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AGRI-ENVIRONMENTAL PRACTICES FOR LAND USE AS A PREREQUISITE FOR BUILDING A SUSTAINABLE AGRI-FOOD SYSTEM

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ABSTRACT
The study analyses the potential of agroecological practices in agricultural land use to ensure increased sustainability of the agri-food system. Conventional agricultural practices are perceived to have an increasingly negative impact on land use, necessitating the adoption of new approaches. In the context of climate change, the role of sustainable land management and its ability to sequester carbon is increasing. The need to support farmers adopting agri-environmental practices is highlighted. The introduction of such practices is seen as a major factor in improving the supply of healthy and safe food.

Key words: agroecology; agroecological practices; sustainable agriculture; sustainable land use; agri-food system

INTRODUCTION

Land use has a global dimension. Many activities related to land and its resources, in particular food production and resource extraction, are subject to global market forces. Growing global demand for feed, food and bioenergy affects local agricultural production in many parts of the world, including Europe and Bulgaria. At the same time, the way in which land and soil is used is directly linked to climate change. Soil contains significant amounts of carbon and nitrogen, which can be released into the atmosphere depending on how we use the land.

In order to achieve sustainable management of land resources, the impact of economic activities, especially agriculture, must be significantly reduced. This will ensure sustainable and productive agriculture, but it must tackle pollution and find new solutions for efficient land use. We must also consider the livelihoods and quality of life of rural communities, ensuring that biodiversity in rural areas is protected.

Land management is a complex exercise, but we all benefit from the services that healthy land and soil provide. To ensure that future generations continue to benefit from these services, decisive action must be taken today. The responsibility for protecting these vital resources lies with everyone, from consumers to farmers and from local to European and global policy makers.

In this sense, the aim of this paper is aimed at investigating the nature of agroecological land use practices and analyzing their application in agriculture to ensure sufficiency of production and build a sustainable food system. Proving the objective implies: clarify the need to implement sustainable agro-ecological land use practices; identify key agri-environmental practices for sustainable land use; importance of agri-environmental practices for climate protection and food chain resilience.

Achieving such results implies compliance with the following assumptions related to the environmental sustainability of agriculture:

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- ✓ There are high ambitions for the EU climate change challenge;
- ✓ Food demand in the EU will be relatively slow in the coming decades and rising incomes in EU countries are shifting consumption towards higher value products;
- ✓ There is a high degree of intensification of European agriculture, leading to soil depletion, increased resource use, etc.;
- ✓ There is an objective trend towards a reduction in the amount of arable land;
- ✓ There are harmful impacts on environmental factors - soil, air quality, climate dynamics, water, biodiversity, landscape, etc. which determines the serious ecological footprint of agriculture on the environment.
- ✓ Conventional agricultural practices have a negative impact on climate and biodiversity and lead to problems with the sustainable use of land resources.

For the purposes of this study, it is assumed that EU agriculture will continue to develop, but on the basis of high environmental standards. It will continue the process of improving resource efficiency, setting high standards to environmental factors, strengthening the sustainability processes of agriculture and land use.

MATERIALS AND METHODS

In line with the stated aim and objectives, the research approach involves different research methods. Analysis, synthesis, deduction and induction are used. Comparative analysis and retrospective analysis were applied within the study. For the purpose of the study, information from FAO, Eurostat and Agrostatistics was used.

RESULTS

Modern agriculture is facing a number of challenges related to population growth, improving access to food, achieving food security, depletion of natural resources, reduction of biodiversity, etc. Increasing aggregate demand for food will affect food prices and food security (1). In addition, global climate change will increasingly affect food production and create difficulties in achieving global food security (2) and will directly affect the development of the agricultural sector (3-4). There are increasing interactions between agriculture and the dynamics of natural resource use, including water quantity and quality, biodiversity, forests and landscapes (5). According to FAO (6), issues of productivity and efficiency in agriculture need to be considered along with achieving farm resilience at the national level and reducing the climate change footprint of agriculture. This implies the implementation of a more holistic approach where the environment in which food is produced is considered along with the people who produce it. Implementing sustainable agricultural models in land use implies focusing on knowledge-based farming practices that provide options to address the environmental, economic and social challenges of conventional agriculture. Globally, there are proposals for technology transfer focused on the global increase in the need for food and agricultural inputs with minimal environmental impacts (7). There are increasing demands for food production with a high degree of safety in terms of population health (8).

Agroecology is seen as an efficient and sustainable model of agricultural production and land use that meets the modern challenges of producing food and agricultural commodities in an environmentally friendly way. In recent years, there have been a number of studies defining agroecology as a science, practice and social movement (9-14). Agroecology can be seen as an interdisciplinary action-oriented approach (15), Agroecology is a contemporary policy integrated into agricultural and rural development policy in a number of countries. It is a key element to integrate the concept of environmental protection with the Common Agricultural Policy (CAP) of the European Union (European Commission).

The shift towards a sustainable model of agriculture and land use implies a paradigm shift towards the implementation of agri-environmental systems. Agroecology applies ecological principles to the design and management of agroecosystems (10). It examines living organisms and their interrelationships in the context of agriculture and land use (11). Agroecology now draws on social, biological and agricultural sciences and integrates traditional scientific knowledge with farmers' knowledge. Agroecological technologies, innovations and practices are intensive rather than capital intensive and are based on knowledge and techniques developed from the experiments of farmers themselves. They are aimed at diversifying farms and the

agricultural landscape, increasing biodiversity, nourishing the soil, improving the utilization of waste in the soil, promoting and judicious use of ecosystem services so that farms are my increasing soil nutrients and regulating pests without resorting to the use of external inputs. Agroecological technologies have a proven ability to sustainably increase productivity, restore soil fertility, and maintain yields over time (10). They can also be seen as the basis for secure farm livelihoods, especially for those of smaller size. Agroecological technologies also have a high degree of climate resilience, and can contribute to mitigating climate change due to the agricultural sector.
The analytical framework of the study of agroecological practices implies the clarification of their nature. It is the understanding of Wezel et al. (16) to consider agroecological practices as agricultural practices that aim to produce significant quantities of food, that best value ecological processes and ecosystem services, integrating them as essential elements in the development of practices, rather than simply relying on conventional techniques such as the chemical application of fertilizers and pesticides, or technological solutions such as genetically modified organisms. They have a strong potential to contribute to improving the resilience of agroecosystems and are based on ecological processes and ecosystem services biological nitrogen fixation, natural regulation of soil processes and soil and water conservation, biodiversity conservation, carbon sequestration, etc. Some of these practices have been applied as traditional for a long time, while others have innovation potential and have been expanding their application in recent decades.

Building on the analytical framework of Hill and MacRae (17) and Wezel et al. (16), three varieties of agroecological practices are described:

1) practices related to increasing efficiency - these are aimed at reducing the resources used and improving crop productivity;
2) substitution practices - these are related to the replacement of some technological solutions by other environmentally friendly ones;
3) practices aimed at redesigning agriculture - practices implying a change of the whole farming system.

Efficiency-enhancing and substitution practices may include: crop and variety selection; segregated fertilization; use of biofertilizers; organic fertilization; drip irrigation; biological pest control, etc. The other group of practices requiring agricultural redesign includes activities such as: crop rotation; multicropping; agroforestry; direct seeding; composting; limited tillage, and others.

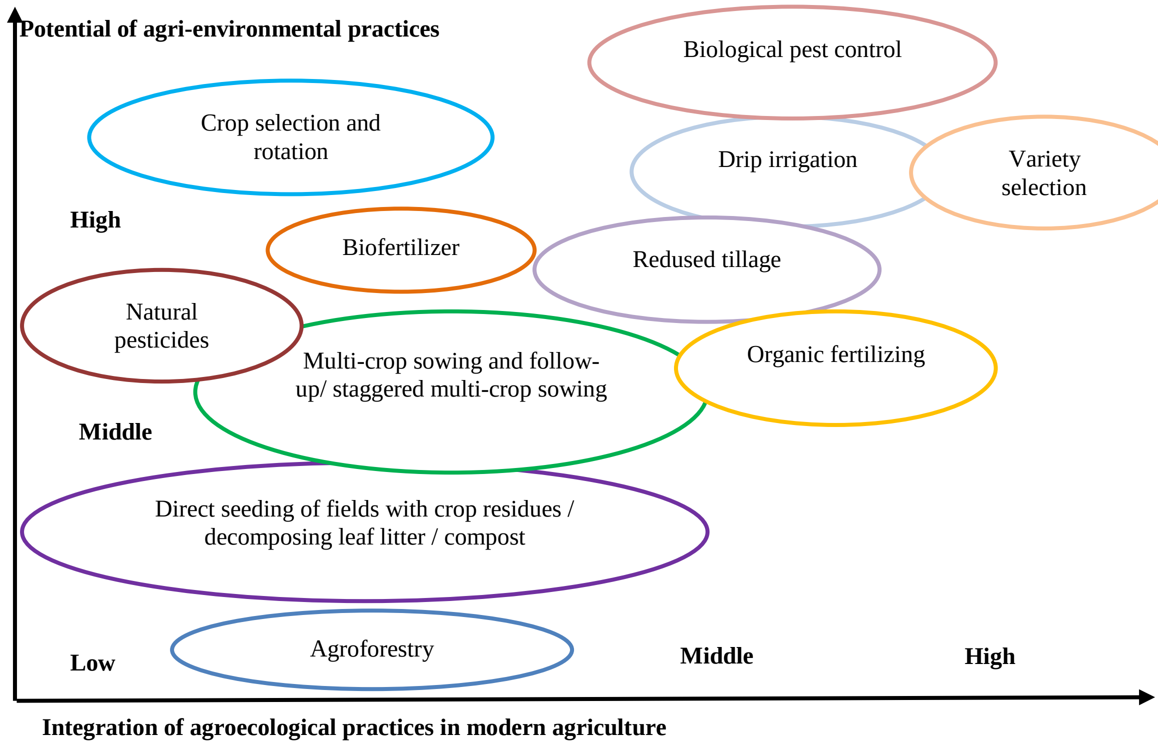
Furthermore, agroecological practices can be distinguished into:

1) Crop management practices - practices addressing crop selection, spatial distribution and rotation; practices related to tillage; practices related to fertilization; practices improving irrigation; practices related to pest management.
2) Land management (landscape) practices - practices that improve the landscape of the farm or area, with the potential to provide habitat for species, improve biological control, and resources for farmers.

The wide variety of agri-environmental practices improving agricultural production and land and protecting the environment have different potential and different level of integration in modern agriculture **(Figure 1)**. In intensive agriculture, the use of such practices is relatively more limited, while in less intensive agriculture and in areas with natural constraints these practices have a much higher potential. Practices related to changing the cropping system have a much lower level of integration because they imply a significant expenditure of time and resources.

Agroecological practices in agriculture can be grouped into 3 main groups, including:

1. Practices for maintaining soil in good agricultural and environmental condition - practices related to crop rotation; practices related to tillage management and practices related to fertilization and crop protection.
2. Practices aimed at protecting and maintaining water quality - practices related to efficient use of water in irrigation and practices related to control of chemical and fertilizer use.
3. Practices related to climate change - biomass utilization practices.



Adapted by Wezel et al. (2014), Agronomy for Sustainable Development. A review.

Figure 1. Potential of agroecological practices and their level of modern integration in agriculture

Crop rotation as an environmental factor is considered in the context of sustainable agriculture. Crop rotation in sustainable agriculture is based on the understanding that plants return more than they draw from the soil as nutrients and minerals. For this reason, the soil must be kept covered with a variety of vegetation for a longer period of time.

The greening of circulation systems should move by imitating the principles on which ecosystems are built. From here, the optimal depletion of natural resources should be used, as well as the relationships between the components of the system should be balanced.

The choice of crops and varieties included in the crop rotation to improve access to nitrogen and water, as well as to overcome the risk of spreading diseases and pests, helps to improve the efficiency of cultivation systems and helps to reduce the use of pesticides. According to Agrostatistics (18), the arable land in the open is 3.236 million ha. (excluding garden vegetables), as on 94.8% of the area (57.7% of the farms) more than 75% of the land is included in the crop rotation. In 31.5% of growers, only 1.2% of the land does not have crop rotation - these are mainly small farms growing one crop **(Table 1).**

Table 1. *Groups according to the percentage of arable open land included in the rotation*

Indicator	Farms	Arable land
>= 75%	57,7%	94,8%
>= 50% и < 75%	6,2%	2,3%
>=25% и < 50%	2,9%	1,2%
>0% и <25%	1,7%	0,5%
0%	31,5%	1,2%

Source: Agrostatistics, Ministry of Agriculture, forestry and food, 2016 (18)

Soil tillage as an ecological factor is considered from the point of view that it aims at creating suitable conditions for germination and development of cultivated plants, limiting the number or destruction of competitors of sown crops, etc. In addition to the positive effects of tillage, there are also negative ones, such as prolonged tillage often leads to a reduction in humus content, intensive tillage destroys the soil structure and intensifies the processes of water and wind erosion, prolonged passage of agricultural machinery on the soil surface causes soil surface compaction and deterioration of aeration and permeability.

From a global environmental perspective, a distinctive feature of modern agricultural tillage technologies is the strong tendency to minimize such tillage, creating the conditions for cultivated plants to grow with minimum energy and material expenditure, but preserving and enhancing soil fertility. Minimum tillage practices vary according to their specific nature and degree of minimization - direct drilling, no tillage, reduced tillage, etc. The retention of crop residues in the surface layer due to minimum tillage helps to protect the soil from erosion as well as overcoming drought during winter moisture accumulation.

The shift from conventional farming to conservation practices (reduced tillage or direct seeding) is an essential opportunity to conserve and improve natural resources and biodiversity. According to Nikolov (19), conservation tillage helps to reduce energy consumption, reduces soil erosion and compaction, increases the activity of soil dwellers and organic matter, and improves the soil's ability to sequester carbon. By reducing tillage, farmers can reduce their production costs by 30-40% compared to conventional farming.

Experience in the country shows that conventional tillage is still the predominant tillage practice, applied by 83.6% of farms on 55.2% of the area. The number of farms applying minimum tillage is increasing to 27% (41.2%) of the area, but the number of farms applying direct drilling on 4.8 thousand ha is still limited. (0.1% of the open areas) **(Table 2).**

Table 2. *Methods of cultivating arable land in the open*

Types of tillage	Farms		Arable land	
	number	%	ha	%
Traditional inversion tillage	94 956	83,6%	1 790 776	55,2%
Conservation, minimal tillage	30 652	27,0%	1 336 894	41,2%
Direct sowing with minimum tillage	91	0,1%	4 845	0,1%
Arable land:	113 640		3 242 908	

Source: Agrostatistics, Ministry of Agriculture, forestry and food, 2016 (18)

The introduction of limited tillage has high ecological potential, but is more difficult to integrate into modern agriculture given the need to redesign the farming system as a whole and to invest heavily in upgrading technical assets. This is a major challenge especially for smaller farms, but has great potential for modern intensive agriculture, providing it with greater sustainability.

Fertilization and crop protection systems, in terms of their greening, must be differentiated according to the agro-ecological requirements of the crops and their specific ability to exploit the favorable environmental conditions, to absorb and utilize mineral substances, and to respond with a corresponding increase in yield. Solving plant protection problems in sustainable agriculture relies primarily on the activation of internal mechanisms to regulate agroecosystems, rather than relying on anthropogenic interference alien to nature. A modern tactic and strategy for plant protection is being developed - Integrated Pest Management (IPM), which is based on an ecological approach to controlling plant diseases and pests.

The use of natural pesticides is an agroecological practice that replaces the use of synthetic pesticides and overcomes the negative effects of the use of the latter. Biological pest control reduces the risk of environmental and human health pollution. But the application of biological pest control is still limited, mainly to organic farming. Although having high potential as an agri-environmental practice, biological control still has difficulties in implementation due to its efficacy, the need for improved management, significant costs and the need for strong knowledge on the part of farmers. Currently, the use of chemical pesticides is predominant in agricultural production in the European country (20), with Agrostatistics of Bulgaria (18) reporting that herbicides are used on 70.5% of the agricultural area, fungicides are used on 53.2% and insecticides are used on 46.6%. The nature of chemical application in agriculture in the country is a consequence of its intensive nature, but in almost 1/3 of the areas no chemical protection agents are applied, which is a great potential for organic agricultural production, especially by smaller sized farms that can more easily implement this practice.

The analysis of the potential for the implementation of sustainable agro-ecological land use practices in agricultural production in the country shows that they have great potential for development in the coming years, but their implementation may require significant resources as well as a redesign of farming systems. Determinants of agroecological practices for the future will be the choice of varieties and crops, organic fertilization, reduced tillage, drip irrigation, biological pest control, which are high potential and with relatively high levels of integration. Small farms can be more flexible in terms of adopting environmentally friendly practices. But this requires a new look at the agrarian policy applied.

A new approach to land use implies a change in behavior by all stakeholders - farmers, agroforesters, conservation bodies, corporations, government. Multi-stakeholder action needs to be mobilized. The large number of actors involved in land use, the variety of motivations, the diversity of activities covered, the variability and uncertainty associated with biological systems create a more complex challenge for the necessary transition to a sustainable food system. In addition, a delicate balance must be struck between climate mitigation, adaptation, ecosystem restoration, food and fibre supply and responsible management of the external environmental footprint. In order to achieve land use change, ten key areas for policy intervention are identified (21): awareness raising; the need for information dissemination, skills and training; regional land use planning; providing financial incentives; overcoming barriers related to access to finance; balancing land use controls and regulations; developing effective monitoring systems; improving market access, etc.

Agriculture in the country needs to realize its dependence and impact on changing natural and climatic conditions. In one sense, this does not require the introduction of measures and activities that enable agriculture to adapt to a changing environment and those that have a positive impact on climate change and promote sustainability on farms.

The means to achieve sustainability of food production should be sought in the CAP. The need for changes in direct payments implies: introducing the extension of the environmental component; supporting sustainable production in areas with specific natural constraints; introducing simplified support schemes for farms offering environmental practices; simplifying cross-compliance rules.

Reducing agriculture's negative impact on the climate cannot be achieved without making fuller use of the world's existing knowledge, technologies and good practices. Measures to reduce the use of fertilisers and pesticides, rational water management, sustainable management of animal waste, increasing the share of renewable energy sources have a positive effect on the climate and reduce production costs. The environmental effect is lasting and positive, but it must be combined with maintaining production levels. In this respect, there is a need to integrate into support policy and the introduction of sustainable production systems related to land use, such as conservation agriculture, organic farming, integrated production of plants and plant products, precision farming, (22) etc.

1) Conservation agriculture has a number of advantages at global regional and company level. According to Nikolov (19), conservation agriculture is a system that not only conserves, but also improves natural resources and biodiversity without requiring a reduction in yields. By reducing tillage, farmers can reduce their production costs by 30-40% compared to conventional farming, which affects air pollution. Conservation tillage improves soil surface runoff and reduces soil erosion. This system is based on biological processes and consequently improves biodiversity in the agricultural production system. Conservation agriculture should not be seen as a low-productivity system. It produces yields comparable to those of modern intensive farming, but is characterized by high sustainability.
2) Organic farming - a production system which avoids or completely excludes the use of synthetic fertilizers, pesticides, growth regulators and additives to animal

feed, and which relies on crop rotations, crop residues, manure, green manuring and organic plant protection to maintain and improve the soil nutrient regime.

3) Integrated production of plants and plant products - uses advances in technology in the cultivation and protection of crops and combines different methods and tools for pest management.
4) Precision agriculture is a modern concept of production. It is seen as a complex system designed to optimize agricultural production by using crop information, modern technologies and methods. It implies the implementation of a unified approach including tillage, sowing, application of plant protection and fertilization, harvesting. The sustainability of the system is implied by a more efficient use of energy, soil and water, with a high level of production and quality of agricultural output.

All sustainable farming and land use systems have their advantages and disadvantages, knowledge of which is important for implementing them in modern practice and determining their effects. Their implementation and development in practice would be of great importance for modern agriculture, but a policy approach to their implementation needs to be adopted:

- ✓ The benefits of adopting sustainable farming and land use systems are particularly large for small farms. They can be found in the following areas:
- ✓ helping to make the best use of the potential of ecosystems and natural biomass cycles, and of land management broken down into different ecological, social and economic components;
- ✓ minimize negative socio-economic impacts on the environment;
- ✓ promote the involvement and knowledge of small-scale food producers and enable farmers to have greater control over resources;
- ✓ emphasize issues of equity, indigenous autonomy and natural resource conservation.

Small farmers have great potential to adapt more easily to the risks of climate change, but significant public support is needed for this adaptation. They are also a source of innovation, both in terms of production methods and at social and institutional level. This implies providing additional public funding specifically for small farmers, with a clear list of agricultural practices that are beneficial for the environment and the climate. There is also a need to redirect agricultural subsidies towards small farmers involved in the transition to agroecology, rather than supporting intensive farming patterns that are incompatible with the necessary changes. Funding should serve to identify and replicate local knowledge and innovations (technical, social and institutional) in climate change adaptation.

It can be summarized that intensive agricultural production systems and land in the EU that show unsustainable implementation should be transformed to ensure greater resilience and to meet the contemporary needs of society. The transformation of the EU food system and land use is imperative to meet the challenges of climate and biodiversity emergencies, improve diets and health and create more sustainable, economically viable land management businesses. The European Green Deal proposal is an attempt to understand this challenge.

CONCLUSIONS

The challenge for the rural agricultural sector in the EU is to realign both the production and consumption of the main marketed foods from the land along a sustainable development path and in the process to redistribute land and reorient land management towards environmental services. Intensive agricultural production systems have large sectors that can be described as environmentally, economically and socially unsustainable, making it necessary to seek changes in technology and policy. Modern agriculture needs practices that ensure the economic, social and environmental viability of farms, especially smaller farms. In this sense, the role of agri-environmental practices can be significant in increasing the sustainability of farms in the EU and at home.

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