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Ensuring Economic and Food Security through the Development of the Agricultural Sector (The (Example of Ukraine)

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Abstract: The purpose of the academic paper is to develop ways in order to increase the level of food security of Ukraine and the world on the basis of sustainable development by providing a bioeconomic vector of development of the agricultural sector. Research methods: analysis of theoretical and empirical scientific papers, analytical reports, policy papers, synthesis, induction, SWOT-analysis. Results: as a result of the study conducted, a bioeconomic model of agricultural sector development has been developed on the basis of sustainable intensification, the application of which will ensure the required level of food security in Ukraine and the world. The model includes a number of aspects for its application in different operating conditions. Conclusions: Ireland, Austria and France are the leaders in the field of food security according to the Global Food Security Index (GFSI). In Ukraine, this index has the lowest value among the studied countries. Ukraine's food security is affected by such negative factors as underdeveloped infrastructure, lack of funding, and lack of a strategic vision of food security at the state level. At the same time, there is a great untapped potential in agricultural production in Ukraine. The developed theoretical bioeconomic model of agricultural development includes the maximum number of factors that affect the quality and stability of production, storage, and minimizes the negative effects of production. It has been taken into account that the long-term ability of the food system for provision of sufficient nutritious food will depend on its ability to respond to environmental and social-economic challenges, minimizing the negative impact on human health and the environment. The SWOT-analysis of the developed model has been carried out, which includes the analysis of benefits and shortcomings, opportunities and challenges as a result of its application. The developed bioeconomic model of agricultural sector development will contribute to solving a wide range of topical issues of economic and food security of Ukraine and the world.

Keywords: food security, sustainable development, bioeconomics, constant intensification, agricultural sector, Ukraine.

INTRODUCTION

The UN Sustainable Development Goals include the eradication of hunger, that is, ensuring food security throughout the world. In order to provide food for the projected 10 billion people by 2050, a balance must be achieved between sustainable development goals, food security, food safety and food losses. For decades, food security and sustainable development have been seen as separate governance issues. In essence, food security was limited to the problem of combating hunger at the global level, while Sustainable Development was linked to food safety and the environmental impact of agricultural production. Global policy changes and crises that triggered jumps in fuel, food and energy price spikes in 2007-2008, 2014 and the coronavirus crisis in 2020 call for a rethinking of the importance of food security and sustainable development and a deepening of their interrelationships. The global problem of recycling surplus food has been replaced by the problem of its

shortage. Further complicating the issue is the depletion of global food supplies, as large areas of agricultural land are used for the production of biofuels rather than food.

The agricultural sector of Ukraine consistently supports its position in the top 10 exporters of grain and oilseeds in the world. The possibilities of increasing the contribution of Agriculture to World Food Security by expanding acreage in Ukraine have now been exhausted. To solve modern problems, it is necessary to introduce intensive technologies in agricultural production.

The most promising strategy for ensuring economic and food security is to ensure development of the agricultural sector on the basis of sustainable development, that is, the transition to a bioeconomic model. The cross-cutting nature of bioeconomics offers a unique opportunity to address comprehensively interrelated social issues such as food security, natural resource scarcity, dependence on fossil resources, and climate change, while achieving sustainable economic development of the agricultural sector.

Reducing sources of loss, i.e. reducing the level of food and waste losses, is the most effective way not only to increase the level of food security, but also to ensure economic benefits from creating a new value chain from waste and related agricultural products.

PURPOSE

The purpose of the academic paper is to develop ways in order to increase the level of food security of Ukraine and the world on the basis of sustainable development by ensuring the bioeconomic vector of development of the agricultural sector.

Research objectives are as follows:

1. to conduct an in-depth comparative analysis of the main indicators of food security of 25 European countries and Ukraine;
2. to investigate the impact of various factors on the dynamics of the Global Food Security Index of Ukraine for the period 2012-2019;
3. to identify key trends in the development of the agricultural sector and their impact on food security;
4. to propose the introduction of a bioeconomic model of agricultural sector development to increase food security.

LITERATURE REVIEW

The global debate on food security continues. A threat to food security occurs when the supply of nutritious and safe food products decreases or becomes impossible, or when the population's ability to pay is low (Bazerghi et al., 2016). Given the rapid population growth, the need to feed such a large number of people with quality food requires changes in agri-food chains over the next 20 years (Kearney, 2019).

Food security is a country's ability to provide its population with access to quality food. This issue should be considered in two dimensions: as an obligation of the state and as an element of national security. According to the Rome Declaration on World Food Security, each country must ensure the right of its population to adequate nutrition. This document includes the following components of food security, namely: physical and financial affordability, food sovereignty, stability to seasonal and weather shocks, and resilience to agricultural production growth.

The issue of food security was on the agenda in the 1970s, and at the World Food Conference in Rome in 1974 the first clear confirmation was made that this issue concerned all humanity. Since that time, the concept of food security has developed dynamically, multiplied and diversified. There are currently almost two hundred definitions of food security (Smith et al., 1993), evidenced in different views and approaches to the problem (Figure 1); however, the most common and mainstream is the definition of the World Food Summit (WFS), which took place in November 1996.

Today, the main task of the agri-food sector is to provide both sufficient quantity and quality of food to meet the needs of an ever-growing population and preserve natural resources for future generations. Accordingly, a new challenge for ensuring food security in the long term is the formation of food policies based on the principles of sustainable development. To improve the conceptual framework, the author's interpretation of the concept of food security is proposed, taking into account the challenges of our time (Table 1).

Table 1: Evolution of the interpretation of the concept of "food security"

Problems	Year	Definition
Food availability	1974	"Availability at all times of the world's essential food supplies for sustainable consumption growth and compensation for fluctuations in production and prices" (WFS, 1974)
Ensuring food	1983	"Ensuring that all people have physical and economic access at all times to the basic foods they need" (FAO, 1983)
	1986	"Access of all people at any time to sufficient food for an active and healthy life" (World Bank., 1986)

Economic capacity to access food	1994 1996	"Availability of basic foodstuffs, which implies the availability of sufficient quantities and free access to them and sufficient purchasing power of the population" (UNDP, 1994) "Food security at the individual, domestic, national, regional and global levels exists when all people at all times have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for active and healthy life" (WFS, 1996)
Social capacity to access food	2001	"Food security is a situation where all people at all times have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and nutritional preferences for an active and healthy life" (FAO, 2001).
Food use	2008	"Food security and food safety is achieved when proper food (in terms of quantity ,quality, safety, socio-cultural acceptability) is available and available to all people at any time and, accordingly, is used and absorbed by them to lead a healthy and active lifestyle" (UNICEF, 2008)
Sustainable development of food security	2020	"Food security - the functioning of the food system that provides consumers with complete, safe, healthy and affordable food, taking into account the optimal use of natural and human resources, protection of biodiversity and ecosystems for present and future generations, is culturally acceptable and accessible, environmentally and economically viable and viable"*

*It has been formulated by the author

Source: Compiled by the author based on the FAO (1983), World Bank (1986), World Food Summit (1996), FAO (2002)

Food security is directly affected by a number of factors that avowedly depend on the level of development of the agricultural sector. One such factor, according to viewpoint of scientists, is the land tenure system (Laborde et al., 2016), that is, the direct dependence of the potential of food production on the available land resources. The level of awareness and education of people is another factor that affects food security, as it encourages people to consume the most nutritious and healthy food to maintain good health (Zhou et al. 2017). According to (Pangaribowo and Gerber, 2016) the introduction of innovation in the agricultural sector with government support is a key factor in achieving food security within the conditions of an increasing population growth. Therefore, it is important for governments to pursue policies that support the introduction and creation of technology, innovation and knowledge in order to achieve food security. In addition, researchers note (Limi et al. 2016) that the availability of good infrastructure plays an important role in ensuring food security, especially in rural areas. After all, increasing the availability of food does not necessarily lead to better food security if consumers are lack of physical access to food.

One of the main means of achieving food security is the introduction of a bioeconomic vector of agricultural sector's development with the introduction of the principles of sustainability. There are studies that address only two dimensions of food security: availability (that is, quantity, type and quality of food stocks) and availability (the ability to purchase products of a certain quantity, type and quality) (Ericksen, 2008). Other researchers (Reilly and Willenbockel, 2010) or, as Ericksen et al. (2009) link economic, environmental and social components only to food consumption issues, without providing a holistic view of the issue.

Recent studies (Gartland and Gartland 2016; von Braun 2018) have shown that biotechnologies in the production of agricultural products that are able to meet the growing demand for food play an important role in achieving food security. Thus, biotechnology can be applied to food production on a sustainable basis, which in turn leads to economic benefits (D'Hondt et al. 2015).

METHODS.

The review of the relationship between food security, sustainable development and bioeconomics is based on theoretical research by analyzing scientific papers, analytical reports, policy documents, etc. The study has used analytical data obtained from official sources AMIS Market Databace, FAO, State Statistics Service of Ukraine. The obtained results are confirmed by the corresponding literature review. In this context, the following key indicators are demonstrated, namely: the dynamics of agricultural production in Ukraine, the dynamics of export and import operations of the agri-food sector of Ukraine, the level of self-sufficiency in basic foods and, etc. They are used in order to determine the current situation with food security in Ukraine and the possibility of conducting a comparative analysis with EU countries.

All these data are assessed by classifying them into four main dimensions of food security, namely: financial and physical affordability of food, quality and safety, and natural resources and sustainability.

Analysis, synthesis, induction and other general research methods have been used to select / group data, identify similarities / differences and identify trends. The SWOT analysis has been used to assess the problems and prospects of implementing a bioeconomic model of development of the agricultural sector of Ukraine, taking into account the identified shortcomings in food security of Ukraine based on indicators of the Global Food Security Index and the theoretical studies of sustainable development.

RESULTS

The country's food security is affected by a large number of factors: the volume of agricultural production, weather conditions, geographical location and others, including even corruption. Taking into account the above, the calculation of the Food Security Index requires simultaneous consideration of various parameters on which the rating is based. Therefore, the capacity of countries to ensure food security varies considerably. One of the most effective ways to assess a country's potential is through the Global Food Security Index (GFSI), which has been published annually by the research company since 2012 The Economist Intelligence Unit (The Global Food Security Index, 2019). Until recently, the Global Food Security Index consisted of three main parameters: quality, safety, financial and physical availability of food. A fourth parameter has recently been added - natural resources and sustainability. This change in methodology is explained by the fact that in 2017, for the first time in the last 5 years, there was deterioration in the food security situation. In addition to traditional factors, issues such as global warming and adverse weather conditions are on the agenda. The US withdrawal from the Paris Agreement has further heightened the negative expectations associated with climate change. In addition, there is currently a global increase in political instability. Thus, starting in 2017, it was decided to publish two versions of the Index: the average food safety rating based on three parameters, and an adjusted one, which includes the fourth parameter - the impact of natural factors (Table 2).

Table 2: Comparative analysis of the main indicators of food security of 25 European countries and Ukraine, 2019

	Rank / Score (3 factors)	Rank / Score (4 factors)	GDP ($PPP) (billion)	Population (million)	Land Area (sq km)	Prevalence of undernourishment (%)	Intensity of food deprivation (kcal/person/day)
Ukraine	76/57.1	77	411.2	42.01	579,290	3.5	18
Serbia	59/62.8	54	128.52	6.96	87,46	5.7	40
Bulgaria	51/66.2	47	166.06	6.99	108,560	3.6	24
Slovakia	47/68.3	35	195.4	5.46	48,080	3.4	22
Russia	42/69.7	36	4,179	148.9	16376870	2.5	6
Romania	38/70.2	34	583.8	19.36	230,080	2.5	5
Belarus	36/70.9	38	195.6	9.45	202,988	2.5	8
Hungary	34/72.7	28	323.5	9.69	90,530	2.5	14
The Czech Republic	32/73.1	24	443.2	10.69	77,220	2.5	5
Greece	31/73.4	29	329.5	10.47	128,900	2.5	5
Spain	25/75.5	22	1,936	46.74	499,564	2.5	9
Poland	24/75.6	21	1,265	38.25	306,190	2.5	3.
Italy	23/75.8	22	2,589	60.55	294,140	2.5	2
Portugal	20/77.8	18	258.2	10.28	91,606	2.5	3
The United Kingdom	17/79.1	17	3,162	67.53	241,930	2.5	3
France	16/80.4	13	3,147	65.13	547,557	2.5	2
Belgium	15/80.7	15	595	11.54	30,280	2.5	1
Denmark	14/81	6	333.8	5.77	41,990	2.5	5
Germany	11/81.5	11	4,526	82.83	349,360	2.5	3
Austria	10/81.7	8	509.2	8.65	82.523	2.5	1
The Netherlands	9/82	9	1,010	17.26	33,690	2.5	10
Sweden	7/82.7	4	561.2	10.05	407,310	2.5	10
Norway	5/82.9	5	362	5.37	365,123	2.5	3
Finland	5/82.9	2	267	5.53	303,910	2.5	4
Switzerland	4/83/1	3	597.6	8.61	39,516	2.5	5
Ireland	2/84	1	433.7	4.88	68,890	2.5	1

It has been compiled by the author on the basis of The Global Food Security Index (2019)

Ireland, Austria and France are leaders in food security. Ukraine has the lowest index value among the countries studied. If we compare the overall rating with the adjusted one, which takes into account the impact of environmental factors, we can observe a significant impact of these factors on the food security of any state. Almost all countries have improved results when natural factors are taken into account, except for Ukraine and Belarus, which show deterioration in food security with the addition of the fourth group of factors.

As for Ukraine, which has a huge unrealized potential in agriculture, as a result, the dynamics of its Global Food Security Index for the period 2012-2019 (Figure 1) shows disappointing results, because only in 2019 Ukraine almost managed to reach the level of food security in 2012. Until 2018, the index showed negative dynamics. In 2019, the value of food availability reached its highest level, but physical availability and quality and safety decreased significantly.

To further assess the state and identify the main problems of economic and food security of Ukraine and its contribution to food security in the world, it is necessary to conduct a more in-depth analysis of the main problem indicators.

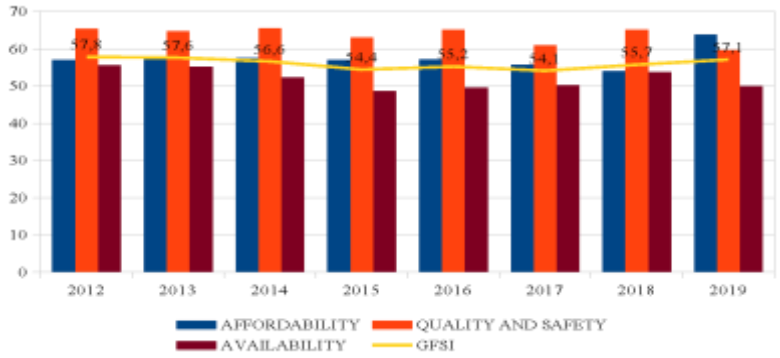


Figure 1. Dynamics of the Global Food Security Index of Ukraine for the period 2012-2019 (in terms of impact factors)

Source: It has been compiled by the author on the basis of The Global Food Security Index (2019)

According to the data obtained (Table 3), the main positive factors affecting the food security of Ukraine (values more than 75% according to the methodology) is the indicator of changes in food costs, a small share of the population that is below the poverty line, favorable tariffs for agricultural imports, the availability and financing of the food safety system, the availability of premises for storing crops, a small number of food losses and a fairly high level of food safety, which is ensured by the functioning of the relevant authorities.

Table 3: Analysis of factors influencing food security in Ukraine

Factor	Indicator	Value in Ukraine / average value in the world	Score, %	Deviation from the average score, %
AFFORDABILITY	Change in average consumption of consumer goods (in 2010 prices)	236,1 / 186, 4	94.5%	(-1.9%)
	Proportion of the population below the poverty line,%	0,1 / 11,5	99.9%	(+16.4%)
	GDP per capita, USD USA	9253 / 23009	6.8%	(-11%)
	Tariffs for imports of agricultural products	9.2 / 15.4	85.5%	(+9.9%)
	Availability and quality of food safety systems, (quality assessment 0-4)	2 / 4	50%	(-24.3%)
	Food Safety (BHP) (0-1)	1 / 0.9	100%	(+8%)
	Financing of BHP systems (0-1)	1 / 0.8	100%	(+15%)
	Coverage of BHP systems (0-1)	0 / 0.7	0%	(-65.5%)
	Operation of BHP systems (0-1)	0 / 0.5	0%	(-54.9%)
	Farmers' access to finance (0-4)	2 /2.6	50%	(-13.9%)
AVAILABILITY	Sufficiency of supply in the market (0-100)	57.1 / 62.9	57.1%	(-3.7%)
	Average food availability, %	119 / 122.6	42.3%	(-5.1%)
	Changes in the relationship between chronic diseases and nutrition, %	0.59 / 0.7	98%	(+0.2%)
	Government expenditure on R&D in agriculture (share of GDP)	0.13 / 1.3	1.1%	(-3.9%)
	Agricultural infrastructure (0-100)	40.7 / 62.9	40.7%	(-8.4%)
	Availability of storage facilities for the harvest (0-1)	1 / 0.9	100%	(+9.7%)
	Road infrastructure (0-4)	1 / 1.8	25%	(-21%)
	Port infrastructure (0-4)	1 / 2.1	25%	(-28.1%)
	Air transport infrastructure (0-4)	2 / 2.4	50%	(-9.1%)

	Railway infrastructure (0-4)	2 / 1.5	50%	(+12.8%)
	Irrigation infrastructure (0-4)	5.2 / 10.4	5.2%	(-5.3%)
	Production instability (deviation)	0.1 /0.1	70%	(-11.2%)
	Political instability (0-100 (highest risk))	75 / 45.4	16.7%	(-32.9%)
	Corruption (0-4 (highest risk))	4 / 2.5	0%	(-38.5%)
	Resistance to urbanization processes, %	3.2 /0.9	90.1%	(+8.1%)
	Food losses, tons	3.7 / 5.6	90.4%	(+5.5%)
QUALITY AND SAFETY	Dietary diversity, %	59 / 52.33	67.2%	(+11.4%)
	Raising food standards (0-100)	0 / 62.9	0%	(-67.4%)
	National dietary recommendations(0-1)	0 / 0.5	0%	(-54%)
	National nutrition plan or strategy (0-1)	0 / 0.8	0%	(-79.6%)
	Nutrition monitoring and surveillance (0-1)	0 / 0.7	0%	(-69.9%)
	Availability of trace elements (0-100)	67.3 / 62.9	67.3%	(+7%)
	Dietary availability of vitamin A. (0-2)	2 / 1.6	100%	(+18.1%)
	Dietary availability of iron, mg per person/day	20.6 / 19.1	43.7%	(+3.9%)
	Dietary availability of zinc, mg per person/day	10.2 / 10.3	58.1%	(-1.3%)
	Protein quality, g	62.1 / 58	53.3%	(+6.3%)
	Food safety (0-100)	95.7 / 62.9	95.7%	(+13.2%)
	Food safety and health agency (0-1)	1 / 0.9	100%	(+12.4%)
	Percentage of the population that has access to drinking water, %	93.8 / 87.2	89.9%	(+10.7%)
	Possibility of safe storage of products for the population, %	100 / 83.2	100%	(+18.5%)

Source: It has been compiled by the author on the basis of

Negative factors (values below 25%) include low GDP per capita, quality, level of funding and coverage of the food safety system, minimal government spending on development and innovation in the food sector, the state of infrastructure facilities, political instability, high level of corruption, lack of state programs and strategies to improve food standards (this segment has zero value for 4 indicators at once).

According to the results of 2019-2020, Ukraine ranked the fourth place in terms of corn exports (30, 5 million tons), the fifth place in terms of wheat escorts (21 million tons), the second place in terms of barley exports (4,7 million tons) and the sixth place in soybean exports (2, 8 million tons). Consequently, Ukraine has firmly entrenched in the top ten grain exports (Agribusiness in Ukraine), see Figure 3.

Providing about 11-13% of GDP and 23% of Ukraine's foreign trade turnover, the agricultural sector demonstrates significant economic potential. During the study period, indicators of agricultural production (Figure 2) show insignificant but stable growth, but mostly due to crop production, while livestock production tends to decrease. The highest growth rates of agricultural production are provided by legumes and industrial crops.

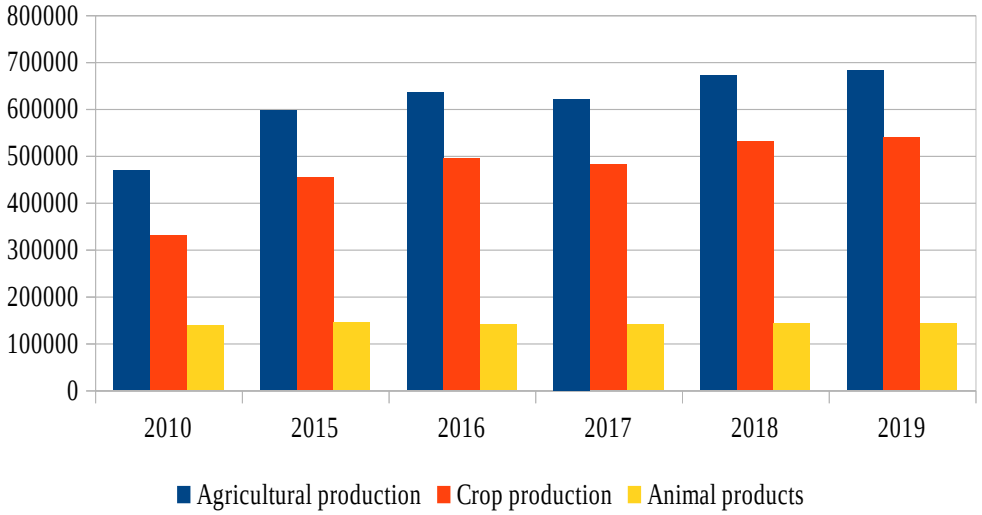


Figure 2. Dynamics of production of agricultural products of Ukraine by types, UAH million

Source: it has been compiled by the author on the basis of data (State Statistics Service of Ukraine)

Under such conditions, the capacity of the agro-industrial complex of Ukraine makes a significant contribution to ensuring global food security through the export of its own surplus (Figure 3).

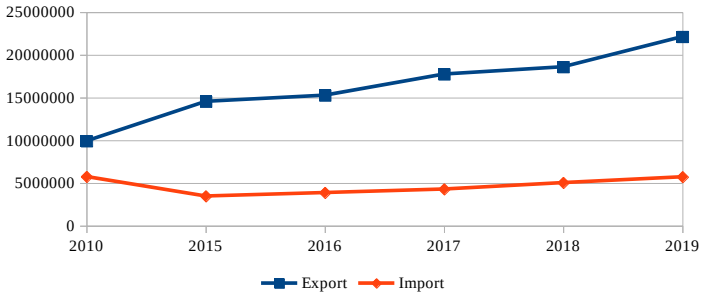


Figure 3. Dynamics of export and import operations of the agri-food sector, UAH mln.
Source: it has been compiled by the author on the basis of data (State Statistics Service of Ukraine)

The share of agricultural products in the structure of Ukraine's export revenue has increased over the past 5 years. However, it should be noted that the basis of agricultural exports is still the export of raw materials, namely products of plant origin - wheat, corn, barley and soybeans. The share of these products in the structure is about 55% (Ukrainian Agrarian Club).
In 2019, the needs of the population for food have been provided mainly through products of domestic origin. This trend has been stable in recent years (Figure 4).

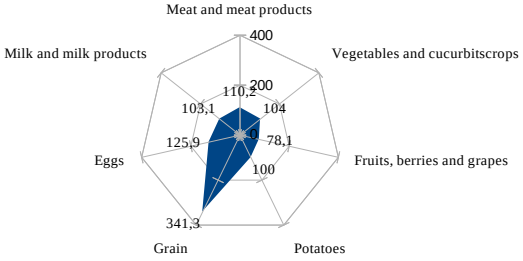


Figure 4. The level of self-sufficiency in basic types of food in 2019,%

Source: it has been compiled by the author on the basis of data (State Statistics Service of Ukraine)
Taking into consideration that the share of cereals in the consumption structure of both advanced and developing countries is about 50%, it is advisable to determine the level of impact of Ukraine's export capacity on food security in the world by the position of grain crops (Figure 5).

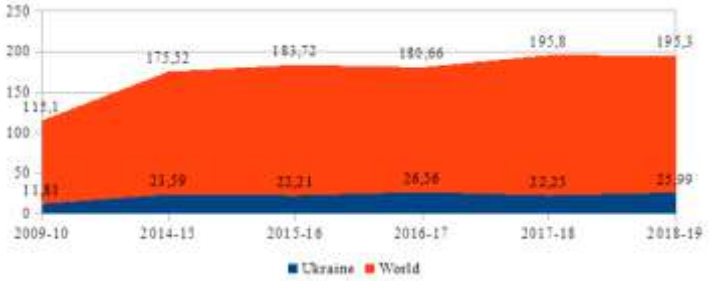
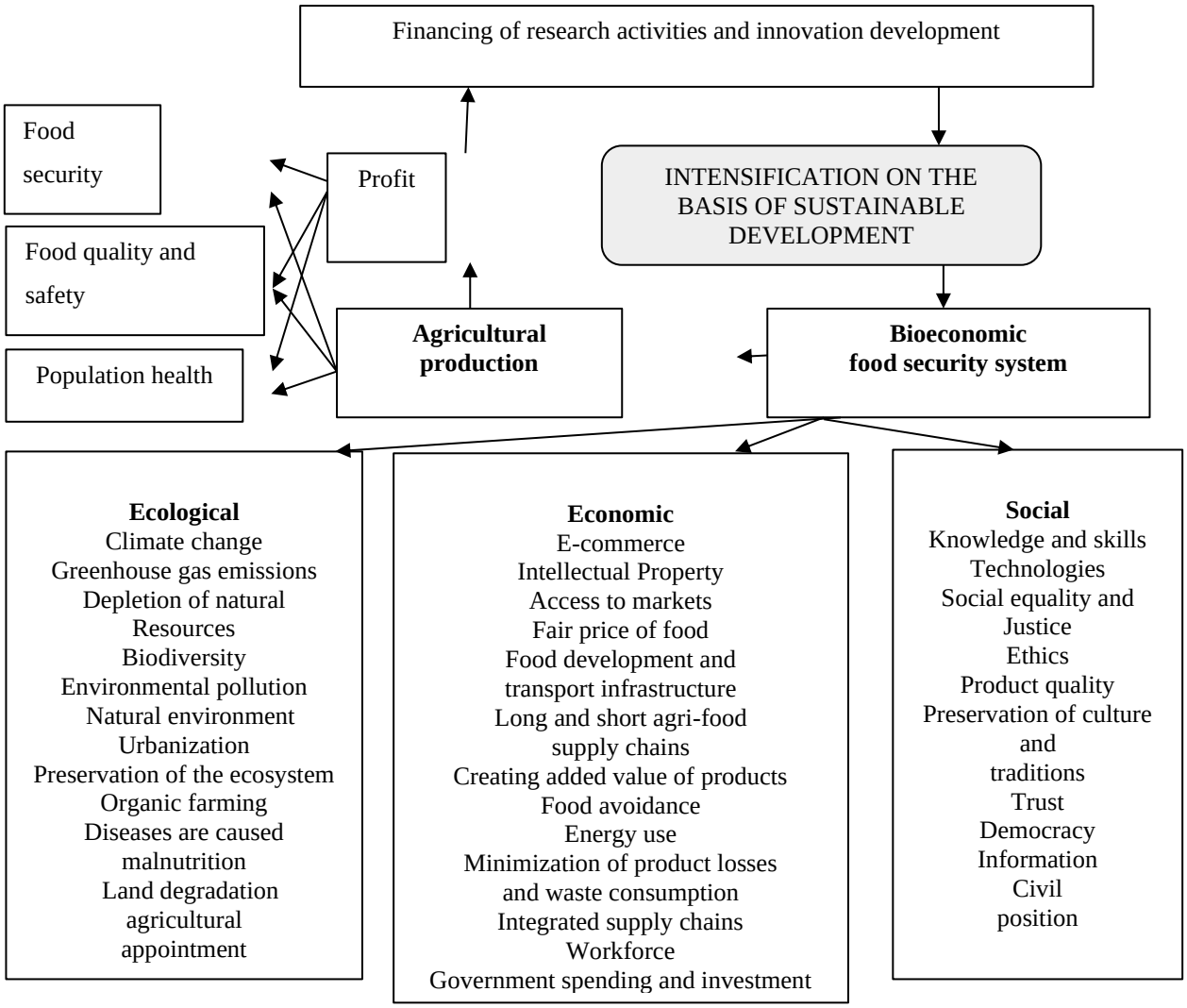


Figure 5. Dynamics of grain crops exports of Ukraine and the world, million tons

Source: it has been compiled by the author on the basis of data (AMIS Market Databace)
Further intensive development of Agriculture has four main threats to the sustainable development of the food security system at the global level: degradation of agricultural land; reduction of biodiversity; pressure of agricultural production on water resources; pollution and depletion of natural resources - all these issues affect the dynamics of climate change, which certainly has an impact on the global geography of food production.
Intensification of agricultural production is nothing more than an increase in production per unit of resources per unit of time. Whereas the definition of sustainable intensification is interpreted as the production of more agricultural products on a certain area of land resources, while reducing the negative impact on the environment; consequently, this allows solving the problems that arise with traditional methods of intensification.
Based on the principles of sustainable intensification (SI) and taking into account the previously considered prerequisites and features of the modern food security system, we have formed a bioeconomic model of agricultural sector development on the basis of sustainable intensification (Figure 6).



The developed model envisages comprehensive (including financial and political) state support for the development of innovations in the agricultural sector, which creates preconditions for sustainable intensification of agriculture through interdisciplinary integrated approaches and further transition to the bioeconomic vector of agricultural development. The introduction of the principles of sustainable intensification makes it possible to balance the environmental, economic and social goals of agricultural production and ensure a smooth transition to a new, bioeconomic model of agricultural sector development.

The effect of the implementation of the principles of sustainable intensification of agriculture is not instantaneous, it is difficult to assess. This leads to the neglect of these issues at the state level, especially in the allocation of national budget resources in most developing countries, including Ukraine.

Ukraine is one of the ten leaders in the production and export of grain crops. Overproduction of crop products forms the country's export capacity. Grain crops production in Ukraine in 2019 exceeded consumption almost twice, while global production does not have such a trend. However, taking into consideration that grain (feed grain) and technical crop products predominate in the share of Ukraine's international exports, the impact of the domestic agricultural sector on food security in the world is exaggerated. Thus, it is necessary to reorient agricultural production from a quantitative component to a qualitative one, that is, to provide world markets with quality, certified products in accordance with international standards and principles of sustainable development.

Today, bioeconomics is a reality, and it has generated growing interest in many parts of the world. To switch to a bio-economic model for the development of the agricultural sector of Ukraine, it is necessary to implement the principles of sustainable intensification, which actually forms a roadmap for the development of the agricultural sector based on the principles of sustainable development.

To ensure the transition to bioeconomic vector of development and functioning of the agricultural sector of Ukraine and increase the level of national and world food security, as well as to further develop the necessary strategic documents, a SWOT analysis of the proposed bioeconomic model of agro-industrial complex

development was conducted. The SWOT analysis makes it possible to assess various strengths and weaknesses (based on GFSI), opportunities and threats (based on the developed literature sources) on the implementation of the principles of sustainable intensification.

Table 4. SWOT analysis of the bioeconomic model of development of agro-industrial complex of Ukraine

Strengths	Weaknesses
● Slight change in the average cost of consumer products ● Low share of the population below the poverty line ● Low tariffs on imports of agricultural products ● Food safety ● Availability of storage facilities for the harvest ● High land fertility ● Significant areas of agricultural land	● Political instability and corruption ● Lack of a developed and approved National Nutrition Plan or Strategy ● Lack of food monitoring and surveillance system ● Weak government policy in the field of raising food standards ● Low level of GDP per capita ● Insignificant government spending on R&D in agriculture ● Uncertainty in the formation of the land market ● Skill gaps - capacity and availability along the supply chain ● Access to finance
Opportunities	**Threats**
● Growing global demand for nutritious food. ● Growing demand for new products due to recent consumer trends, organic products ● Green / Sustainable reputation ● Potential for new foreign direct investment (FDI) ● Use of alternative fuels by converting losses and wastes of agriculture. for biomass	● Price volatility / lack of profitability ● Fluctuations in foreign currency ● Disruption of the supply chain due to potential disease risks or food safety ● Challenging targets for greenhouse gas emissions ● Global competition ● Biodiversity loss and declining water quality

Source: It has been compiled by the author

DISCUSSION

The growing impact of agricultural production on the state of the environment contributes to the emergence of the concept of sustainable intensification (SI) of agricultural production as one of the most powerful areas in discussions on food security. The main defining principle of SI agricultural sector is that changes should be implemented on the basis of technological and scientific innovations (from increasing the efficiency of agri-environmental methods of food production to experiments using modern genetics). According to FAO (Collette et al., 2011), SI of agricultural production envisages an increase in production from the same area of land while reducing the negative impact on the environment and increasing the contribution to natural capital and flows of environmental services (Pretty et al., 2011).

The basic problematic issues of ensuring food security in Ukraine are as follows: political instability and corruption; the lack of a developed and approved National Plan or Food Security Strategy; the lack of a monitoring and control of the system for nutrition; weak government policy in the field of raising food standards; low GDP per capita; low government spending on R&D in agriculture; uncertainty in the formation of the land market, which is connected with the corruption component and is one of the most important factors in ensuring food security (Laborde et al., 2016); gaps in skills - ability and availability along the supply chain, access to finance. Most of them can be solved by changing traditional approaches to innovative ones. In particular, it has been proposed to use the principles of SI in order to ensure the further development of the agricultural sector of Ukraine.

The key principles of SI of agricultural production are as follows (Sonnino, 2014): systematic approach to the management of natural resources (land, water, seeds and fertilizers), to support natural processes that ensure plant growth (including pollination, natural predation to control pests and the action of soil biota, provides plants with access to nutrients); integration of different areas of knowledge to bridge the gap between agro-industrial / biotechnological and agri-environmental opportunities; interaction with traditional and local knowledge; involvement of local farmers in the innovation process.

Based on the study conducted, it becomes clear that traditional approaches to food security in Ukraine have at least two negative trends: firstly, the lack of complexity and innovation in the development of food security strategies; secondly, and as a result, ignoring a wide range of sustainable development issues, especially at the stages of agricultural production. The designed bioeconomic model of agricultural sector development on the basis of sustainable intensification forms a promising basis for rethinking the agricultural sector in terms of sustainability, that is, for the introduction of research and policy components that would take into account "deeply interdependent economic, social and environmental systems" (Misselhorn et al., 2012, p.10). As Garnett and Godfray (2012, p. 49) point out, "a system of agri-food production that is socially, economically or ethically

unacceptable to a large part of the population, will not show signs of continuity and flexibility, no matter how environmentally oriented it is". Taking this into account, the social component of the developed model provides large-scale informing and training in order to form an appropriate worldview in the society for ensuring the transition to a bioeconomic vector of development of the country's agricultural sector. After all, according to the reviewed studies (Zhou et al. 2017), the level of awareness and education of people significantly affects the level of food security.

An example of the introduction of sustainable intensification is a doubling of the yield of vegetable crops with the same impact on the environment as with the traditional method of cultivation. Such changes will require consumers and food business entities to adapt quality requirements and product specifications (Johnson et al., 2018). The transformation of the global agri-food system in the bioeconomic direction will lead to provision of an adequate level of global food security and become more sustainable. An important direction of development in this area is the introduction of modern IT technologies that enable more efficient use of resources and food processing. State support for the development of innovations in the agricultural sector will be a major factor influencing the bioeconomic development of the entire system, as it has been confirmed by relevant studies (Pangaribowo and Gerber, 2016).

CONCLUSION

There is a strong link between food security and sustainable agricultural development at both the global and national and local levels. The introduction of the principles of sustainable intensification in the agricultural sector increases food security and ensures the transition to the bioeconomic vector of development of the entire country.

Unfortunately, the value of the Global Food Security Index of Ukraine is in the last place among 25 European countries. At the same time, Ukraine is characterized with an extremely large and unrealized potential for the development of agricultural infrastructure, which is one of the factors influencing the value of this index. Therefore, in order to address the issue of food security of Ukraine and the world, a theoretical bioeconomic model of agro-industrial development has been developed; it is focused on strengthening the food security system on the basis of sustainable development, which takes into account various factors of its effectiveness (economic, social and economic). The designed bioeconomic model of agricultural development is the author's contribution to the development of more systematic research and programs that go beyond conventional issues and components of the food security system (that is, supply and demand) in order to provide a holistic study of complex interconnections within the food security system (see Figure 2). In addition, the designed model forms a long-term perspective of development that corresponds to the latest world concepts and considers food security as a process and not as a goal in itself. SWOT analysis of the developed model has been also conducted, which includes an analysis of strengths and weaknesses, opportunities and challenges.

The application of the developed model should increase the economic and food security of Ukraine.

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