PRODUCTION OF SAFE FOOD WITH PRESERVATION OF RESOURCES

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Abstract

The agriculture of the Republic of Serbia is specific, as a mixture of old and new, traditional and innovative. Food production is one of the most important sectors of agriculture and economy of any country. Ensuring of food safety for humans and animals, adapting to climate change and protecting the environment are a basis for sustainable agricultural development. There is a need for concepts that will make food practices more sustainable. For a healthy and environmentally friendly food system for humans and animals, the implementation of sustainable models of agricultural practices is important as a way to attract and prepare the next generation of leaders for the agricultural workforce while improving global food security. When developing a model of good agricultural practices, the goal is to protect the life and health of people and animals, to rationally manage and restore resources that have been partially degraded by agricultural activities.

Key words: Food safety, Resources, Environmental protection, Agricultural practices.

Introduction

Food safety is one of the most important systemic issues of any country, which includes the responsibilities, duties, traceability in production of all participants in the food production chain. The basic principles of food safety are the principle of risk analysis, the precautionary principle, the principle of protecting consumer interests and the principle of transparency. The legal regulation that defines the general conditions for food safety for humans and animals in the Republic of Serbia has been defined by the Law on Food Safety ("Official Gazette of the RS", no. 41/2009 and 17/2019), introducing a concept that encompasses food chain aspects, which makes food safety in Serbia an integrated and comprehensive system (Vujović, 2017).

Due to agricultural activities, humanity faces environmental pollution and degradation of natural resources. Producing safe food and protecting the environment, organic production as a sustainable system combines traditional and new technological solutions, both from the aspect of biological diversity of flora and fauna in the agroecosystem, and from the aspect of nutritional values and the absence of harmful residues in food (Stevanović et al., 2022).

The concept of sustainable development is the primary goal in the preservation of natural resources. To realize this goal, it is important to know the opportunities and obstacles for introducing the concept of circular economy in agribusiness, with reference to organic production and positive effects that are achieved by combining the concept of long-term sustainability and organic production as an agricultural activity of a green and healthy future. Along the way, it is important to face certain challenges, such as global warming, the depleted ozone layer, fertile land turning into infertile, the extinction of plant and animal species, increased amount of waste, the greenhouse effect and others (Vučinić et al., 2022).

Requirements and practice in Serbia and in the world when it come to the production of safe food and preservation of the environment encompass the introduction of sustainable models of agricultural practices collecting the existing knowledge and approaches from science to implementation (Simić et al., 2020).

In the production of safe food, it is extremely important to reduce the number of harmful substances in food or to eliminate them completely. Various toxic and carcinogenic substances can be found in food, coming from natural sources, from the environment or created during food processing (Đorđević et al., 2020).

In agricultural production, proper use of inputs is a prerequisite in the transition from conventional to controlled and organic production. The goal of controlled application of inputs is to obtain safe products, eliminate harmful ecological processes and restore resources degraded by agricultural activities. Right advice from experts increases the possibilities for farmers, end users of applying the concept of sustainable production, in a global competitive environment through better planning and optimization of costs (Janković et al., 2019).

The intensification of agricultural production and ever-increasing amounts of inputs have enabled a significant increase in production, but also increased environmental pollution, which in the absence of the necessary market regulations has resulted in unsustainable agricultural practices. The aim of the European agricultural development strategy is to promote smart models that coordinate the natural, social and economic aspects of agricultural production with the aim of developing and maintaining long-term multigenerational programs (Feher and Beke, 2013).

Conceptual models of resource management in agriculture in accordance with good agricultural practice can be applied to all farms. The application of developed models of agricultural practices is a strategic goal for preserving the environment and ecology, to which farmers, agricultural advisory services, institutes and faculties can make a major contribution (Janković et al., 2020).

Farmers, advisors and other agricultural experts need more knowledge on the production of safe food. The development of courses and digital tools, as well as the use of the agricultural knowledge and information system (AKIS) can significantly contribute to spreading the knowledge on the aforementioned topics. This model represents a system of agricultural knowledge and innovation that connects people and organizations in order to promote mutual learning, knowledge generation, sharing and the use of technology, knowledge and information related to agriculture. This system

may include farmers, agricultural workers, agricultural educators, researchers, and experts (Janković et al., 2022).

In the social and ecological development of sustainability, biodiversity plays a multiple role. Increased attention has been put on mitigating plant diseases in agricultural ecosystems by using biodiversity (Wang et al., 2021).

Furthermore, the use of organic fertilizers such as manure make a fair share of nutrients return to the soil, to become accessible to cultivated plants, so that organic matter is recycled into available elements. Manure can significantly improve the fertility of soil if it is applied in a timely manner, and if applied incorrectly, it can endanger the environment bringing higher amounts of nitrates, nitrites and phosphates in the soil, and in surface and ground water. Manure produced on farms could be partially used for biogas production, and the obtained overheated substrate as nutritious organic fertilizer, which would reduce the harmful impact of manure on the environment (Brkić and Janjić, 2011).

Elaboration

There is market demand for quality fresh and processed agricultural products, which requires the application of the latest achievements in production, including: modern technology, assortment, application of agrotechnical measures, quality certification in line with standards, adaptation to market requirements, diversification of production, creation and development of brands, promotion and marketing of food products, infrastructure development and cooperation with partners in the entire food chain.

In order to obtain safe products, special focus in plant production should be paid on improving knowledge on integral plant protection, crop rotation, correct plot selection, genotypes resistant to diseases and pests, resistance management plan, proper and adequate fertilization, soil analysis, and applying new active substances safer for humans, animals and the environment.

Consumers are aware of the role that food plays in preventing diseases and therefore demand healthier foods with increased levels of bioactive compounds. The European Union countries increasingly empower and support organic production and production of food with lower amounts of residues of various contaminants or zero residues in some cases (“Zero Pesticide Residue”). In order to meet consumer demands in terms of quality, there is a constant need to improve agricultural production.

The production of safe food faces a number of challenges, such as an increased occurrence of the existing or new diseases and pests, various food contaminants and unfavorable climate changes.

Traceability and reliability in the production process are important for food quality and safety. In agricultural production, it is extremely important to know the procedures that enable risk management to obtain safe products. The most common groups of potential food contaminants that should be focused on in the production chain are pesticides, mycotoxins, microbial organisms and heavy metals.

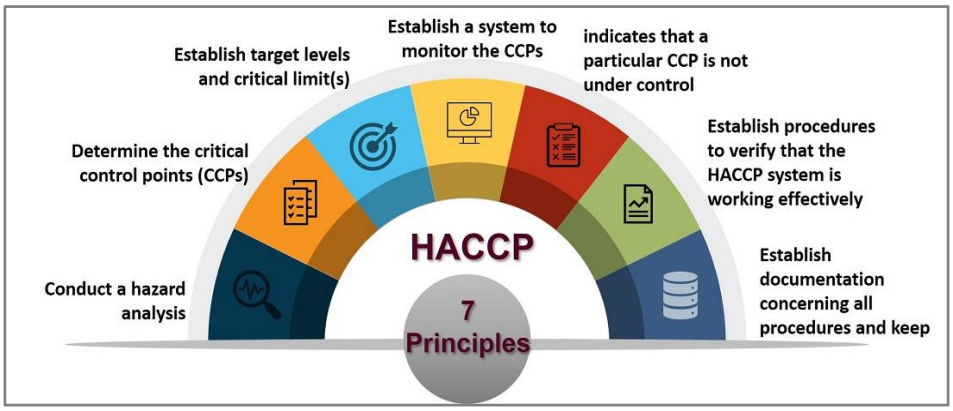
It is important to adopt conceptual models that will contribute to the improvement of the ecological, production and economic potential of farms, through a more rational

and sustainable use of products for crop protection and nutrition, through the protection of biodiversity and the environment, as well as through ensuring, above all, high yield and competitiveness, and safe food for people and animals.

What is needed is a constant multidisciplinary approach and new knowledge to improve the advice given by experts as well as further education of farmers on proper management of inputs and resources in agriculture. By applying good agricultural practice, it is necessary to completely eliminate potential food contaminants or keep them at a level that does not endanger food safety and or impair the conservation of resources, Pict. 1a-b, and 2-3.

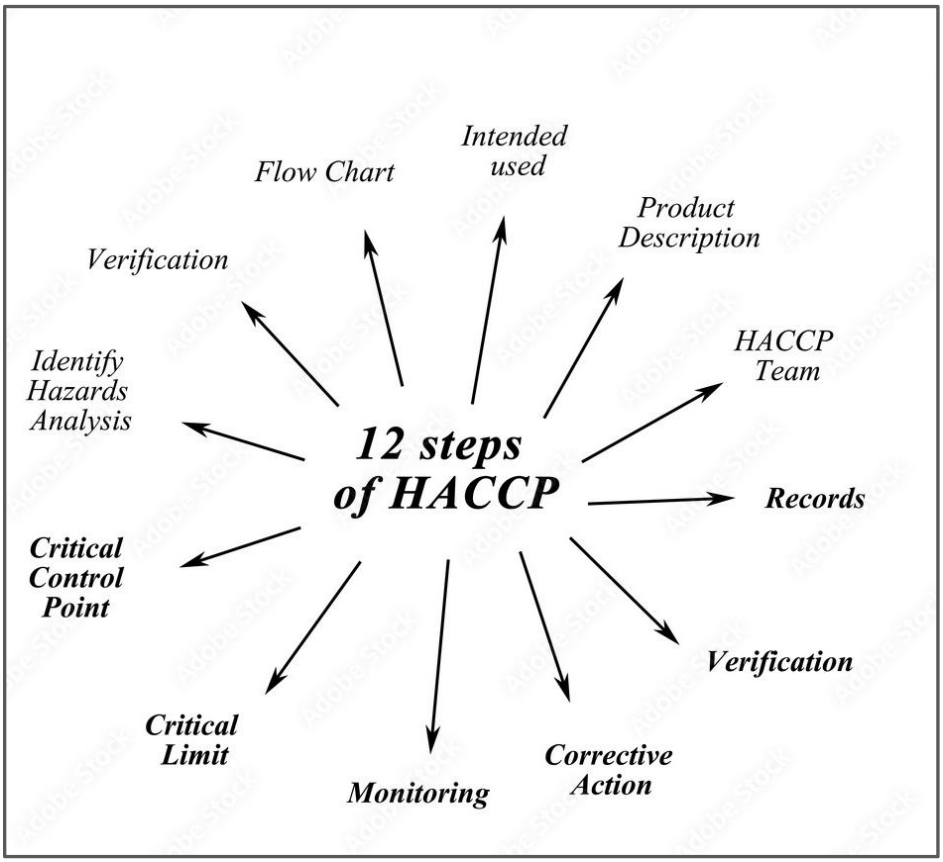
A. B.

Picture 1. HACCP control, a., food control, b.



Picture 2. HACCP Principles

Despite the defined rules for the sustainable use of potential contaminants, the negative impact of their application can cause: the accumulation of toxins in food, ecological problems, loss of biodiversity and the risk of developing resistance in harmful organisms.



Picture 3. 12 steps of HACCP Principles

Common contaminants in agricultural products are mycotoxins, which are secondary products of mold metabolism, with acute toxicity to human and animal health. A synthesis of mycotoxins can occur at all stages of food production, and the key method is to prevent and reduce the possibility for contamination.

Plant-based food can carry microbiological contaminants such as bacteria, fungi, molds, viruses, parasites, which can harm human and animal health. Inadequate handling of fertilizers of animal origin can transfer pathogens from animal to plant systems.

The safety of agricultural products can also be threatened by soil contamination with heavy metals. The World Health Organization has included lead, cadmium, mercury and arsenic as contaminants that should be monitored in food.

One of the most significant and widespread potential sources of contamination of food and resources is the use of crop protection products, having an extremely important role in plant production and affecting the quality and quantity of yield, but also the health condition of end products and consumers. In conventional production, there is a risk of bioaccumulation of toxins in the food chain, which can have serious consequences for human and animal health. That is the reason why it is important to know the effects of pesticides on the ecosystem, as well as measures to minimize their negative impact. Pesticides can contaminate soil, water and air, affecting not only

harmful but also beneficial organisms. Inadequate use of pesticides can lead to the accumulation of toxins in soil and produce. Monitoring of pesticide residues in food of plant and animal origin is carried out in accredited laboratories based on samples submitted by competent inspection bodies.

Crop production relies on the use of synthetic pesticides to protect crops from diseases and pests. Knowledge on the importance of implementing integrated measures in crop protection is necessary when providing expert advice to farmers.

Implementation of concepts related to the chemical's strategy for sustainability and a toxic-free environment is quite important. One of the examples of good practice in environmental protection is the establishment of a system for disposal of crop protection product waste from individual users. It is important to have a continuous training of farmers and agricultural experts on proper handling of empty pesticide packaging, proper waste management, to show that it is possible to have a system that reduces the risk to human and animal health and the environment.

Excessive use of pesticides and other potentially harmful substances can lead to soil and water contamination, while insufficient use can be ineffective in managing harmful organisms. Regular monitoring of effectiveness and impact on the environment is essential for the sustainable use of pesticides. This enables the adapting of strategies and methods to minimize negative impacts and to combine different methods, including biological, mechanical and chemical, to achieve effective and sustainable pest control.

Despite being a key factor in agricultural production in terms of ensuring food quality and high yield, pesticides often have unexpected impacts on human health (during application itself and due to pesticide residues in food) and on the environment, non-target organisms and natural resources (soil, water, air, pollinators and natural enemies).

Education of farmers on the proper use of pesticides, as well as alternative methods of controlling harmful organisms is crucial for the sustainable use of crop protection products. Reducing potential contaminants in agricultural products is a complex task that requires a coordination between farmers, advisors and regulatory bodies.

In terms of environmentally improved agricultural production, the introduction of a field book for keeping records of treatments can be beneficial for farmers and consumers.

Through coordination, education and innovation, it is possible to achieve a sustainable application of inputs in agriculture that is in line with ecological and health standards. It is necessary to facilitate the transition from conventional to precision agriculture while minimizing the risk of investing into the acquisition of new systems. Precision agriculture is a concept that offers great opportunities in improving the quality and quantity of production.

Integrated production and crop protection is a combination of different methods of controlling harmful organisms, including biological, mechanical and chemical methods. This approach is designed to be efficient, economical and environmentally-friendly.

High costs of alternative methods and a lack of financial incentives are the main obstacles to reducing the use of pesticides. In addition, market pressures can make the transition to more sustainable methods difficult. Moreover, the effectiveness of alternative methods is not always at the level of chemical pesticides, some of these methods are less known or have not been sufficiently researched, and there is also a problem with the availability of these alternatives on the market.

Access to biological control methods facilitates the shift from chemical crop protection products. Biological control agents are a viable alternative for controlling the use of chemical products and harmful organisms. Biological control agents are of increasing importance in sustainable agriculture and play a key role in the success of integrated pest management. It is important to encourage farmers to use less pesticides, and shift towards organic farming. Significant progress in reducing the use of chemical crop protection products in an economically viable manner can be achieved by increasing the percentage of crops on which biological control agents are used.

Intensive cultivation of plants has contributed to increased food availability through the development of new genotypes with higher productivity and reducing losses caused by biotic and abiotic stress.

Despite significant challenges in reducing pesticide use, there is also much room for improvement.

In pest control, traditional approaches often involve the use of chemically synthesized pesticides that can be harmful to the environment, human and animal health. Application of modern technologies can enable more precise and efficient application of pesticides. Sensors and drones are used to accurately map fields and identify areas most susceptible to pest attacks. Based on this information, pesticides can be applied selectively, reducing the total amount of chemicals used.

Under climate change harmful organisms adapt more quickly and become resistant to existing control methods. It is necessary to find a balance between the effective control of harmful organisms and the minimization of the negative impact on the ecosystem. Pesticides are effective in the short term, but their use can have long-term negative environmental consequences, such as water and soil contamination, as well as negative effects on beneficial organisms. Combining chemical with mechanical and biological methods can significantly reduce the need for chemical intervention, and the use of pheromone traps to monitor the population of harmful insects can help determine the best time for applying pesticides.

Farmers need a right form of affordable advice. Expert advice should be available to both small and professional farmers, and tailored to the type of a farm and the multifunctional role of agriculture. Advisory services should contribute to innovations in rural areas, environmental protection, investments in rural development, adaptation to climate change, etc. Knowledge of safety factors in food production is necessary along with risk management. Education of farmers on the proper use of pesticides, as well as alternative methods of controlling harmful organisms, is a key in promoting the sustainable use of crop protection products. This includes not only formal training, but also dissemination of information through advisory services, workshops and educational materials.

Decision-makers can offer subsidies and financial incentives for the implementation of sustainable methods, as well as reimbursement of part of the costs for the purchase of environmentally-friendly products or equipment. In addition, there are programs for certification of sustainable practices, and there is also the possibility of partnering with the private sector in order to finance sustainable initiatives.

Conclusion

The application of good agricultural practice models is important for the preservation of natural resources, environmental protection, reduction of the negative effects of agricultural production, optimization of production and preservation of biodiversity and the environment.

The final goal of applying the concept of good agricultural practice is the mass and quality production of safe food while respecting economic and ecological principles.

It is important to improve the knowledge of farmers in order to use inputs in agriculture rationally and in accordance with regulations.

Additionally, changing practices is hampered by lack of awareness among farmers about non-pesticide methods and their effectiveness.

Proper advice from experts can help farmers, the end users in the concept of sustainable production, to be more sustainable in the global competitive environment.

Application of modern technologies can enable more precise and efficient application of pesticides. Digital platforms can facilitate communication and exchange of information between different actors in agriculture and contribute to the introduction of non-pesticide methods of controlling harmful organisms.

It is necessary for the agricultural sector to be more technologically advanced based on innovative technologies and knowledge, as the greatest value based on scientific research.

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