRODUCTION – SOCIO-ECONOMIC CASE STUDY . . . . . 87**
9. Vili Dragomir - **IMPACTS AND ADOPTION OF ROMANIAN AGRICULTURE SECTOR TO CLIMATE CHANGE: A BIBLIOMETRIC STUDY . . . . . 99**

**PLENARY SECTION**  
*Second day, 16<sup>th</sup> December 2022.*

1. Aleksandra Vujko, Olgica Zečević Stanojević, Leposava Zečević - **THE IMPACT OF EMPOWERMENT ON MARRIED WOMEN THROUGH SELF-EMPLOYMENT IN RURAL TOURISM . . . 109**
2. Anamarija Koren, Ana Marjanović Jeromela - **ALTERNATIVE CROPS KNOWLEDGE MANAGEMENT FROM THE STANDPOINT OF SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT . . . . . 123**
3. Gordana Radović, Vladimir Pejanović, Dejan Zejak - **AGRICULTURAL INSURANCE: CURRENT DEVELOPMENT IN SERBIA AND MONTENEGRO . . . . . 133**
4. Jasmina Mijajlović, Nikola Mihailović - **COOPERATIVE SOCIETY IN FUNCTION OF SUSTAINABLE RURAL DEVELOPMENT . . . . . 143**
5. Milena Jakšić, Dragan Stojković, Milko Štimac - **ANALYSIS OF OPPORTUNITIES AND LIMITATIONS OF RASPBERRY COMMODITY EXCHANGE DEVELOPMENT IN SERBIA. . 153**
6. Olivera Jovanović, Jovan Zubović - **IMPORTANCE OF THE AGRO-FOOD SYSTEM FOR ECONOMIC DEVELOPMENT IN SELECTED LMICs . . . . . 167**
7. Tamara Gajić, Drago Cvijanović - **RURAL TOURISM AND WELL-BEING OF VILLAGE RESIDENTS IN SERBIA . . . . 177**
8. Tatjana Dimitrijević, Mihailo Ratknić - **VALUES OF ECOSYSTEM SERVICES: OXYGEN PRODUCTION IN THE FORESTS OF BELGRADE . . . . . 189**

## WORKING SECTION

1. Alecsandra Parnus Rusu, Eliza Gheorghe, Raluca Mitulescu Avram, Nicoleta Marin Ilie, Daniel Ifrim - **SUPPORTING RURAL TOURISM IN ROMANIA THROUGH THE NATIONAL RURAL DEVELOPMENT PROGRAMME 2014-2020. . . . . 201**
2. Anastasia Morozova, Irina Pavlenko - **TOURISM IN THE SUSTAINABLE DEVELOPMENT SYSTEM: THE CASE OF IZOBILNENSKY DISTRICT . . . . . 213**
3. Biljana Grujić Vučkovski, Zoran Simonović, Irina Marina - **COMMERCIAL BANKS AS SUPPORT FOR RURAL DEVELOPMENT OF SERBIA. . . . . 223**
4. Biljana Panin, Ani Mbrica - **ENVIRONMENTAL CONDITIONS OF RURAL AREAS OF SERBIA AND PERSPECTIVES FOR RURAL DEVELOPMENT . . . . . 235**
5. Bojana Bekić Šarić, Vesna Paraušić, Sladjan Rašić - **HARVESTING AND PROCESSING OF PROPOLIS . . . . . 245**
6. Boris Kuzman, Nedeljko Prdić, Sara Kostić, Anton Puškarić - **APPLICATION OF INNOVATIONS IN AGRICULTURE AND DIGITISATION OF SALES AS A BASIS FOR THE FUTURE. . . . . 253**
7. Ganda Rosoiu Iulia Maria, Budu Radu Alexandru, Nitu Rares Mihai – **DIGITIZATION: A NEW STAGE IN THE EVOLUTION OF AGRICULTURE . . . . . 263**
8. Daniela Valkova – **TESTING RESULTS OF NEW IMI SUNFLOWER HYBRIDS IN DAI-GENERAL TOSHEVO . . . 271**
9. Dubravka Užar, Radovan Pejanović - **BRANDING OF AUTOCHTHONOUS CHEESES THROUGH GEOGRAPHICAL INDICATIONS IN THE REPUBLIC OF SERBIA . . . . . 279**

10. Dumitra Edi Cristian, Alexandra Elena Tanase Mihai, Popa Claudiu Aurelian - **DIGITAL AGRICULTURE IS MOVING TOWARDS SUSTAINABLE AGRICULTURE . . . . . 291**
11. Gordana Dozet, Vojin Đukić, Zlatica Mamlić, Gorica Cvijanović, Nenad Đurić, Snežana Jakšić, Marija Bajagić - **ORGANIC SOYBEAN CULTIVATION WITH A SUSTAINABLE SYSTEM . . . . . 301**
12. Istrate George-Alexandru, Stana Cristian - **DIGITAL COMMUNICATION IN PUBLIC INSTITUTIONS: CHALLENGES AND OPPORTUNITIES . . . . . 311**
13. Jonel Subić, Nataša Kljajić - **ECONOMIC AND FINANCIAL ASPECTS OF CABBAGE PRODUCTION ON THE FAMILY FARM . . . . . 323**
14. Katica Radosavljević, Vesna Popović, Branko Mihailović - **IMPROVING THE RURAL ECONOMY AS A FUNCTION OF SUSTAINABLE DEVELOPMENT IN SERBIA . . . . . 335**
15. Lana Nastić, Marko Jeločnik, Velibor Potrebić - **INFLUENCE OF FINANCING METHOD ON EFFICIENCY OF INVESTMENTS IN BLUEBERRY PRODUCTION . . . . . 345**
16. Lela Ristić, Danijela Despotović, Petar Veselinović - **IMPLEMENTING SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT CONCEPT IN THE EU AND SERBIA . . . . . 355**
17. Ljiljana Rajnović - **THE LEGAL NATURE OF AGRICULTURAL LAND DIVISION AGREEMENTS WITH REFERENCE TO THE PRINCIPLE OF REGISTRATION AND RELIANCE IN THE CADASTRE . . . . . 365**
18. Maria Cristina Sterie, Eduard Alexandru Dumitru, Gabriela Dalila Stoica - **SHORT SUPPLY CHAIN - BIBLIOMETRICS ANALYSIS . . . . . 377**

19. Marija Inđin, Ivana Božić Miljković - **PROBLEMS AND OPPORTUNITIES IN THE TRADE EXCHANGE OF AGRICULTURAL PRODUCTS BETWEEN SERBIA AND THE EUROPEAN UNION . . . . . 385**
20. Marija Mosurović Ružičić, Marija Lazarević Moravčević - **INNOVATION POTENTIAL OF AGRICULTURAL COMPANIES IN SERBIA . . . . . 395**
21. Milena Rikalović, Sonja Josipović - **PRINCIPLES OF SUSTAINABLE AGRICULTURE AS A TOOL FOR THE IMPROVEMENT OF RURAL AREA LIFE QUALITY IN THE REPUBLIC OF SERBIA . . . . . 407**
22. Milica Luković, Danijela Pantović - **PLACE OF NATURE-BASED TOURISM IN ECOSYSTEM SERVICES VALUATION IN RURAL LANDSCAPE . . . . . 419**
23. Miroslav Nedeljković, Radivoj Prodanović, Adis Puška - **TRENDS OF TRADE INDICATORS OF POTATOES IN BOSNIA AND HERZEGOVINA . . . . . 431**
24. Radmila Jovanović, Predrag Vuković, Jean Andrei Vasile - **SMART (TOURIST) CONCEPT IN RURAL AND VITICULTURAL AREA STUDY CASE: NEGOTIN WINEGROWING REGION . . . . 441**
25. Raluca Ignat, Valentin Lazăr, Daniela Zănescu, Monica Triculescu - **QUALITY OF LIFE IN ROMANIA IN THE CONTEXT OF SUSTAINABLE DEVELOPMENT . . . . . 451**
26. Sanjin Ivanović, Saša Todorović - **THE RISKINESS OF FEED GRAIN PRODUCTION: AN EXAMPLE OF SERBIAN FAMILY FARMS . . . . . 461**
27. Slađana Vujičić, Marija Lukić, Milivoje Ćosić, Biljana Prodanović - **YOUTH ENTREPRENEURSHIP IN AGRICULTURE . . . . . 471**
28. Slavica Arsic - **IMPORTANCE OF BEEF IN THE DIET AND PRODUCTION IN THE REPUBLIC OF SERBIA . . . . . 481**



29. Vera Popović, Marko Burić, Vesna Gantner, Snežana Janković, Dragan Dokić, Vladimir Filipović, Jela Ikanović, Radmila Bojović - **STATE AND THE IMPORTANCE OF ORGANIC PRODUCTION TO HUMAN HEALTH . . . . . 489**
30. Violeta Babić, Vera Rajičić, Dragan Terzić, Marija Vučić - **WOMEN’S ENTREPRENEURSHIP IN THE FUNCTION OF AGRICULTURAL DEVELOPMENT . . . . . 503**
31. Vladimir Miladinović, Mira Milinković, Vladan Ugrenović - **THE INFLUENCE OF NATIONAL PARKS ON SUSTAINABLE RURAL DEVELOPMENT IN THE MEMBER STATES OF THE EUROPEAN UNION . . . . . 515**
32. Vlado Kovačević, Raluca Andreea Ion, Marijana Jovanović Todorović - **APPLICATION OF BLOCKCHAIN IN EU ORGANIC AGRICULTURE. . . . . 529**

# ALTERNATIVE CROPS KNOWLEDGE MANAGEMENT FROM THE STANDPOINT OF SUSTAINABLE AGRICULTURE AND RURAL DEVELOPMENT<sup>1</sup>

Anamarija Koren<sup>2</sup>, Ana Marjanović Jeromela<sup>3</sup>

## 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 changes, 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). Therefore, 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 challenges to commercialization of alternative crops according to Kim (2016).*

<b>OPPORTUNITIES</b>	Promotion of biodiversity and human health	<ul style="list-style-type: none"> <li>• ecological health</li> <li>• use of underused natural plant resources</li> <li>• health benefits due to high plant content of bioactive compounds</li> </ul>
	Economic benefits	<ul style="list-style-type: none"> <li>• diversification of farm income</li> <li>• adding values to the existing crops</li> <li>• spreading out risks</li> <li>• less affected by price fluctuations</li> </ul>
	New market opportunities	<ul style="list-style-type: none"> <li>• access to regional, domestic, and global markets with new products</li> <li>• well suited for conventional, organic, upscale and ethnic markets</li> </ul>
	Environmental protection	<ul style="list-style-type: none"> <li>• low inputs</li> <li>• perform well under water- and nutrient-limited conditions</li> <li>• could be grown in marginal and degraded lands</li> </ul>
<b>CHALLENGES</b>	Lack of cultivars.	<ul style="list-style-type: none"> <li>• imported germplasm not adapted to local production conditions</li> </ul>
	Limited information on cultural practices	<ul style="list-style-type: none"> <li>• specific growing requirements</li> </ul>
	Marketing and handling issues	<ul style="list-style-type: none"> <li>• limited knowledge of market demands</li> <li>• the high risks inherent in establishing a viable supply chain for a new crop product</li> <li>• a long period before profits are measured</li> </ul>
	Policy and research issues	<ul style="list-style-type: none"> <li>• little public funding for research</li> <li>• minor attention from the decision-makers and institutions</li> </ul>

## 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 jatropa) 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 foundation 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 current issues of arid agriculture. Some of the solutions are to breed staple crops varieties adapted to unfavorable 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 United 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). KCSAAC 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 gather 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.



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