THE ACADEMY OF APPLIED TECHNICAL STUDIES BELGRADE

INTERNATIONAL SCIENTIFIC AND PROFESSIONAL CONFERENCE

# POLITEHNIKA 2023

# CONFERENCE PROCEEDINGS

Belgrade, 15th December 2023

INTERNATIONAL SCIENTIFIC
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# POLITEHNIKA 2023

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## FOREWORD

The International Scientific and Professional Conference POLITEHNIKA 2023 represents the seventh edition of the POLITEHNIKA scientific and professional events, occurring biannually since its inaugural event in 2011. POLITEHNIKA 2023 upholds a distinguished tradition and commitment to integrating higher education and practical application across a diverse spectrum of disciplines represented by defined thematic scopes.

Organized with the patronage of the Ministry of Education of the Republic of Serbia, the Ministry of Environmental Protection of the Republic of Serbia, the Ministry of European Integration of the Republic of Serbia, the Directorate for Occupational Safety and Health, the Office for Dual Education and National Qualifications Framework, the Conference of Academies of Applied Studies in Serbia, the Chamber of Commerce of Serbia, the Chamber of Commerce of Belgrade, the Institute for Standardization of Serbia, the Association of Belgrade Architects, the City of Požarevac and the Tourist Organization of the City of Požarevac, POLITEHNIKA 2023 stands as a collaborative platform at the intersection of academia, governmental institutions and industry.

This year heralds a notable progression with its international status and the incorporation of 10 conference scopes. Expanding beyond the thematic domains featured in previous events, the Conference now encompasses Environment and Sustainable Development, Occupational Safety and Health and Fire Safety, Smart Management Systems, Graphic Engineering, Design, Traffic Engineering, Biotechnology and Healthcare, Mechanical Engineering, Ecotourism and Rural development, and Mechatronics. By engaging experts, emerging professionals, and practitioners from these domains, the conference unifies fields of study programs of the Academy of Applied Technical Studies Belgrade. The thematic scopes, coupled with the structure of the compiled papers in this Proceedings, exhibit a rich diversity and multidisciplinary approach, fundamentally contributing to a holistic examination and resolution of societal and scientific challenges.

Comprising over 220 peer-reviewed contributions, the Proceedings represent a substantial intellectual asset, aligning with the conference's overarching objective of fostering the exchange of knowledge, research findings, and professional experiences among experts from industry, research institutions, and higher education establishments.

The Proceedings of the International Scientific and Professional Conference POLITEHNIKA 2023 serve as a comprehensive snapshot of the current landscape within the thematic realms of the conference, offering both insights and directives for ongoing scientific and professional development. Moreover, they proffer concrete solutions to practical challenges grounded in contemporary trends and pertinent insights.

The Academy of Applied Technical Studies Belgrade extends its sincere appreciation to all conference supporters whose financial contributions played a pivotal role in its successful realization. Special acknowledgment is reserved for the authors of the papers, whose diligence and eagerness to present their work to a wider audience, alongside the reviewers and members of the International Scientific Committee, Program Committee and Organizational Committee, have collectively contributed to the triumph of the International Scientific and Professional Conference POLITEHNIKA 2023.

Belgrade, December 2023
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# ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

## INVITED PAPERS

**Srećko Stopić, PhD, Bernd Friedrich, PhD, Process Metallurgy and Metal Recycling, RWTH Aachen University, Germany**
*Advances in understanding of a role of unit metallurgical operations for recycling*

**Svetlana Grujić, PhD, Faculty of Technology and Metallurgy, University of Belgrade**
*Emerging pollutants in the environment: contamination of the Danube river basin in Serbia*

**Marija Nikolić, PhD, Faculty of Technology and Metallurgy, University of Belgrade**
*Biodegradable polyesters – from ecology to medicine*

# DESIGN

## INVITED PAPER

**Jelena Ristić Trajković, PhD, Faculty of Architecture, University of Belgrade**
*Society, Ecology and Design Education: Transformative Learning for Future Sustainable and Healthy Environments*

# MECHANICAL ENGINEERING

## INVITED PAPERS

**Tamara Bajc, PhD, Faculty of Mechanical Engineering, University of Belgrade**
*Energy savings and $CO_2$ emission reduction potential through the existing building renovation*

**Marko S. Jarić, PhD, Innovation Centre of Faculty of Mechanical Engineering in Belgrade**
*Analysis of remediation of horizontal cylindrical tank for oil storage*

# ECOTURISAM AND RURAL DEVELOPMENT

## INVITED LECTURES

**Marko Perić, PhD, Faculty of Tourism and Hospitality Management, University of Rijeka, Croatia**
*Challenges of sustainable tourism: Example of Croatia*

**Snežana Štetić, PhD, Balkan Network of Tourism Experts, Igor Trišić, PhD, Faculty of Geography, University of Belgrade**
*Selective forms of tourism and sustainable development of rural tourist destinations*

## INVITED PAPERS

**Radomir Stojanović, PhD, Western Serbia Academy of Applied Studies**
*Education as a pillar of sustainable agritourism in Serbia*

**Jelena Premović, PhD, Faculty of Economics, University of Priština & Faculty of Economics and Engineering, University Business Academy in Novi Sad**
*Cultural heritage as a generator of sustainable development of tourism in local communities in the countries of the Western Balkans*

**Vladimir Živanović, Nevena Majstorović, Zlatibor Tourism Organization, Zlatibor**
*Analysis of the real number of tourist overnights based on the estimation of water consumption in Zlatibor*

# MECHATRONICS

## INVITED PAPER

**Andrea Matta, PhD, Dept. of Mechanical Engineering, Politecnico di Milano, Italy Mohsen Jafari, PhD, Dept. of Industrial and Systems Engineering, Rutgers University, USA**
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ENVIRONMENT AND SUSTAINABLE DEVELOPMENT. MECHATRONICS. OCCUPATIONAL SAFETY AND HEALTH AND FIRE SAFETY. SMART MANAGEMENT SYSTEMS. GRAPHIC ENGINEERING. DESIGN. TRAFFIC ENGINEERING. BIOTECHNOLOGY AND HEALTHCARE. MECHANICAL ENGINEERING. ECOTOURISM AND RURAL DEVELOPMENT.

# APPLICATION OF NEW TECHNOLOGIES FOR ADAPTATION TO CLIMATE CHANGES IN AGRICULTURAL PRODUCTION– A REVIEW

*Aleksandar Stevanović [1], The Academy of Applied Technical Studies Belgrade*
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**Abstract**: *Climate change seriously threatens food security worldwide, causing extreme weather conditions and reducing agricultural productivity. Increased temperatures and greenhouse gas emissions are the main drivers of these changes. While increased $CO_2$ concentration can enhance plant growth, elevated temperatures and other factors offset these benefits. Therefore, it is essential to consider adaptation measures, including the development of climate-tolerant crop varieties and innovations in agricultural practices to preserve food security in a changing climate. Smart agriculture involves the use of advanced technologies such as climate, soil, and plant monitoring sensors, IoT devices that enable the connectivity of various aspects of agricultural production, and data analytics for decision-making. These technologies enable farmers to better understand environmental changes and respond quickly to unpredictable climatic conditions.*
**Keywords:** climate, climate change, agriculture, adaptation strategies, biodiversity

## 1. INTRODUCTION

Global climate change has reached a serious threat level for global food security and the nutrition of the world's population. The effects of these changes are becoming increasingly apparent, jeopardizing the sustainability of agriculture and food supply stability. The main factor responsible for this situation is the increased emissions of greenhouse gases, leading to global warming and the greenhouse effect. Rising surface temperatures on Earth have a range of serious consequences, including extreme weather events like droughts, floods, and storms, as well as altered precipitation patterns. These climate factors continually reduce the productivity of various agricultural crops, resulting in lower yields and reduced food quality. Increased temperatures also shorten the growing seasons, directly impacting crop yields. Global temperatures are expected to continue rising, leading to more frequent and prolonged heatwaves, further negatively affecting agricultural production [1,2,3,4].

Changes in temperatures and precipitation patterns have a significant impact on planting, crop yields, and phenological characteristics. Climate change and its unpredictable variability present real threats to agriculture and global food security. The increased concentration of $CO_2$, a significant greenhouse gas, has a complex impact on agriculture. On the one hand, it can accelerate plant growth and increase productivity through enhanced photosynthesis. However, these benefits are offset by increased temperatures, which lead to higher plant respiration, increased

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evapotranspiration (loss of water through plants), increased pest occurrences, changes in weed flora, and shortened crop durations. All these changes make agriculture more vulnerable to climate impacts. In light of these challenges, it is clear that concrete steps need to be taken to mitigate the negative effects of climate change on agriculture and food security [5, 6].

A key approach in this context is the development of heat-tolerant crop varieties and the implementation of innovations in existing agricultural practices. These adaptation strategies play a crucial role in reducing the harmful consequences of climate change on global food security and are essential steps towards preserving food supply stability in a changing climate. The agricultural sector faces serious challenges in the context of the need to adapt to climate change. With the expected growth of the world's population to nine billion by 2050, there is a need to ensure an adequate food supply and other basic needs. However, limited arable land for expansion and increasingly frequent extreme weather events due to climate change pose significant threats to agriculture. Various technologies and practices have been developed worldwide to facilitate agriculture's adaptation to climate change. These include improved weather forecasting, water conservation, drip irrigation, sustainable soil management, livestock improvement, and changes in crop varieties and planting systems. Some of these approaches require financial investments, while others require changes in practices and increased awareness among farmers. Technological strategies for adapting to climate change in agriculture are based on agroecological principles and encompass diverse scientific technologies from climatology, biology, and agronomy. They also focus on social and institutional capacity-building processes for adaptation. These technologies include climate change planning, sustainable water and soil management, sustainable crop and livestock management, sustainable agriculture systems, capacity building, and the involvement of relevant stakeholders. Instead of technologies that tend to homogenize the natural environment and agricultural production, those that promote diversity and environmental conservation are preferred. Most of these technologies are already known and applied, but they are adapted based on specific conditions and needs caused by climate change. Agroecology as a multidisciplinary approach, explores the sustainability of agricultural systems and promotes biodiversity conservation. This approach provides a useful framework for selecting and implementing technological solutions in agriculture, considering a comprehensive assessment of factors that affect their efficiency and ecological integration. Making informed decisions about appropriate technological solutions requires taking into account specific local contexts, including social and cultural norms, to achieve the optimal impact on system sustainability. When it comes to adapting agriculture to climate change, it is especially important to emphasize the preservation of water resources and the promotion of sustainable irrigation methods. Introducing improved plant genetic varieties, precise monitoring of weather conditions, and the application of precision agriculture play a crucial role in addressing the challenges brought about by climate instability. Through collaboration between farmers, researchers, and authorities, an integrated approach can be developed to ensure the resilience of agriculture to climate change and contribute to global food security. Adapting to climate change in agriculture requires a systematic approach that encompasses various technological and social aspects to achieve sustainable solutions [7].

Impact translates from climate to the environment, to the productive sphere, to economic and social dimensions, bringing a range of additional risks on availability of food, on access to food and utilization of food, as well as on the stability of these characteristics, for both farm and non-farm households [7].

## 2. THE IMPACT OF CLIMATE CHANGE ON AGRICULTURE AND ADAPTATION STRATEGIES

Climate change has a significant and profound impact on the agriculture sector worldwide. Increasing global temperatures, altered precipitation patterns, and more frequent extreme weather events pose serious challenges to food producers. Maintaining the sustainability of agriculture and global food security requires the implementation of diverse adaptation strategies. These strategies need to be quantified using modeling approaches to better understand and predict the potential

effects of climate change on agriculture. To address these challenges, farmers and scientists are collaborating to develop adaptation strategies. This includes adjusting planting dates to maximize crop potential and reduce losses due to unfavorable weather conditions [5]. Optimal plant densities are also being researched, as higher plant density can offset yield losses. Genetic selection and technology play a crucial role in adapting agriculture to climate change. Developing crop varieties that are tolerant of higher temperatures, drought, and unpredictable rainfall becomes imperative. Scientists are focusing on selecting genotypes that better withstand stress and developing genetically engineered varieties that are more resilient to climate change. Innovations in agriculture are also of vital importance. Precision agriculture, the use of satellite monitoring, and automated irrigation systems can significantly optimize resource utilization and reduce food production losses. Given the changing climate conditions that lead to reduced water availability for agriculture, preserving water resources is imperative. Efficient irrigation systems and water recycling become key to sustainable food production. Furthermore, precise nutrient management can enhance crop resilience through improved fertilizer efficiency and reduced greenhouse gas emissions. Farmer education plays a crucial role in successfully addressing climate change. Farmers need training on the latest techniques and practices to better cope with changes and manage their resources more efficiently. At the policy and regulatory level, governments and international organizations must recognize the urgency of the issue and adopt policies that support sustainable agriculture and the reduction of greenhouse gas emissions. Addressing climate change in agriculture requires a comprehensive approach and collaboration across different sectors. Preserving the future of agriculture and global food security demands thoughtful and effective measures to safeguard our planet and ensure an adequate food supply for future generations.

## 3. PRECISION AGRICULTURE AND ITS ROLE IN CLIMATE CHANGE ADAPTATION

Precision agriculture plays a crucial role in adapting to climate change. With changing climate conditions, farmers face increasing challenges in preserving crop productivity and sustainability. This modern agricultural practice utilizes advanced technology, including GPS, sensors, drones, and satellites, to enable precise resource management such as water, fertilizers, and pesticides. This approach reduces resource overuse and economic costs, which becomes increasingly important in the context of growing climate change unpredictability. Several key ways in which precision agriculture can help in adapting to climate change include: GPS (Global Positioning System, sensors, drones, satellites, crop adaptability, early warning of damage, sustainable practices, precision agriculture [8].

The combination of these technologies allows farmers to better understand and respond to climate change, increasing agriculture's resilience to extreme weather conditions, droughts, floods, heatwaves, and other challenges brought by climate change.

## 4. BIODIVERSE AGRICULTURE, OR "ECOLOGICALLY INTENSIVE AGRICULTURE"

Biodiverse agriculture, also known as "ecologically intensive agriculture," is a key aspect of modern agriculture focused on the sustainable preservation of biodiversity within agricultural ecosystems. Like natural ecosystems, agricultural ecosystems depend on the diversity of plant and animal species to achieve sustainable productivity, fertility, and resilience to external changes and disruptions. The concept of biodiverse agriculture relies on a high level of biological diversity within agricultural systems to achieve sustainable productivity and resilience, while also contributing to environmental protection and reducing the need for chemical agents. This approach plays a crucial role in addressing current climate changes as it promotes ecosystem services and reduces the need for chemical agents. However, while this concept is of fundamental importance, its complexity has not yet been fully understood, making its regulation challenging. In the context of ensuring global food supply, careful consideration should be given to protecting valuable ecosystems and their biodiversity. In the food production sector, priority should be given to the

restoration and preservation of ecosystems, requiring long-term planning and fundamental changes in economic, production, and development strategies. It is also necessary to restructure food systems to achieve a neutral or positive impact on the environment while ensuring healthy nutrition and food security. Low-impact strategies must become a priority.

Agroecology, as an approach that promotes sustainable agricultural production and biodiversity conservation, provides a useful framework for selecting technology adapted to local needs. In making informed decisions about the appropriate technological options, it is essential to consider local contexts, including social and cultural norms. To support the decision-making process, the application of a community-based adaptation (CBA) framework is proposed, involving various stakeholders and enabling participatory planning, monitoring, and implementation of adaptation activities. Additionally, setting criteria for prioritizing adaptation technologies, taking into account ecological sustainability, access to climate change information, water, carbon, and nutrient cycles, economic aspects, cultural diversity, scaling, and institutional integration. Adaptation in agriculture requires a comprehensive approach, encompassing technical and social aspects to preserve productivity while protecting the environment. An impact assessment of climate change provides a scientific basis for the development of adaptation strategies that can mitigate the negative effects of climate change on agricultural crops. Biodiversity, including genetic diversity, species diversity, and ecosystem interactions, enhances ecosystem resilience to changing conditions and environmental stresses. Genetically diverse populations and species richness have a higher potential for adapting to climate change. Therefore, the use of native and locally adapted plants and animals is promoted, as well as crop and livestock variety selection.

## 5. AGRICULTURE ADAPTED TO CLIMATE CHANGE

In order to effectively address the challenges of climate change in the context of agriculture, it is necessary for farmers to adopt an approach that involves the development or transformation of their agricultural systems. This approach involves replacing old procedures and practices with new agricultural methods and techniques that are in line with the requirements of climate change [9,10]. Agriculture adapted to climate change (ACC) can be described as a comprehensive approach to agricultural management aimed at achieving sustainable growth in agricultural productivity and income, addressing food security and climate change issues, directing agricultural development to achieve climate change mitigation and adaptation goals, and efficiently managing agricultural growth [11,12,13,14,15]. ACC encompasses a wide range of adaptive measures and practices aimed at reducing the impact of climate change, sustainably increasing agricultural productivity (in the context of food, fibers, and fuels production), reducing greenhouse gas emissions, increasing agricultural resilience to climate change, and promoting national food security and development goals [12,13,16,17]. ACC doesn't only address ecological aspects but also takes into account social and economic aspects to achieve comprehensive benefits and reduce compromises, including institutional, political, and technological practices [15]. ACC activities involve a combination of traditional agricultural practices that have evolved over time and innovative agricultural technologies that are widely recognized and promoted. This includes approaches such as agroforestry, conservation agriculture, biodiversity-based agriculture, water management, and sustainable land management practices or technologies [15,18,19]. At the farm level, the implementation of ACC measures depends on the socio-economic environment influenced by institutional patterns, resource availability, and climatic conditions. Using different methods allows farmers to synergize ACC practices and technologies, increasing farm productivity while addressing interconnected challenges [13,19,20]. While it is desirable to achieve all the set ACC goals, in the real world of agriculture, compromises between productivity, sustainability, and climate change mitigation will be necessary. Today, the concept of ACC plays a crucial role for many organizations dealing with the intersection of climate adaptation and agriculture. ACC provides guidance for identifying successful models of agricultural production among different approaches. Any agricultural technology that surpasses conventional practices can contribute to achieving ACC goals

and be recognized as climate-sustainable [21]. Currently, existing directions for ACC development include (i) the application of advanced internet technologies to ensure information security in agriculture; (ii) the improvement of crop structures and management methods; (iii) the provision of "Internet + weather" services; (iv) the improvement of the quality of agricultural services; and (v) the development and application of agricultural weather disaster insurance [12]. These concepts and strategies will enhance environmental protection, support sustainable agricultural progress, and reduce the impact of climate change.

Climate change represents a significant and serious threat to global food security and agricultural sustainability. Rising temperatures, altered precipitation patterns, and increased greenhouse gas concentrations significantly affect plant productivity, reducing yields and food quality. These effects are becoming increasingly evident and are expected to continue in the future. To preserve global food security, urgent measures to adapt to climate change are necessary. This includes developing crop varieties tolerant to high temperatures and implementing innovations in agricultural practices to mitigate the negative effects of climate change on food production. It is also important to work on reducing greenhouse gas emissions to slow down global warming and mitigate the climate impacts on agriculture. Sustaining the world food supply system requires a multidisciplinary approach involving farmers, researchers, government and international organizations to develop strategies and solutions to address this serious threat and ensure an adequate and safe food supply for the growing global population [22, 23].

## 6. CONCLUSION

Climate change poses a serious threat to the agriculture sector and global food security. Rising temperatures and increased $CO_2$ concentrations in the atmosphere can have complex effects on plant growth and productivity while simultaneously increasing the number of pests and weeds. Additionally, the microbial population in the soil can also be affected by climate change, which can impact the availability of nutrients for plants. Climate-smart agriculture is becoming crucial for adapting to these new conditions, but it requires innovations and changes in agricultural practices. It's also important to understand the economic consequences of climate change in agriculture, including the costs of adaptation and reduced yields. To address these challenges, serious global steps are needed to reduce greenhouse gas emissions and slow down temperature rise. Additionally, local and regional initiatives for adapting to climate change in agriculture are becoming increasingly important to preserve food security and sustainable agricultural production.

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