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# TRANSITION FROM CONVENTIONAL TO AGROECOLOGICAL SYSTEMS, CASE STUDY OF BOSNIA AND HERZEGOVINA

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## ABSTRACT

The main objective of the research is to analyze the possibility of introducing the agro-ecological concept through appropriate agro-ecological measures in agricultural policy of Bosnia and Hercegovina. For this purpose, theoretical and empirical studies have been conducted. Theoretical research included analysis of the strategic and regulatory framework in the European Union and Bosnia and Hercegovina and analysis of the development of the concept of agro ecology. Empirical research has included surveying holders of agricultural holdings of subjects according to the Eco Stack project methodology. The survey results confirm that farmers are generally not familiar with the concept of agro ecology, but do apply some of the agro-environmental measures. On the basis of the research results, steps have been proposed to introduce a new model of support for the application of the agro-environmental concept and measures in the framework of agricultural policy of Bosnia and Hercegovina.

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## Introduction

Agro ecology as a practice has developed gradually in recent decades, but it has only recently been promoted through various movements, organizations and institutions, farmers' groups and schools. Agro ecology is not yet clearly part of EU legislation (although it is part of a funding scheme under the existing CAP), but it is recognized as a

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way to improve the environmental characteristics of production. On the other hand, the conservation of biodiversity, including agrobiodiversity, has been a goal of European policy for decades. Measures to support rural development include measures of agro-environmental practices that reduce food losses and waste, soil protection, conservation of water systems, prevention of deforestation and maintenance of biodiversity and ecosystem health.

According to the definition of the United Nations Food and Agriculture Organization (FAO, 2018), agro ecology is an integrated approach that simultaneously applies environmental and social concepts and principles in the design and management of food and agricultural systems. This approach seeks to optimize the interactions between plants, animals, humans and the environment, taking into account the social aspects that must be addressed for a sustainable and equitable food system. Agro ecology is also part of FAO's shared vision of achieving a sustainable food and agriculture system. Until the late 1990s, agro ecology was defined as the ecology of the overall food chain (Francis et al., 2003). The agroecosystem is not only observed at the farm level, but includes all aspects and participants in the food system.

To change the overall food system, it was necessary to provide both political and economic focus (IPES-Food, 2016). This has led to the further development of the definition of agro ecology which can be summarized as follows: "Agro ecology is the integration of research, education, action and change that brings sustainability to all parts of the food system (environmental, economic and social aspects). It is transdisciplinary in value all forms of knowledge and experience in a modified food system. It is participatory in that it requires the participation of all stakeholders - from the farm to the table and all others in between. It is action-oriented as it confronts the economic and political structures of the current industrial food system with alternative social structures and political actions. The approach is based on environmental thinking and a holistic understanding of the sustainability of the food system". This means that agro ecology is science, practice and social movement and all three elements together are needed to drive the transformation of the food system (Gliessman, 2018).

Agro-environmental measures in Europe were defined in the early 1980s. Initially, the measures were defined as a means of resolving conflicts between farmers and government institutions responsible for land conservation measures in important semi-natural areas such as lowland wetlands and mountain areas. The first program of agro-environmental measures under the auspices of the CAP was introduced in 1985 and is designed to protect the habitats and landscapes of agricultural land in environmentally sensitive areas that are threatened by intensification of agriculture. The evaluation of these measures carried out during the 1990s showed that they were justified because they led to significant benefits in the conservation of valuable semi-natural habitats, biodiversity, landscapes, water and land. Based on the results of the socio-economic evaluation, it was concluded that these measures may be a decisive factor that will determine farmers to stay in the agricultural business in situations where they are hesitant. By the end of the last century, these measures have become mandatory in

all EU member states by farmers concluding agreements on a voluntary basis on the implementation of agro-environmental measures under the new EU Rural Development Policy. These measures are supported through the European Agricultural Fund for Rural Development (EAFRD), which has identified a wide range of measures for different environmental, social and economic needs in rural areas (Cooper et al., 2010).

The main goal of the research is to analyze the possibility of introducing the agro-ecological concept through appropriate agro-ecological measures in agricultural policy of Bosnia and Hercegovina, which should contribute to sustainable development of agriculture and rural areas through sustainable use of natural resources, ecosystem conservation, biodiversity conservation and resources to produce and access sufficient quantities of food.

### **Materials and methods**

Theoretical and empirical research has been conducted to assess the possibility of introducing agro ecology as an agricultural system through appropriate agro-environmental measures in the agricultural policy of Bosnia and Hercegovina (BiH).

Theoretical research included analysis of documents at the UN - FAO level, review of selected scientific papers and analysis of strategic and regulatory framework in the EU and BiH. The analysis of relevant strategies and other documents (international and domestic) related to the introduction of the agro-environmental concept in the framework of agricultural policy, at the level of the EU and RS, provides an assessment of the compliance of these acts.

Empirical research has included surveying holders of agricultural holdings of subjects according to the Eco Stack project methodology<sup>5</sup>: survey of subjects, analysis of the possibility of introducing the concept of agro ecology and biometric and statistical data processing. Farmers of different ages, genders and levels of education were interviewed. The list of farmers was obtained from the RS Ministry of Agriculture, Forestry and Water Management (MAFWM) for the Eco Stack project. The households in which the survey was conducted were selected by random sampling within the Farm Household Register of the Republic of Srpska entity of Bosnia and Hercegovina. In total 250 households were sampled from 25 municipalities. The questionnaire included general questions about the farmer and the property and questions related to the application of any agro-environmental measures in practice. Based on the results of the survey, the level of application of agro-ecological measures in BiH agriculture was determined, as well as the level of knowledge of the concept of agro ecology, the importance of sustainable development, biodiversity conservation and introduction of ecosystem measures.

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5 The paper is part of the research project “Stacking of ecosystem services: mechanisms and interactions for optimal crop protection, pollination enhancement, and productivity - EcoStack”. Horizon 2020 project, Grant Agreement No. 773554. <https://www.ecostack-h2020.eu/>

The analytical-synthetic method of studying the mentioned documents and the obtained data of the conducted survey assessed the possibilities for the introduction of a new model of support for the application of the agro-ecological concept and measures within the existing agricultural policy of Bosnia and Hercegovina.

## Results and Discussions

Measures that encourage green farming and enforce environmental rules form a central part of the EU CAP<sup>6</sup>: cross-compliance (standards link financial support to EU rules on the environment, as well as human, plant and animal health); green direct payments put in place mandatory actions (maintaining permanent grassland, crop diversity and ecological focus areas) and rural development policy supports investments and farming activities that contribute to climate action and the sustainable management of natural resources. Out of 13 agro-environmental measures identified in EU strategic framework, 11 EU like measures are found in Bosnia and Hercegovina strategic documents (Table 1).

**Table 1.** Comparison on AEM and practices in EU and BiH as defined in legal documents

Focus areas and AEM measures in EU		AEM like measures in BiH
FA 4A: Restoration, conservation and enhancement of biological diversity; FA 4B: Improving water management; FA 4C: Prevent soil erosion and improve land management.	M01 - Knowledge transfer and information actions	-Improving fertility, quality and cultivation of agricultural land
	M02 - Advisory services	-Sustainable use and maintenance of pastures and natural meadows
	M04 - Investments in physical assets	-Support for the production of organic products
	M07 - Basic services and reconstruction of villages	-Support for integrated agricultural production
	M08 - Investments in forest areas	-Support for measures to protect biodiversity and sustainable use of genetic resources
	M10 - Agricultural-environmental-climate	
	M11 - Organic agriculture	
	M12 - Nature	
FA 5A: Increasing the efficiency of water use in agriculture;	M01 - Knowledge transfer and information actions	Improving water supply in rural areas
	M02 - Advisory services	
	M04 - Investments in physical assets	
	M10 - Agro-environment-climate	
	M16 - Cooperation	

6 [https://ec.europa.eu/info/food-farming-fisheries/sustainability/environmental-sustainability/cap-and-environment\\_en](https://ec.europa.eu/info/food-farming-fisheries/sustainability/environmental-sustainability/cap-and-environment_en)

Focus areas and AEM measures in EU		AEM like measures in BiH
FA 5B: Increasing energy efficiency in agriculture and food processing;	M01 - Knowledge transfer and information actions M02 - Advisory services M04 - Investments in physical assets M16 - Cooperation	
FA 5C: Facilitating the supply and use of renewable energy sources;	M01 - Knowledge transfer and information actions M02 - Advisory services M04 - Investments in physical assets M06 - Development of agriculture and business M07 - Basic services and reconstruction of villages M08 - Investments in forest areas M16 - Cooperation	Investment in renewable energy sources on agricultural holdings - solar and geothermal energy, energy from organic waste
FA 5D: Reduction of greenhouse gas and ammonia emissions from agriculture;	M01 - Knowledge transfer and information actions M02 - Advisory services M04 - Investments in physical assets M06 - Development of agriculture and business M10 - Agricultural-environmental-climate M11 - Organic agriculture M16 - Cooperation	
FA 5E: Promoting the protection and sequestration of carbon in agriculture and forestry	M01 - Transfer of knowledge and action M02 - Advisory services M04 - Investments in physical assets M08 - Investments in forest areas M10 - Agro-environment-climate M13 - Restricted areas M16 - Cooperation	Identification and special support to areas with natural constraints Research and protection of natural heritage

*Source:* own research

However, although many agro-environmental measures are envisaged in the strategic documents at various levels of competences<sup>7</sup>, there are no such measures in relevant laws and bylaws, i.e. in the rulebook on financial incentives for agricultural and rural development. Most measures are only indirectly related to agro ecology. Conservation of biodiversity, protection and sustainable use of genetic resources, conservation of natural landscapes and agricultural systems of high natural value are not recognized as essential values of cultural and natural heritage. In the table below a comparative view is presented of agro environmental support measures in EU and BiH strategic framework.

The results of the survey are given in the following sections: general data on surveyed farmers, application of agro-environmental measures and analysis of applied agro ecological measures.

By analyzing the general data on surveyed farmers, it can be concluded that the average respondent is a male, 46.8 years old, with experience in managing property less than 10 years, he is the owner of the farm, the farm is less than 5 ha in size of agriculture area that is fully in use, it is registered as a commercial farm, it has 1-2 permanent employees or a family member, they practice mixed agricultural production, with corn as the main crop. The average respondent does not apply any standards in production, however, this general picture of the average producer indicates an extensive way of production that largely corresponds to the principles of environmental sustainability. This was confirmed by the answers from the second part of the research. In terms of farm size, this sample corresponds to the average of all farms registered in the Register of Agricultural Farms in the Republic of Srpska: there were 190,861 ha of registered agricultural land in the register, which is an average of 4.48 ha per farm (Strategic Plan for Agriculture and Rural Development, 2016 -2020). In terms of age, the sample also confirms the results of the Pilot Census of Agriculture, according to which the average age of members of mixed farms is 45.8 years (Šegrt, 2019). According to the same survey, 1.49 GRJ (annual work units) are engaged in agriculture on mixed farms, which also coincides with the results of this survey.

The analysis of the Application of agri-environmental measures found that 56% of respondents apply some of the agri-environmental measures. As reasons for the application of these measures, the producers themselves state the following:

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7 According to the Dayton Peace Agreement, Bosnia and Herzegovina (BiH) is a decentralized state consisting of two Entities, Republic of Srpska (RS) and the Federation of Bosnia and Herzegovina (FBiH). In addition, District Brčko was established as a single administrative unit of local self-government and exists under the sovereignty of BiH.

mandatory measures in a certain production system (integrated production, organic production), production for their own use; “healthier” products, less pathogens (Table 2).

**Table 2.** Agro-environmental measures applied

<b>Agro-environmental measures</b>	<b>Reasons for applying the measure</b>
Hotels for wild bees	Better pollination than with honey, especially with pears
Organic compost; grass strips; mulch	Generally healthier products and biodiversity conservation
Nettle solution; garlic solution	Mandatory measures in organic production; Generally healthier products; Preservation of beneficial organisms
Nitrogen fixation with Alfilaria, bee flight control	Bees are important pollinators in our system and their conservation is crucial
Crop rotation.	Crop rotation reduces the total number of pathogens Better yield and fewer pests in general
Nettle spraying; red onions around crops to cut the path of land insects; tomato leaf as a semi-mulch against Phyllostet; crop rotation	Fewer pests and diseases in general
Crop rotation; spraying with nettle and garlic floral ribbons; grass strips; traps; local varieties	I believe in the ecosystem as a whole and try to have such behavior inside and outside the cultivated fields
Crop rotation; manure	Production for own use
Mulch grass;	Integral production in a perennial plantation

*Source: own research*

On the other hand, when it comes to pest control measures, the majority of respondents (56%) use chemical protection measures, citing economy and efficiency as the main reasons. Among other methods of pest control, respondents state the following: use of chemicals in specific conditions: organic preparations (8%), integrated production (4%), a combination of mechanical weed control and chemical pest control (4%), without chemicals except herbicides for maize (4%), mechanical weeding (28%), application of herbal preparations like nettle and garlic solution (8%). A significant number of farmers (24%) are aware that the measures still cause negative effects in the environment (fewer birds, bees, bumblebees), although they do not see the shortcomings of the applied measures in the production itself and consider them effective. Some are aware that these measures do damage to biodiversity, but they do not have enough knowledge or will to switch to sustainable production systems. Those who apply mechanical weed control measures, as the main drawback state that these measures are time and labour demanding.

By analysing individual agro-environmental measures (Table 3), it can be concluded that the mixture of varieties, wild species, crop rotation and sett-aside measure are the most commonly used.

**Table 3.** Application of individual agro-environmental measures

Measure	Share of farmers who apply the measure
Crop rotation	44%
Cover plants	4%
Intermediates (beans in corn)	16%
A mixture of varieties (Combinations of several varieties in orchards and field crops)	60%
Local varieties	40%
Direct sowing	4%
Biological control of harmful organisms	28%
Grass strips	32%
Floral ribbons	16%
Sett-aside of the land	44%
Wild species of animals and plants	56%

*Source: own research*

When analyzing the answers to the question about future plans, 40% of the surveyed farmers have a plan to introduce some agro-environmental measures and practices, 8% of which plan specifically to switch to agro-ecology as a way of production. Out of the 60% farmers who have stated that they do not plan to introduce these practices, 16% farmers are still considering introducing these measures. The reasons why they are not being introduced now are different:

- not enough information,
- if he had good advice, he would introduce it,
- significant measures that can only be introduced under the supervision of experts,
- has no plan now but is willing to introduce them.

Basically, most of the answers are positive towards the introduction of agro-environmental practices, but the main limiting factors are lack of information, insufficient knowledge, the need for professional support and an environment that is not ready to go in that direction.

The findings of other authors also confirm neglecting of agro environmental measures. In its analysis of the agricultural sector in Southeast Europe (Albania, Bosnia and Herzegovina, the Former Yugoslav Republic of Macedonia, Kosovo, Montenegro and Serbia), the OECD states in its 2018 publication: “the current structure of agricultural producer support across the region is market distorting, and thus unlikely to bring about long-term productivity gains. Regulations for agricultural inputs are largely in place, while those for encouraging efficient natural resource use and pollution prevention are being developed. Mrdalj et al. (2016) also conclude that: “The strategic objectives of rural development policy in the Republic of Srpska are largely aligned with the strategic framework at EU level, especially for Axis 1 and 3, while Axis 2 at the Republic of



Srpska level doesn't recognize any of the EU instruments for support of environment and countryside". Žurovec and others (Žurovec and others, 2015) state that: "current BH policy resembles the EU policy in the mid-80s, which will not directly promote productivity increases in BH's agriculture. Budgetary transfers related to direct support to producers and payments based on output form more than 40% of the total agricultural budget". Bajramović also confirm this statement stating that: "identified structure of direct payments in BiH and its entities and a considerable share of output based direct payments are not in favor of European integration and harmonization with the EU CAP" (Bajramović et al., 2016).

### Conclusions

Based on the analysis of the possibility of introducing the agro ecological concept as a way of applying agro ecological measures in agriculture of Bosnia and Hercegovina, conducted through theoretical and empirical research, the following conclusions can be made:

1. The strategic documents for Agricultural and Rural Development for the period 2016-2021 identified a number of measures that correspond to agro-environmental measures at the EU level.
2. The regulatory framework for the implementation of strategic guidelines for agricultural and rural development provides an incentive for only a small number of measures that correspond to agro-environmental measures planned in the strategic framework.
3. Preservation of biodiversity, protection and sustainable use of genetic resources, preservation of natural landscapes and agricultural systems of high natural value are not recognized as essential values of cultural and natural heritage.
4. Surveyed farmers apply a number of agro-environmental measures, although they do not receive incentives for them.
5. Farmers are generally unfamiliar with the concept of agro ecology or schemes of agro-environmental measures, except for the concept of organic agriculture and partly with the concept of integrated agriculture.

Based on all the above, having in mind the preserved natural values of agricultural landscapes of BiH, the share of rural population, the existence of educational programs at agricultural faculties, a small number of support measures that can be classified as agro-environmental measures, the latest CAP proposal and clear calls for transition to agro ecology, the following steps can be proposed to introduce a new model to support the implementation of agro-environmental concepts and measures within the framework of BiH agricultural policy:

1. Establishment of an expert body for the development and application of agro ecology and agro-environmental measures in agriculture in BiH, which will include all actors: producers, consumers, local authorities, protected areas, food industry,

companies in the field of seed and planting material production; local initiatives, the so-called “seed keepers”; schools, kindergartens, scientific and professional institutions, relevant ministries, etc. This body, in cooperation with the authorities, would propose programs to strengthen public awareness, workshops, training, etc., with the aim of establishing a system of changing values on the importance of nature and natural resources as the basis of life.

2. Clear and concrete support for the transition of society to agro ecology, starting from 0) the starting point where there is no integration of agro ecology in agricultural practice on the farm, through several steps: 1) increasing the efficiency of external inputs on the farm; 2) replacement with alternative practices and inputs; 3) design of the overall agro-ecosystem; 4) re-establishing links between those who “grow” and those “who eat”, developing alternative food networks until the final transition to 5) a newly built food system that is sustainable and equal for all.

The first three steps take place at the level of the agroecosystem and the last two at the level of the overall food system; the first two steps are gradual, and the next three steps are really transformation and transition to another system.

### **Conflict of interests**

The authors declare no conflict of interest.

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