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ON THE PROBLEM OF THE DEVELOPMENT OF 'SUSTAINABLE' AGRICULTURE IN MODERN ECONOMIC REALITIES

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Sustainability of agriculture is one of the main directions of development of the industry, which today has a high relevance due to the fact that the industry itself, on the one hand, uses land as the main resource, on the other hand, there is a significant amount of waste in the production of agricultural products, which worsen the environment. Accordingly, the ***relevance*** *of the topic under consideration is determined by the need to solve the problem of finding a balance between the need to intensify the level of agricultural production and the preservation of environmental well-being. The purpose of the work is to consider the problematic aspects of the development of "sustainable" agriculture in modern economic realities and identify ways to solve certain problems. In the course of the research, the works of various specialists in the field under consideration were analyzed, on the basis of which a review of the author's positions regarding the problem under consideration was conducted.*

According to the results of the study, the following ***conclusion*** *was made: the direction analysis of the sustainable agriculture development showed that in modern conditions it is necessary to focus on a set of indicators that will assess the level of decline in environmental well-being in a particular region and determine the directions of reducing the harmful impact of agriculture on the environment.*

However, taking into account the complex nature of agricultural systems and multidimensional sustainability issues, a single change in agriculture (for example, the introduction of a new technology or a new policy) can lead to multiple cascading impacts on three aspects of sustainability, and therefore some of the performance indicators may improve and others may worsen. Thus, understanding the compromises and synergies between indicators is crucial for policy makers when developing strategies aimed at ensuring sustainability.

Keywords: *agriculture; sustainable development; modern economy; environmental problems; ways of solutions*

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К ПРОБЛЕМЕ РАЗВИТИЯ «УСТОЙЧИВОГО» СЕЛЬСКОГО ХОЗЯЙСТВА В СОВРЕМЕННЫХ ЭКОНОМИЧЕСКИХ РЕАЛИЯХ

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Устойчивость сельского хозяйства – это одно из основных направлений развития отрасли, которое на сегодняшний день имеет высокую актуальность по причине того, что сама отрасль, с одной стороны, использует в качестве основного ресурса земельные угодья, с другой стороны, при производстве сельскохозяйственной продукции имеет место значительное количество отходов, которые ухудшают экологию. Соответственно, ***актуальность*** *рассматриваемой темы определена необходимостью решения проблемы поиска баланса между необходимостью интенсификации уровня производства сельскохозяйственной продукции и сохранением экологического благополучия.*

Цель работы *– рассмотреть проблемные аспекты развития «устойчивого» сельского хозяйства в современных экономических реалиях и обозначить пути решения определенных проблем. В процессе исследования были проанализированы работы различных специалистов в рассматриваемой области, на основе чего был проведен обзор авторских позиций относительно рассматриваемой проблемы, а также применены сравнительный и аналитический методы исследования.*

По результатам исследования был сделан следующий ***вывод****: анализ направления развития устойчивого сельского хозяйства показал, что в современных условиях необходима ориентация на комплекс индикаторов, которые позволят оценить уровень снижения экологического благополучия в том или ином регионе и определить направления снижения вредного воздействия сельского хозяйства на окружающую среду. Однако, учитывая сложную природу сельскохозяйственных систем и многоплановые проблемы устойчивости, одно изменение в сельском хозяйстве (например, внедрение новой технологии или новой политики) может привести к множественным каскадным воздействиям по трем аспектам устойчивости, и, следовательно, некоторые из*

показатели эффективности могут улучшиться, а другие могут ухудшиться. Таким образом, понимание компромиссов и синергизма между показателями имеет решающее значение для разработчиков политики при разработке стратегий, направленных на обеспечение устойчивости.

Ключевые слова: *сельское хозяйство; устойчивое развитие; современная экономика; экологические проблемы; пути решения*

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Introduction

Agriculture is of fundamental importance to society as a reliable source of nutrition necessary for human existence. Agriculture also provides income and employment for rural communities and people throughout the food supply chain [1]. However, the intention of increasing agricultural productivity in order to feed the world's growing and increasingly affluent population is accompanied by growing environmental and social compromises. For example, agriculture:

- is a major factor in deforestation and loss of biodiversity;
- uses about 90% of reactive nitrogen (N) and phosphorus (P) in its activities, as well as most of the chemical pesticides;
- it is because of the activities of agricultural enterprises, 21-37% of anthropogenic greenhouse gas emissions are emitted into the atmosphere [2].

Within the framework of solving food problems, agriculture still faces the task of increasing productivity to meet the growing needs of society for food, fiber and energy. This problem is complicated by its potential consequences for diet and nutrition, climate change and environmental degradation. Therefore, it is extremely important for a particular country and the whole world to develop a sustainable agricultural sector that would be not only productive, but also adequate in terms of nutrition, but also compatible with ecosystem health and biodiversity. All this characterizes the need to turn to sustainable agriculture [3].

The purpose of the work is to consider the problematic aspects of the development of "sustainable" agriculture in modern economic realities and identify ways to solve certain problems.

Research methods

In the course of the research, the works of various specialists in the field under consideration were analyzed, on the basis of which a review of the author's

positions regarding the problem under consideration was conducted. Comparative and analytical research methods were also given.

Results

Sustainable agriculture was explicitly included among the Sustainable Development Goals (SDGs), which were ratified by all Member countries of the United Nations (UN) in 2015. Consistent and transparent assessments are needed to ensure that countries are responsible for sustainable agriculture commitments and awareness in policy development [4]. However, definitions of sustainable agriculture vary significantly, and there are few quantitative assessments of agricultural sustainability for countries around the world today. Some scientists and practitioners view sustainable agriculture as a set of management strategies, while others define sustainable agriculture as an ideology or a set of specific goals.

Nevertheless, there is a growing consensus on creating sustainable agriculture based on its impact on the three pillars of sustainability, namely the environmental, economic and social components. Several systems and indicators have been developed to quantify the sustainability of food systems on a scale from national to global and sustainable intensification of agriculture on a farm scale [5]. However, only a few have focused on assessing the impact of agricultural production on a variety of environmental, economic and social aspects of sustainability on a national scale, setting thresholds or targets, as well as analyzing the synergies and compromises between these impacts. For example:

- indicators of sustainable agricultural growth developed by the World Resources Institute (WRI) assess the impact of agricultural production on the environment only;
- integrated indicators of sustainable food systems and healthy nutrition and the Food Sustainability Index assess the effectiveness of the entire food system instead of focusing on the impact on the three pillars of agricultural sustainability. Data on many of these indicators related to agriculture are limited [6].

Sustainable agriculture indicators are also being developed within the framework of the SDG indicator system by the UN Interdepartmental and Expert Group. The indicator that appeared in the final list for measuring sustainable agriculture was as follows: “SDG 2.4.1: The proportion of agricultural areas where productive and sustainable farming methods are used.” For a detailed description of this indicator, the Food and Agriculture Organization (FAO) of UN led the methodological development of this indicator, which is now recog-

nized by the international community. Implementing methodologies based on farm surveys will require time and resources, especially to identify and compare historical trends [7].

Despite the efforts of several organizations, the call for monitoring agriculture around the world has not yet resulted in actual data sets that would allow trends to be assessed. The lack of a consistent quantitative assessment of agricultural sustainability in many parameters prevents the identification of undesirable compromises of agricultural interventions and the development of win-win solutions for several sustainability goals [8].

Accordingly, a certain set of indicators or the so-called matrix for assessing the sustainability of the agricultural sphere is needed to bring indicators for assessing sustainable agriculture [9]. This matrix should include a set of quantitative indicators to measure the impact of agricultural production on environmental, social and economic aspects of sustainability for different countries or regions of the world.

Researchers emphasize the multidimensional nature of sustainability as the conceptual basis of such a matrix, moving from one-dimensional policies, such as increasing crop productivity, to coordinated thinking and actions among the social, economic and environmental aspects of sustainable agriculture.

Within the framework of the development of this matrix, researchers identify key aspects of sustainable agriculture for evaluation in each dimension (environmental, economic and social) based on a broad overview of existing structures and indicators, developed a list of indicators by synthesizing existing data from several sources and disciplines, and justified a number of quantitative socio-economic and biophysical indicators and thresholds for their sustainability.

The resulting matrix of indicators makes it possible to assess the sustainability of agriculture in countries around the world on a national scale.

The agrosphere sustainability assessment matrix focuses on the direct impact of agricultural production on the environment and the economy, as well as on the broader impact on society as a whole, recognizing that agriculture is deeply interconnected with other sectors (for example, industry). In particular, from an ecological point of view, sustainable agriculture avoids inefficient use of water resources, further loss of biodiversity as a result of the transformation of natural habitat into agricultural land, unreasonable use of chemical compounds that negatively affect local and regional water and air quality, greenhouse gas emissions that disrupt the global climate and loss of health and soil fertility [10].

From an economic point of view, sustainable agriculture increases the economic viability of the agricultural sector by increasing agricultural productivity and profitability, promoting agricultural innovation, providing farmers with access to markets and credits, increasing farmers' ability to manage risks and reducing food losses in the supply chain.

From a social point of view, sustainable agriculture improves the well-being of farmers, respects the rights of farmers, promotes equal opportunities in rural communities and benefits the whole society by increasing the sustainability of the food supply system, improving nutrition and health. These are the main aspects of agricultural sustainability [11].

The state of agricultural sustainability can be recorded by defining indicators for each of the main aspects mentioned above, and ideally these indicators should:

1) be closely related to one of the main aspects of agricultural sustainability and have a monotonous connection with it;

2) have available data for all countries and for several years;

3) measure performance, not driving forces or methods;

4) be simple and clear. However, in practice, such indicators are rare; therefore, it is necessary to establish appropriate criteria for evaluating indicators and establish principles for selecting indicators [12].

The researchers propose a number of universal indicators of the agrosphere sustainability assessment matrix, which act as basic and can be expanded in the future (Table 1).

Table 1.

Universal indicators of the agrosphere sustainability assessment matrix

The aspect of sustainability	Evaluation indicators
Environmental aspect	
Water availability	sustainability of irrigation water consumption
Pollution	excess nitrogen
	excess phosphorus
Land use and loss of biodiversity	lost forest area due to agricultural activities (land use change)
Climate change	greenhouse gas emissions from agricultural activities per harvested area (greenhouse gas)
Soil health	soil erosion
Economic aspect	
Labor productivity in agriculture	agricultural GDP per agricultural worker (labor productivity)
Availability of credit	access to finance for farmers

Farmer's risks	crop price volatility (price volatility)
Support of agriculture	state expenditures on agriculture per agricultural worker (state support)
Market access	total value of agricultural exports as a percentage of agricultural GDP (trade openness)
Food losses	percentage of food loss (food loss)
The social dimension	
Stability	H-index of agricultural product diversity (crop diversity)
	availability of food for the low-income population (availability of food)
Health and nutrition	prevalence of malnutrition (malnutrition)
Farmers' well-being	rural poverty ratio (rural poverty)
Equality	evaluation of the global gender gap report (gender gap)
Farmers' rights	land rights

The level of influence of each indicator listed in the table can be optimal, high or critical in terms of its impact on reducing the sustainability of agriculture in one aspect or another.

Discussion

Let's consider the presented indicators in detail. Environmental measurement includes a number of indicators that measure the impact of agricultural production on major environmental problems. These environmental problems, with the exception of soil erosion, correspond to the assumed planetary boundaries, which are strongly affected by agricultural activities, including the use of fresh water (water consumption: sustainability of irrigation water consumption), human disturbance of nitrogen and phosphorus cycles (N excess and excess phosphorus), land system change, loss of biodiversity (land use change: deforestation as a result of agricultural activities) and climate change (greenhouse gas: greenhouse gas emissions from agricultural activities) [13]. Consequently, the definitions of these indicators and their threshold values correspond to the literature data on planetary boundaries with some changes that allow for country-level assessments and cross-country comparisons.

Although the soil erosion indicator is not included in the planetary boundaries, it provides an initial assessment on a national scale of one of the aspects of soil health, interest in which is growing, but data on a national scale is limited.

Although this indicator does not reflect all the problems associated with the state of the soil, it is the only indicator for which at least basic estimates with

global coverage are available, by country and over several years. It should be recognized that agricultural production has other environmental impacts that are not directly measured by these six indicators (for example, environmental damage caused by the use of pesticides and loss of biodiversity due to changes in the composition of crops or other changes in land use other than deforestation) [14]. The assessment of these impacts within the framework of the agrosphere sustainability assessment matrix requires future efforts to develop the concept of a data array.

The economic component includes six indicators that measure the economic viability of farmers and agricultural enterprises, taking into account both the costs and benefits of agricultural production.

In terms of costs, the economic parameter measures farmers' access to financing options (access to financing: access to financing index), price support from the government (government support: government spending on agriculture as a percentage of gross domestic product of agriculture), which potentially helps farmers and agro-enterprises to reduce their costs and increase their innovation potential and food losses throughout the supply chain (food losses: the indicator of food losses after harvest and before consumption as a ratio to domestic supply).

In terms of benefits, the economic aspect evaluates the productivity of farmers and their exposure to crop price volatility. Unlike environmental indicators, the limits for most economic indicators are not widely recognized and have not been established, and, consequently, the definition of agreed thresholds may be difficult in different countries. In the literature, it is proposed as a first approximation to solve this problem to determine the 75th and 25th percentiles of the existing values for five of the six economic indicators in a particular country for all years. With this approach, indicator values beyond the 75th percentile indicate likely sustainable methods, while values below the 25th percentile are likely unstable.

The social dimension includes six indicators measuring the direct impact of agriculture on farmers' livelihoods and the broader impact on society. These include farmers' welfare (rural poverty: rural poverty ratio), farmers' rights (land rights: Landmark Land Rights Protection Index) and equality (gender gap: global gender gap Index). Although there are many other aspects of well-being, rights and equality, these indicators contain sufficient data and reflect important aspects of farmers' livelihoods [15].

The impact of agricultural production on health and nutrition is very large and often depends on social norms, culture, access to information and other socio-economic and physiological factors.

Sustainable agriculture is fundamental to the sustainability of food systems; i.e., the ability of food systems to adapt to external disturbances and ensure a stable food supply. Here, the sustainability of the food system is measured using two indicators: socio-economic sustainability, which takes into account the availability of food for low-income households.

As in the case of economic indicators, it is difficult to determine the thresholds for the sustainability of social indicators. Thresholds for social indicators are mainly based on literature and expert opinions.

Analysis of the current state of agricultural sustainability based on literature analysis has shown the following. Four of the six environmental measurement indicators (i.e. excess nitrogen, excess phosphorus, greenhouse gases, soil erosion) indicate that more than 50% of the world's population is in high-risk countries.

Many high-income countries with relatively small agricultural land or relatively homogeneous climates face problems with crop diversity (for example, Iceland and the United Kingdom), and most high-income countries in Europe urgently need to reduce greenhouse gas emissions in the agricultural sector. Lower-middle-income and low-income countries located in South Asia, the Middle East and sub-Saharan Africa demonstrate an urgent need to eradicate rural poverty and improve food availability and nutrition, especially in low-income households [16].

The analysis shows that a large proportion of high-income countries have achieved sustainable economic goals in comparison with other income groups, while the share of countries with insufficient or low-income populations is characterized by a decrease in the level of sustainability of agriculture.

Environmental indicators vary according to a country, mainly due to differences in natural resources, farming methods and stages of development. Environmental problems are particularly acute in rapidly developing middle-income countries. For example, almost all environmental indicators of three major developing countries have deteriorated over the past 5 years. There is only some improvement in the situation with soil erosion in China and India and land use changes in Brazil; however, such an improvement is still not enough for these countries to receive a sufficient or high assessment of the manifestation of this indicator [17].

Low-income countries such as Ethiopia and Tajikistan face increasing environmental risks, such as higher greenhouse gas emissions and increased soil erosion. In some high-income countries, such as Australia and the United States, there are trends towards significant improvements in some environmental in-

dicators, such as water consumption, excess phosphorus and soil erosion [18]. However, the phosphorus excess indicator is still quite high in Australia, and some indicators, such as nitrogen excess and soil erosion, are still dangerously high in the US.

In other words, countries, especially those in the high-income group, can potentially demonstrate obvious environmental indicators by adjusting the portfolio of domestic production towards more environmentally friendly and profitable products or importing more agricultural or food products [19].

Conclusion

The analysis of sustainable agriculture development has shown that in modern conditions it is necessary to focus on a set of indicators that will assess the level of decline in environmental well-being in a particular region and determine the directions of reducing the harmful impact of agriculture on the environment. However, taking into account complex nature of agricultural systems and multifaceted sustainability issues, a single change in agriculture (for example, the introduction of a new technology or a new policy) can lead to multiple cascading impacts on three aspects of sustainability, and therefore some of the performance indicators may improve, while others may worsen [20]. Thus, understanding the compromises and synergies between indicators is crucial for policy makers when developing strategies aimed at ensuring sustainability.

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