

## Opportunities for Application of the Bioeconomy in Rural Areas - Principles and Practice

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### Abstract

*Bioeconomy is an innovative approach in the economy of the region, aimed at integrating the available natural and labour resources, production facilities, the achievements of science in the field of innovation technologies. These are related to the production of material goods, the conversion of production and energy in the direction of fuller utilization of organic and mineral sources as a raw material resource for achieving sustainable development in the field of production and consumption, stable economic development and growth living standards of the population while protecting the environment and resources. The aim of the report is to analyze the possibilities for applying the bioeconomy in rural areas through research and innovation, stimulating private investment, developing new value chains and engaging stakeholders. The role of the CAP in supporting and financing activities of the bio and circular economy models is argued.*

*Keywords: Bio economy; CAP; circular economy; environment; resources*

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### Introduction

Agriculture and forestry are an integral part of the rural economy. They provide the basis for food, feed and non-food products to meet the needs of consumers and a wide range of industries developing in the area. About 70% of the EU's land area is covered by forests or agricultural land, which is why primary production activities have a huge impact on the integrity of rural areas in terms of preserving natural capital, quality of life and job creation.

In recent decades, there has been a remarkable increase in the productivity of the agricultural and forestry sectors, but in part this is at the expense of environmental pollution. The growing world population together with economic growth and changing consumption patterns further increase the demand for primary products. This leads to pressure to increase agricultural productivity, which is accompanied by declining natural resources and the effects of an increasingly changing climate. Coordinating production with the sustainable management of land and other natural resources is considered a major challenge for current and future agricultural and forestry systems. Research and innovation are crucial to support the transition to more sustainable, "triple-efficient" types of primary production, covering economic, social and environmental goals. As the European Commission notes, "We live in a world of limited resources. Global challenges such as climate change, land degradation and ecosystems, combined with growing demand for food, feed and energy, are forcing us to look for new ways to produce and consume. A sustainable and circular bioeconomy contributes to addressing these challenges." (European Commission, 2018)

### 1. The concept of bioeconomy - characteristics, goals and objectives

Bio economy is thought to be closely linked to the early development of theories of fishing economies, mainly in the mid-1950s by Canadian economist Scott Gordon (Gordon Scott, 1954).

The authors base their ideas on the achievements of the time in biological fishing modeling. In support of their thesis are the works of M. B. Schaefer (Schaefer, 1957), who establishes relationships between fishing activities and biological growth through mathematical modeling. Empirical research confirms the link between economics and ecology, the environment and resource protection.

The terms "bioeconomy" or "bio-based economy" were used in the first years of the 21st century (Kamm &Kamm, 2004) and a few years later bioeconomy entered the political discussions

in the European sphere (European Commission, 2012).

However, the theory of the bioeconomy stems from earlier strategic programs of the European Commission (EC), including the 1993 White Paper, which emphasizes the need for non-physical investment based on knowledge and the role of biotechnology in innovation and growth (European Commission, 1993). The 2000 Lisbon Agenda requires global leadership in the knowledge-based economy to ensure competitiveness and economic growth (European Commission, 2000).

The conference in 2007 outlined the prospects for the European bioeconomy over the next 20 years (German Presidency, 2007 ) to establish:

- knowledge-based bioeconomy in European political circles;
- the bioeconomy as a key component for smart and green growth (European Commission, 2000) .

According to modern economic views, "the bioeconomy can be defined as an economy in which the basic building blocks for materials, chemicals and energy are obtained from renewable biological resources" (Kes McCormick & Niina Kautto, 2013).

The main goal of the bioeconomy is the maximum utilization of all organic and mineral raw materials obtained from agricultural production, forestry, fish farming, aquaculture, industry. Through the achievements of innovative biotechnologies and nanotechnologies their transformation into by-products for final consumption. and energy, achieving a full cycle of substances and increasing energy independence from depletable energy sources at the expense of inexhaustible ones.

The main task of the bioeconomy is to achieve sustainable development in the agricultural sector, forestry, industry, energy, improving market sales, increasing employment of the population, increasing the competitiveness of the economy.

An important role in achieving the mission and goals of the bioeconomy is played by the active involvement of science and the application of innovative achievements in the processes of production and transformation of production, the use of biotechnologies related to the participation of microorganisms, the achievements of genetics for productivity, adaptability of plants and animals in the agricultural sector, nutrigenetics and nutrigenomics, the intersection between genes, nutrition and health, improving the quality and nutritional value of products and diversifying the range of products, the introduction of specific regional, branded and boutique products.

Bioeconomy as an innovative direction in the organization of the use of natural resources, expanding the production of energy from renewable and inexhaustible energy sources and consumer products, fair distribution of material goods, ensuring employment and environmental protection requires the coordination and active participation of workers in the production sphere, the representatives of the small and medium enterprises, the industry, the business, the science, the managers at the local, municipal and regional level and the consumers.

From the point of view of rural development, the bioeconomy is an innovative approach to solving the problems of the population by integrating the available natural and labor resources, production capacities, the achievements of science in the field of innovative technologies related to the production of material goods. energy, for fuller utilization of organic and mineral sources as a raw material resource for achieving sustainable development in the field of production and consumption, stable economic development and raising the living standard of the population while protecting the environment and resources.

## **2. The bioeconomy as an element of the EU's Common Agricultural Policy (CAP)**

Today's European bioeconomy encompasses agriculture, forestry and fisheries, the food sector, bioenergy and the organic products sector. It generates an annual turnover of 2.3 trillion euros and provides employment to about 18 million people. It is estimated that organic products-based sectors could create up to one million green jobs by 2030, especially in rural and coastal

areas. These figures not only emphasize the importance of the existing bioeconomy for the European economy and society, but also point to opportunities for better integration of activities from different sectors and expansion of the production of bio-based products. Europe is considered a world leader and pioneer in a number of areas of life sciences and related technologies. However, the United States and some Asian countries, such as China, are investing heavily in the bioeconomy. One such indication is the National Bioeconomy - a US Plan (White House, 2012) published in 2012 to strengthen its work on the bioeconomy and bio-based products. Because Europe is believed to be lagging behind these countries in market development (Maximilian Kardung&all, 2021).

Although the bioeconomy already accounts for a significant share of the EU economy, the EU strategy of 2018 signals its potential to give even more to the economy, more to society and more to the environment.

A sustainable bio-economy, while beneficial to all, is of particular importance to rural communities. The bioeconomy depends on biological resources (plants, animals, microorganisms and extracted biomass, including organic waste), which are produced mainly in rural areas. It employs primary producers of agricultural and forestry products. The processing and distribution of organic products, from food and feed to fuels and materials, creates new opportunities for processors, retailers and consumers, especially in rural areas but also outside them.

The political impulse behind the bioeconomy is aimed at creating and retaining jobs; reduced emissions and reduced dependence on fossil resources, renewed and strengthened EU industrial base and modernized primary production, as well as ecosystem restoration and enhanced biodiversity.

In practice, there is no single bioeconomy in Europe, but several different ones adapted to local conditions and assets. In terms of rural development, the bioeconomy can cover a wide range of sectors. It includes, but is not limited to: terrestrial ecosystems and the services they provide; agriculture and forestry as primary production sectors that use and produce biological resources; and the processing and production of food, feed, organic products, energy and services. The fact that biomass processing is most efficient at source, due to reduced transport costs and associated greenhouse gas emissions, as well as the variety of agricultural by-products suitable for biomass, underscore the strong economic potential of the bioeconomy for rural areas.

The European Agricultural Fund for Rural Development (EAFRD) supports a wide range of rural bioeconomy projects as well as awareness-raising activities to provide key investments to enable the transformation of the bio-economy in rural areas.

The bioeconomy is part of the nine objectives of the CAP. The main documents supporting the bioeconomy are:

- Europe 2020 Strategy - the goal is to develop the bioeconomy as a key element for smart and green growth in Europe.
- Strategy "Innovation for Sustainable Growth: A Bioeconomy for Europe". In 2012, the first bioeconomy strategy was presented. The aim is to use resources sparingly, sustainably using renewable resources for industrial purposes and environmental protection.
- In 2018, the European Commission updates the strategy for the bioeconomy "Sustainable Bioeconomy for Europe: strengthening the link between the economy, society and the environment." The aim is to strengthen the development of a sustainable European bio-economy in order to correspond as well as possible with the UN Program and the Paris Agreement on Climate Change. The EU's Bioeconomy Strategy 2018 defines the bioeconomy as "those parts of the economy that use renewable biological resources from land and sea, such as crops, forests, fish, animals and micro-organisms, to produce food, materials and energy." [6]
- The Horizon 2020 Research and Innovation Program supports the rural bioeconomy.
- RDP 2014-2020 direction "Food security, sustainable agriculture and forestry, marine and inland water research and bioeconomy".

The RDP 2014-2020 plays an important role in the introduction of the circular economy model. It has an impact on the conservation of biodiversity, resource efficiency, sustainable use of natural resources, adaptation of economic activity to climate change. The Program aims to achieve cross-sector objectives related to the bioeconomy, innovation in agricultural and non-agricultural activities and achieving sustainability in rural development.

Some of the measures in the RDP 2014-2020 support the preservation of water quality, protection of natural landscapes and rare breeds of animals and plant varieties, protection of important habitats and biodiversity in lands of high natural value, promotes sustainable land management, undertake various measures to preserve carbon stocks in the soil and act in the direction of preventing soil erosion and floods, stimulate the development of organic farming.

Priority areas set out in the RDP 2014-2020 and related to the circular economy are:

Priority 1 - Stimulating innovation, cooperation and knowledge base development in rural areas; Strengthen the links between agriculture, food production, forestry and research and innovation, including with a view to improving environmental governance and environmental performance. Priority 4 - Restoration, protection and strengthening of biological diversity; Improving water management; Prevent soil erosion and improve their management.

Priority 5 - Increasing the efficiency of water consumption in agriculture; Increasing the efficiency of energy consumption in agriculture and the food industry; Facilitating the supply and use of renewable energy sources, by-products, waste and residues, and other non-food raw materials for the purposes of the bioeconomy; Reduction of greenhouse gas and ammonia emissions from agriculture; Stimulating carbon storage and absorption in the agriculture and forestry sector.

According to the future Common Agricultural Policy, the European Commission will not approve a Member State's national strategic plan that does not include the promotion of the bioeconomy in agriculture.

Through the national strategic plans set out in the proposals for the new CAP, all Member States will outline how they want to achieve these 9 objectives, including the promotion of the bioeconomy, using CAP instruments.

EU member states will have more freedom under the EC's proposal for the future CAP, which will allow them to focus on their bioeconomy and respond to the higher ambitions of future environmental and climate change policy.

Globally, the bioeconomy has significantly gained in importance in recent years as a broad range of potential benefits has been detected by several countries. Amongst others, the EU and the OECD have emphasized the need for increased international cooperation to further facilitate the development of bioeconomic activities.

### **3. Application of the bioeconomy in rural areas**

The European Network for Rural Development (ENRD) is the structure that brings together all the stakeholders aiming to achieve improved rural development results in the EU. The network serves as a hub for the sharing of information about how Rural Development policy, programmes, projects and other initiatives are working in practice and how they can be improved to achieve more. A Thematic Group (TG) is working from September 2018 to July 2019, open for all stakeholders and public interested in bioeconomy. The overall objective is to encourage the development of sustainable bioeconomy value chains in rural areas.

Food production and agriculture are the dominant segments of the bioeconomy in terms of employment, turnover and value added. The need to apply the principles of a resource-efficient circular economy throughout the food system and by consumers is widely recognized. Environmentally sustainable food systems involve building 'climate-smart' food systems adapted to climate change, conserving natural resources and contributing to climate change mitigation. Applying the principles of a resource-efficient circular economy throughout the food system will reduce the impact on the environment. Similarly, circularity means that food and waste losses are

minimized throughout society.

Food and agriculture systems are a key part of the bioeconomy, but they urgently need to be transformed to become more resilient, more sensitive to food, stable and inclusive. The alternative and more sustainable sources of protein for animal consumption are one of the ways in which the bioeconomy can yield results. In Denmark, an EAFRD project uses food waste to raise insects for feed.

New processing technologies can support the production of healthier foods and higher value-added products, with a positive impact on value chains and the food industry. A notable example is the Slovak EAFRD-funded project supporting the production of higher quality soy flour.

A sustainable bioeconomy can turn biowaste, residues and discarded raw materials into valuable resources and create innovations and incentives to help retailers and consumers reduce food waste by 50% by 2030.

Some of the main activities related to the bioeconomy are the production of biomass, biogas, manure, biodiesel.

Bioenergy is the largest renewable energy source in the EU and is expected to remain a vital component of the energy mix until 2030. The European Agricultural Fund for Rural Development (EAFRD) helps farmers, foresters and rural communities to make the most of their biomass .

Bioenergy is renewable energy created from biomass - plant or animal material, such as manure, plant residues or wood, usually obtained from by-products. Biomass in agriculture is obtained from the main yield of agricultural crops (economic biomass) and residues (solid waste) after harvest. Biomass is used for food, feed, production of biobased products and energy. Waste products are becoming more and more used as attention is paid to sparing land use and maintaining a balance between food and feed production on the one hand and bio-based products on the other. Although at a higher cost, the utilization of waste products leads to more efficient use of resources and environmental protection.

The production of basic biomass in agriculture in the country in 2019 amounts to 15.1 million tons, which is 2.6 times more than in 2007. The highest growth is in industrial crops, and the largest volume is biomass from cereals .

In the production of biogas, various raw materials of agricultural origin are used - silage corn, manure, grass silage, livestock waste, etc. 40% of the production of biogas from agricultural substrates is obtained from silage corn. In 2019 185.6 thousand tons were used, ie nearly 87 thousand decares are intended to serve the production of biogas from the harvested 299.3 thousand decares. On the other hand, 277,000 dairy cows need 1,260,000 tons of silage, which requires 590,000 decares, or twice as much as the harvested ones. Therefore, the shortage is 291 thousand decares, without silage corn being used for biogas production, and when using it - 378 thousand decares.

A number of energy projects have been funded with EU assistance. In Belgium, a study has been carried out on the production of biogas and the successive development of a biomethane plant. In Sweden, a group of farmers is expanding the capacity of a biogas plant that converts agricultural and household waste into renewable fuel, allowing them to take advantage of a good business opportunity. In this way, they help to diversify the local economy, while increasing the competitiveness of farms and reducing the cost of buying fertilizers. In the future, the company aims to produce more biogas for vehicles and plans to increase the amount of processed manure in the plant by hiring more farmers.

Manure is increasingly used for on-site biogas production on farms. It is only one of the substrates involved in the production process. There is no data on the amount used to produce biogas, but indicative estimates can be made. Assuming that biogas from anaerobic substrates is produced from agricultural raw materials and that 40% of the produced biogas is from manure, as it is only one of the substrates, 18.2 t.

Biodiesel is produced mainly from rapeseed and sunflower and belongs to the category of

"first generation biodiesel". Produced from organic waste (used animal and vegetable oils and food waste) is second generation biodiesel. According to the Law on Energy from Renewable Energy Sources, the biological component in diesel fuel should be 6%, of which 5% biodiesel first generation and 1% - second generation. In 2018, the mandatory use of second-generation biodiesel was introduced, but no significant change is expected in the amount of energy crop production, which significantly exceeds the amount that is processed in the country into biodiesel. Sunflower exports are mainly to the Netherlands and Germany, and the rapeseed exports to Belgium, Germany and France.

The sustainable bioeconomy of rural areas depends on many factors, including the creation of sustainable and local value chains that promote the circular use of biological resources. Understanding the specific bioeconomic profile of a rural area will best determine the types of value that local biomass can provide. The Quality Suber SL project in Spain, for example, contributes to the development of the local value chain and promotes the sustainable management of Catalan cork oak forests by improving the processes of purchasing, preparing and commercializing cork. In rural Finland, a start-up company produces wood fiber-based biocomposite and explores business growth opportunities.

Bioeconomy activities are not necessarily sustainable. The use of biological resources and the production of biomass for food, feed, fuel and bio-based products can have both positive and negative environmental and socioeconomic impacts. The debates and experience related to bioenergy attest to this. Of paramount concern is that the development of the bioeconomy does not undermine food security, especially in areas with high levels of malnutrition. This includes the impact of environmental microbial resources on the composition of the human microbiome, which plays a role in preventing or contributing to malnourishment, including obesity, and other non-communicable diseases. Moreover, the combination of bioeconomy and digitalization and often seen as major drivers of the transformation of productive sectors. Almost fifty countries have placed the promotion of the bioeconomy on their political agendas, including the creation of dedicated visions, strategies and action plans. (Gomez San Juan & all, 2019).

The agriculture and forestry sectors have been creating value in the European economy for several generations. Now, in addition to their traditional roles, farmers and foresters are at the heart of the European bioeconomy. They provide huge amounts of biological resources that are already being transformed or have the potential to be transformed into new, innovative products and are driving the move away from non-renewable materials and energy sources. The goal of moving towards a carbon-neutral society, in line with the European Commission's long-term strategy for 2050 "Clean Planet for All", as well as the EU's Bioeconomy Strategy, involves replacing petroleum and non-renewable materials with biological ones. This includes the conversion of organic waste, agricultural and forestry residues and industrial processes, and food waste into valuable and safe bio-based products to meet the goals of the circular economy.

### **Conclusion**

The development of the bioeconomy is an opportunity to find solutions to societal challenges in rural areas related to ensuring food security; expanding information on the bioeconomy and strengthening the dialogue between society and bioeconomy stakeholders; reducing dependence on non-renewable resources; limiting climate change, protecting biodiversity and natural resources; stimulating employment, economic growth and competitiveness; full participation of the agricultural sector in building an innovative economy that combines the pursuit of food security and sustainable development of the sector with the use of renewable biological resources for industrial and energy purposes, ensuring biodiversity and environmental protection. This vision is fully compatible with the strategy for the development of the bioeconomy as a means of achieving sustainable rural development, opening new market niches, improving the organization of production processes and sales of organic products, creating clusters involving all participants in

the conversion chain of raw materials in products, increasing gross value added and increasing its competitiveness.

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