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BIOECONOMY: PROSPECTS FOR THE SUSTAINABLE DEVELOPMENT OF AGRIBUSINESS

Introduction

On 22 June 2022, the European Commission adopted ground-breaking proposals to restore damaged ecosystems and restore nature across Europe, from farmland and seas to forests and urban environments. The European Commission also proposes to reduce the use of chemical pesticides by 50% by 2030. These are flagship legislative proposals that follow the Biodiversity and Farm to Fork strategies and will help ensure the sustainability and security of food supplies in the EU and around the world.

The Nature Restoration Act proposal is a key step in avoiding ecosystem collapse and preventing the worst effects of climate change and biodiversity loss. Restoring wetlands, rivers, forests, grasslands, marine ecosystems, urban environments and the species they host is an important and cost-effective investment: in our food security, climate resilience, health and well-being. In the same vein, new rules on chemical pesticides will reduce the ecological footprint of the EU food system, protect the health and well-being of citizens and agricultural workers, and help mitigate the economic losses we are already suffering from declining soil health and the loss of pollinators , caused by pesticides.

Purpose, subject and research methods

The purpose of the article is to reveal the perspectives of the bioeconomy for the sustainable development of agribusiness.

Research methods: general scientific methods: analysis, synthesis, induction, deduction, systems approach and modeling – to study the theoretical issues of forming a strategically-oriented model of sustainable development; generalization method – for the formation of a strategically oriented model of sustainable development.

The research methodology involves the use of general scientific and specific methods used in economics, ecology and biotechnology, and is based on an interdisciplinary approach.

The scientific novelty of the obtained results is to determine the directions of development of Ukrainian bioeconomy based on the use of biotechnology in food, agricultural and environmental sphere.

Research results

The European Green Deal sets the EU's ambition to become climate neutral by 2050, safeguarding people, planet and prosperity. The transition to a modern, resource-efficient, prospering and competitive economy, in which environment, health and wellbeing are priorities, requires deep and widespread action across all sectors of the economy.

The Bioeconomy Strategy, with its systemic perspective, plays an important role in achieving climate neutrality and environmental, economic, and social sustainability.

Bioeconomy encompasses all sectors and associated services and investments that produce, use, process, distribute or consume biological resources, including ecosystem services. As such it is a natural enabler and result of the European Green Deal transformation

Bioeconomy policies take a cross-sectoral perspective to improve policy coherence and identify and resolve trade-offs, for example on land and biomass demands. Bioeconomy policies contribute to build a bioeconomy addressing all three dimensions of sustainability:

1. Environment: management of land and biological resources within ecological boundaries;
2. Economy: sustainable value chains and consumption;
3. Society: social fairness and just transition.

The 2018 Bioeconomy Strategy complements sectoral policies and enables countries and regions to design transition pathways according to their specific challenges and opportunities, benefitting from a non-prescriptive, integrated and systemic framework.

This review has also identified gaps in the current Action Plan that require further action. First, increased focus on how to better manage land and biomass demands to meet environment and economic requirements in a climate neutral Europe. Second, work on more sustainable consumption patterns to ensure environmental integrity.

The bioeconomy is now more important than ever to contribute to the green and fair transition in Europe. The EU Bioeconomy Strategy has shown to be successful; yet continued implementation of the Action Plan should put an increased focus on better management of biological resources and sustainable consumption patterns [1].

Our current fossil-based economy has reached its limits [2] and the transition to a new societal and economic model, based on the sustainable and circular use of resources, has become one of the Union's core tasks.

To tackle this challenge the European Commission adopted a Bioeconomy Strategy in 2012 [3], and updated it in 2018 [4]. The updated Strategy reaffirmed the five original objectives: ensure food and nutrition security, manage natural resources sustainably, reduce dependence on non-renewable, unsustainable resources, mitigate and adapt to climate change and strengthen European competitiveness and create jobs. These objectives, in line with the targets of the European Green Deal, are now more relevant than ever, following the unprovoked Russian invasion of Ukraine and the need to speed up achieving independence on energy [5] and to strengthen food security [6]. The EU Bioeconomy Strategy enables a green and just transition and covers all three dimensions of sustainability: environment, society and economy.

To reach these objectives, the updated Bioeconomy Strategy was accompanied by a targeted Action Plan along three main action areas: (1) strengthen and scale-up the bio-based sectors, unlock investments and markets; (2) deploy local bioeconomies rapidly across Europe; and (3) understand the ecological boundaries of the bioeconomy.

The Council of the European Union recognised the importance of the bioeconomy as a major component for the implementation of the European Green Deal [7].

Bioeconomy is a natural enabler and result of the European Green Deal transformation.

Bioeconomy governance is crucial to maximise synergies and resolve trade- offs.

Bioeconomy policies should be built on all sustainability dimensions:

- management of land and biological resources within ecologic boundaries;

- sustainable value chains and consumption; and social fairness and just transition.

The concepts of bioeconomy and of bioeconomy policy have evolved from the first EU Bioeconomy Strategy in 2012 [3], to the updated 2018 Bioeconomy Strategy [4]. The bioeconomy covers all sectors and systems that rely on biological resources (animals, plants, micro-organisms and derived biomass, organic waste), their functions and principles. The EU Bioeconomy Strategy can help to identify, assess and address trade-offs between policy targets and competing uses of land, sea and biomass [8] in order to optimise the use of material resources and services, including ecosystem services. This allows to identify win-win solutions that generate economic gains, preserve the environment, and increase resilience and capacity for recovery.

Bioeconomy governance is crucial to maximise synergetic effects of sectoral policies [9], create a level playing field and to frame coherent sustainability criteria across policy areas. Fostering interministerial cooperation, policy coherence and vertical coordination at local, national, EU and international levels allows the bioeconomy to fulfil its potential.

Bioeconomy policies help to build a bioeconomy based on all sustainability dimensions [10]. They enable all people to enjoy a 'bio-based' lifestyle, providing them with bio-based material (food, fibre, bio-based materials, energy) and non-material (clean air and water, biodiversity, climate mitigation and adaptation, recreation) products and services, thus contributing to the objectives of the New European Bauhaus [11] and its values of sustainability, inclusion and quality of experience [12].

In the centuries-old history of human development, there have always been differences in views on the problems of attracting resources for food needs, in assessing the ratio of needs and methods of their satisfaction. The nature of these views largely depended on the historical era, economic, philosophical, and ethical views that prevailed in society. Even the ancient Greek philosophers noted the contradiction between the limitlessness of human needs and the limited possibilities of their satisfaction. Socrates' statement is known: "the less a person needs, the closer he is to the gods." The patterns of development of human society and the environment, from which man draws renewable and non-renewable resources for the production of agricultural products and food, are qualitatively different. This is the main contradiction of the "man – nature" relationship, characteristic of all stages of the development of economic systems. At the same time, each historical stage has its own type of human relationship to the problem of attracting natural resources in order to satisfy its own needs and fill the agro-food market [13, p. 175].

In the development of human society in the third millennium, a decisive role is assigned to biotechnological research, including in the field of agrarian biotechnology and sustainable agriculture. In this connection, it is advisable to turn to the identification of modern concepts, which reveal the possible impact of new agricultural technologies on man and his environment. Among many scientific concepts and views on ways to overcome the food problem, several main ones can be singled out. First of all, these are concepts that directly connect the provision of food to the population with the demographic situation on Earth. The second group should include technocratic teachings. Less numerous, but extremely versatile, is the humanistic direction.

The limits of the intensification of the production of agricultural products and food were determined by the possibility of using the renewable resources of the planet (energy, mineral resources for the production of machinery, fertilizers).

The statement of modern scientists and agribusiness representatives that "biotechnology will feed the world" is now being criticized by some economists.

They believe that these technologies could certainly contribute to the growth of agricultural productivity and the solution of the food problem in poor and developing countries. However, they are practically inaccessible to local farmers. Therefore, agricultural biotechnologies are currently not a sufficient condition for providing the world with food - they primarily ensure the maximization of the profits of farmers in developed countries.

Biotechnology has turned from an ordinary industry into a system-creating factor in the development of the economies of individual states and the world economy in general. A special term denoting this phenomenon appeared - bioeconomy and the field of bioeconomy based on relevant knowledge. According to the forecasts of experts of the Organization for Economic Cooperation and Development (OECD), in the 21st century biotechnology will play a decisive role in political and economic stability in both developed and developing countries and will have an anthropogenic impact on the planet. Thanks to the achievements of biotechnology, humanity will be able to take full advantage of the plant in the coming decades as the cheapest and most ecologically safe factory for the production of most of the materials, food, medical drugs, chemical compounds, raw materials, etc. that are necessary for man. Biotechnology helps the environment, because it reduces the risk of toxic contamination of soils and groundwater, and increases the efficiency of agriculture. As a result, providing food for the ever-growing population can be combined with stopping the trends of environmental destruction [13, p 185-186].

Throughout the development of mankind, the improvement of biological and agronomic technologies for obtaining food products took place along with the optimization of methods of soil cultivation, product processing and the attraction of new energy resources. However, during the millennia, the agricultural products themselves, obtained as a result of such development of agricultural technologies, have practically not changed. Product differentiation occurred primarily at the level of final products, as well as their form and packaging. However, the "chemical" and "genetic" revolutions have changed agricultural products and food products themselves. The first introduced various chemical compounds into it as a result of intensive use of mineral fertilizers, pesticides, herbicides, insecticides, etc.; the second caused a change in the DNA structure of products. Products obtained as a result of the use of new agricultural biotechnologies do not differ outwardly at the stage of final consumption from their counterparts from the traditional and organic sectors in terms of taste, smell, color, etc. In this sense, biotechnologies can be conditionally comparable to evolutionary agricultural technologies [13, p. 192].

The specificity of the modern world food problem is that there is generally enough food to eliminate hunger in the world, but there is unevenness in its production and consumption, that is, the geography of food production does not coincide with the geography of their consumption. Developed countries, home to

21% of the world's population, account for 46% of the world production of grain crops (including wheat - 54%), potatoes – 58%, sugar – 32%, oil – 34%, meat – 45% , milk – 60%. The situation with providing food products of own production in the least developed countries, where 43% of the world's population lives, is difficult. They provide, respectively, 24% of world grain production, potatoes – 19%, sugar – 24%, oil – 24%, meat – 9%, milk – 10%. The traditional system of agriculture, which provides the bulk of food in these countries, is not designed for such a large population.

Even more striking is the inequality in the distribution of the world consumption fund: the share of developed countries in the world consumption fund for all products (except rice) significantly exceeds the share of their population in the world. The uneven distribution of production and consumption in the world leads to a situation where malnutrition and hunger are observed in some countries, while in others there is excess production and consumption of food. This state of the world food system implies a mandatory increase in the intensification of production and an increase in the circulation of food products through the channels of domestic and foreign trade in order to provide the global population with food products. It is absolutely obvious that there is a need for further development and expansion of the capacity of the world agro-food market, as well as the equalization of its certain disparities, based on the search for new biotechnologies.

The main advantages of agricultural products obtained with the help of new biotechnologies include: – increasing the yield of crops due to providing them with specified properties and reducing losses from diseases and pests; – reducing the use of pesticides and herbicides and thus reducing the chemical impact on the soil; – releasing renewable natural resources, replacing them with more productive ones obtained with the help of biotechnology; – creation of food products with predefined properties, for example, from products for people with diseases of the digestive system, for cancer and AIDS patients, milk substitutes for babies; – creation of flavorings and food additives on a natural, not chemical basis (it is known that the capacity of the world market of flavoring and food additives, for the production of which chemical compounds are used, is more than 6 billion US dollars annually); – reducing the level of impact on the environment due to the use of less harmful methods of soil cultivation; - reduction of plant and animal diseases.

Many European regions have multiple strategies in place, or under development, that are relevant to the bioeconomy or tackle it from different angles. This means that the number of bioeconomy strategies at regional level is considerably higher than the number of regions with bioeconomy strategies.

Research has revealed that there are 359 strategies (published and under development), at regional level in the EU-27 that are fully or partially dedicated to bioeconomy and contribute to its deployment across European regions

(situation as of November 2021). Of these, 345 are strategies at (sub-national) regional or local level. In addition, 14 multi-regional strategies have been identified that cover different regions. Of these, 10 have a cross-border, macro-regional or interregional perspective, while 4 cover various regions in one country.

Of the total 359 regional and interregional strategic frameworks, 334 are published (as of November 2021). Of these 334, 324 are regional and 10 are multi-regional strategic frameworks. Of these regional strategies, 32 are fully dedicated to bioeconomy, 83 cover bioeconomy within a sectoral strategy and 209 treat bioeconomy as an embedded topic within a wider strategic framework [14] (Figure 1).

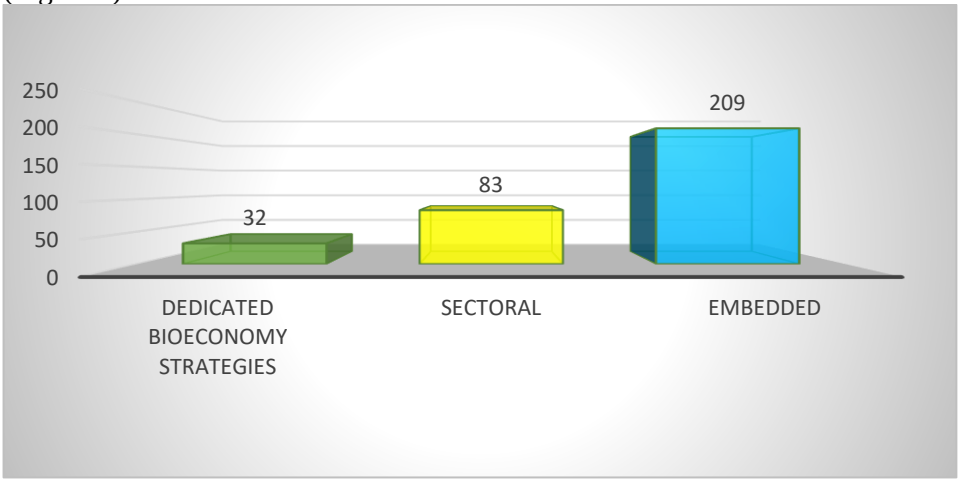

Fig. 1. Regional strategies where bioeconomy is treated as a main theme, sectoral topic or is embedded in a wider strategic framework

Overall, 41 strategies (32 regional and 9 multi-regional) are fully dedicated to the bioeconomy, i.e. directly focus on the deployment of the bioeconomy. Of those remaining, 97 strategies have a strong focus on the bioeconomy, whereas 196 have a minimum bioeconomy content.

Bioeconomy is addressed in sectoral strategies in 83 cases of the published regional strategies [14] (Figure 2). In most cases, it is addressed in forestry plans/strategies (29), followed by waste plans (26), strategies on energy (13) or focusing on agriculture/agri-food (11). Bioeconomy is addressed in sectoral strategies on aquaculture/fisheries or algae (3) or on construction (1) in several cases.

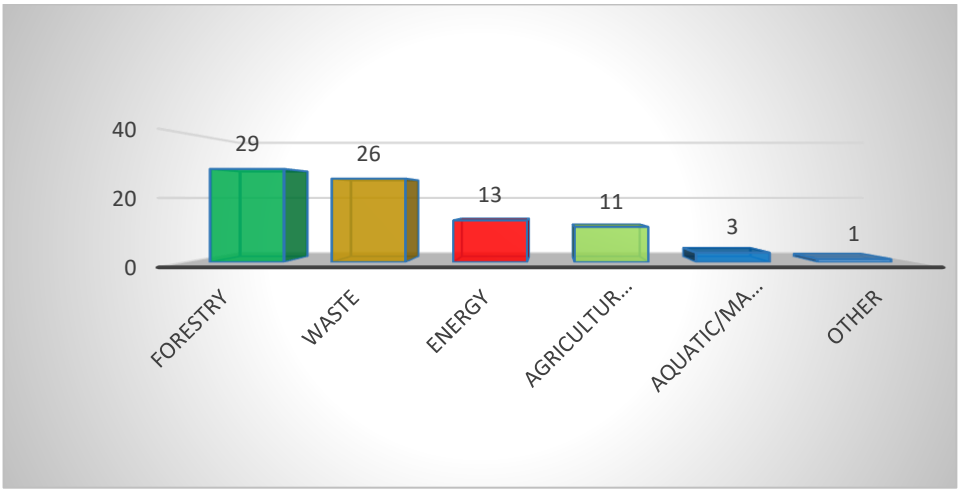

Fig. 2. Bioeconomy covered in sectoral strategies

In 210 cases (209 regional and 1 macro-regional), bioeconomy is embedded into wider strategic frameworks (Figure 3). This is mostly the case within regional/territorial or rural development plans (54), within Smart Specialisation Strategies (49), within the context of circular economy strategies (31), within strategies for economic/industrial development or sustainable development strategies/plans (17), within climate/low-carbon plans (15), and within regional research/innovation strategies (12). In several cases, bioeconomy is part of green (5) or blue transition (3) strategies or of recent Recovery and Resilience Plans (RRP) at regional level (2) [14].

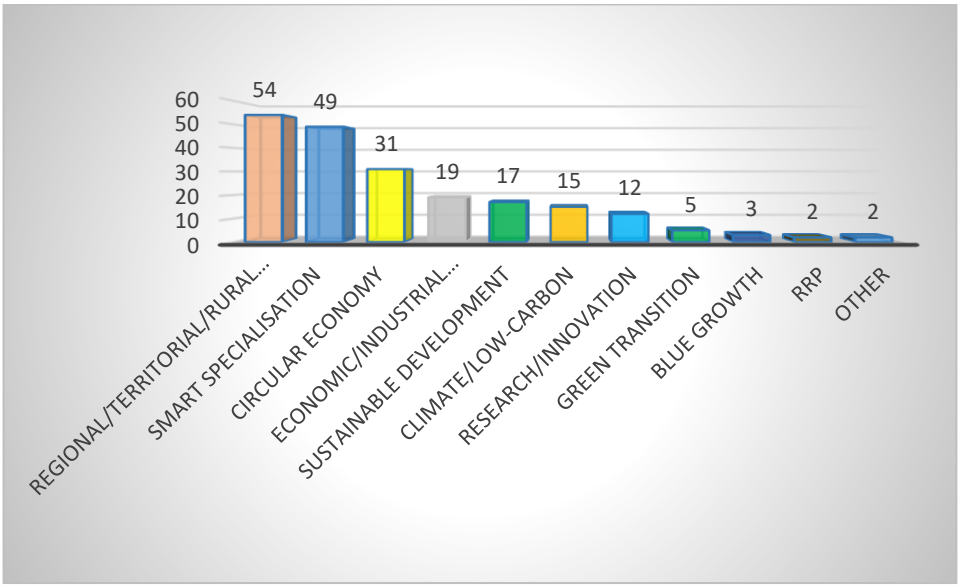

Fig. 2. Bioeconomy embedded in wider strategies

In order to have ready access to biological resources (e.g., crops, forests), implementation of many aspects of the bioeconomy will occur at the regional scale and involve rural communities. Policies to encourage the development of bioeconomy clusters and regions, including resources for planning and the creation of networks that facilitate collaboration between diverse stakeholders, including firms from divergent sectors and small businesses, are common. More than 130 federal programs support economic development activities [15]. The nature and scope of such programs vary; however, a few programs may be of particular interest as they relate to the bioeconomy and regional development. For example, the Build to Scale program (formerly Regional Innovation Strategies) within the Department of Commerce's Economic Development Administration (EDA) awards grants to develop and support regional innovation initiatives and the Small Business Administration (SBA) supports regional development efforts through its Regional Innovation Clusters program. Congress appropriated $38 million to the Build to Scale program and $6 million to the Regional Innovation Clusters program in FY2021 [16]. Both programs have awarded grants to regional efforts in areas that would fall under the bioeconomy. As it relates to rural development, USDA's Rural Business Development Grants program supports technology-based economic development, feasibility studies and business plans, leadership and entrepreneur training, and rural business incubators, among other activities [17]. Congress appropriated $37 million to the Rural Business Development Grants program in FY2021 [18].

According to an analysis by the OECD, bioeconomy-related policies focus primarily on supply-side or technology push measures (i.e., support for R&D and demonstration efforts). The OECD indicates that a shift to "a bio-based economy will likely require a balance of more demand-side [or market pull] measures in order to help ensure a market for innovative products" (see Table 1) [19].

In particular, they emphasize the importance of public procurement in helping to create a market for bio-based products. The OECD recognized the USDA's BioPreferred Program as the most advanced effort in this regard. The BioPreferred Program – initially established in the 2002 farm bill and reauthorized and amended by Congress in the 2018 farm bill – requires federal agencies and contractors to give purchasing preferences to bio-based products [20]. Specifically, USDA is required to identify eligible product categories and to specify the minimum bio-based content required for each category. Currently, there are 139 product categories and approximately 14,000 bio-based products under the program. In addition to the federal purchasing requirements, the BioPreferred Program also includes a voluntary labeling initiative in which a business can display a "USDA Certified Biobased Product label" on a product that meets USDA criteria [21].

Although the Farm Bill mandates that federal agencies and contractors purchase biobased products when doing so does not impose cost or performance penalties, no regular report is available through which to understand the progress or scale of biobased procurement. Updating the reporting mechanisms involved in the federal procurement of biobased products, setting procurement targets, and increasing funding for the program to enable increased awareness and standardized reporting –such as a realtime public-facing dashboard to report federal progress in biobased procurement – would go a long way toward stimulating the bioeconomy and supporting jobs in rural areas where many source materials are concentrated.

Table 1. OECD Identified Policy Measures for Creating a Bioeconomy Innovation Ecosystem

Supply-Side/Technology Push	Demand-Side/Market Pull	Crosscutting
Local access to feedstocks	Targets and quotas	Targets and quotas
International access to feedstocks	Mandates and bans	Certification
R&D subsidy	Public procurement	Skills and education
Skills and education	Labels and raising awareness	Regional clusters
Flagship financial support	Direct financial support for bio-based products	Public acceptance

Tax incentives for industrial R&D	Tax incentives for bio-based products	Metrics, definitions, and terminology
Metrics, definitions, and terminology	Incentives related to greenhouse gas emissions	
Technology clusters	Taxes on fossil carbon	
Governance and regulation	Removing fossil fuel subsidies	

Source: [22]

A number of nations, especially those in the European Union are increasingly connecting their bioeconomy strategies and policies to action plans associated with creating a more sustainable and circular economy. According to the European Parliamentary Research Service, Unlike the traditional linear economic model based on a 'take-make-consume-throw away' pattern, a circular economy is based on sharing, leasing, reuse, repair, refurbishment and recycling, in an (almost) closed loop, where products and the materials they contain are highly valued. In practice, it implies reducing waste to a minimum [23].

Many countries see a connection between the bioeconomy and a circular economy as a means to address a number of the Sustainable Development Goals (SDGs). In 2015, 193 countries, including the United States, adopted the SDGs as part of the 2030 Agenda for Sustainable Development. The SDGs include ensuring sustainable consumption and production patterns, taking urgent action to combat climate change and its impacts, and ensuring access to affordable, reliable, sustainable and modern energy for all, among others [24]. In 2021, the Food and Agriculture Organization of the United Nations (FAO) released a set of principles and criteria with the aim of ensuring that the "bioeconomy, when implemented correctly, can benefit individual communities and the global environment in ways that are in line with the SDGs." [25]. FAO's principles are that a sustainable bioeconomy should:

- support food security and nutrition at all levels;
- ensure that natural resources are conserved, protected, and enhanced;
- support competitive and inclusive economic growth;
- make communities healthier, more sustainable, and harness social and ecosystem resilience;
- rely on improved efficiency in the use of resources and biomass;
- be underpinned by responsible and effective governance mechanisms;
- make good use of existing relevant knowledge and proven sound technologies and good practices, and where appropriate, promote research and innovations;
- use and promote sustainable trade and market practices;
- address societal needs and encourage sustainable consumption; and

- promote cooperation, collaboration, and sharing between interested and concerned stakeholders in all relevant domains and at all relevant levels.

Conclusions

Bioeconomy management is critical to maximizing synergies and resolving trade-offs regarding the prospects for sustainable agribusiness development. Bioeconomy policy should be based on all aspects of sustainability: management of land and biological resources within ecological limits, sustainable value and consumption chains and social justice and just transition.

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Abstract

In the distribution of the world consumption fund, the unevenness is increasing: the share of developed countries in the world consumption fund significantly exceeds the share of their population in the world. The uneven distribution of production and consumption in the world leads to a situation where malnutrition and hunger are observed in some countries, while in others there is excess production and consumption of food. This state of the world food system implies a mandatory increase in the intensification of production and an increase in the circulation of food products through the channels of domestic and foreign trade in order to provide the global population with food products. It is absolutely obvious that there is a need for further development and

expansion of the capacity of global agribusiness, as well as the equalization of certain disproportions, based on the search for new biotechnologies and the development of bioeconomy.

Keywords: agro-industrial complex, agriculture, European integration, sustainable bioeconomy strategy, biomass, food crisis, potential supplies, competitiveness of a country

JEL Classification: M21