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BIOECONOMY: NEW DIRECTIONS OF DEVELOPMENT

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Abstract
Aim. Today the world scientific community has not yet formed an agreed point of view on the definition of a "green" economy. Many important generalizations in this direction require development. This is necessary for a more detailed understanding of the essence of the construct under study, the definition of scientific and practical goals in this area, the identification of approaches, and the construction of classifications. The purpose of the article is to consider the definitive aspect of the concept of "bioeconomics".
Methodology. The scientific content of the official websites of Russian and foreign research institutions working in this field, using the terms "bioeconomics", "biotechnology", "bioengineering education", "transdisciplinarity" was the methodological basis for the analysis of theoretical and practical aspects of bioeconomics and the proposed conclusions.
Results. As a result of the generalization of already formed theoretical and practical approaches, a classification of directions for the development of bioeconomics has been obtained. In the course of the author's research, the following tasks were solved: a) identifying the role and place of bioeconomics in the system of sciences; b) consideration of the priority directions of its development in the innovative economy in the conditions of continuous transformational processes, globalization, automation.
Research implications. The solution of these problems creates a theoretical basis for the training of specialists focused on the implementation of competencies in the field of bioeconomics.

Keywords: bioeconomics, factors of development of bioeconomics, approaches to the definition of bioeconomics, directions of development of bioeconomics, biotechnology, transdisciplinarity, bioengineering education.

БИОЭКОНОМИКА: НОВЫЕ НАПРАВЛЕНИЯ РАЗВИТИЯ

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Аннотация

Цель. Сегодня в мировом научном сообществе ещё не сформирована согласованная точка зрения по поводу определения «зеленой» экономики. Многие важные обобщения в этом направлении требуют развития. Это нужно для более детального понимания сущности изучаемого конструкта, определения научных и практических целей в этой области, выявления подходов, построения классификаций. Цель исследования – рассмотреть дефинитивный аспект понятия «биоэкономика».

Процедура и методы. Методологической основой для анализа теоретических и практических аспектов биоэкономики и предлагаемых выводов выступил научный контент официальных сайтов исследовательских российских и зарубежных учреждений, работающих в этой сфере, с использованием терминов «биоэкономика», «биотехнологии», «биоинженерное образование», «трансдисциплинарность».

Результаты. В результате обобщения уже сформировавшихся теоретических и практических подходов получена классификация направлений развития биоэкономики. В ходе авторского исследования решены следующие задачи: а) выявление роли и места биоэкономики в системе наук; б) рассмотрение приоритетных направлений её развития в инновационной экономике в условиях непрерывных трансформационных процессов, глобализации, автоматизации.

Теоретическая и/или практическая значимость. Решение этих задач создаёт теоретическую основу для подготовки специалистов, ориентированных на реализацию компетенций в области биоэкономики.

Ключевые слова: биоэкономика, факторы развития биоэкономики, подходы к определению биоэкономики, направления развития биэкономики, биотехнологии, трансдисциплинарность, биоинженерное образование

Introduction

The main factors that scientists recognize as prerequisites for the development of bioeconomy are as follows: exhaustibility of mineral, raw materials and energy resources; finiteness of minerals; population growth, inevitably accompanied by problems of food shortages; environmental damage caused to the environment; intensive space exploration leading to detrimental impacts on the near-Earth environment; the approach of the Fourth Industrial Revolution and quantum computing, which change the mental model of a person, change his lifestyle and contribute to the formation of a new system of institutions; the transformation of science, the rapid development of biotechnology as a field of science, the emergence of nanotechnologies and nanomedicine; accelerating the pace of technology development in the conditions of the singularity. The factor of economic growth and development of modern states is the knowledge factor [12]. And only those countries that actively use new knowledge, that is, are knowledge-intensive, by 2030–2050. can become economically developed.

These circumstances, as well as the desire to improve the quality of life and increase its duration, oblige modern society to move to mechanisms to maintain a balance between consumed limited resources and the accumulation of waste that causes environmental damage. This problem is solved by a new paradigm, which is called "bioeconomics". The transition to the bioeconomy involves the use of natural potential by a person on a renewable basis, that is, its conservation, protection [7]. Quite a lot of works of both foreign and Russian scientists are devoted to the definitive aspect of the concept of "bioeconomics", but, despite this, at present, the world scientific community has not

yet formed a consensus on the definition of bioeconomics or, as it is also called, "green" economy. Many serious generalizations in this area, in our opinion, should be developed. This is necessary for a deeper understanding of the essence of the concept under study and the construction of a classification of approaches to it.

The purpose of the work is to try to classify approaches to the definition of bioeconomics. The classification proposed in the article is based on a generalization of the approaches of foreign and Russian scientists. The main objectives of this study are: a) determining the role and place of bioeconomics in the system of sciences; b) analysis of priority areas for its development in an innovative economy in the context of digitalization and continuous transformation processes. The solution of these problems, in our opinion, creates a theoretical basis for the training of a new type of specialists focused on the implementation of competencies in the field of bioeconomics.

As a methodological basis for the analysis of theoretical and practical aspects of bioeconomics and the proposed conclusions, we used the scientific content of the official websites of Russian and foreign research institutions working in this area. The author focused on the presence in the content of the site materials (releases, scientific articles and monographs) of the terms "bioeconomics", "biotechnology", "transdisciplinarity. The study used the method of analyzing theoretical ideas about bioeconomics, bioengineering education, transdisciplinarity.

Definition of approaches and their classification

Analyzing the sources devoted to the definitive aspect of bioeconomics, the following explanations can be made for the purpose of their further development and use in explaining phenomena, processes and laws that go beyond the scope of traditional sciences.

In line with the scientific approach, bioeconomics is defined as a social science that integrates biological and economic disciplines. According to the scientific approach, bioeconomics is defined as a science that has emerged as a result of the integration of biology and economics, that is, natural and humanitarian (partly social) sciences. In our opinion, it would be appropriate to supplement and/or develop this approach as a transscientific one, that is, from the point of view of transdisciplinarity. This approach is appropriate due to the fact that "bioeconomics" as an independent science does not have a single theoretical basis, and therefore it is necessary to emphasize that in this case both different fields of science and various areas of practical activity are combined, designed to continuously solve the most important problems. national economic tasks [5]. That is, it is legitimate to consider bioeconomics as a symbiosis of theories and practices of various sciences (disciplines) [3].

The cognitive approach characterizes bioeconomics as a field of economic knowledge based on three "pillars": 1) the use of knowledge of gene and cellular processes for the design and development of new products; 2) the use of renewable biological sources and efficient bioprocesses to stimulate sustainable production; 3) integration of knowledge in the field of biotechnology and its application in various sectors. The knowledge (cognitive) approach considers the knowledge and cognitive principles of the economy as the basis for the formation of a new bioeconomic science, which integrates and "builds" around itself all other sciences and, above all, biology, biotechnology, etc.

The process approach considers the bioeconomy as a process of sustainable production and transformation of biomass for food, medical, fiber and industrial products and energy. This approach proceeds exclusively from a practice-oriented vision, considering

it as a procedure for the sequential transformation of the original biomass into new types of products that can be obtained under the conditions of the hybridization of sciences.

The resource approach implies a more efficient use of resources, primarily natural and renewable ones. The approach is based on an assessment of the efficiency of the economy, that is, on the indicator "environment intensity" of the economy. In the resource approach, we are talking about both the efficient use of natural raw materials (that is, resource conservation) and the prudent use of renewable resources. This approach relies on the understanding of the bioeconomy as a specific activity in which basic materials, chemicals and energy are obtained from renewable biological resources, animal and plant sources, and not through the wasteful use of natural resources. The bioeconomy should be based on the continuous updating of technologies and the improvement of their environmental friendliness, as well as the reduction of the environmental intensity of the economy. The next problem of bioeconomics is related to the use of biomass, which is available to modern mankind. In the production of food or high-quality industrial products (chemicals, drugs, cosmetics, alcohol or paper), only a small amount of organic plant matter is used. In this case, everything else is thrown into a landfill or burned. The transition to renewable sources of raw materials and energy involves solving the problem of increasing the efficiency of resource consumption.

The biosystem direction approaches the essence as a system of interrelated and interdependent biosystems (more precisely, types of activities) associated with the production, distribution and consumption of the results of processing biological resources. The operation of such a complex mechanism is aimed at improving the well-being of society in the long term, in which future generations are protected from significant environmental risks or environmental scarcity. The systemic (biosystemic) approach to building a new economy assumes that man and nature form a mechanism where all types of activity, like elements of a mosaic, create a single living organism, in which the interaction of all biological diversity (that is, the richness of flora and fauna) is preserved. However, when building a bioeconomy, it is not enough to rely only on a systematic approach, since the organization of waste-free production is possible both on the basis of a systematic approach and a synergistic effect. These two principles are interrelated. Ecological agriculture is a classic example of combining the principles of systemic and synergistic effects. Bionics (that is, the translation of biological processes and structures into the language of new technologies and products) is based on learning from nature, the study of simple biotechnological transformations of substances occurring in nature itself and the transfer of these natural processes into real production.

The symbiotic approach represents an economy that links technology, markets, people and politics together. It actively establishes links between branches of science and practice that have never had relations with each other before, but already in the structure of new symbiotic relationships, where one branch uses the by-products of another. Economics "interacts" with chemistry. biochemical technology, genetics, microbiology, bioengineering, electronics, mechanical technology and other scientific disciplines. From the position of the symbiotic approach, it is important that the bioeconomy brings together phenomena that have so far been incommensurable: business and sustainability, ecosystem services and industrial use, biomass and products for the mass consumer, etc. [11]. The basis of a sustainable economy of the countries are effective industrial symbioses, hybrids, new raw materials, as well as biological-based processes [9].

The competence-based approach focuses on education, training of personnel in demand for work in priority areas of the bioeconomy. We are introducing an educational approach, since in the conditions of intensive development of priority areas of the bioeconomy, the problem of training personnel capable of making managerial decisions, organizing and

managing innovative projects, and performing complex economic calculations related to the evaluation of global and costly projects related to scientific research in different areas of bioeconomics, requiring a large amount of funding (investment), the ability of personnel to assess the relevance of research results in the development of priority areas of bioeconomics. In our opinion, the main task of universities that train masters in economics and provide additional professional education is to train specialists and masters in economics and management who have a basic education in a non-economic profile (engineering, natural science, medicine, etc.).

It should be noted that the educational (competence-based) approach to the definition of the concept under study is closely related to the knowledge (cognitive) approach, and the latter occupies a central place in ensuring the economic growth of developed countries. On the other hand, the most important resource that determines the development of the bioeconomy of knowledge is its personnel, the demand for which is constantly growing. If the goal of the first approach is to create and continuously update knowledge, then the second approach obliges the higher education system to form and use innovative educational technologies and methods of broadcasting (transferring) new knowledge to students and listeners so that they can later use them in the real sector when creating innovative goods and services in various areas of bioeconomy development.

According to the educational approach to the development of priority areas of bioeconomics, it is important to develop flexible skills for students that would help them adapt to new environmental conditions, "feel" new trends in the development of the economy, make a correct assessment of the external environment and its constantly changing requirements, continuously learn and develop in transformational economy, be able to manage projects and lead a team that participates in the implementation of the project. Today it is impossible to be a good "loner specialist", it is necessary to work together with specialists from different fields of science to create an innovative product. All these factors convincingly require the development of the listed competencies of personnel for their successful implementation in the priority areas of the bioeconomy [10]. In this regard, first of all, both the key competencies of employees and the content and structure of human capital as a whole are being reviewed. An increasingly significant role in the market is played by people who are able to work in conditions of uncertainty and perform complex analytical tasks that require non-routine actions and quick adaptation to the current situation. The changing global landscape of employment and lifestyles is transforming the structure of demand for new individual and collective skills [1].

The cluster approach is based on a combination of the principles of network interaction (primarily public-private partnership) and a single technological platform. The cluster approach builds the bioeconomy on the principles of the territorial community of a group of companies, institutions and institutions, interconnected: a) by a single technological platform; b) on the basis of voluntary and partnership (network) interaction; c) according to the branch principle, or according to the principle of mutual complementation of branches. Thus, bioeconomics: a) is one of the key innovative areas of sustainable development of the country's economy; b) is based on the achievements of the "biotechnological revolution" of the late XX – early XXI centuries; c) is based on the principle of combining the cluster approach, public-private partnership and technology platforms [6].

Scientists note that the following areas of development of biotechnologies are the most priority in the world and Russia in the near future: agricultural, that is, agrobiotechnologies (including environmental, environmental, bioremediation of soils, water, air, safe waste processing, technologies for the protection of cultivated plants), biomedical (primarily biopharmaceutical), bioenergy and industrial (including biodegradable). Although other areas of bioeconomics, such as biomedicine, biodiagnostics, bioinformatics,

nanobiotechnologies, bioenergetics, marine biotechnologies, etc., are also developing quite intensively. Moreover, a number of new biotechnologies have already appeared. For example, biopolymer biotechnologies can very soon be singled out as a separate direction in the development of biotechnologies. The rapid development of innovative areas of bioeconomy can be explained by the fact that mankind has long been trying to find a way to control nature, for example, new methods for obtaining plants with improved desired qualities, such as high yields, large fruits with special taste properties, winter hardiness and other attractive qualities. Man also, throughout the history of his existence and evolutionary development, has been trying to obtain improved breeds of animals through selection. In the modern theory and practice of the development of the science of selection, two ways of obtaining the desired qualities can be distinguished: traditional and innovative. Over the past two decades, the most popular in science is the second way - the selection method, based on the achievements of genetic engineering.

The classification proposed in the article is based on a generalization of the approaches of foreign and Russian scientists. We set ourselves the task of determining the role and place of bioeconomics in the system of sciences and analyzing the priority areas for its development in an innovative economy in the context of digitalization and continuous transformation processes. The solution of these problems, in our opinion, creates a theoretical basis for the training of a new type of specialists focused on the implementation of competencies in the field of bioeconomics [4]. The achievements of recent years in the field of biology, chemistry, immunology, cell biology and other sciences make it possible to make a breakthrough in the field of their applied application [8].

In recent decades, in addition to the development of an integrated bioeconomy based on the principles of interdisciplinarity, transdisciplinarity and multidisciplinarity of biotechnologies, other processes are also intensively occurring, caused by the influence of many external factors, for example, global and intensive digitalization, which has led to an exponential general intellectualization of society. In this regard, the modern system of higher education is faced with the question of the priority of competencies that it needs to transfer to students - highly specialized ("hard") or universal ("soft"). If traditional education emphasized the acquisition of highly specialized competencies by students, then the education system of the 21st century is based on universal and flexible competencies (cognitive abilities, system skills, the ability to solve complex problems, the ability to work with research content, social and production skills, resource management skills, technical skills, physical abilities) [2].

Conclusion

So, to achieve the goals of the "green" economy, a high level of education, the development of human capital, technology transfers and innovations are required. Research funding, increased investment in research programs are the keys to the success of bioeconomy projects. High-quality interaction between the academic environment, business, investors and the state can produce tremendous results for the benefit of society.

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