Eastern Journal of European Studies
DOI: 10.47743/ejes-2023-0110 | June 2023 | VOLUME **14**, ISSUE **1**

The agribusiness ecosystem as a way to a balanced recovery of the agrarian economy of Ukraine

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Abstract
The recovery of Ukraine's economy requires a systematic approach. Correlation analysis confirmed the high degree of dependence of Ukraine's GDP on the volume of agricultural products. The study of trends in the development of the industry revealed a number of problems: the predominance of economic goals over growing environmental threats, the production of products with low added value, high dependence on exports, and others. The creation of an agribusiness ecosystem has been proposed in the development of a strategy for post-war recovery. Innovative technologies of Industry 4.0 will make this transition more efficient. To evaluate the effectiveness of the created agribusiness ecosystem, an integral indicator of balanced development is proposed. Based on the analysis of the economic, environmental, social, innovative spheres, the application of four directions to evaluate the outcome for all actors of the agribusiness ecosystem is substantiated. This approach contributes to the overall recovery of the national economy.

Keywords*:* agribusiness ecosystem, sustainable development, circular economy, innovation, multi-criteria assessment

Introduction

In the process of society's evolution, scientists and researchers are constantly trying to solve the issue of developing an optimal model of development. The development of the world economy since the time of the industrial revolution has followed the model of a linear economy, when resources are extracted and transformed into goods and services, sold and used, and then disposed of. A linear economy links material well-being to the extraction of resources but often ignores the excessive pressure on the environment (Karakas, 2022; Michelini et al., 2017). Climate change and the deterioration of the environment are threats to the further development of the world, including Europe (Trusina & Jermolajeva, 2021). To increase the resource efficiency and competitiveness of the countries of the European Union, the European Green

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Course was adopted (European Commission, 2019). It is based on ensuring the sustainable development of society through economic growth without reference to the use of resources, and even on achieving complete climate neutrality by 2050 through transition to a circular economy model. The Ukrainian economy is very closely dependent on the conditions of the world market since one of its basic industries is agriculture, most of which is exported (Tiurina et al., 2021). The military actions on the territory of Ukraine have led to significant economic, social, and environmental problems. This affected, among other things, the functioning of agriculture, both at the production and at the logistics stage. Thus, we consider the issue of increasing the level of competitiveness of the domestic agricultural sector to be urgent, based on the introduction of a model of balanced development, relying on the principles of the circular economy. The relevance of the chosen research topic is also justified by the fact that, given the war in Ukraine, agriculture is the basic branch of the national economy. A significant part of agricultural products is sold for export. Increasing the productivity and efficiency of enterprises of the industry, based on sustainable development, will allow not only to obtain an economic effect for Ukraine but also to partly contribute to the identifying solutions to certain global problems of mankind, in particular, the achievement of sustainable development goal № 2 - end hunger, the protection of fruits, the protection and defective nutrition and promote sustainable agricultural products (United Nations, 2016). Agriculture is, on the one hand, a raw materials supplier for processing industries (food, chemical and other industries) while, on the other hand, it uses resources (equipment, technology, and others) supplied by other sectors of the economy. Therefore, the use of the ecosystem approach will make it possible to comprehensively ensure the sustainable development of the national economy. The combination of relevant economic agents into a single business ecosystem will provide the maximum effect for all potential stakeholders while taking into account not only economic interests, but also social needs and environmental restrictions.

The main purpose of the paper is to search for approaches to ensure the balanced development of the national economy. The economy of Ukraine, significantly affected by the war will need to be restored in the future and has therefore been chosen as a topic of study. One of the basic sectors of the Ukrainian economy is agriculture for Ukraine is one of the key suppliers of agricultural products to the world market and has not stopped exporting grain, not even during the war. Therefore, we believe that it is necessary to pay attention to the Ukrainian agriculture. In order to ensure the sustainable development of the economy, it is advisable to use a systematic approach rather than analyses of individual manufacturers of the industry. In particular, the author proposed and substantiated the feasibility of creating an agribusiness ecosystem that includes both agricultural producers and related industries agents. We assume that this approach will stimulate the balanced development of not only agriculture, but also of the national economy.

The article is structured as follows. After a brief review of the literature, in the second part, the materials and methods are described. In the third part, the dynamics of the development of agriculture in Ukraine, its role in the formation of the gross domestic product is analysed, and the problems that hinder the sustainable development of the industry are highlighted. In the fourth part, an agribusiness ecosystem based on a circular economy is proposed. The fifth part presents a mathematical model for evaluating the effectiveness of the agribusiness ecosystem development, and the last part concludes.

1. Literature review

The desire of mankind to obtain the maximum economic result from activities has led to a significant negative impact on the environment, social inequality and other problems (Naidu et al., 2021; Wiedmann et al., 2020). In an effort to maximize profits, business owners are trying to reduce the cost of environmental protection measures, material resources, labour costs, and other components. These factors make it necessary to take into account the environmental and social components in identifying an optimal strategy for the development of economic entities (Barkai, 2019; Kharazishvili et al., 2020; Luttmer & Samwick, 2018). Sustainable development was defined in the World Commission on Environment and Development's 1987 Brundtland report (Brundtland Report, 1987) as development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This concept lays the basic principles for the balanced development of society. In subsequent years, scientific institutions, public and professional organizations were engaged in the development of scientific and methodological foundations for the sustainable development of society (Hajian & Kashani, 2021). A literature review shows different approaches to the interpretation of the concept of sustainable development (Baum, 2021; Lemke, 2021; Tariq & Jadoon, 2022). At the same time, difficulties arise due to the translation of this term into different languages (Ostarkova & Stanickova, 2021). Given the versatility of factors and the assessment of sustainable development, separate areas that take into account the specifics of a particular factor are distinguished. Scientists (Kharazishvili et al., 2020) pay more attention to the social component when assessing sustainable development. Hickel (2020) focuses on the environmental dimension of sustainable development.

Analysing scientific approaches to the definition of sustainable development, one can note the macro-level of assessment, that is, the use of methodological tools for assessing the level of sustainable development of the country. At the micro level, the compliance of the company's strategy and its actual activities with the concept of sustainable development is determined by the norms of corporate social responsibility (Galeazzo et al., 2023; Tsalis et al., 2020). This approach takes into account the need to provide stakeholders with not only financial statements, but also

disclosure of the enterprise's activities to achieve sustainable development. A number of standards have been developed for the preparation of non-financial reporting of enterprises (GRI Standards, 2022). The preparation of non-financial reporting allows, on the one hand, to systematize the achievements of enterprises in implementing the principles of sustainable development in their activities and, on the other hand, it contributes to the formation of a favourable image in society (Villiers et al., 2022). This encourages businesses to be more socially responsible. The review of the literature indicates the absence of a systematic approach to the formation of a model for the balanced development of the national economy, taking into account the interaction between its economic entities. The concepts of sustainable development (Brundtland Report, 1987), harmonious development (Cao et al., 2023), and sustainable competitiveness (GSCI, 2020) are based on taking into account the economic, ecologic, and social spheres to assess the development of the economy, usually at the macro level. The concept of corporate social responsibility is implemented at the micro level (Fatima & Elbanna, 2023). In our view, the existence of interrelations between the elements (subjects) of the economic system, which would allow them to be combined into a single system, remains insufficiently studied. This approach is partly taken into account by the EU Global Value Chain Initiative (EC, 2022; Montanino et al., 2021). The main purpose of the document is to establish interaction between industrial producers to ensure European industrial sovereignty. This issue has become relevant given the consequences of the COVID-19 crisis (EVCs, 2020). Given the scale and organizational issues, this area of research requires further methodological processing.

We believe that the ecosystem approach will allow for building a balanced systemic interaction between all participants in the business ecosystem. The concept of the ecosystem in economics is borrowed from ecology. At the beginning of the twentieth century, this term was proposed by Tansley to understand the ecosystem as a functional unit in ecology, which contains organisms and a non-living environment. All these components mutually influence each other. They are necessary to support life within this environment in the form that exists on Earth (Jonson, 2020). An ecosystem is understood as a set of living organisms (communities) and their habitat, which form a stable life system due to the circulation of organisms. From this, we get the main conclusion - to exist today and in the future, living organisms compete and interact with each other, and change and adapt to the conditions of the external environment. In turn, the external environment also changes and has an indirect effect on the elements of the internal environment. In the economic space, the concept of a business ecosystem was introduced by James Moore at the end of the nineteenth century, who adapted it to the business environment (Moore, 1993). In particular, a company (enterprise) should be considered not as an individual participant in the market, but as a representative of a business ecosystem that includes many participants from different industries. That is, the business ecosystem is a collection of players of certain functional groups.

Business ecosystems must also adapt to changing conditions, changing from one state to another. In the process of such changes, business ecosystems must evolve, moving from a random set of elements to a more structured composition. The literature review reflects that today, there are different approaches to the definition of the concept of "business ecosystem" considering the type and scale of activity, methods of communication, and management (Tsujimoto, 2018). The need to consider geographical limitations in the analysis of economic ecosystems is substantiated by the authors in the paper (Auerswald & Dani, 2019). The negative anthropological impact on the environment, and excessive demand for natural resources, which led to the deterioration of the land, are analysed in the work (Cheng et al., 2018). The relationship between ecosystem services and economic development is proven in the work (Xukun et al., 2022). In particular, the growth of the ecological-economic interconnection index over the past fifteen years has been proven, which is more noticeable in poorer regions.

When building a business ecosystem, we consider it expedient to take as a basis the model of a circular economy, which provides for closed cycles in the processes of production, circulation and consumption (Ghosh, 2020). The need for a transition to a circular economy using modern information technologies has been proven (Fatimah et al., 2020) using the example of Indonesia. In particular, the application of a reasonable waste management system to achieve sustainable development goals is proposed. In the book (Ghosh, 2020), scientists presented the current state of implementation of the circular economy model using the example of different countries. Scientists (Hysa et al., 2020) substantiate the feasibility of using the circular economy model to ensure the sustainable development of society, taking into account three components: economic, environmental, social. Innovative technologies have been developing rapidly in recent years, which, from our point of view, is one of the factors in the development of the economy and must be taken into account in building a model of balanced development. The article (Silvestre & Ţîrcă, 2019; Voitko et al., 2020) also shows the need to take into account innovative technologies to ensure sustainable development.

In addition, the goals of sustainable development of society involve solving a number of global problems of mankind (United Nations, 2015). The paper by Wang et al. (2022) proves the importance of agricultural products for solving the problem of food security. As ways of ensuring the sustainable development of agriculture, scientists in this paper suggest spreading greening and reducing the level of energy consumption. However, these measures have limited results and cannot fully ensure the balanced development of the agricultural sector. The importance of introducing a circular economy in the agricultural sector is noted in the work (Achillas, 2021), which has significant potential due to the reduction of operating costs, and greening of the manufacturer's brand, as a result - the achievement of a larger market share. Scientists (Juan et al., 2021) claim that there is currently no methodological justification for adopting the circular economy model in agriculture. In particular, the authors propose

a set of indicators that can be used to assess the level of circularity in agriculture. In the paper (Marinova & Bogueva, 2022) five underlying principles, namely regeneration, land-effectiveness, integrated management, focus on quality food, and localisation, are outlined together with comments on what is necessary for a transition to circularity from the current linear agricultural model. But agricultural activities such as fertilization and other crop management techniques contribute to greenhouse gas emissions and pollution (Tagarakis et al., 2021).

The article of Ritchie et al. (2022) describes the impact of agriculture on the environment in three ways: consumption of large amounts of fresh water, greenhouse gas emissions and huge land use. In addition, processed agricultural products, in particular food, also have a big impact on the environment, as they account for 26% of global greenhouse gases (Poore & Nemecek, 2018). The need to take into account the conditions of manufacture of products at all stages of their life cycle is recognized in (EU, 2020). In particular, it is proposed to define the industrial value chain, from the product development stage to its delivery to the user. In this case, the emphasis is on the environmental friendliness of the product (Walker et al., 2021). We believe that solving the problem of forming a competitive national economy requires a systematic approach, by taking into account the balance of development in the economic, social and environmental dimensions, as well as by taking into account the innovative potential of each industry. The combination of the base industry with all stakeholders into a single business ecosystem by taking into account the internal relationships between them will allow us to get the maximum result at the level of the entire ecosystem. This problem is now especially acute for Ukraine, whose main sectors of the economy is agriculture. As a result of the military aggression of the Russian Federation, the country's economy has suffered significantly, irreparable consequences have been inflicted on people's lives and health, large-scale environmental consequences, etc. (Jenkins, 2023; Neuman & Hurt, 2023). In addition, the global economy is also affected, both socio-economically and environmentally (Artuc et al., 2023; WTO, 2023). Since the agricultural sector is basic for Ukraine in these conditions (FAO, 2022), we believe that this area of activity requires immediate attention. We assume that the application of the ecosystem approach to build an agribusiness ecosystem can be an effective impetus for the post-war recovery of the Ukrainian economy, which will stimulate the development of related industries and the national economy based on a circular economy and innovative technologies.

2. Materials and methods

The information basis for the study was scientific articles and books by world scientists, as well as the regulatory framework of Ukraine and the European Union, analytical reviews of experts in macroeconomic development and in the sectoral context (Hajian & Kashani, 2021; Ritchie et al., 2022; Walker et al., 2021). For

economic and mathematical analysis and for identifying patterns of development of agriculture, the data of the State Statistics Service of Ukraine (State Statistics Service of Ukraine, 2022) were used. A historical-logical approach was used to systematize scientific approaches to determining the goals and key directions of economic development. Critical analysis was used in the study of scientists' approaches to the formation of sustainable development of the economy, and the levels of assessment of the balance of development were determined: macro- and micro-levels.

Using the methods of analysis and synthesis, the main components of a balanced development of the economy are determined: economic, environmental, social and innovative. A systematic approach was used to prove the need to apply the concept of a business ecosystem. It takes into account not only the efficiency of each individual economic entity, but also the need to identify the internal relationships between them in order to obtain the maximum effect in the creation and functioning of the agribusiness ecosystem as a single organism. Critical analysis and a logical approach made it possible to substantiate the need to expand the areas for evaluating the effectiveness of the created business ecosystem with the inclusion of an innovative component in it. An economic and statistical analysis made it possible to identify the dynamics of the development of the gross domestic product and its structure during 2010-2021.

Correlation analysis proved a strong direct relationship between Ukraine's GDP and the volume of agricultural production (the correlation coefficient is 0.9468). Given the identified relationship, as well as the fact that Ukraine is one of the key suppliers of agricultural products on the international market (FAO, 2022), this industry was chosen as the subject of further research. Based on the data of the State Statistics Service of Ukraine (State Statistics Service of Ukraine, 2022), the volumes of agricultural production (in the context of crop production and animal production) and ways to increase productivity (the use of various types of fertilizers and their impact on productivity) were analysed. Possible environmental threats due to the excessive use of mineral fertilizers to increase the level of profitability of the industry, with an increase in the yield of 1 ha of agricultural land, have been identified.

To reduce the negative impact on the environment, ensuring the social component with an appropriate economic level of well-being, the use of a systematic approach to build an agribusiness ecosystem with the participation of agricultural producers, producers of related industries, consumers and other stakeholders is proposed. As indicated by (Ghosh, 2020; Hysa et al., 2020; Juan et al., 2021), a transformation from a linear economy model to a circular economy model is necessary to ensure the sustainable development of the national economy. The circular economy is focused on reducing the use of primary resources and the burden on the environment. An important requirement is the observation of responsible consumption by all economic agents throughout the product life cycle: from the development stage to the consumption stage (EC, 2022). Therefore, the principles of the circular economy are at the heart of the proposed agribusiness ecosystem.

The identification of the internal and external environment of the agribusiness ecosystem was carried out on the basis of an analysis of the degree of influence of factors and the possibility of managing the objects of the system. Based on the specifics of the activity, several groups of consumers of agricultural products have been identified, and divided into two areas of activity: processing and trading. Each of these groups is divided into constituent elements. Agricultural producers were also divided into two groups: crop production and animal production. According to the types of resources used by agricultural producers, suppliers were divided into ten groups, taking into account the specific needs of both animal production and crop production. The definition of forward and backward movement of assets between all participants in the agribusiness ecosystem is based on the principles of the circular economy, which includes waste minimization, reuse/recycling and extension of the use life.

To assess the possible options for building relationship chains between counterparties within the agribusiness ecosystem, a mathematical model for assessing the balance of system development is proposed, taking into account the economic, environmental, social and innovative activities of the three main participants: agricultural producers, resource suppliers, product consumers. This model allows us to determine the best option for choosing participants in the agribusiness ecosystem and building relationships between them based on the calculation of an integral indicator.

To obtain the best result at the system level, there may be cases where individual characteristics are not the best value for specific system participants. It is precisely the balance between the interests and capabilities of each participant in the agribusiness ecosystem, taking into account the socio-economic and environmental consequences of making a decision, that will make it possible to identify the best option. Since innovations are developing rapidly, information and communication technologies of Industry 4.0 are actively used, it is proposed to include an innovative component in the assessment. We believe that the innovative component is necessary to comply with the conditions of the agribusiness ecosystem and its further functioning based on the principles of the circular economy. For mathematical processing of the initial information, according to the proposed model, a large amount of data will be used.

For this, appropriate software development tools can be applied, which requires further research. Due to the limited statistical data and access to internal information of individual participants in the agribusiness ecosystem, a theoretical description and mathematical interpretation of the proposed model for assessing the balanced development of the agribusiness ecosystem was carried out. An analysis of the current state of agricultural development made it possible to identify reserves for increasing its efficiency based on the use of the proposed approach.

3. Agriculture of Ukraine: development trends and current state

According to the Food and Agriculture Organization of the United Nations (FAO, 2022), Ukraine is among the most important producers of agricultural commodities in the world. In the cereal sector, its contribution to global production is especially significant for barley, wheat, and maize. On average, during the period 2016-2021, Ukraine accounted for 4% of the world production of these crops. In the oilseed complex, its contribution to global production was particularly important for sunflower seeds. The average share of Ukraine in global rapeseed and soybean production is 2 %. The share of agricultural products in Ukraine's GDP proves that this industry is one of the basic ones. The GDP of Ukraine for the last five years is shown in Table 1. Due to market fluctuations and other processes, product prices may change, but on average, agriculture accounts for about 11% of Ukraine's GDP.

The analysis of statistical data revealed a high degree of correlation between the volume of agricultural products and the GDP of Ukraine. The correlation coefficient between them is 0.9468.

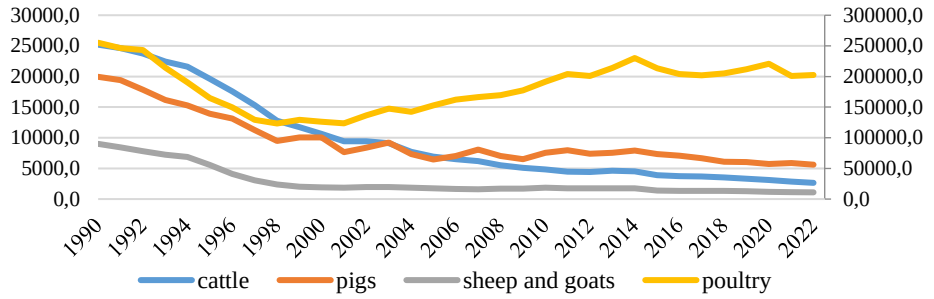
Table 1. Some components of the GDP structure of Ukraine, 2016 - 2021

Share in GDP, % (at constant prices of 2016)	2016	2017	2018	2019	2020	2021
Agriculture, forestry and fishing, % GDP	11.7%	11.2%	11.7%	11.4%	10.6%	11.8%
Mining and quarrying, % GDP	5.5%	5.1%	5.0%	4.8%	4.8%	4.7%
Manufacturing, % GDP	12.2%	12.4%	12.2%	11.9%	11.7%	11.5%
Information and communication, % GDP	3.7%	4.0%	4.1%	4.2%	4.5%	5.0%

Source: Author's representation based on the State Statistics Service of Ukraine (2022)

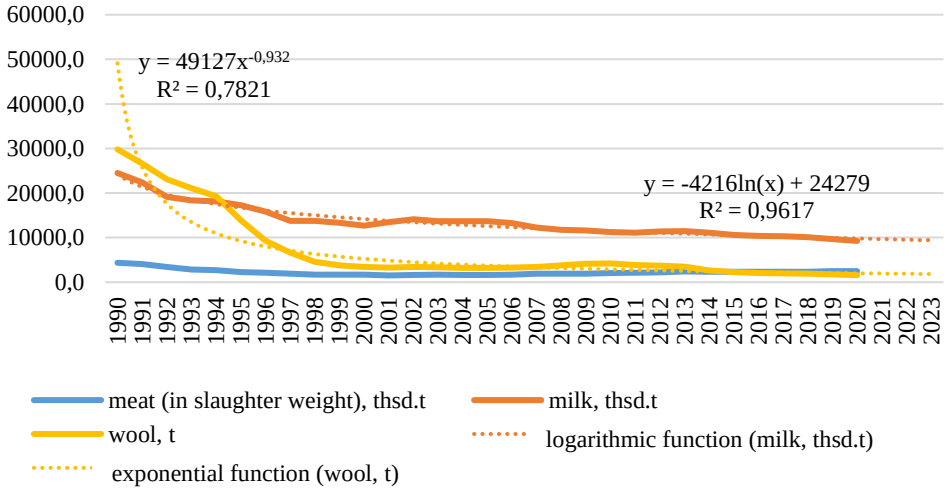
The analysis of the dynamics of the indicators of the two components of agriculture shows that the number of livestock in Ukraine is constantly decreasing (Figure 1), with the exception of poultry farming. A forecast was made for the types of animal products (Figure 2). According to the results of the regression analysis, the expected decrease in the volume of milk and wool was obtained, even without taking into account the hostilities on the territory of Ukraine.

Figure 1. Dynamics of the number of agricultural animals at 1st January, thousand heads, 1990 - 2022



Source: Authors' representation based on the State Statistics Service of Ukraine (2022)

Figure 2. Forecasted volumes of livestock products in Ukraine



Source: Authors' representation

Table 2. Profitability level of agricultural production in enterprises (animal production), %

Year	Agricultural production	Including						
		animal production	beef and veal	pork	mutton and goat	poultry meat	milk	eggs
2001	18.3	-6.6	-21.4	-7.2	-24.9	-1.7	-0.8	25.1
2002	4.9	-19.8	-40.5	-16.9	-26.7	-1.1	-13.8	14.6
2003	12.6	-18.8	-44.3	-33.0	-37.8	11.0	9.9	18.5
2004	8.1	-11.3	-33.8	-14.4	-44.3	3.8	-0.4	15.2
2005	6.8	5.0	-25.0	14.9	-32.1	24.9	12.2	23.5

2006	2.8	-11.0	-38.4	-9.2	-34.3	12.1	-3.7	-6.8
…	…	…	…	…	…	…	…	…
2018[1]	...	...	-17.7	6.9	-16.6	5.7	16.1	5.4
2019[1]	...	...	-27.1	4.7	-39.7	-3.7	20.6	-23.5
2020[1]	...	...	-24.2	2.6	-39.4	-0.2	20.4	-19.2

Source: Author's representation based on State Statistics Service of Ukraine (2022)

The analysis of statistical data indicates a reduction in the volume of animal production in Ukraine as a component of agriculture. As we can see in Table 2, over the past decades, the profitability of this type of activity has been rapidly declining, with the exception of poultry farming and pork, which does not bring significant profits, though it is not unprofitable, compared to cattle farming. An analysis of the cost structure of animal production is given in Table 3.

Table 3. Costs structure of agricultural production (services) in enterprises in 2020

Types of costs	Agricultural production (services)		Crop production (services)		Animal production (services)	
	million UAN	% to the total costs	million UAN	% to the total costs	million UAN	% to the total costs
Costs - total	**369 313,6**	**100.0**	**278 990,6**	**100.0**	**90 323,0**	**100.0**
Direct costs - total	**205 418,5**	**55.6**	**136 622,4**	**49.0**	**68 796,1**	**76.2**
including seeds and planting materials	27 423,5	7.4	27 423,5	9.8	x	x
fodder	53 333,1	14.4	x	x	53 333,1	59.0
including purchased fodder	21 958,5	5.9	x	x	21 958,5	24.3
other agricultural products	6 215,3	1.7	2 716,6	1.0	3 498,7	3.9
inorganic fertilizers	45 878,4	12.4	45 878,4	16.4	x	x
oil products	23 567,3	6.4	22 230,4	8.0	1 336,9	1.5
electric power	3 775,8	1.0	1 793,0	0.6	1 982,8	2.2
fuel	1 708,3	0.5	1 081,9	0.4	626,4	0.7
spare parts, repair and construction materials to repair	17 231,9	4.7	14 717,0	5.3	2 514,9	2.8
Labor costs	**25 850,3**	**7.0**	**18 147,2**	**6.5**	**7 703,1**	**8.5**
Other direct costs	**85 807,1**	**23.3**	**77 742,7**	**27.8**	**8 064,4**	**8.9**
Indirect costs	**52 237,7**	**14.1**	**46 478,3**	**16.7**	**5 759,4**	**6.4**

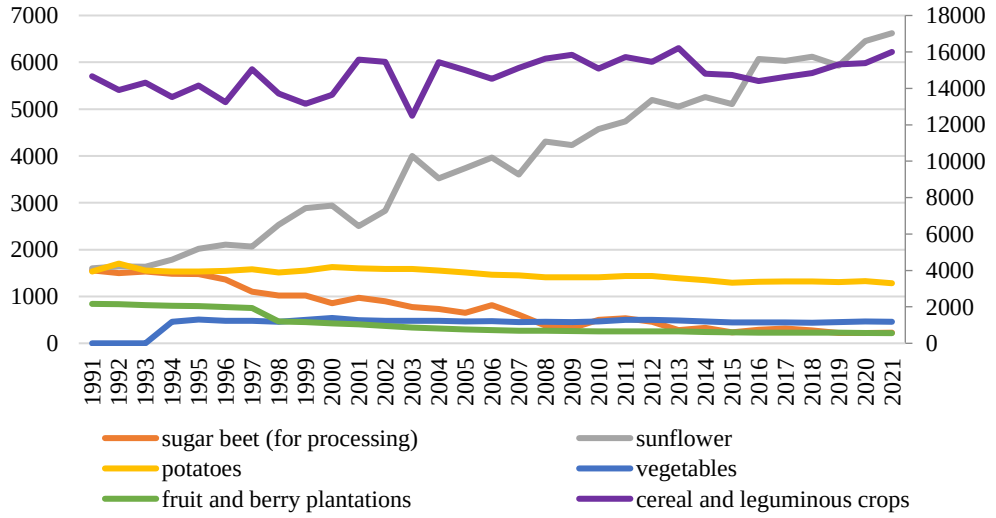
Source: Author's representation based on State Statistics Service of Ukraine (2022)

[1] Data exclude the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and a part of temporarily occupied territories in the Donetsk and Luhansk regions.

A significant part of the costs is for feed - 59%. The use of manual labour to a certain extent, rising energy prices and other cost components make animal production less attractive for business. It should be noted that the presence in the structure of animal production of 24.3% of the cost of purchased feed could be reduced through the use of waste or processed products of our own production or crop production. This savings could be provided by the organization of supply chains between producers and processors within a single agribusiness ecosystem.

Trends in the development of crop production in Ukraine, as the second component of agriculture, were also analysed. The area of land devoted to crops such as cereals and vegetables, and sunflower, is increasing (Figure 3). Areas for sugar beet, potatoes, and other vegetable crops, and fruit and berry crops are significantly reduced. This situation is explained by the action of at least two factors: the demand for grown products and the payback of funds invested in the production process. From the point of view of the payback period, funds invested in a production process with a shorter operating cycle are returned faster. Growing fruits and berries require more time and higher initial costs, respectively, and the payback period is longer.

Figure 3. Dynamics of the planted area of crops, thousand hectares, 1991-2021



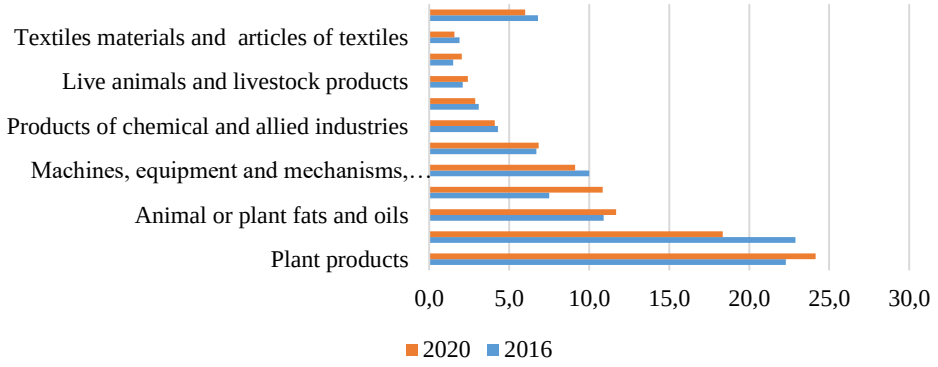
Source: Authors' representation based on the State Statistics Service of Ukraine (2022)

The second factor is the demand for cultivated products. Most agricultural products are exported (Figure 4). The volume of export of agricultural products from Ukraine has a growing tendency. At present, we see the importance of ensuring the export of agricultural products from Ukraine, even under war conditions. This is because these products contribute to solving the global problem of mankind - overcoming hunger. The main types of agricultural products produced in Ukraine

and subject to export are cereals and oilseeds. Grain and sunflower seeds are highly profitable crops (Table 4).

A more detailed analysis shows the impact of the following factors: productivity growth (Figure 5) due to the use of mineral fertilizers, the use of automated processing tools and Industry 4.0 technologies in crop production, growth in demand and price levels in foreign markets, etc.

Figure 4. The structure of export of Ukrainian products, %, 2016 - 2020



Source: Authors' representation based on the State Statistics Service of Ukraine (2022)

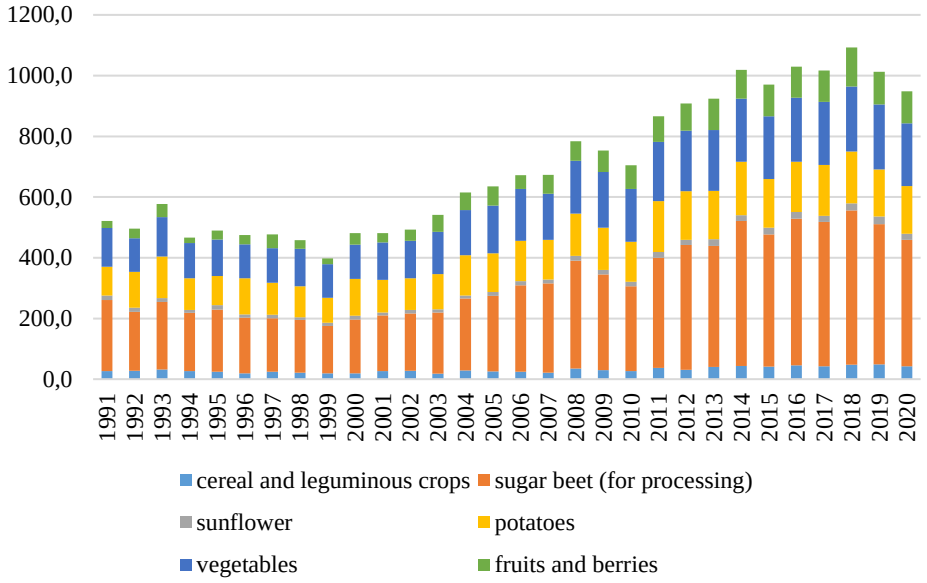
Table 4. Profitability level of agricultural production in enterprises (crop production), %

Year	Agricultural production	Including					
		crop production	grain	sunflower seeds	factory sugar beets	potatoes	vegetables grown in the open
2001	18.3	35.8	43.3	68.7	1.5	11.4	-0.8
2002	4.9	22.3	19.3	77.9	-8.6	24.2	8.9
2003	12.6	41.7	45.8	64.3	6.2	33.5	30.9
2004	8.1	20.3	20.1	45.2	-0.8	-0.7	-5.0
2005	6.8	7.9	3.1	24.3	4.8	17.8	16.1
2006	2.8	11.3	7.4	20.7	11.1	56.2	14.8
…	…	…	…	…	…	…	…
2018[2]	...	...	24.7	32.5	-11.4	6.8	16.7
2019[2]	...	...	11.8	23.5	-15.4	15.4	7.0
2020[2]	...	...	20.0	39.4	-13.5	11.0	8.3

Source: Author's representation based on State Statistics Service of Ukraine (2022)

[2] Data exclude the temporarily occupied territory of the Autonomous Republic of Crimea, the city of Sevastopol and a part of temporarily occupied territories in the Donetsk and Luhansk regions.

Figure 5. The yield of crops, centners per ha of the harvested area, 1991 - 2020



Source: Authors' representation based on the State Statistics Service of Ukraine (2022)

Over the past thirty years, the productivity of crops in Ukraine has increased by an average of 1.5 times, fruits and berries by 4.6 times. The results of selection, improvement of existing and application of new technologies, as well as application of fertilizers should be noted. In particular, from the point of view of sustainable development of territories, we are more interested in organic farming. However, official statistics indicate an increase in the use of fertilizers, with a greater emphasis on mineral fertilizers.

The analysis of the data allows us to conclude that there has been a significant increase in agricultural areas treated with mineral fertilizers in Ukraine, from 11.2% in 2000 to 39.5% in 2020. At the same time, the share of organic fertilizers remained practically unchanged at around 2%. The correlation analysis on the example of cereals showed a high level of dependence of their yield on the number of applied mineral fertilizers (Kcorrelation = 0.862) and an almost inverse relationship concerning organic fertilizers (Kcorrelation = - 0.742).

The regression equation allows predicting the change in grain yield depending on the application of mineral and organic fertilizers with the current method of organizing production:

$$Y=15,786+0,0009X1+0,14X2 \quad (1)$$

Y - yield of crops, centners per ha of the harvested area;

X1 - use of organic fertilizers per unit of planted area;

X2 - use of inorganic fertilizers per unit of the planted area.

In pursuit of the goal of obtaining the maximum profit at present, agricultural producers annually increase the number of mineral fertilizers applied, which negatively affects the quality of land. Since most of Ukraine's agricultural products are exported, including to EU countries, Ukrainian producers will have to consider the requirements of the Green Deal when growing crops and livestock.

An analysis of the cost structure of crop production in Ukraine (Table 3) also indicates significant costs for the purchase of mineral fertilizers (16.4%), which could be reduced through the introduction of organic farming (the use of animal husbandry waste, humus of crop residues, food industry waste). At the same time, this would contribute to a partial solution to environmental problems, namely through the reduction and recycling of waste. An analysis of the data of the State Statistics Service of Ukraine (State Statistics Service of Ukraine, 2020) showed that, in 2020, almost 4.9 million tons of waste, which could have been recycled or used, were generated, taking into account the closed business ecosystem (straw, corn stalks, substandard vegetables and cereals, etc.).

Seeds and planting material (9.8% of the total costs, Table 3) are imported by Ukrainian farmers from abroad. Accordingly, the development and support of the domestic scientific sector would contribute to the development of selection, stimulating the development of related industries.

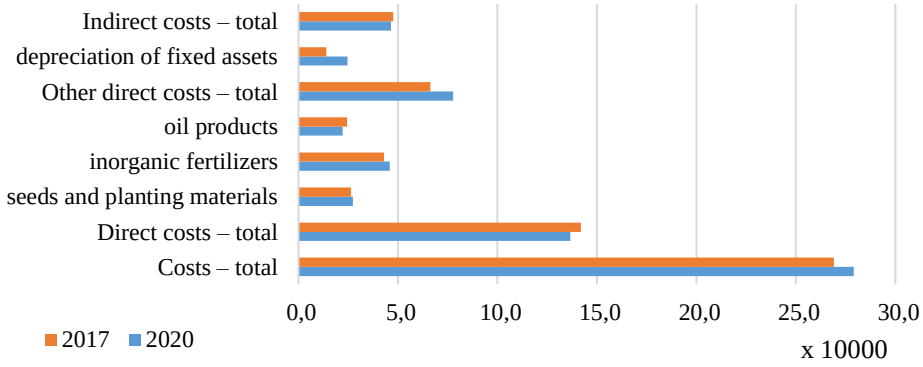
A comparative analysis of changes in production costs for crop and livestock production (according to aggregated indicators) during 2017-2020 is shown in Figure 6.

Summing up the results of the analysis of Ukrainian agriculture, the following negative factors should be noted:

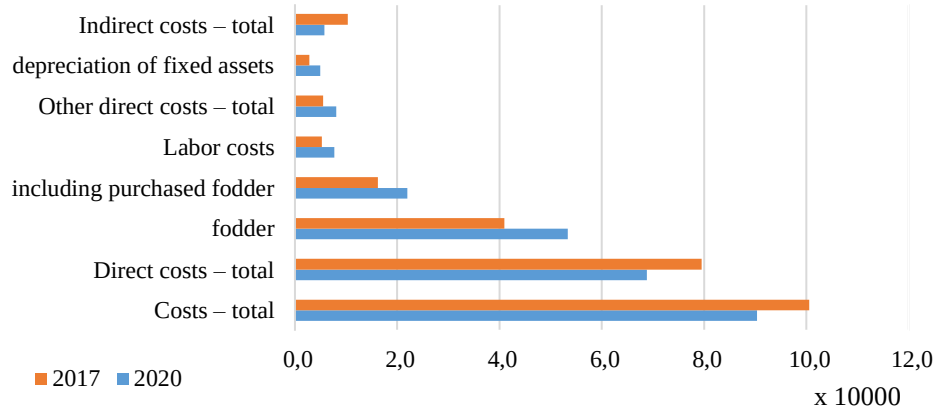
- a clear trend towards the redistribution of production volumes towards the growth of crop production;
- the prevalence of short-term purely economic interests of agricultural producers, as shown by the structure of cultivated plants and the methods used to increase yields;
- an increase in the negative impact on the environment, requiring a transition to a green economy model;
- the growing amount of expenses for purchased feed, purchased seeds and planting material, mineral fertilizers;
- updating the material and technical base of crop production, as shown by the growth of depreciation.

It should be noted that compliance with existing trends in the Ukrainian agriculture may affect the deterioration of the environmental situation. Thus, we believe that a revision of the existing system for organizing production and logistics processes in the Ukrainian agricultural sector is required. As a possible way to solve this problem, we propose the use of an ecosystem approach.

Figure 6. Dynamics of the main components of the cost price of agricultural products of Ukraine, 2017-2020



a) Crop production



b) Animal production

Source: Authors' representation based on the State Statistics Service of Ukraine (2022)

4. Agribusiness ecosystem based on the circular economy

The report of the International Commission on Environment and Development under the leadership of G. H. Brundtland "Our Common Future" defined the concept of "sustainable development" as development that meets the needs of the present without compromising the ability future generations to meet their own needs for the first time in 1987 (Brundtland Report, 1987). This approach becomes an alternative to the traditional one based on unlimited economic growth. At the same time, sustainable development is considered not as an unchanging harmonious state, but as a process of changing the scale of production, the use of resources, the development of technologies, and other factors of production. Thus, recognizing the laws of a market economy at a global scale, the need for state regulation is

determined to achieve the goals of sustainable development. The problem of the balanced development of society requires a revision of the principles of further development with a shift in emphasis from the ideology of accumulation of material wealth to the ideology of reasonable sufficiency, which ensures a balanced effect of the socio-economic system.

A resolution adopted by the UN General Assembly in 2015 approved the 2030 Agenda for Sustainable Development (United Nations, 2015), which adopted 17 sustainable development goals. The Sustainable Development Goals are a universal call to action to end poverty on our planet, improve the quality of life and improve opportunities for all people in the world. Recently, there has been some progress in achieving the stated 17 sustainable development goals, but it is insufficient (Redek et al., 2020). With the aim to get an urgent response from the EU countries regarding climate change and environmental degradation, the European Green Deal was signed in Brussels in 2019. This is a new growth strategy aimed at developing a society with a modern, resource-efficient, and competitive economy. The Green Deal is an integral part of the strategy to implement the United Nations 2030 Agenda and the Sustainable Development Goals. A key goal of the new policy will be to stimulate the development of leading markets for climate-neutral and circular products in the EU and beyond (European Commission, 2019). Since most agricultural products from Ukraine are exported to European countries, a prerequisite for Ukrainian agriculture is compliance with the Green Deal requirements for producers.

One of the key tasks of the Green Deal is the transition from a linear to a circular economy model. The circular economy is gaining increasing attention around the world as a means of reducing dependence on primary materials and energy. In a circular economy, products are designed to be durable, reusable, and recyclable, and materials for new products come from old products. As much as possible, everything is reused, recycled, recycled back into raw materials, used as an energy source, or at the very least, disposed of (Acar & Yeldan, 2019). Consequently, this will lead to more sustainable patterns of production and consumption and can thus provide opportunities for developed and developing countries to achieve economic growth and inclusive and sustainable industrial development. The use of modern digital technologies, which are rapidly developing in Industry 4.0, is an integral component of the Green Deal implementation in all sectors of the economy (Berg et al., 2021). The Green Deal also provides for a programme “From Farm to Fork”, aiming to make food systems fair, healthy, and environmentally friendly. To implement this programme, we consider it necessary to organize agribusiness based on the use of the ecosystem approach.

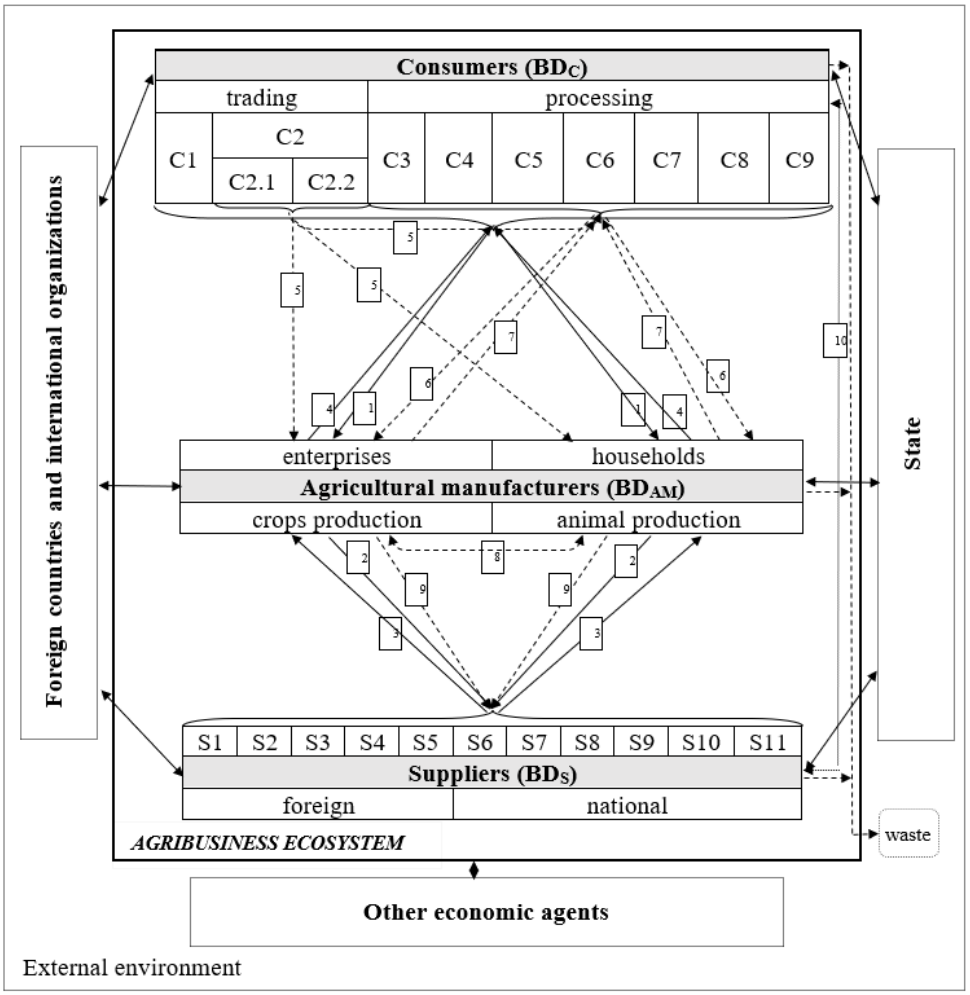
The functioning of each business unit takes place within the framework of the agribusiness ecosystem, as a system of rational combination and use of production resources (land, labour, material and financial, informational, etc.), considering the balance of economic, environmental, social and innovative components of its development. The basic participants in the agribusiness ecosystem are described

(Skorobogatova, 2022). Achieving the maximum effect of agricultural production depends on how close the connection between the main elements of the agribusiness ecosystem is ensured (Figure 7). The main elements of the agribusiness ecosystem are:

- Customers (buyers) of agricultural products, which are divided into two groups - trading and processing. Sales of agricultural products can be carried out on external markets C1 (export) and the domestic market C2 - through intermediaries C2.1 (trade networks, retail trade) and directly to end consumers C2.2. Processing was also included among the consumers of agricultural products, namely: manufacturers of food, beverages, tobacco products (C3), manufacturers of textiles, clothing, leather products (C4), wood products, paper, printing (C5), manufacturers of chemicals and products (C6), manufacturers of pharmaceutical products and preparations (C7), furniture manufacturers (C8), biofuel producers (C9).
- Agricultural manufacturers, which, depending on the form of business organization, are divided into legal entities (enterprises) and households, by the legislation of Ukraine. Farms can also be formalized as enterprises or households. As a rule, household farms include family farming, which produces products for itself, and the surplus can be sold on the market. Depending on the type of product, agriculture is also divided into crop production and animal production.
- Suppliers of inputs for agriculture, which may be national or foreign. Depending on the supplied resource, suppliers are divided into the following groups: melioration (S1), technologies (S2), land S3), personnel (S4), machinery (S5), fertilizers (S5), plant protection products (S6), breeding (S7), packaging (S8), feed (S9), veterinary drugs (S10).

As in any system, there are certain relationships between its elements. As seen in Figure 7, customers show demand for agricultural products (arrows 1). After analysing the demand for products, agricultural manufacturers determine the demand for the inputs they need for production (arrows 2). Depending on the cost of the resource, the period of its use, and their financial capabilities, agricultural manufacturers acquire them, lease them or share them (arrows 3). Next, the production process is carried out using the necessary resources, and the products are sold to customers (arrows 4). Of course, depending on the agricultural products, the production cycle duration can vary, for example, when growing grain or raising cows. It should be noted that the transition to environmentally friendly, organic production using the circular economy model makes it possible to almost eliminate waste that must be disposed of outside the system. In Figure 7, the waste streams produced by each of the participants and redirected for processing by other participants in the system are shown by dotted lines. For example, unsold and unused volumes of food from resellers and end consumers can be returned to agricultural manufacturers and used as animal feed or fertilizer, sent to processing enterprises for food production, etc. (arrows 5).

Figure 7. Diagram of the agribusiness ecosystem



Source: Authors' representation based on Skorobogatova (2022)

Similarly, the waste from agricultural processor products can be used in agriculture (arrows 6) or redistributed among producers in other industries. In turn, crop and livestock waste can be used as raw material for some types of industries (arrows 7), for example, in the production of biofuel, textile, and furniture production. Crop waste can be used as feed in animal production, and animal waste can be used as fertilizer, for example (arrow 8), and also as a raw material for some supplier producers (for example, fertilizer production, packaging, feed, etc.) (arrows 9). National resource suppliers and processors are mutual suppliers to each other through waste recycling (arrow 10). Thus, waste that is subject to disposal outside

the agribusiness ecosystem is minimized by the introduction of the circular economy model (arrow 11). All three main elements of the agribusiness ecosystem also interact with external actors. These include partners in foreign countries, international organizations, and governments of other countries. In addition, the state, as a regulatory body, also influences the development of the agribusiness ecosystem. In order to avoid the complication of the logical chain of relationships between the participants in the agribusiness ecosystem, Figure 7 does not reflect the settlement flows between them.

As noted earlier, to ensure the sustainable development of the economy, in particular in the transition to organic farming in the framework of the strategy "From farm to fork" under the Green Deal, it is necessary to move from increasing productivity by any means to ensuring acceptable sufficiency. Of course, the food problem is one of the global problems of mankind. In particular, Sustainable Development Goal 2 is about zero hunger. This implies the need to take urgent action to provide food and humanitarian assistance to the most vulnerable regions. However, the desire to increase crop yields by increasing the use of mineral fertilizers leads to a deterioration in land quality, which will affect the overall state of the ecosystem. We believe that it is a balanced approach to building an agribusiness ecosystem that will take into account economic, environmental, social aspects, as well as the potential of innovative solutions that can be used in this case. The first step in making a decision to include a particular agent in the agribusiness ecosystem, building supply chains between the participants in this system and external agents, as well as implementing investment projects, should be a balanced assessment.

5. Assessment of agribusiness ecosystem development

For the sustainable functioning of the economy, it is necessary to ensure a balance between life activity and the possibilities of the biosphere, which would allow the constant reproduction of the planet's renewable resources and ensure the economic implementation of non-renewable resources. In our understanding, this means that the main issue in making a decision and choosing among the available alternatives should not be maximum economic efficiency, but the balance of the development of the business ecosystem in key areas. The ecosystem approach in the economy, from our point of view, involves the coordinated activity of the agents of the system, taking into account the interests, needs and capabilities of each participant in order to obtain the optimal result at the level of the business ecosystem. The balance of the assessment, in our understanding, lies in the observance of the sustainable development of the system in four key areas: economic, environmental, social and innovative. The economic component involves obtaining a positive economic effect (profit), at least - the break-even activity of each economic agent. The environmental component should take into account the degree of improvement in the state of the

environment as a maximum, not cause harm - as a minimum. The social component involves the observation of social standards in the organization of labour, participation in solving social issues related to the activities of each economic agent. The innovative component takes into account the degree of progressiveness of the technologies used, their compliance with the principles of economic circularity and regulatory requirements, which will make it possible to fully assess the possibilities for the development and functioning of the business in the new conditions. Based on these assumptions, a simulation model for evaluating the effectiveness of the creation (functioning) of an agribusiness ecosystem is proposed, whose mathematical interpretation is given in Table 5.

The level of balance in the development of the agribusiness ecosystem (BD_{ABES}) should be determined by the total result of all participants in this system: suppliers (BD_S), customers (BD_C), and agricultural manufacturers (BD_{AM}). It should be noted that the system works as balanced as possible when the most positive result is achieved for all four components (economic, environmental, social, and innovative) of all participants in the system. However, this does not mean that in the chosen option for each of the participants, the maximum result will be obtained. This is the systematic approach - the overall result of the system as a whole is important, and not each of its participants. We should be guided by the search for a balanced solution for the entire system, and not its elements. If there are several alternative options for choosing the path of development or the formation of the agribusiness ecosystem, then, the option that has the highest BD_{ABES} result will be selected. In this case, the total results for the participants (suppliers, manufacturers, customers) must be at least zero. Otherwise, they will not be interested in participating and may bring negative results to the overall system. Thus, we believe that the proposed model for assessing the balance of development of agribusiness ecosystems will make it possible to objectively assess the feasibility of implementing a particular project and make an informed decision.

A large number of indicators can be used for mathematical processing of initial data when calculating the construction of supply chains between agents of the agribusiness ecosystem. Suitable software development tools can be used for this. Since there is a problem with the limited statistical data in the public domain and the disclosure of internal information of individual agents of the agribusiness ecosystem, we can list the results expected from the implementation of the proposed approach.

Table 5. Model of an assessment of agribusiness ecosystem development

Participants in the agribusiness ecosystem	Economic component	Environmental component	Social component
1. Customers:	$EC_C = EC_S + EC_P$	$EN_C = EN_S + EN_P$	$S_C = S_S + S_P$
- sellers (i=1…I)	$EC_S = \sum EC_{Si}$	$EN_S = \sum EN_{Si}$	$S_S = \sum S_{Si}$
- processors (y=1…Y)	$EC_P = \sum EC_{Py}$	$EN_P = \sum EN_{Py}$	$S_P = \sum S_{Py}$
2. Agricultural manufacturers:	$EC_{AM} = EC_{CP} + EC_{LP}$	$EN_{AM} = EN_{CP} + EN_{LP}$	$S_{AM} = S_{CP} + S_{LP}$
- crop producers (k=1…K)	$EC_{CP} = \sum EC_{CPk}$	$EN_{CP} = \sum EN_{CPk}$	$S_{CP} = \sum S_{CPk}$
- livestock producers (l=1…L)	$EC_{LP} = \sum EC_{LPl}$	$EN_{LP} = \sum EN_{LPl}$	$S_{LP} = \sum S_{LPl}$
3. Suppliers:	$EC_S = EC_{NS} + EC_{FS}$	$EN_S = EN_{NS} + EN_{FS}$	$S_S = S_{NS} + S_{FS}$
- national suppliers (n=1…N)	$EC_{NS} = \sum EC_{NSn}$	$EN_{NS} = \sum EN_{NSn}$	$S_{NS} = \sum S_{NSn}$
- foreign suppliers (m=1…M)	$EC_{FS} = \sum EC_{FSm}$	$EN_{FS} = \sum EN_{FSm}$	$S_{FS} = \sum S_{FSm}$
Total	$EC = EC_C + EC_{AM} + EC_S$	$EN = EN_C + EN_{AM} + EN_S$	$S = S_C + S_{AM} + S_S$

Participants in the agribusiness ecosystem	Innovation component	Participant's total score
1. Customers: - sellers (i=1…I) - processors (y=1…Y)	$I_C = I_S + I_P$ $I_S = \sum I_{Si}$ $I_P = \sum I_{Py}$	$BD_C = EC_C + EN_C + S_C + I_C = \sum EC_{Si} + \sum EN_{Si} + \sum S_{Si} + \sum I_{Si} + \sum EC_{Sy} + \sum EN_{Sy} + \sum S_{Sy} + \sum I_{Sy}$
2. Agricultural manufacturers: - crop producers (k=1…K) - livestock producers (l=1…L)	$I_{AM} = I_{CP} + I_{LP}$ $I_{CP} = \sum I_{CPk}$ $I_{LP} = \sum I_{LPl}$	$BD_{AM} = EC_{AM} + EN_{AM} + S_{AM} + I_C = \sum EC_{CPk} + \sum EN_{CPk} + \sum S_{CPk} + \sum I_{CPk} + \sum EC_{CPl} + \sum EN_{CPl} \sum S_{CPl} + \sum I_{CPl}$
3. Suppliers: - national suppliers (n=1…N) - foreign suppliers (m=1…M)	$I_S = I_{NS} + I_{FS}$ $I_{NS} = \sum I_{NSn}$ $I_{FS} = \sum I_{FSm}$	$BD_S = EC_S + EN_S + S_S + I_S = \sum EC_{NSn} + \sum EN_{NSn} + \sum S_{NSn} + \sum I_{NSn} + \sum EC_{NSm} + \sum EN_{NSm} + \sum S_{NSm} + \sum I_{NSm}$
Total	$I = I_C + I_{AM} + I_S$	-
Integral index	$BD_{ABES} = BD_C + BD_{AM} + BD_S$, $BD_{ABES} \rightarrow max$, $BD_C > 0$, $BD_{AM} > 0$, $BD_S > 0$	

Source: Authors' representation

Economic component: a) reducing the costs of agricultural producers by reducing the cost of purchasing mineral fertilizers, reducing the cost of garbage removal and disposal, reducing the cost of purchased animal feed, reducing the cost of energy, water, reducing low-skilled human labour; increase in sales volumes due to the image of an environmentally friendly and socially responsible manufacturer; b) reducing the costs of processors of agricultural products due to direct and reverse logistics, reducing the cost of garbage removal and disposal, increasing sales markets

due to the production of environmentally friendly products, reducing low-skilled human labour, increasing sales due to the image of an environmentally friendly and socially responsible producer; c) reduction of consumers' expenses for the purchase of products due to their cheapening; e) increase in tax revenues to the budget and extra-budgetary funds.

Environmental component: increasing land fertility, reducing soil damage by machinery, reducing pollution of territories for landfills, reducing pollution of water sources by harmful effluents from fields and production, manufacturing environmentally friendly products, reducing the consumption of natural resources through closed production cycles.

Social component: increasing the motivation of employees, improving the health of the population (in the long term), a sense of teamwork, moral satisfaction and a sense of security.

Innovative component: compliance with the requirements of European legislation on the quality and conditions of manufacturing products, reducing the need to upgrade non-current assets through the use of sharing, reducing the risk and degree of dependence on breaking supply chains, instability and volatility in foreign markets. We assume that the use of the proposed approach to assess the performance of the agribusiness ecosystem will allow us to evaluate the feasibility of making a decision regarding its functioning and development, as well as to make the necessary management decisions.

Conclusions

In the course of the study, some scientific approaches to the formation of the concept of economic development were analysed. It was found that the concept of sustainable development, based on a harmonious combination of economic, social and environmental vectors, is subject to supplementation and refinement, taking into account the peculiarities of the functioning of the global economy in the current conditions. Due to the rapid development of information and communication technologies and the active dissemination of Industry 4.0 technologies, both in production processes and in public life, it was proposed to add the fourth assessment component of the balanced development of the economic system - innovation.

As the Ukrainian economy has been severely damaged by the war, it is important to find ways to rebuild it. One of the basic sectors of the Ukrainian economy is agriculture, whose share is more than 10% of the country's GDP. In addition, Ukraine is one of the most important suppliers of crop products on the international market, exports do not stop, even during the war. An analysis of the data of the State Statistics Service of Ukraine for 1990-2022 revealed a number of problems that hinder the balanced development of the industry: the prevalence of short-term economic goals of producers; focus on crop production due to the high level of profitability of growing sunflower, grain, while ensuring productivity

growth by using mineral fertilizers, which will also have negative environmental consequences; the predominant use of a linear model of the economy, which affects the structure of exports of agricultural products, high dependence on foreign markets for the provision of seeds and planting material, feed, mineral fertilizers, all lead to the export of agricultural products with low added value.

To ensure a balanced development of agriculture and stimulate the renewal of the Ukrainian economy the creation of an agribusiness ecosystem, based on the principles of a circular economy, is proposed: a closed cycle from product development to its consumption. A diagram of the agribusiness ecosystem is presented with the allocation of the external and internal environment, the main agents (agricultural producers, resource suppliers, consumers) and the relationship between them based on direct and reverse logistics. The inclusion in the system of agricultural producers and of related industries, alike, will contribute to the simultaneous stimulation of other sectors of the economy based on a systematic approach. To determine the effectiveness of the functioning of the created agribusiness ecosystem, as well as to make appropriate management decisions, a simulation model is proposed. This model takes into account the economic, innovative, environmental and social aspects of each of the agents of the agribusiness ecosystem. The target function is the maximization of the integral indicator of the balanced development of the system. We believe that the proposed approach will contribute to the development of an effective strategy for restoring the Ukrainian economy through balanced development based on the circular economy and Industry 4.0.

References

Acar, S., & Yeldan, E. (2019). *Handbook of Green Economics.* Academic Press.

Achillas, C. (2021). Agricultural chains sustainability within the concept of circular economy. *Bio-Economy and Agri-production*, 31-41. https://doi.org/10.1016/B978-0-12-819774-5.00002-3

Artuc, E., Falcone, G., Porto, G., & Rijkers, B. (2022). *Agricultural Trade, Food Prices, and Household Welfare: The Impact of the Ukraine War.* The World Bank. https://thedocs.worldbank.org/en/doc/cf35f8cba5a275e4cd84452a4d1546d7-0050022022/original/Ukraine-PRT-Dec7-Rijkers.pdf

Auerswald, P., & Dani, L. (2019). *Economic Ecosystems*. In G.L. Clark, M. P. Feldman, M. S. Gertler & D. Wójcik (Eds.), *The New Oxford Handbook of Economic Geography*, (pp. 245 - 268). Oxford University Press. https://ssrn.com/abstract=3494495

Barkai, H. (2019). *The Evolution of Israel's Social Security System: Structure, Time Pattern and Macroeconomic Impact*. Routledge. https://doi.org/10.4324/9780429437212

Baum, R. (2021). Sustainable development - a modern understanding of the concept. *Annals PAAAE, XXIII(*2), 9-29. https://doi.org/10.5604/01.3001.0015.0026

Berg, H., Bendix, P., Jansen, M., Blevennec, K., Bottermann, P., Magnus-Melgar, M., Pohjalainen, E., & Wahlstrom, M. (2021). *Unlocking the potential of Industry 4.0 to reduce the environmental impact of production.* Eionet Report - ETC/WMGT 2021/5. https://www.eionet.europa.eu/etcs/etc-wmge/products/unlocking-the-potential-of-industry-4-0-to-reduce-the-environmental-impact-of-production/@@download/file/Final%20for%20website.pdf

Brundtland Report (1987). *Report of the World Commission on Environment and Development: Our Common Future.* https://sustainabledevelopment.un.org/content/documents/5987our-common-future.pdf

Cao, S., Ma, Z., Liu, Z., Guo, J., & Yuan, W. (2023). Achieving Harmony between the Economy and the Environment. *Habitat International, 131*, 102733. https://doi.org/10.1016/j.habitatint.2022.102733

Cheng, X., Chen, L., Sun, R., & Kong, P. (2018). Land Use Changes and Socio-economic Development Strongly Deteriorate River Ecosystem Health in One of the Largest Basins in China. *Science of the Total Environment, 616-617*(7), 376-385. https://doi.org/10.1016/j.scitotenv.2017.10.316

European Commission. (2019). *The European Green Deal.* https://commission.europa.eu/strategy-and-policy/priorities-2019-2024/european-green-deal_en

European Commission. (2020). *Emerging industries and value chains.* https://single-market-economy.ec.europa.eu/industry/strategy/cluster-policy/emerging-industries-and-value-chains_en

European Commission. (2022). *Just and sustainable economy: Commission lays down rules for companies to respect human rights and environment in global value chains.* https://ec.europa.eu/commission/presscorner/detail/en/ip_22_1145

European Union. (2020). *Contribution to the Green Deal and the Just Transition Scheme.* https://investeu.europa.eu/contribution-green-deal-and-just-transition-scheme_en

European Value Chains. (2020). https://www.interregeurope.eu/news-and-events/news/european-value-chains-evcs

Food and Agriculture Organization (FAO). (2022). *The importance of Ukraine and the Russian federation for global agricultural markets and the risks associated with the war in Ukraine*. https://www.fao.org/3/cb9013en/cb9013en.pdf

Fatima, T., & Elbanna, S. (2023). Corporate Social Responsibility Implementation: A Review and a Research Agenda Towards an Integrative Framework. *Journal of Business Ethics, 183*(1), 105-121. https://doi.org/10.1007/s10551-022-05047-8

Fatimah, Y. A., Govindan, K., Murniningsih, R., & Setiawan, A. (2020). Industry 4.0 based sustainable circular economy approach for smart waste management system to achieve sustainable development goals: A case study of Indonesia, *Journal of Cleaner Production, 269*, 122263. https://doi.org/10.1016/j.jclepro.2020.122263.

Forrester, J.W. (1971). *World Dynamics* (2nd ed.). Pegasus Communications.

Galeazzo, A., Miandar, T., & Carraro, M. (2023). SDGs in corporate responsibility reporting: a longitudinal investigation of institutional determinants and financial performance, *Journal of Management and Governance*, 1-24. https://doi.org/10.1007/s10997-023-09671-y

Ghosh, S. K. (2020). *Circular Economy: Global Perspective*. Springer Singapore. https://doi.org/10.1007/978-981-15-1052-6

GRI Standards. (2022). *The global standards for sustainability impacts*. https://www.globalreporting.org/

Global Sustainable Competitiveness Index (GSCI). (2020, November). *The Sustainable Competitiveness Report (*9th ed.), Methodology, calculation, & report compilation by SolAbility. https://solability.com/sustainability-publications/the-global-sustainable-competitiveness-index-2

Hajian, M., & Kashani, S. J. (2021). Evolution of the concept of sustainability. From Brundtland Report to sustainable development goals. *Sustainable Resource Management*, 1-24. https://doi.org/10.1016/B978-0-12-824342-8.00018-3

Hickel, J. (2020). The sustainable development index: Measuring the ecological efficiency of human development in the Anthropocene. *Ecological Economics*, *167*, 106331. https://doi.org/10.1016/j.ecolecon.2019.05.011

Hysa, E., Kruja, A., Rehman, N. U., & Laurenti, R. (2020). Circular Economy Innovation and Environmental Sustainability Impact on Economic Growth: An Integrated Model for Sustainable Development. *Sustainability*, *12*(12), 4831. https://doi.org/10.3390/su12124831

Jenkins, B. M. (2023, March 7). *Consequences of the War in Ukraine: The Economic Fallout.* https://www.rand.org/blog/2023/03/consequences-of-the-war-in-ukraine-the-economic-fallout.html

Jonson, B. (2020). Abiotic ecosystems? A critical examination of Arthur Tansley's ecosystem definition. *Environmental ethics*, *42*(1), 39-53. https://doi.org/10.5840/enviroethics20204215

Juan, F., Velasco-Muñoz, J., Mendoza, J., Aznar-Sánchez, J., & Gallego-Schmid, A. (2021). Circular economy implementation in the agricultural sector: definition, strategies and indicators. *Resources, conservation and recycling*. *170*, 105618. https://doi.org/10.1016/j.resconrec.2021.105618

Karakas, G. (2022). Factors affecting food waste awareness in Turkey. The case of Gorum province, *Eastern Journal of European Studies*, *13*(1), 271-289. https://doi.org/10.47743/ejes-2022-0113

Kharazishvili, Y., Kwilinski, A., Grishnova, O., & Dzwigol, H. (2020). Social Safety of Society for Developing Countries to Meet Sustainable Development Standards: Indicators, Level, Strategic Benchmarks (with Calculations Based on the Case Study of Ukraine). *Sustainability*, *12*(21), 8953. https://doi.org/10.3390/su12218953

Lemke, C. (2021). Conceptual framework of sustainable development, *Sustainable Management, Wertschöpfung und Effizienz*, 9-39. https://doi.org/10.1007/978-3-658-33246-4_2

Luttmer, E. F. P., & Samwick, A. A. (2018). The welfare cost of perceived policy uncertainty: Evidence from social security. *American Economic Review*, *108*(2), 275-307. https://doi.org/10.1257/aer.20151703

Marinova, D., & Bogueva, D. (2022). Circular Agriculture. In: D. Marinova & D. Bogueva (Eds.), *Food in a planetary emergency* (pp. 75-92). Springer Singapore. https://doi.org/10.1007/978-981-16-7707-6_5

Meadows, D., Meadows, D., Randers, J., & Behrens, W. (1972). *The limits to growth. A Report for the Club of Rome's Project on the Predicament of Mankind*. Universe Books.

Michelini, G., Moraes, R. N., Cunba, R. N., Costa, Y. M., & Omettoa, A. R. (2017). From linear to circular economy: PSS conducting the transition, *Procedia CIRP*, *64*, 2-6. https://doi.org/10.1016/j.procir.2017.03.012

Montanino, A., Giovane, C., & Carriero, A. (2021). *Strategic Value Chains. Towards a Resilient and Sustainable. Post-Pandemic Recovery.* Centre for European Policy Studies. https://www.ceps.eu/wp-content/uploads/2021/07/Strategic-Value-Chains_CEPS-TF-WGR.pdf

Moore, J. (1993). Predators and prey: a new ecology of competition. *Harvard Business Review*, *71*(3), 75-86.

Naidu, R., Biswas, B., Willett, I. R., Cribb, J., Singh, B. K., Nathanail, C. P., Coulon, F., Semple, K. T., Jones, K. C., Barclay, A., & Aitken, R. J. (2021). Chemical pollution: A growing peril and potential catastrophic risk to humanity. *Environment International*, *156*, 106616. https://doi.org/10.1016/j.envint.2021.106616

Neuman, S., & Hurt, A. (2023, February 22). The ripple effects of Russia's war in Ukraine continue to change the world. *National Public Radio* https://www.npr.org/2023/02/22/1157106172/ukraine-russia-war-refugees-food-prices

Ostarkova, J., & Stanickova, M. (2021). How well do we know the issue of resilience? Literary research of current levels of knowledge. *Eastern Journal of European Studies*, *12*, 12-42. https://doi.org/10.47743/ejes-2021-SI02

Poore, J., & Nemecek, T. (2018). Reducing food's environmental impacts through producers and consumers. *Science*, *360*(6392), 987-992. https://doi.org/10.1126/science.aaq0216

Redek, T., Domadenik, P., & Koman, M. (2020). Sustainable Development Goals in the EU and the Challenges in Their Implementation. In V. Zabkar & T. Redek (Eds.), *Challenges on the Path Toward Sustainability in Europe* (pp. 11-29). Emerald Publishing Limited. https://doi.org/10.1108/978-1-80043-972-620201003

Ritchie, H., Rosado, P., & Roser, M. (2022). *Environmental Impacts of Food Production.* Our World in Data. https://ourworldindata.org/environmental-impacts-of-food

Silvestre, B. S., & Ţîrcă, D. M. (2019). Innovations for sustainable development: Moving toward a sustainable future, *Journal of Cleaner Production*, *208*, 325-332, https://doi.org/10.1016/j.jclepro.2018.09.244.

Skorobogatova, N. (2022). Creating the model of balanced business development based on ecosystem approach. *Technology Audit and Production Reserves, 2*(4(64), 6-10. https://doi.org/10.15587/2706-5448.2022.256610

Tagarakis, A., Dordas, C., Lampridi, M., Kateris, D., & Bochtis, D. (2021). A smart farming system for circular agriculture. *Engineering Proceedings*, 9(1), 10. https://doi.org/10.3390/engproc2021009010

Tariq, A., & Jadoon, M. (2022, January 3). Interpreting sustainable development through different approaches. *Strategic Foresight for Asia.* https://strafasia.com/interpreting-sustainable-development-through-different-approaches/

The State Statistics Service of Ukraine. (2022). http://www.ukrstat.gov.ua/

Tiurina, A., Kapelista, I., Omelchenko, A., Obykhod, H., & Pavliuk, S. (2021). Sustainable economic development of Ukraine through agro-sector growth. *Scientific Horizons*, *24*(12), 92-101. https://doi.org/10.48077/scihor.24(12).2021.92-101

Trusina, I., & Jermolajeva, E. (2021). The scientific discourse on the concept of sustainable development, *Eastern Journal of European Studies*, *12*(2), 298-322. https://doi.org/10.47743/ejes-2021-0215

Tsalis, T. A., Malamateniou, K. E., Koulouriotis, D., & Nikolaou, I. E. (2020). New challenges for corporate sustainability reporting: United Nations' 2030 Agenda for sustainable development and the sustainable development goals. *Corporate Social Responsibility and Environmental Management*, *27*(4), 1617-1629. https://doi.org/10.1002/csr.1910

Tsujimoto, M., Kajikawa, Y., Tomita, J., & Matsumoto, Y. (2018). A review of the ecosystem concept - towards coherent ecosystem design. *Technological Forecasting and Social Change*, *136*, 49-58. https://doi.org/10.1016/j.techfore.2017.06.032

United Nations. (2015). *Transforming our world: the 2030 Agenda for Sustainable Development* https://www.un.org/ga/search/view_doc.asp?symbol=A/RES/70/1&Lang=E

United Nations. (2016). *17 Goals to Transform Our World*. https://www.un.org/sustainabledevelopment/

Villiers, C., Torre, M., & Molinari, M. (2022). The Global Reporting Initiative's (GRI) Past, Present and Future: Critical reflections and a research agenda on sustainability reporting (standard-setting). *Pacific Accounting Review*, *34*(5), 728-747. https://doi.org/10.1108/PAR-02-2022-0034

Voitko, S., Gaidutskiy, I., & Skorobogatova, N. (2020). Industry 4.0 and next normality in ensuring sustainable development. *III International Conference on High Technology for Sustainable Development (HiTech).* https://doi.org/10.1109/hitech51434.2020.9363981

Walker, C., DeMatteis, L., Lienert, A. (Eds.). (2021). *Selecting value chains for sustainable food value chain development - Guidelines*. FAO. https://doi.org/10.4060/cb7623en

Wang, Y., Liu, G., Cai, Y., Giannetti, B., Agostinho, F., Almeida, C., & Casazza, M. (2022). The ecological value of typical agricultural products: an emergy-based life-

cycle assessment framework. *Frontiers in Environmental Science*, *10*, 824275. https://doi.org/10.3389/fenvs.2022.824275

Wiedmann, T., Lenzen M., Keyßer, L., & Steinberger (2020). Scientists' warning on affluence. *Nature Communications, 11*(1), 1-10. https://doi.org/10.1038/s41467-020-16941-y

World Trade Organization (WTO). (2023). *One year of war in Ukraine: Assessing the impact on global trade and development.* https://www.wto.org/english/res_e/booksp_e/oneyukr_e.pdf

Xukun, S., Shen, Y., Xiao, Y., Yuqing, L., Hao, C., Lingfan, W., Su, Z., Murong, Y., Qiusheng, W., & Guohua, L. (2022). Identifying ecological security patterns based on ecosystem services is a significative practice for sustainable development in southwest China. *Frontiers in ecology and evolution, 9*. https://doi.org/10.3389/fevo.2021.810204