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*M.P. TALAVYRIA, doctor of economic sciences, professor,
director of Institute Economics and Management,
National University of Life and Environmental Sciences of Ukraine*
*V.V. LYMAR, candidate of economic sciences,
competitor for doctor's degree, senior lecturer of
agrarian economy department
Separated subdivision of National University of Life and Environmental Sciences of
Ukraine «Nizhin Agrotechnical Institute»*
*V.V. BAIDALA, candidate of economic sciences,
associate professor (docent) of economic theory department
National University of Life and Environmental Sciences of Ukraine*
*R.T. HOLUB, post-graduate student**
National University of Life and Environmental Sciences of Ukraine

Approaches to the definition of production determinants of bio-oriented economy

Scientific problem. One of the greatest global challenges of the 21st century in times of

climate change will be to sustain a growing world population both with sufficient foodstuffs and with renewable commodities – as industrial raw materials and for energy production. The world population is expected to grow to over 9.5 billion people by 2050. Combined with changes in consumer preferences, the conse-

* Scientific supervisor – M.P. Talavyria, doctor of economic sciences, professor.

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quence is that global food security is certain to become a critical future challenge. Alongside, the world's available arable land is steadily decreasing as a result of soil degradation and expansion of residential areas, and climate change will exacerbate this surface loss. The finite nature of fossil resources and the related increase in prices means that demand will rise sharply for renewable energy and raw materials. Of all the various sources of renewable energy, bioenergy has to date made the largest contribution to electricity, heat, and fuels. Biomass also represents the only renewable carbon source for use as an industrial raw material. Furthermore, biological resources hold a vast reservoir of natural materials for industrial purposes, which can be produced using limited resources.

The provision of food, energy and resources, and the protection of the climate and environment are not only in the national interest, but are also a global commitment. Making proper use of technological progress is thus an obligation that makes demands on science and industry in equal measure. For business, innovative products and procedures provide an opportunity for technology leadership and the possibility of helping to shape the necessary transition to sustainable production.

The aforementioned challenges illustrate that, with decreasing arable land, greater quantities of biomass will have to be produced in an internationally competitive and sustainable manner. Under this premise, it will be important to find efficient and holistic (systemic) solutions.

A promising approach for this structural change from a petroleum-based to a bio-based economy, which has the potential to enable economic prosperity with ecological and social compatibility, is to strengthen the knowledge-based bio-oriented economy through the strategic promotion of research and innovation. This includes the agricultural economy, as well as all manufacturing sectors and associated service areas that develop, produce, process, handle, or utilize any form of biological resources, such as plants, animals, and microorganisms [1].

Analysis of recent researches and publications. Bio-oriented economy isn't a new phenomenon in a whole sense of this word. In a specific form its roots deepen into far past, par-

ticularly the existence and functioning of agriculture which is the main productive branch of bio-oriented economy. However, it has become an interest of scientists relatively not long ago what causes a few scientific works in this field. It is necessary to say that European colleagues have more experience in bio-oriented economy investigating than Ukrainian researchers. That is why this paper is built on the experience of foreign colleagues, among them the most attention is given to Maciejczak M. [3, 23], Takacs I. [15], Mundlak Y., Butzer R. [20], Davide V., Francesco M., Daiele M., Mario M., Gianluca S. [25] and McCormic K. [27]. Besides it is investigated and analyzed the materials of German Bioeconomy Council [21] and European Commission [28-30].

The objective of the article is bio-oriented economy investigating on the base of systematic approach and definition of its main production determinants.

Statement of the main results of the study. Bio-oriented economy creates the base for renewable biological resources using and conversion of them into goods with high value added, such as food and biofuels. Its branches have powerful innovation potential thanks using of technologies and tacit and explicit knowledge. [2, P. 21].

From the view of systematic approach bio-oriented economy is a phenomenon which has a positive impact on the environment and society and economy as a whole by application of innovative technologies in traditional branches, for example in food. [3].

As argued by De Soto [4] the traditional Pareto criteria of allocative efficiency, which have predominated in economics up today, are tainted with a definite static character and therefore are inadequate to be applied as normative guidelines to the rich dynamics of real-life socio-economic conditions. The efficiency in the dynamic terms means to make such a choice between current and future consumption, which provides the expected increase in consumption per capita while maintaining the internal and external equilibrium of the economy in long term. Dynamic efficiency is the state of the economy, the essence of which is ratio of the level of saving and investment, which can increase consumption in the future [5].

However in order to ensure consumption, savings and investments, the bio-oriented economy sector, under dynamic and constant changes, needs to produce added value from raw materials, which in turn will serve as a basis for income and profits. Classical and neoclassical economic theories distinguish between three factors of production: land, labor and capital. Some authors on the basic factors of production include also entrepreneurship and knowledge. It is argued in this paper that while these factors have been much discussed and extended at different points in economic evolution, in any of the advanced economies of the world today, especially in such emerging concepts as bio-oriented economy, they are vastly antiquated. There is a need to focus on the basic economic assumptions, such as the production functions, and to fill in the gaps in current understanding of the bio-oriented economy, in order to describe the main factors that drive its development.

In mainstream economy there are 3 main factors of production: land, labor and capital. Land as a factor of production is understood very broadly. This concept includes minerals, underground and surface waters, territory, fauna, flora and atmosphere. Labor and more precisely – work is understood as a physical person's ability to perform certain actions, together with his/ her skills motivations. Today the identification of working with human capital is spreading. Capital as a factor of production is understood in substantive terms (rather than financial). It consists of machinery and equipment for the production of other goods. Some authors on the basic factors of production include entrepreneurship and knowledge. Entrepreneurship is sometimes included in the labor factor [6-7].

The above classification of factors has come under criticism by many economists [8-10]. Firstly, from many of critical assumptions one can distinguish problems with substitution. Each unit of a factor can be distinguished from other unit of that factor, but one factor can be substituted for some other factor. For example, land can be used intensively by employing more labor or more capital in the form of fertilizers, better seeds and superior techniques. By so doing, one can substitute labor or capital for

land. Similarly, labor can be substituted for capital, and capital for labor in a factor. The degree of substitution of one factor for another will, however, depend on the most efficient method of production to be used relative to the cost of the factor to be substituted. Secondly, another problem arises as a critique because land, labor and capital often get intermixed into one another and it is difficult to specify the contribution of each separately. Finally, there are arguments against too wide a meaning of factors of production. It is argued that it is more convenient to consider only the land which can be bought and sold as a factor of production, rather than such elements as sunshine, climate, etc. which don't enter directly into costs. Similarly, it is not accurate to group together the services of an unskilled worker with that of an engineer, or of an engine driver with that of a serviceman in the railways. Therefore as shown by Xu B. [11], who proposed an alternative theory of 6 forces of essential factors of production; several authors find it more accurate to lump together each group as a separate factor of production. This method gives a large number of factors of production and each group is regarded as a separate factor.

Thus, in the large body of scientific literature it is possible to identify that just classical production factors. Thanks to technological advancement some name technology as a new production force [12]. They say that due to technology, firms can capture high growth under dynamic changes in the environment. A lot of researchers including Schumpeter [13] consider innovations as a new production factor. This scientists [14-16] focus on marginal utility of innovations as a source of growth. Other researchers focus on institutions as a fundamental cause of long-run growth [3, 17-18]. One could argue if the above approaches and the variables indicted are new factors, they could be considered especially from an epistemological point of view really as new production factors. [19-20]. The determinant is a factor which decisively affects the nature or outcome of something and a thing that decides whether or how something happens [21].

There is no particular focus on the bio-oriented economy as a special subject of research from the production factor point of view,

so far. This is not due to the novelty of the idea, but rather from its complexity. As Maciejczak M. [3] argues, bio-oriented economy brings together processes that have so far been disparate: business and sustainability, ecosystem services and industrial applications, innovations and technologies, biomass and products, all for mainstream economies in order to meet growing consumer expectations. It actively establishes links between industries, both old (which for a long time formed a chain of added value) and new (which previously had no connections within a new, symbiotic relationship where one industry utilizes the by-products of another. Thus it forms a new network-oriented platform. The bio-oriented economy creates a new dimension within existing elements of the socio-economic system, in which large-scale progress in various forms, especially biological and technical, is created, as well as successfully product and process innovations.

Having in mind the common definition of bio-oriented economy, which states that it is the knowledge-based production in all economic sectors within the frame of a sustainable economic system [22], it needs to be stated that the sources of biomass are primary production de-

terminates of the bio-oriented economy. The biological resources exclusively are acting as substitutes for other (fossil) resources. Two other production determinants are also included in the above definition. They are related to knowledge, and focus on the investment in research and development (R&D) in the bio-oriented economy system as well as people employed in it, who have obtained sufficient knowledge to explore, commercialize and develop products and processes important from the point of view of firms and society. Finally, the fourth determinant is connected to the organization of the system. It is the institutional arrangements that enable implementation of solutions that ensure competitiveness under dynamic changes.

With considering classical view of productive forces; labor, land, capital and entrepreneurship it is given four production determinants of bio-oriented economy are presented in figure 1.

These factors are characterized by the homogeneity and the orientation on generating the highest marginal utility and added value not only from the firm but also from the network.

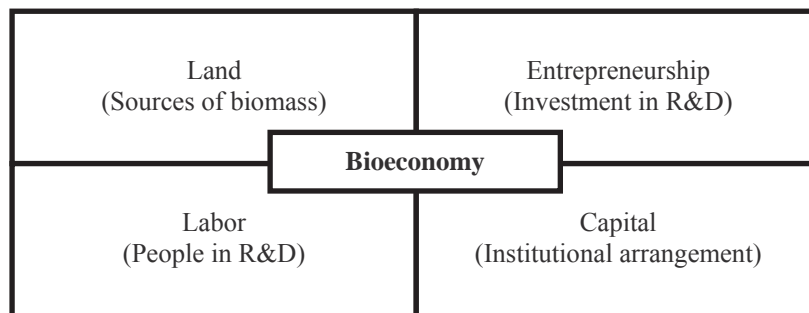


Figure 1. Bio-oriented economy production determinants

Made by the authors according to: [23].

It was investigated a lot of publications of foreign authors and analytical documents of international organizations. It is presented sev-

eral approaches to understanding of bio-oriented economy (Table 1).

Table 1

Scientific approaches to the definition of bio-oriented economy

№	Authors	Approach to the definition
1	Enriquez-Cabot J. [24]	A part of economy which uses biological knowledge with commercial and industrial aim to improve person's welfare
2	Davide V., Francesco M., Mario M., Daniele M., Gianluca S. [25]	Bio-oriented economy covers production of renewable resources and its conversion into food, feed, bio-based products and bioenergy. It includes agriculture, forestry, fishery, pulp industry and a part of chemical, biotechnological and energetic branches

3	McCormick K. [27]	An economy where the basic building blocks for materials, chemicals and energy are derived from renewable biological resources, such as plant and animal sources
4	German Bioeconomy Council [22]	Knowledge-intensive production and using of biological resources for ensuring of all economic sectors by products, services, processes in the context of sustainable economic system
5	European Commission [26]	An economy using biological resources from the land and sea as well as waste, including food wastes, as inputs to industry and energy production, it also covers the use of bio-based processes to green industries
6	European Commission [29]	Production paradigms that rely on biological processes and, as with natural ecosystems, use natural inputs, expend minimum amounts of energy and do not produce waste as all materials discarded by one process are inputs for another process and are re-used in the ecosystem

Source: made by the authors.

It is given several approaches to understanding of bio-oriented economy. However, authors have found and analyzed over 46 definitions of this phenomenon.

As argued above, from the one side bio-oriented economy it is not a new phenomenon, in some aspects its roots go deep in far history. But fast STP development, innovations, knowledge and technologies open it from a new side and demonstrate its potential which can be useful for humanity.

Conclusions. As a result it is got such conclusions. Bio-oriented economy is not a new phenomenon in particular sense of this word. Its roots deepen in far past, particularly the fact of existing and functioning of agriculture as the main branch of bio-oriented economy. It is defined that it creates the basis for renewable biological resources using and conversion of them into goods with high value added such as food

and biofuels. From the point of view of systematic approach bio-oriented economy is a phenomenon which can have a positive impact on the environment, society and economy by application of innovation technologies in tradition branches, for instance, food. Bio-oriented economy connects from the first view incomparable things: business and sustainability, ecosystems services and industry, innovations and technologies, biomass and final goods, all, that in traditional economy meet the needs of customers. It set relations between old branches (what form added value chains) and new ones setting symbiotic connections where products of one branch are raw materials for the other one. In this way it forms a new network-oriented platform. It is defined such production determinants of bio-oriented economy: land (biomass), entrepreneurship (investment in R&D), labor (people in R&D) and capital (institution arrangement).

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*О.М. НЕЧИПОРЕНКО, кандидат економічних наук, доцент,
провідний науковий співробітник
Національний науковий центр "Інститут аграрної економіки"*

Особливості господарювання на зрошуваних землях України

Постановка проблеми. Нині в Україні зрошуване землеробство знаходиться на межі конфлікту двох політик – аграрної і водної. Перша – направлена на захист економічних інтересів сільгосптоваровиробників і забезпеченість їхніх доходів, друга – на збереження монопольного становища струк-

тур Держводагентства України в питанні надання постійно зростаючих у ціні іригаційних послуг. Компроміс можливий при формуванні прийнятної для обох сторін вартості поливної води, до якої належать: плата за ресурс (дозвіл на спец водокористування), витрати на його транспортування та подачу, а також вартість витраченої на вказані послуги електроенергії. Крім того, аграрій

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