Geo-management in organic agriculture

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CONTENT

INTRODUCTION

Development of world economies in our time is under the influence of globalization of world economic relations, characterized by the growth of anthropogenic pollution of environmental objects, as well as the growth of role of the agrarian and economics of natural resources. The paradigm of public life's ecologization has led to an understanding the need of developing the information support for organic agricultural production, increasing the scientific research of the quality of life support and substantiation of practical recommendations of systematic agrarian nature management.

Organic production is rapidly spreading in Ukraine, and therefore, our country, on the basis of natural and climatic conditions and geographical location, is considered by the world community as a potential supplier of organic products. According to IFOAM (International Federation of Organic Movement), in 2003 there were 31 organic farms registered in Ukraine, and in 2015 there were more than 180 such farms. As of 2018, there were registered 350 organic market operators. Their total area is about 1% of Ukrainian agricultural land, while in European countries this indicator reaches 10%.

Scientists have proved that the formation and differentiation of the agricultural production'sorganic sector will lead to synergistic results in the medium term: preserving the quality of land resources as the nation's natural capital; increasing the production of the most competitive high-quality products; diversification of the agro-industrial production and export of the most profitable crops and finished products; creating the new jobs; stopping the «extinction» of rural settlements; compliance with the euro integration requirements for the certification of agricultural products for its export under the International System for the Certification of Constancy and Carbon and other international agreements.

The development of organic production and its information provision in our time is to: improve solutions for ensuring the objectivity of the economic assessment of the natural resource

potential and quality of land resources for organic production; provision of innovation mechanism of the agrarian production management on the basis of geo-information and analytical systems; development of standards and technologies for improving the quality and safety of food products; implementation of advanced technologies of the agro-industrial complex and processing industry; consideration of the objective factors of the market economy'sdevelopment and increasing the export potential of the state. Organic production is aimed at developing the system of organic land use and solving the objectives of the UN Environment Program (UNEP) on the implementation of the Global Green Movement in Ukraine, aimed at environmentally clean development, creation of an appropriate infrastructure and employment growth in the economic sectors. Such approaches are based on synergy and methodological principles: agrarian and environmental economics, environmental management, geo-information technologies, implementation of world experience for Ukraine and promotion of the competitiveness of the national economy. Therefore, an urgent problem today is theoretical, methodological and practical, on socio-ecological and economic grounds, geo-management and mechanisms for ensuring the competitiveness of organic agriculture in Ukraine under the conditions of European integration.

Development of a scientific project is a unique scientific research, that defines the needs of the agrarian sector's subjects and offers alternative options for its solution. Implementation of innovation geo-information management will allow to solve the urgent issues of regional and national development of Ukraine by overcoming the existing imbalances, ensuring the creation of competitive agro producers and agroecoregions. It is important to develop clusters, that will promote the creation of high-tech associations with a closed cycle of organic production and a high level of value added in the final product, creation of infrastructure in the united territorial communities.

To issue of using the information technologies in natural resources management is paid much attention in the publications of domestic and foreign authors such as: I. Borysiuk, O. Borodin,

V. Gorkavyi, G. Zhavoronkov, T. Kalna-Dubiniuk, M. Kropyvko, I. Kryvoruchko, P. Sabluk, V. Sytnyk, O. Ulyanchenko, L. Fedulov, O. Shnypko and others. The features of using the GIS in the agricultural sector are presented in the works of such scientists as: V. Medvedev, V. Ushkarenko, M. Romashchenko, F. Lysetskyi, G. Heuvelink, M. Pinheiro, K. Natarajan, N. Fagerholm etc. Particular attention of domestic and foreign scientists is dedicated to the advantages and necessity of creating the geo-information portals for all spheres of management, primarily the agrarian sector. L. Bernardand D. Maguire emphasize that creating a geoportal will ensure the consistency with many state institutions through online access to spatial data and thematic services to create an effective mechanism for its interaction.

The following author's as V. Artish, V. Borysova, N. Holovchenko, N. Zinovchuk, O. Dudar, M. Kapshtyk, O. Kornitska, V. Kysil, Y.Tarariko, V. Pysarenko, M. Shykula, J. Urban and others devoted their works to the study of organic production. Theseresearches became a scientific basis for the implementation of organic land use as a way of agriculture ecologization in Ukraine. At the same time, there are no systematic studies on: social and ecological and economic efficiency of organic land use using the information technologies; export opportunities and mechanisms of forming clusters for the production of batches of organic products for export.

The information, methodological and practical results obtained by the authors on informatization of organic production will allow to disseminate knowledge in branch and regional institutes of agricultural production, scientific institutions, departments of agro-industrial development in regional state administrations, that will promote the dissemination of knowledge and transition to organic land use.

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1. JUSTIFICATION OF THEORETICAL, METHODOLOGICAL AND PRACTICAL COMPONENTS OF ORGANIC PRODUCTION DEVELOPMENT

1.1. Theoretical, methodological and practical components of organic production development in Ukraine

The increase in the food needs' level of the population and the awareness of humanity of the deterioration of the natural environment caused by the intensification of agriculture, caused an interest in agricultural production methods that guarantee the necessary quality and food safety, and also do not harm the environment. The XXI century beginning was marked by the active transition of the agrarian sector from the chemical form of agriculture to organic. Today in the world, they work in more than 140 countries on 32 million hectares of land. The global market for these products is growing every year by 5 billion USD. In Ukraine, 51.4 million hectares of land potentially suitable for the needs of agriculture, of which 28.1 million hectares are highly suitable (for organic farming). In particular, in the Ukraine's Polissya, up to 20% of agricultural land is not used and can be used for organic production in a reduced transition period [1].

The development of organic production addresses the provisions of the Europe 2020 Strategy and sets three interconnected and mutually reinforcing priorities: smart economic growth based on knowledge and innovation as key elements of competitiveness; sustainable growth is a development of a resource-saving, low carbon and competitive economy; promoting the development of a socially oriented economy with a high employment rate.

Topicality of such production' distribution lies in the fact that the share of exports of agricultural products in the structure of GDP is in different years 30 - 50%. Hence, for more than 20 years, the agro-industrial sector constantly contributes to the flow of foreign currency funds to the state, including through the exploitation of natural capital - land resources. However, high-tech organic

production makes it possible to obtain the same, in comparison with traditional production, results in areas less than 30% of agricultural land. Therefore, organic production begins the «growth points» (new production of niche and district highly profitable crops), ensures food security and diversification of production, promotes the development of new areas for information activities for organic producers, ensures environmental sustainability and increases the price of agricultural land, etc.

Innovations in the organic sector of the economy are:

- mechanisms of geo-management of competitive development of organic agrarian production using geoinformation systems and technologies of remote sensing of the Earth;
- substantiation of the geoinformation-analytical system components of the agrarian sector, that includes subsystems (management of geostationary databases, making management decisions' subsystem, etc.);
- projects of applied web platforms of consulting and management of agrarian enterprises;
- theoretical and practical developments on the substantiation of methods and methods for evaluating the effectiveness of organic production;
- methods, schemes and justification of expenses for transition of traditional farms to organic land use;
- national standards and certification systems of organic crop production;
- toolkit and organizational and economic mechanism of management of organic land use and recommendations for estimating the value of organic land;
- models and mechanisms for the organization of clusters in organic production; substantiation of diversification and specialization in the growth of the role and share of organic production in the general agricultural production in the nearest time period.

These innovations can only be implemented using methodological developments based on a systematic approach in the economy, the environment, the social sphere, taking into account synergistic effects and consistent with the global level, for

example: the position of the geoinformation and analytical portal for the organic sector of the economy and the consideration of virtual water in organic production.

The development and implementation of innovative development models and geo-management will enable agrarian sector of Ukraine to choose solutions that are adapted to real business conditions based on professional information. As a result, the following results will be obtained and substantiated in the further researches of world and national science: the mechanisms of geo-management and ensuring the competitiveness of organic agriculture at the local, regional and national levels. In our opinion, obtaining the expected results and their organic combination in the newest mechanisms of geo-management and ensuring the competitiveness of organic agriculture will form a unique synergistic effect of the safety of products and food security of Ukraine. The development, implementation and use of modern integrated multi-level geographic information systems for evaluation and effective geo-management has high resource and socio-economic efficiency. The obtained scientific and practical results are based on the development of an innovative model, mechanism and interconnections of components of geo-management that will not have analogues in national and world practice. Thus, the innovative geo-management strategy is promising, characterized by novelty and of great importance in terms of use in organic farming in Ukraine, which will ensure high competitive positions and increase the food security of the state [2-5].

Today, organic production is recognized as one of the promising directions of development of the agro-food sector of Ukraine and officially is a priority of the state agricultural policy. This is to a large extent promoted by the active state policy on the development of the organic sector aimed at improving the legal framework and institutional, organizational, economic, methodological, advisory, and educational support. Suggestions for improving information provision are provided (see Figure 1.1).

In order to achieve this goal, the Ministry of Agrarian Policy and Food of Ukraine developed three policy documents aimed at

supporting organic agriculture, namely, the Strategy for the Agrarian Sector Development «3 + 5», the Integrated Strategy for

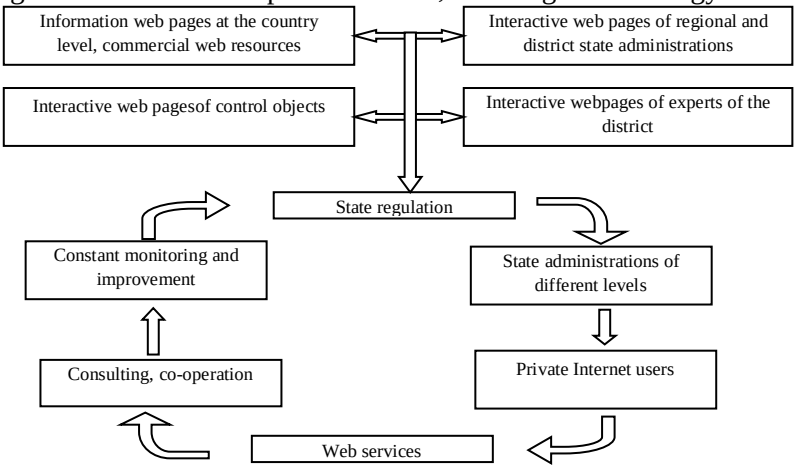

Fig. 1.1. Scheme of the information network for the systematic development of organic production

the Development of Agriculture and Rural Areas in Ukraine for 2015, -2020 years and the Strategy for improving the management mechanism in the field of use and protection of agricultural lands of state ownership and disposal.

The legal and economic basis for the production and circulation of organic agricultural products is regulated by the Law of Ukraine «On the Production and Circulation of Organic Agricultural Products and Raw Materials» No. 425-VII dated September 3, 2013, according to which, organic agricultural production «is a production according to established rules, which allow to produce organic products with healing properties»; as well as to preserve and restore natural resources in the process of production activity. The field of organic production also includes products harvested in forests, resulting from beekeeping and fishing.

In 2018, Verkhovna Rada of Ukraine has adopted in the first reading a draft LawNo 5448-d «On Basic Principles and Requirements for Organic Production, Circulation and Marking of

Organic Products», which is proposed to introduce a fine for the sale of products with an organic state logo in the absence of a certificate [6]. The new version of the law envisages not only the improvement of the legal regulation of organic production, but also the harmonization of Ukrainian legislation with the legislation of the European Union in this area. This will increase the competitiveness of domestic organic products and expand the external markets of its sales.

In general, the draft Law proposes to:

– define the rights and obligations of the subjects of the market of organic products, in particular, market operators, certification bodies;

– establish the powers of the central executive authorities, which carry out state administration and control at organic production sphere;

– establish requirements for the production, marking and circulation of organic products, certification procedures for organic production, detailing by industry;

– introduce registration of certification bodies, market operators and organic seeds;

– introduce a clear mechanism of state control (supervision) for the activities of market participants of organic products and liability for violations of legislation in this area. Economic mechanisms and principles for the development of organic production are shown in Fig. 1.2.

To date, a number of by-laws have been adopted for the regulatory support of organic production:

– Decree of the Cabinet of Ministers of Ukraine «On Approval of Detailed Rules for the Production of Organic Products (Raw Materials) of Plant Origin» No. 587 dated August 31, 166, which establishes requirements for producers of organic products engaged in plant growing, namely, crop rotation, soil cultivation, fertilization of agricultural crops, selection of seeds and seedlings, plant protection, etc.;

– Resolution of the Cabinet of Ministers of Ukraine «On Approval of Detailed Rules for the Production of Organic Products (Raw Materials) of Animal Origin» No. 241 dated March 30, 2006;

– Decree of the Cabinet of Ministers of Ukraine «On Approval of Detailed Rules for the Production of Organic Products

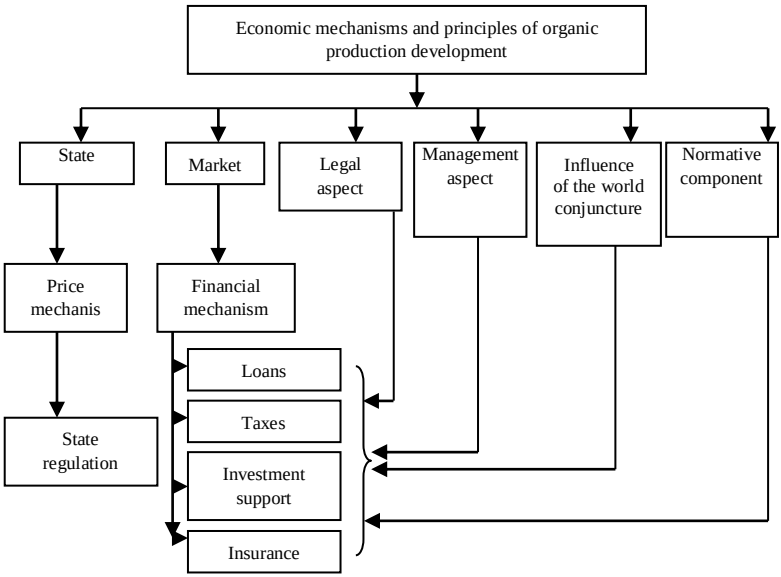

Fig. 1.2. Economic mechanisms and principles of organic production development

(Raw Materials) of Beekeeping» No. 208 dated 23.03.16;

– Resolution of the Cabinet of Ministers of Ukraine «On Approval of Detailed Rules for the Production of Organic Products (Raw Materials) of Aquaculture» No. 982 dated September 30, 15;

– Resolution of the Cabinet of Ministers of Ukraine «On Approval of Detailed Rules for the Production of Organic Seaweeds» No. 980 dated September 30.

Organic production is also consistent with the provisions:

- Law of Ukraine «On Standardization» of May 17, 2001 No. 2408-III;
- Law of Ukraine «On Standards, Technical Regulations and Procedures for Conformity Assessment» dated 01.12.2005, No. 3164-IV;
- Law of Ukraine «On confirmation of conformity» dated May 17, 2001 No. 2406-III;

- Law of Ukraine «On ensuring the sanitary and epidemiological well-being of the population» No. 4004-XII of 24.02.1994;
- The Law of Ukraine «On Safety and Quality of Food Products» No. 771/97 of 23.12.1997.

In order for the law to work fully after its adoption, it is necessary to develop and approve about 20 normative legal acts, among which:

1. Procedure for certification of organic production, circulation and marking of organic products (including issuance of a certificate, its duplicate);

2. The procedure for the implementation of state supervision (control) over the activity of subjects of the market of organic products (including scheduled and unscheduled measures), etc.

Organic agricultural production, as a new industry, needs state support to ensure the stable development of this promising sector of production for Ukraine. Studies have shown that the prerequisites for the successful development of organic and ecological farming products in the EU member states are the following: strong institutional and legal framework, financial assistance to farms from the European fund, state assistance in promoting such agriculture, support for science and advocacy, confidence in the labeling of ecological agriculture, growing demand for high-quality products abroad and within countries, administrative support through government orders and state procurement Succession.

Today, organic farming in Ukraine operates in a situation where:

- land reform is incomplete and there is no agricultural land market;
- there is no socially responsible marketing approach from producers and marketing organizations, sellers and other participants;
- practically there is no state financial support for domestic producers, which worsens their position on the world market of organic products;
- lack of qualified specialists, and there is no training for agronomists specializing in organic production in educational institutions;

- there is no national certification system for organic production, therefore Ukrainian producers are forced to apply to foreign organizations for conformity assessment;
- National regulatory documents on organic production have not been developed, as a result of which relations in the field of production, processing and marketing of organic products remain unregulated;
- the procedure for certification of organic production, circulation and marking of organic products (including the issue of a certificate, its duplicate) has not been developed;
- does not have a functioning state control system that would be accredited at the national and international levels, covering both the organic sector operators and products.

An action plan for the formation of an ecological and economic system for the development of organic production is shown in Figure 1.3.

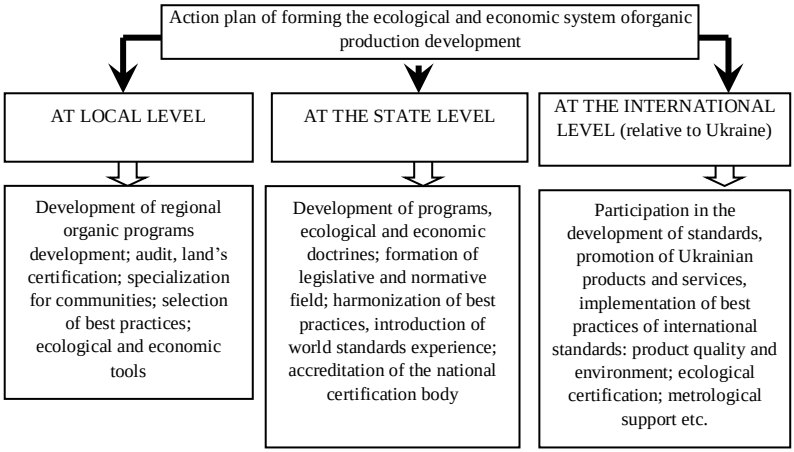

Fig.1.3.The essence of action plan of forming the ecological and economic system of organic production development

At the regional level, support for organic production is foreseen in the draft decision of the regional council «On the Integrated Program for the Development of the Agro-Industrial Complex of Rivne Oblast for 2018-2022».

Among the priority directions of development of the agro-industrial complex is planned to:

- develop the organic agriculture and food production;
- increase in the share of organic produce in the total volume of gross agricultural production in the Rivne region;
- reduce the agricultural land pollution and increase of food production, safe for human health;
- develop the internal market of organic products and satisfaction of consumers, increase of export of organic products.

Therefore, for Ukraine a system of methods for managing the distribution of organic agricultural production at the state level was developed (Fig. 1.4).

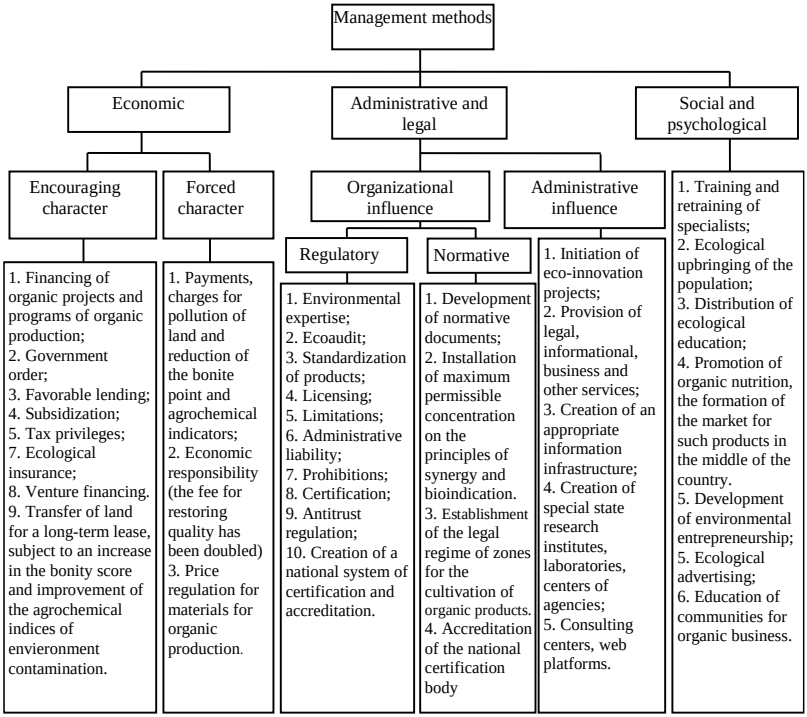

Fig. 1.4. System of management methods for distribution of organic agricultural production at the state level

Over the past 5 years, organic production in Ukraine has increased by 90%, and if earlier the organic trend was only niche and unpromising, now it is innovative, highly profitable and export oriented.According to data of 19 organic products'certification bodies operating in Ukraine, the total area of certified land according to organic legislation of the European Union at the beginning of 2017 is 381 thousand hectares. Of these, 91 thousand hectares are in the transitional period, and the remaining 290 thousand hectares are already certified. That makes 0,89% of the total area of agricultural land in the country. There are currently 429 operators in the Ukrainian market of organic products, of which 294 are organic producers, the rest are traders and processors (Fig.1.5, Fig. 1.6) [7].

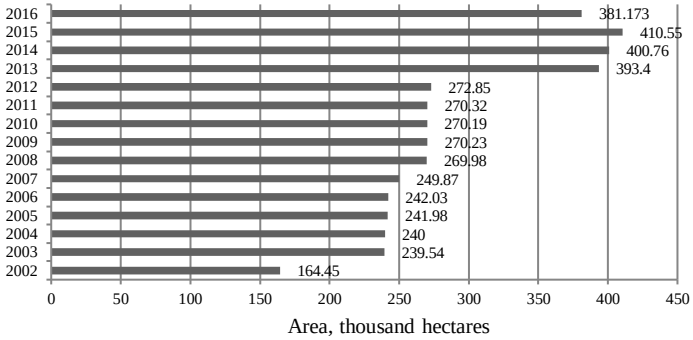

Fig.1.5. The area of organic land in Ukraine

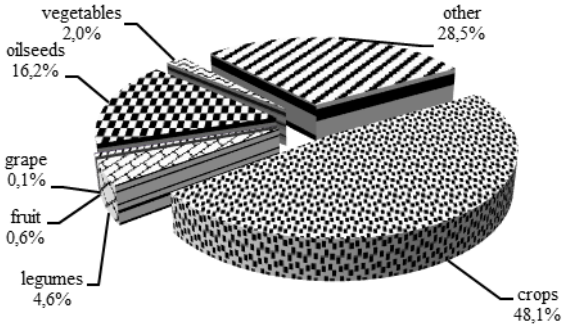

Fig.1.6. Structure of organic land by cultures

The domestic organic products market began to emerge in the early 2000s, in 2008 the first Ukrainian marked organic products appeared on the shelves of Ukrainian stores. The main sales channels were supermarkets and specialized stores in big cities. The range of organic products on the shelves of stores is still incomplete, but expands every year. Consumers can buy in the stores the following categories of Ukrainian organic products: dairy and meat products, groceries and bakery products, flour, pasta, vegetable oils, drinks (fruit / vegetable / berry juices, birch juices, herbal teas), canned foods (e.g. berry pastes, syrups, jams), some vegetables and fruits, etc.

The analysis of the organic market of Ukraine showed that during 10 years its significant growth from 1 million euro in 2007 to 21,2 million euros in 2016 which is 25% more than in the previous year. A significant increase in the organic market in Ukraine took place in 2013 (12 times compared to 2007). This positive tendency testifies to the desire of Ukrainians to lead a healthy lifestyle by spending money on ecological and organic products. The dynamics of the development of the internal market for organic products in Ukraine is presented in Table 1.1.

Table 1.1

Dynamics of development of the organic products' internal market in Ukraine [8-12]

Indicator	Years									
	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Market volume, million euro	0,5	0,6	1,2	2,4	5,1	7,9	12,2	14,5	17	21,2

Due to the low consumption of organic products in the country, exports remain the driving force behind the development of the organic market in Ukraine. This is facilitated by proximity to the EU borders (the second largest organic market in the world) and the excess demand for Ukrainian organic raw materials on foreign markets compared with domestic ones. According to Organic Standard, the largest importers are the EU countries: Germany, Austria, Poland, Italy, France, the Netherlands, Denmark, Switzerland, as well as in the United States and Canada. In 2016,

164.8 thousand tons of organic products worth more than 45 million euro were exported, including 157.6 thousand tons (80%) to the EU. 47% of exports are grain, among other important positions - seeds, oilseeds, dairy products and honey. In terms of organic farmland, Ukraine ranks 11th in Europe and 20th in the world (Figure 1.7).

The dynamics of the change in the area of organic land in Ukraine has a positive upward trend until 2015, however, in 2016, it has a slight decrease (Fig.1.8). This is due to the political and economic situation in the country and the decline in purchasing power of the population.

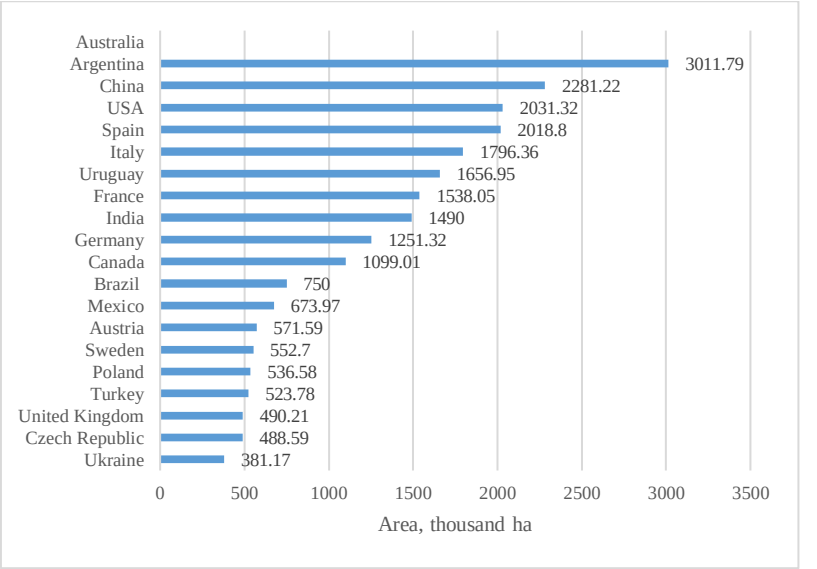

Fig.1.7. Top 20 countries with largest areas of organic agricultural land, 2016 (compiled by authors for [8-12])

Ukraine, in terms of the organic market, is among the countries of the world in the last third. This is due to the fact that Ukraine - belongs to developing countries and organic began to develop actively several years ago. The dynamics of the change in the volume of the organic market in Ukraine is shown in Fig. 1.9.

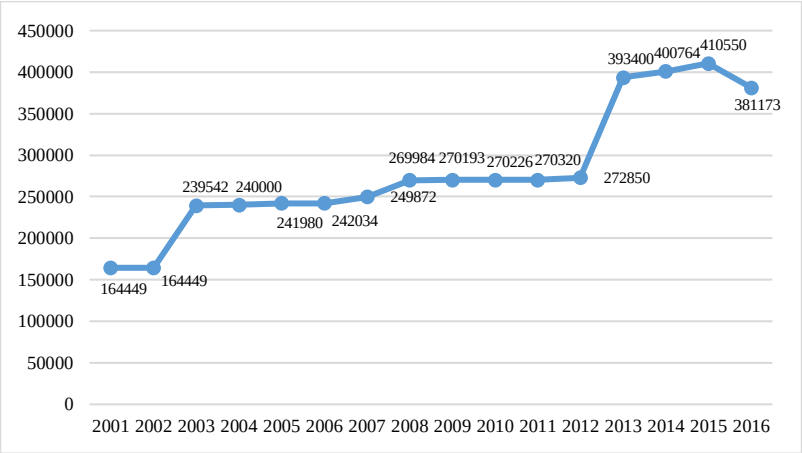

Fig. 1.8. Dynamics of changes in the area of organic land in Ukraine during 2001-2016

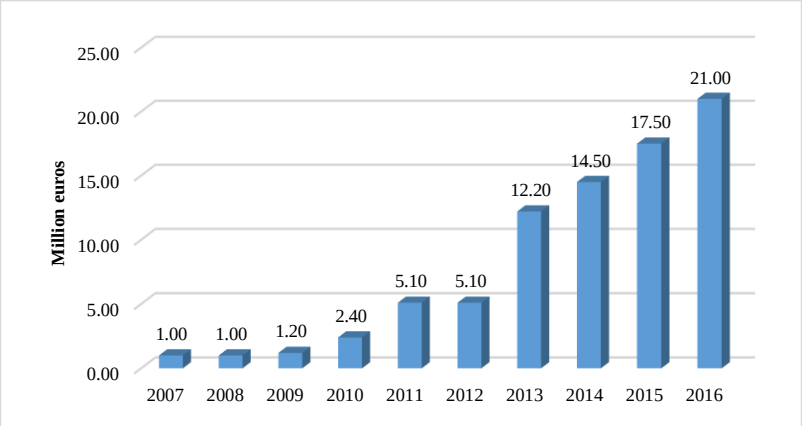

Fig.1.9. Dynamics of changes in the volume of the organic market in Ukraine during 2007-2016 (compiled for [13])

Despite the fact that the number of producers of organic products in Ukraine, compared with the leaders of the countries, is rather small, however, there is clearly a positive tendency to increase their number (Fig. 1.10).

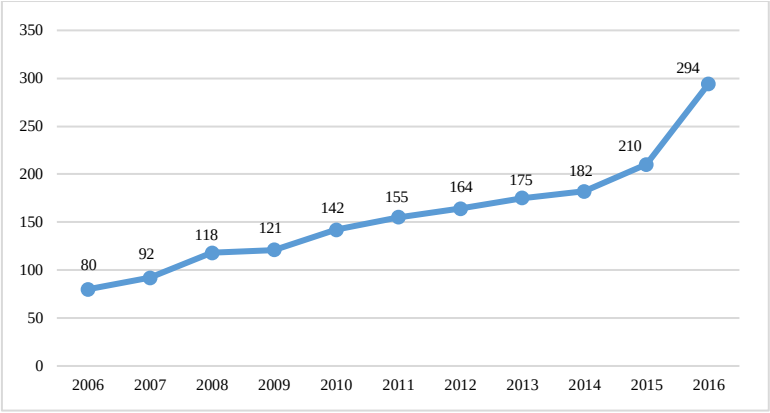

Fig. 1.10. Dynamics of changes in the number of producers of organic products in Ukraine during 2006-2016

Over the past 10 years, the number of organic producers has grown by 367% (or +214 enterprises) from 80 enterprises in 2006 to 294 enterprises in 2016. This indicates the development and prospects of the organic sector in Ukraine. Analysis of organic market operators in Ukraine (Table 1.2) showed that the number of exporters of organic products decreased by 16.7% over the past 5 years, while the number of importers increased by 21.9%.

Table 1.2

Dynamics of change of organic market operators in Ukraine [13]

Years	Exporters of organic products	Importers of organic products	Processors of organic products	Producers of organic products
2012	36,00	41,00	59,00	164,00
2013	36,00	41,00	59,00	175,00
2014	55,00	60,00	59,00	182,00
2015	30,00	50,00	110,00	210,00
2016				294,00

The dynamics of exports and imports of organic products in Ukraine, the number of producers, retail sales are given in

tables 1.3-1.5. The trends in the tables show the growth in sales of organic products to 21 million euros, the number of operators over 350, and the increase in per capita consumption of quality products.

Table 1.3

Organic retail sales

Year	Organic area (agricultural land), ha	Share of organic area from agricultural land's total area, %	Organic producers	Organic retail sales, million euros
2001	164'449.00	0.40		
2002	164'449.00	0.40	31.00	
2003	239'542.00	0.58*	69.00	
2004	240'000.00	0.58*	70.00	
2005	241'980.0	0.59*	72.00	
2006	242'034.00	0.59*	80.00	
2007	249'872.00	0.61*	92.00	1,0
2008	269'984.00	0.65*	118.00	1,0
2009	270'193.00	0.65*	121.00	1,2
2010	270'226.00	0.65*	142.00	2,4
2011	270'320.00	0.65*	155.00	5,1
2012	272'850.00	0.66*	164.00	5,1
2013	393'400.00	0.95*	175.00	12,2
2014	400'764.00	0.97*	182.00	14,5
2015	410'550.00	0.99*	210.00	17,5
2016	381'173.00	0.89*	294.00	21,0

Table 1.4

Number of organic operators in the Ukrainian market

Years	Exporters of organic products	Importers of organic products	Processors of organic products	Producers of organic products
1	2	3	4	5
2002				31
2003				69
2004				70
2005				72
2006				80
2007	8	11	9	92

continuation of tabl. 1.4

1	2	3	4	5
2008	8	11	9	118
2009	18	0	32	121
2010		7	14	142
2011	32	28	45	155
2012	36	41	59	164
2013	36	41	59	175
2014	55	60	59	182
2015	30	50	110	210
2016				294
2018				350

Table 1.5

Trends in organic products market

Years	Organic consumption per capita, euro / person	Organic retail sales, million euros
2007		1,0
2008		1,0
2009	0.02	1,2
2010	0.05	2,4
2011	0.10	5,1
2012	0.10	5,1
2013	0.26	12,2
2014	0.31	14,5
2015	0.39	17,5
2016	0.49	21,0

In order to develop the organic sector of the economy, a matrix has been developed for assessing the priority of methodological and methodological approaches to assessing the natural resource potential in the agrofores for the purpose of developing the organic land use (Table 1.6).

Table 1.6

Matrix of prioritization of methodological and methodical approaches to the assessment of natural resource potential in the agro-sphere

Resources and features / Approach to assessments	territorial	land	water	biological	raw materials	water management	fishery	forestry	agricultural	exploitation of reclamation systems	recreational	support for biological and landscape diversity
Cost-effective	-	±	±	-	±	±	±	±	±	-	-	-
Effective	±	±	-	±	±	±	±	±	±	+	+	±
Cost	-	+	+	±	±	±	±	±	+	±	±	±
Rent	±	+	±	±	±	±	+	+	+	±	+	-
Market	+	+	+	+	±	±	+	+	+	±	+	±
Alternative cost	-	+	+	+	±	±	+	+	+	+	+	±
Total value	±	+	+	+	±	±	+	+	+	+	+	±

* + - priority; ± - average priority; - - non-priority type; the dark color highlighted the methodical approaches selected for the development of proposals for the development of a methodology for assessing the nature of resource potential, for organic land use, dashes marked auxiliary approaches

Consequently, development of the Ukrainian's economy organic sector requires the further development of legislative and regulatory documents, the development of web resources, the implementation of best world practices, valuation and ecological and economic tools in such a sector of the agrarian economy of the state, as evidenced by the work of scientists [14].

To motivate the responsibility for the development of organic production as a component of the national economy, a system of taxation of enterprises in Ukraine was proposed with proposed changes in the development of organic production (Fig.1.11)

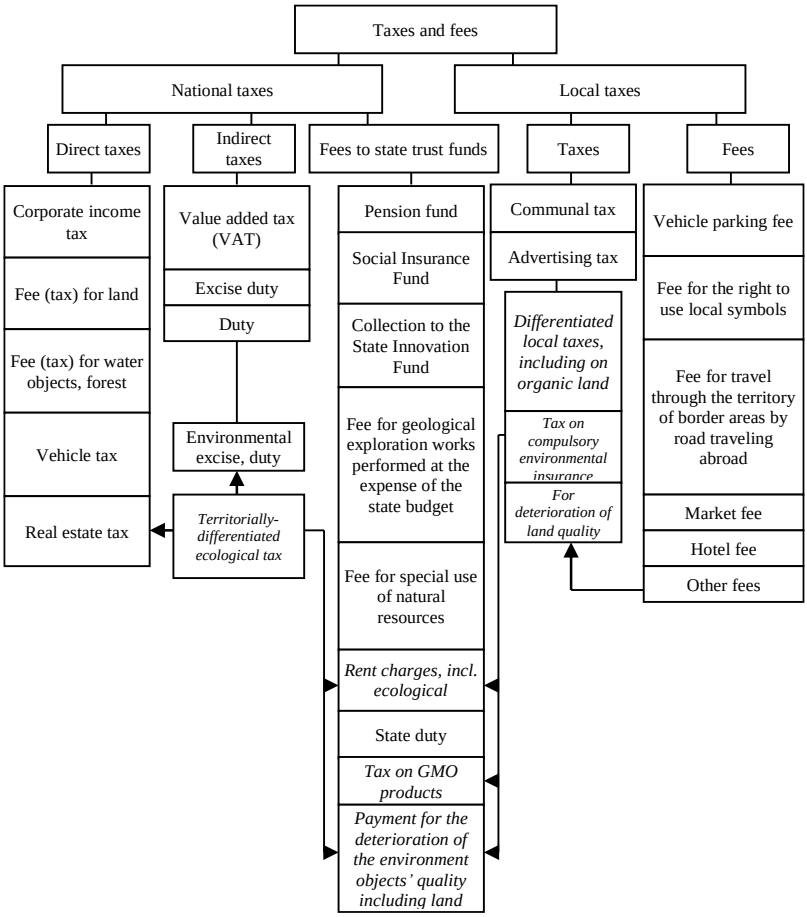

Fig.1.11 - Taxation of enterprises in Ukraine with proposed changes in the development of organic production (in italics)

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1.2. Development of organic production in the world and the EU

Each country in the European Union has assumed responsibility in promoting the development of organic production and pays state aid for the so-called «organic load» for producers of organic products.

The amount of organic aid in the EU countries is not the same, in Greece, Cyprus and Malta, governments paid over EUR 600/ha, Belgium, Italy, Lithuania, Austria and Slovenia over EUR 200 / ha, with the rest of the EU received over EUR 100 / ha, only the Czech Republic, Denmark, Estonia and the United Kingdom received less than EUR 100/ha.

According to the data of the International Federation of Organic Agricultural Movements (IFOAM), the Research Institute of Organic Agriculture (FiBL) and the Environment and Agriculture Foundation (SOL) over the past 10 years, the total number of certified lands for organic farming has increased 3.2 times (from 11 to 35 million ha), as well as other areas of organic production (forests, beekeeping, aquaculture, non-agricultural land) almost 3.8 times. By the beginning of 2010, in the world, the total area of agricultural land has amounted to 35 million hectares, which uses organic methods of management, processed by 1.4 million producers (from small family to large, with tens of thousands of hectares). The regions with the largest organic agricultural area - Australia and Oceania (12.1 million hectares) represent 2.8% of the agricultural land in the region and 37% of the world's organic agricultural land, Europe (8.2 million hectares) is 1,72% of the agricultural land in the region, and 24% of the world's

organic agricultural land and Latin America (8.1 million hectares) represent 23% of the total organic land in the world [8-12].

According to the ratio of organic farming areas to the total area of agricultural lands in the European countries, such countries as Switzerland, Austria and Sweden are leading, with certified organic farming of more than 10% of the total agricultural area, in Portugal, Italy, Germany, Czech Republic, Slovakia, Norway, Finland and the countries. The Baltic states - from 5 to 10%, in Spain, France, the United Kingdom, Belgium, the Netherlands, Luxembourg, Poland, Hungary, Romania and Greece - from 1 to 5%, in all other European countries - less than 1%.The share of organic products in the overall structure of food sales in Europe as a whole is now around 1.5%. Among the countries with the largest share of organic products in the food market, Denmark should be noted - 6.7%, Austria - 5.3%, Switzerland - 4.9%, Sweden and Germany by 4% each, and Italy - 3%, [15-17].

The shortage of organic products in the European Union forces to import the organic materials from other countries. Most of EU countries can provide organic produce less than 50%.At one time, the demand for organic products in the EU countries has stimulated the emergence of organic movement in Ukraine and domestic producers began to focus on market demands for such products.

The global turnover of organic food products reached 89.7 billion dollars in 2016 (more than 80 billion euros).The United States is the leader with a turnover of 38.9 billion euros, followed by Germany (9.5 billion euros), France (6.7 billion euros) and China (5.9 billion euros). In 2016, the commodity turnover of most major markets continued to grow by more than 10%, while the French organic market grew by 22%.

The highest per capita expenditures are in Switzerland (274 euros), while Denmark has the highest share of organic products in the food market (9.7%). Leading countries for consumption of organic products are given in Table 1.7.

At the end of 2016, the total area of organic lands in the world has amounted to 57.8 million hectares, an increase of 15% compared with 2015. This is the greatest growth in history (Fig. 1.14).

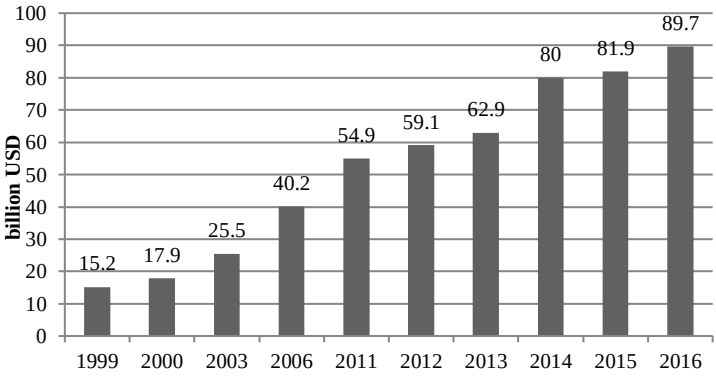

Fig.1.12. World market of organic products [15-17]

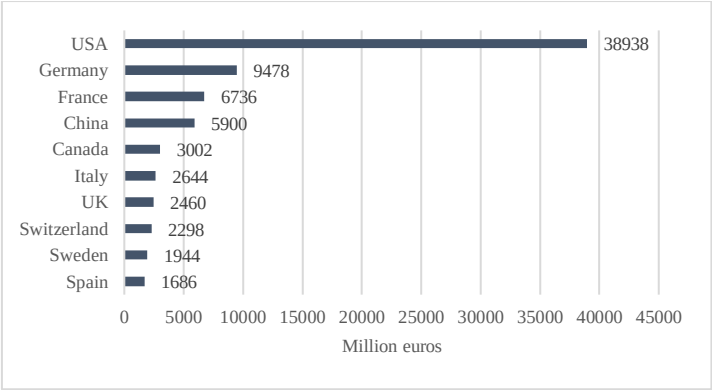

Fig. 1.13. Major markets of organic products [15-17]

Australia has the largest organic area (27.2 million hectares), followed by Argentina (3 million hectares) and China (2.3 million hectares). Almost a half of all organic agricultural land in the world is in Oceania (27.3 million hectares), in second place Europe (23%, 13.5 million hectares), in the third – Latin America (12%, 7.1 million hectares).

Table 1.7

Leading countries for organic products consumption, 2015

No	Country	Consumption per capita, euros
1	USA	111
2	Germany	106
3	France	83
4	China	3
5	Canada	77
6	United Kingdom	40
7	Italy	38
8	Switzerland	262
9	Sweden	177
10	Spain	32
	Ukraine	**0,39**

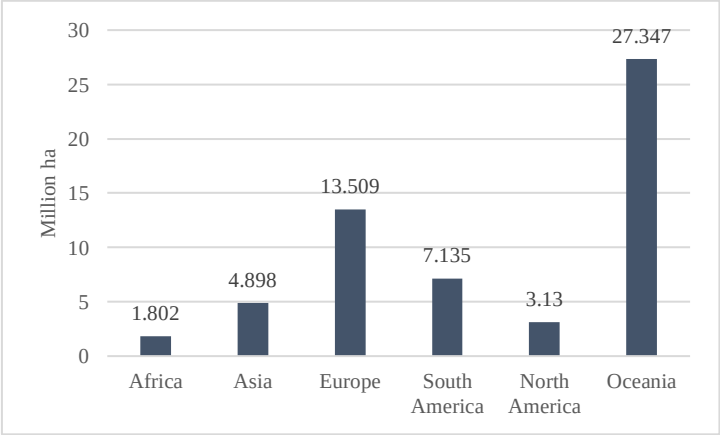

Fig.1.14. The area of organic lands by region

In 15 countries, the share of organic land is 10% or more. Countries with the largest share of organic land on the total agricultural land are Liechtenstein (37.7%), French Polynesia (31.3%) and Samoa (22.4%), (Table 1.8).

Table 1.8

The areas of organic land in the world, 2016 [13]

No	Country	Area of organic agricultural lands, ha	The share of organic lands in the total area of agricultural lands,%	Number of producers of organic products
1	2	3	4	5
1	Australia	27145021	6,68	2075
2	China	2281215,42	0,44	6308
3	USA	2031317,96	0,59	14217
4	Spain	2018802	8,66	36207
5	Italy	1796363	14,49	64210
6	Uruguay	1656952	11,47	6
7	France	1538047	5,54	32264
8	India	1490000	0,83	835000
9	Germany	1251320	7,48	27132
10	Canada	1099013,9	1,68	4205
11	Brazil	750000	0,27	10336
12	Mexico	673967,95	0,63	210000
13	Austria	571584,5	21,94	24213
14	Sweden	552695	18,02	5741
15	Poland	536579	3,72	22435
16	United Kingdom	490205	2,85	3402
17	Czech Republic	488591	11,5	4271
18	Ukraine	381173	0,89	294
19	Argentina	301794	2,03	1148

In the world context, the largest areas of organic agricultural lands are in Australia (over 27 million hectares), China (over 2 million hectares), and USA (about 2 million hectares). Ukraine, behind the areas of organic lands in the world, occupies 18th position with the 381,173 thousand hectares. However, after analyzing the structure of agricultural land, it is evident that Austria (21.94%), Sweden (18.02%) and Italy (14.49%) have the largest

share of organic land. In Ukraine, less than 1% of organic agricultural land.

Areas of organic agricultural land and its share in the overall structure of land are shown in Fig. 1.15, 1.16.

Among European countries, in terms of organic land, Ukraine ranks 11th (Table 1.9).

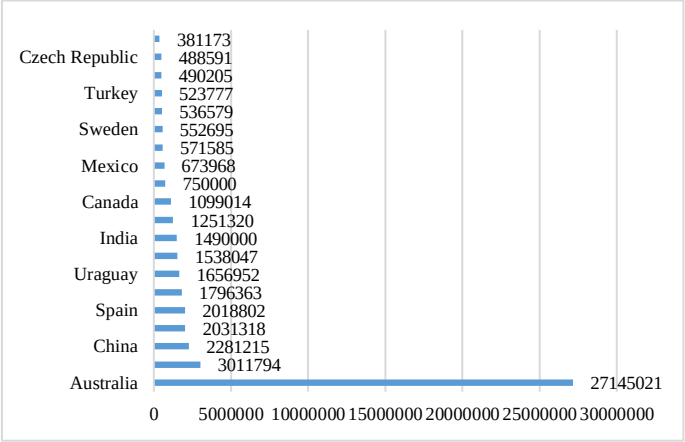

Fig. 1.15. The largest areas of organic agricultural lands in the world, ha, 2016 (built according to [18])

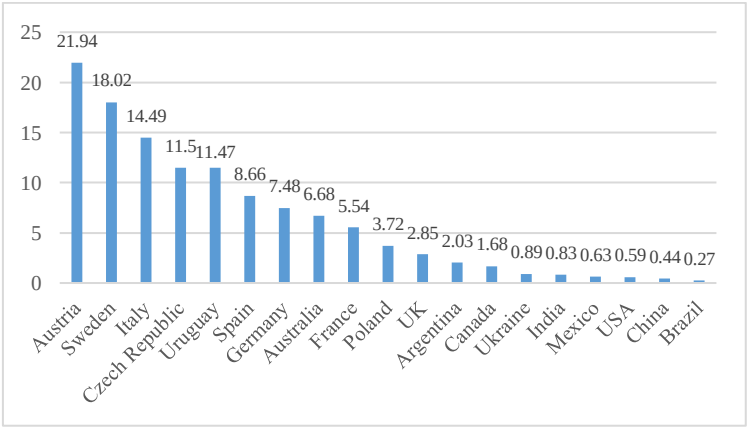

Fig. 1.16. Share of organic lands in total agricultural lands in the world,%, 2016 [13]

Table 1.9

The areas of organic land in Europe, 2016 [13]

Country	The area of organic agricultural lands, ha	The share of organic lands in the total area of agricultural lands,%
1	2	3
Spain	2018802	8,66
Italy	1796363	14,49
France	1538047	5,54
Germany	1251320	7,48
Austria	571584,5	21,94
Sweden	552695	18,02
Poland	536579	3,72
Turkey	523776,79	1,36
United Kingdom	490205	2,85
Czech Republic	488591	11,5
Ukraine	381173	0,89
Greece	342584	4,19
Russian Federation	315154,77	0,14
Latvia	259146	14,27
Portugal	245052	6,73
Finland	238240	10,44
Romania	226309	1,73
Lithuania	221665	7,65
Denmark	201476	7,69
Slovakia	187024	9,87
Hungary	186347	4
Estonia	180852	18,89
Bulgaria	160620	3,45
Switzerland	141249	13,46
Croatia	93593	5,96
Belgium	78451,55	6
Ireland	76701	1,55
Netherlands	52204	2,83
Norway	47621	4,78
Slovenia	43579	8,97
Moldova	30141,9	1,23
Iceland	22710,16	1,21

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1	2	3
Serbia	14358	0,41
Cyprus	5550	5,08
Luxembourg	4274	3,26
Liechtenstein	1383	37,7
Malta	24	0,23

According to FIBL [13] in 2016, from 230 countries in the world,there are 178 countries, that are cultivated the organic agriculture, 87 of them have its own legislative acts in the field of production and circulation of organic products. 17 countries are in the process of developing and adopting a regulatory framework for organic farming.

IFOAM has registered 46 organic standards as being relevant to the basic. Of these: 5 operates in several countries, 29 national ones.

The market for organic products is one of the most dynamically developing in the world. From 2000 to 2016, it grew more than in five times from 18 billion dollars to 90 billion dollars (Figure 1.17).

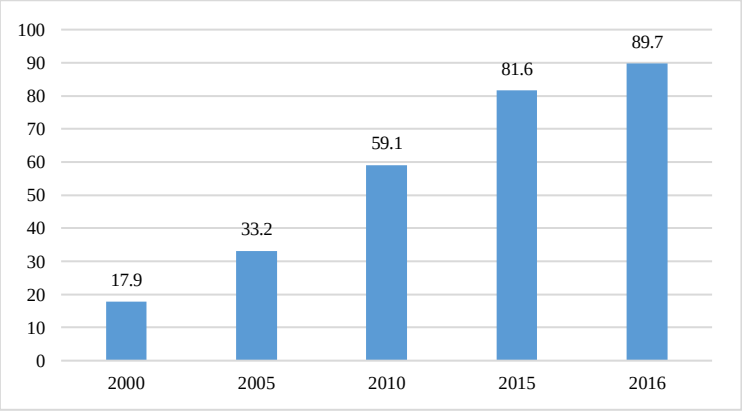

Fig. 1.17. The dynamics of sales changes of organic products in the world(according to FiBL / IFOAM)

Thus, organic production has become a profitable activity. According to Grand View Research, 2018 – 2020, the market will continue to grow at a rate of 15-16% per year and will reach about 212 billion dollars in 2020 – 2022. It is planned that by 2025 the volume of organic products market can amount from 15 to 20% of the world agricultural market.According to the research, it was found that the largest volume of the organic market is expected to be in the United States of America (EUR 38,937.57 million), while the smallest in Montenegro (EUR 0.1 million) and Belize (EUR 0.08 million).

Among the EU countries, the largest volume of the organic market is Germany (€ 9478.48 million) and France (€ 6736 million). The analysis of indicators for the development of the organic market showed that the largest producers of organic products are in India (835 thousand producers), Uganda (210,352 thousand producers) and Mexico (210 thousand producers). In Ukraine, as of 2017, there are 294 producers (Fig. 1.18).

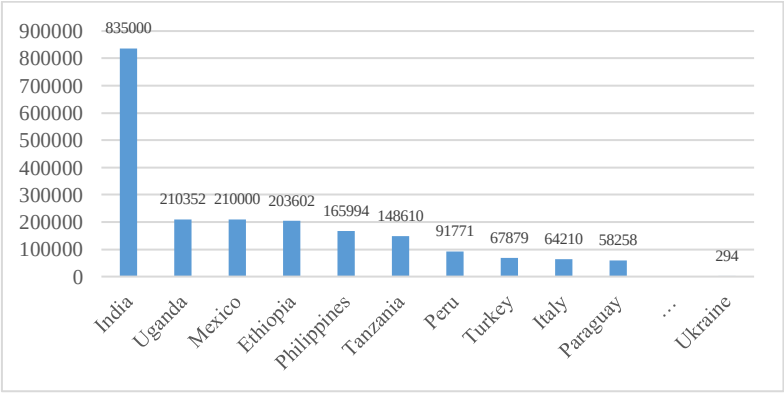

Fig. 1.18. Countries with the largest number of producers of organic products

It is worth noting that by the number of per capita products, European countries are significantly ahead of everyone in the world (Fig. 1.19). Mostly, organic products are consumed in Switzerland (EUR 274.26 / person), Denmark (EUR 227.42 / person) and

Sweden (EUR 197.34 / person), and the smallest - in Italy (EUR 43.58 / person).)

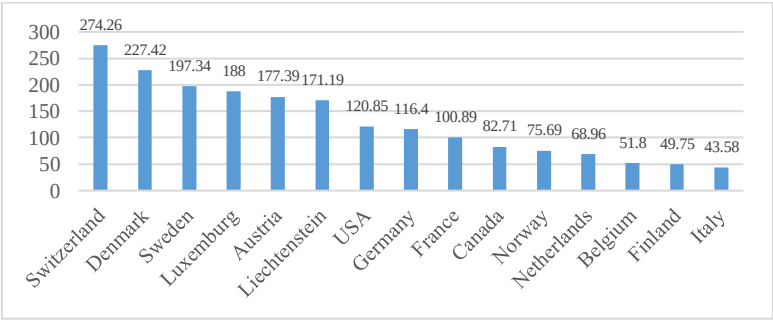

Fig. 1.19. Consumption of organic products per capita in countries of the world, euro / person

The system of certification institutes in the EU is public-private. Its essence is reduced to the fact that state bodies carry out accreditation of private certification bodies and oversee their activities. The last control the operators engaged in organic production and certify their products in accordance with the legislation of the European Union. The International Federation of Agriculture (IFOAM) is the leading organization that forms the basic international standards for the organization of production and processing, as well as accrediting certification bodies. Its standards contribute to the coherence of national legislation in this area, eliminating the barriers associated with export-import of environmentally net products.The experience of foreign countries points to the special importance of the system of certification of organic products in the process of formation of the organic food market. In each EU country, the certification system is the third independent party. It carries out the certification and control of production separately from operators of the market of products of organic origin, involved in organic production. Currently, in Ukraine, the system of certification bodies in the field of production and processing of organic products is practically absent, with the exception of several disparate organizations. Namely: BIOLan Ukraine Association and Organic Standard Ltd.

Consequently, the development of organic production in the world and in the EU is taking place in the direction of specialization and expansion of the assortment. Also, the rapid growth of demand for ecological and organic products and services confirms the prospect of further development of organic plant growing, livestock farming, aquaculture, wildlife harvesting and beekeeping, etc.

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1.3. Directions of organic production support at the local and state levels

Currently, the basic ways of organic production development have already been formed in the world's countries:

- sufficiently large-scale investment-backed agricultural organic production (USA);
- small-scale agricultural or other organic production with low investment security, export orientation and high social value of such activities (Africa);
- small-, medium-sized agricultural and other organic production under conditions of significant financial support of the producer by the state institutions (the countries of Europe, first of all the EU);
- predominantly organic livestock farming on the grazing system (Oceania and Australia);
- mixed forms, determined by export opportunities, domestic demand (in some countries - the demand of tourists) - Ukraine.

It is with the export attractiveness of international markets for organic products related prospects for the development of organic production in the country. Ukraine has a real opportunity to provide healthy products not only to the domestic market, but also to occupy relevant niches in foreign markets.

Due to the low solvency of consumers and non-formed internal market, the organic sector remains export-oriented. Selling own products abroad is the dream of any farmer, so many organic farms are immediately created with the export model of sales. On the one hand, it is the earnings of the currency, which has tripled in Ukraine over the past three years. On the other hand, access to an ever-expanding market makes possible to increase the volumes of organic production and increase export potential. Already in the world the demand for organic raw materials exceeds the supply.

In the EU countries, there are limited opportunities for producing the environmentally net products despite the active expansion of the organic products market. First of all, it is because of the lack of free, undistributed or non-traditional agricultural land. Secondly, the limitation criterion is relatively poor soils for which intensive technologies have been used for a long time.

Among the countries of Europe, the largest organic farming area is Spain. As of today, organic produce is cultivated in Spain at an area of 2 million hectares. Italy, where the total organic area is 1.7 million hectares, is also the leading position in this area in Europe. The third place is France - 1.5 million hectares, followed by Germany with an index of 1.1 million hectares and Austria - 571 thousand hectares. It should be noted that over the past 5 years, the area under organic production in Europe has increased by almost 2 million hectares, and the number of registered organic producers at the end of 2016 reached a level of 295.6 thousand UAH [19].

Consequently, the development of organic production depends on the availability of a state system of its support. For example, in the Rivne region to support farms planning to work in the field of organic substances within the next 5 years, the project program is to allocate from the regional budget about 226 thousand UAH annually [20].

Adoption and implementation of similar regional support programs for the organic sector in the transboundary regions of Ukraine and Belarus can become an additional impetus for the further development of organic movement in the whole of Ukraine. Most regions receive informational, educational and financial support for organic production, including berry growing, as part of agribusiness development programs (Lviv, Volyn, Transcarpathian, Ivano-Frankivsk, Zhytomyr, Khmelnytskyi, Chernivtsi, Chernigiv, Sumy, Poltava, Cherkassy, Kropyvnytskyi, Odesa). Three regions are expected to support, as they are included in the agro-industrial development programs projects, in particular in Rivne (Table 1.10). In 8 regions there are no state support, in particular, in Kyiv, Kharkiv, Dnipropetrovsk and others regions.

In Rivne region, for the organic production development, the main funds of the regional budget are directed to cover the costs associated with certification (for 6 farms within 120 thousand UAH), compensation for measures on agrochemical certification of land (up to 20 farms within 66 thousand UAH) and educational and information-consulting services (200 farms within 40 thousand UAH).

Table 1.10

Support for the development of organic production for 2018-2022

The direction of funds of the regional budget	Recipients of funds	The amount of the financial support	Expected volumes	The annual need for funds from the regional budget, ths. UAH.
Support for the development of organic production for 2018 - 2022 years				
Compensation for expenses incurred by a business entity (agricultural producer) for the certification of organic production and processing	business entities that have received a certificate of organic production and processing	in the amount of actual expenses, but not more than 30 thousand UAH. per business entity	6 business entities	120
Compensation for expenses incurred by a business entity that goes into organic production associated with the implementation of measures for the agrochemical certification of agricultural land	business entities that transition to organic production	in the amount of actual expenses, but not more than 3300 UAH. for a plot of up to 30 hectares	20 business entities	66
Promotion of the development of organic production, informational and consulting support of business entities for the production of organic products	organizers of events - certification bodies of products, public organizations in the field of organic production	conducting seminars, studying experiences, preparing brochures, booklets	200 business entities	40

The proposed system of measures for the period 2018-2022 will not solve the problem of the development of organic production in the region, but will give an opportunity to attract the

attention of agricultural enterprises, farmers, processors to this area. In addition, it is planned to attract financial resources in the form of international assistance and grant programs for the development of organic production, in particular, in berry growing. In particular, in 2018, the EU technical assistance project «Formation of an entrepreneurial environment for the production of organic berries in the transboundary region of Ukraine and Belarus» is being implemented in Rivne region, which aims at creating an educational, business, entrepreneurial space for the development of organic berry growing.

In Zhytomyr region it is planning to provide the financial support to farms in the organic production sphere at the expense of bank own credit resources and other financial institutions as a result of their activation under the programs of micro-lending. In addition, funds will be invested in the form of international assistance and grant programs. Thus, the project «German-Ukrainian Cooperation in the Field of Organic Agriculture» is being implemented on the basis of Zhytomyr National Agroecological University. The project is funded through a bilateral program of cooperation between the Federal Ministry of Food and Agriculture of Germany and aims to improve the expertise of technical and managerial staff in the field of organic farming (Table 1.11).

Table 1.11

Development of organic production in Zhytomyr region [21]

Priority tasks	Development of organic production
1	2
List of program activities	Financial-credit and investment support – providing on a competitive basis financial support to business entities in the field of organic production to partially compensate for their costs for certification and procurement of seed material – informational support for the organic production development – ensuring a high level of awareness of the population, commodity producers, state authorities and local self-government regarding the development of organic production, taking into account the specifics of the region; – creation and promotion of a special WEB-site, which will cover the state of development of organic production in the region;

continuation of tabl.1.11

1	2					
	– issue and distribution of information materials on the benefits of organic production, technologies for the production of organic products; – regular fairs and exhibitions of organic produce; – development and promotion of the regional brand of organic produce; Formation of infrastructure supporting the development of organic production – creation of the Polissia Center for Organic Production on the basis of Zhytomyr National Agroecological University; – creation and operation of a regional certification body; – creation of a regional network of trading facilities in which products will be sold under the regional brand of organic products (Polissya Organic); – creation of the Polissya Regional Laboratory, which will allow conducting a full range of analyzes for assessing the soil fertility, quality of products and drinking water; Conducting the scientific research and qualification improvement for the sphere of organic production – conducting research on the development of technologies for the cultivation and processing of certain types of products, natural organic growth stimulators of plants, biological preparations and methods for controlling pests, diseases of plants and animals adapted to local conditions; – development and introduction of special training courses on organic production in the educational institutions of the region, training courses for workers in the agrarian sector; – providing trainings and advices to agricultural producers, in particular farmers, on the organization of organic production, certification rules (round tables, forums, seminars, conferences, regular preparatory courses, including outbound					
Deadline	2016-2020					
Performers	Management of APR of the RSA, RSA, agriculture enterprise (by agreement)					
Sources of funding	34,695	2016	2017	2018	2019	2020
Regional budget	3,695	0,1	0,095	-	1,5	2,0
Non-budget sources	31,0	7,0	6,0	6,0	6,0	6,0
Expected results	Increase in the number of business entities and volumes of production of organic agricultural products					

In Volyn, at programs of support for organic producers, entrepreneurs will be compensated for 50% of the costs for organic production certification (Table 1.12).

Table 1.12

Organic producers' support programs in the Volyn region [22]

Priority tasks	Development of organic production					
List of program activities	partial reimbursement of the cost of certification services to organic producers					
Deadline	2016 – 2020					
Performers	Department of agro-industrial development of regional administration, district state administrations, structural subdivisions on agro-industrial complexes of district state administrations					
Sources of financing, ths. UAH	500	2016	2017	2018	2019	2020
		100	100	100	100	100
Regional budget	250	50	50	50	50	50
Local budget	250	50	50	50	50	50
Expected results	development of organic production in the region.					

In the Poltava region, the agro-industrial development program includes measures aimed at supporting not only the production of organic products in the region, but also increasing its consumption (Table 1.13).

Organic production is consistent with the conservation and reproduction of soil fertility. Therefore, if the region does not envisage measures for the development of organic production, farms may receive financial assistance in the framework of the implementation of relevant targeted programs. Thus, in the Lviv region, financial support is provided in the form of subsidies to the area of land, which will be used for conservation and restoration of soil fertility. Funds are provided to business entities of the agro-industrial complex, individual entrepreneurs, agricultural cooperatives in the form of subsidies to the area of land on which measures for the conservation and reproduction of soil fertility will be carried out, provided in the following areas:

- deoxidation of soils (liming) by introducing the limestone meliorants in the amount of up to UAH 500 per hectare;

- enrichment of soils with biological nitrogen after use of inoculants of nitrogen-fixing microorganisms in the amount of up to 160 UAH per hectare;

Table 1.13

Organic producers' support programs in the Poltava region [23]

Priority tasks	Development of organic production					
List of program activities	– compensation in the amount of 100% of expenses in connection with the conduct and confirmation of conformity of production of organic products (raw materials) and obtaining the certificate, including during the transitional period, regardless of types of agricultural activity and types of processing products; – compensation for 40% of the cost of supplied organic products to preschool, school, medical and social institutions of the region on the terms of public procurement. Compensation is provided on condition of co-financing from local budgets in the amount of not less than 10% of the cost of delivered products.					
Deadline	2016 – 2020					
Performers	Department of Agro-Industrial Development of Poltava Regional State Administration					
Sources of financing, ths. UAH	6,2	2016	2017	2018	2019	2020
Regional budget	3,7	0,7	0,45	0,85	0,85	0,85
Local budget	2,5	0,5	0,5	0,5	0,5	0,5
Expected results	development of organic production in the region					

- sederation of soils after sowing crops in the amount of up to 350 UAH per hectare.

In Kropyvnytskyi region state administration, it is planned to provide 12 million UAH to finance the mentioned areas from the regional budget starting from 2018, 2 million UAH every year.

Financial support to economic entities in the field of agriculture for individuals in the form of subsidies to the area of land on which measures will be taken to preserve and reproduce the soil fertility. The support will be provided by the Program participants to the winners of a competition in a number of areas, among which are the costs associated with measures aimed at ensuring organic farming [24].

After analyzing information on support for organic farming, it has been proved that it is relevant and not sufficient in most region of the state.

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2. DEVELOPMENT' BASIS OF GEO-MANAGEMENT IN ORGANIC PRODUCTION

2.1. Geo-management based on the methodology of environmental audit and certification

Formation of geo-management and integrated management system for the implementation of national concepts, programs of economically feasible and socio-ecologically balanced development includes: implementation of legislative and regulatory documents as elements of national strategies of innovative development of the country; extending the scope of responsibility of all environmental actors, including government bodies, producers and consumers; reform and improvement of existing economic instruments of nature management and environmental protection activities; involvement of private capital in environmental activities; creation of appropriate investment, tax, credit conditions for its realization [25].

Problems of balancing the socio-ecological and economic development were studied by O. Vrublevska, M. Hazuda, Ya. Henyk, L. Hryniv, M. Holubets, A.Holovko, M. Dolishnii, B. Danylyshyn, I. Dubovich, P. Zhuk, L. Zahvoiska, V. Kravtsiv, V. Lavnyi, V. Miklovda, Ye.Mishenin, O.Pavlishchuk, I. Solovii, I. Syniakevych, Yu. Stadnytskyi, P. Skrypchuk, Yu. Tunytsia, Ye. Khlobystov, M. Cherniavskyi,P. Angelstam, M. Elbakidze, M. Nijnik, W. Kettonandothers [26-37].

Fundamental, theoretical, methodological and applied aspects of research on these problems of institutional development of economic and land relations in the agricultural sector of the economy are covered in the works of H. Barns, T. Veblen, U. Hamilton, A. Holichynkov, J. Jonson, T. Ehhertson, F. Zhakoba, H. Kleiner, J. Commons, Yu. Lopatynskyi, U. Mitchel, V. Nil, D. Nort, N. Panin, K. Panunzio, R. Radaiev, V. Yakubenko and others.

Much attention to these topics is paid domestic scientists. It is highlighted in works of D. Bambindra, M. Bohira, M. Boiko, V. Halushka, D. Hnatkovych, V. Horlachuk, O. Hutorov, A. Danylenko, D. Dobriak, Y. Dorosh, O. Drebot, V. Druhak,

I. Koshkalda, P. Kulynych, M. Lykhohruda, A. Martyn, V. Mesel-Veseliak, A. Miroshnychenko, L. Novakovskyi, P. Sabluk, P. Skrypchuk, A. Sokhnych, M. Stupen, A. Tretiak, O. Ulianchenko, M. Fedorov, M. Khvesyk, O. Khodakivska, P. Cherniaha, O. Shpykuliak, O. Shpychak, A. Yurchenko, V. Yurchyshyn and others [14-25].

Theoretical and methodological researches of O. Balatskyi, L. Melnyk, L.Gryniv and other scholars confirm the need for further methodological substantiation of the aspects of agrarian and environmental economics in order to study and evaluate, use, preserve, and environmental certification of natural capital [50-54].

Nowadays there is the development of interdisciplinary knowledge, interpenetration (for example, nano technology, security, information technologies, environmental standardization and certification), the grouping of sciences is not by object and object, but by the problems and the most relevant causes of their occurrence, functioning and provisions that improvement of any subsystem should not occur due to deterioration of the state of other subsystems. The introduction of an innovation strategy for Ukraine's development, harmonization of the life of the society and the environment, and the preservation of natural capital requires methodological improvement of existing systems of methodological support and development of components of geo-management in the agrarian sector of the economy, in particular.

The value of such development directions of geo-management in its single complex, that gives a synergistic effect for the economy and whole society to take into account: direct value and quality of natural capital in general and each resource in particular; indirect cost as a set of conditions and state of the environment and the economy of the region (state) in general (quality of the environment for life support of the population); the cost of a delayed alternative - the potential benefits of future certification requirements (certified agricultural products, management systems, agricultural land and forests, natural and economic systems, as this information becomes more and more important in the global society and economy).

In assessing the objects of the environment, the uncontested truth is the consideration of natural factors in combination with the quality of land, economic conditions and their informational support as the object of management in economic relations. The combination of natural factors used in production to one degree or another yields income and can act in the form of resources. According to L. Melnyk, the consumer value of natural factors is determined by their ability to meet the needs of a person or society and perform certain functions, that is, to be a commodity [52]. Since mainly all products and services are subject to certification, then the certification procedures for products and services may be used for environment [53, 54]. A characteristic feature of the implementation of natural factors is direct (the object of purchase and sale is directly the factor environment: land resources, wildlife, forests) and their implementation is indirect (occur when the object of sale is not the natural factor itself, but also the functions that it performs and implements which affects the processes of selling other items or services, such as resorts). In such cases, the following are particularly valuable: information on real processes in socio-ecological and economic systems for a well-balanced agrarian nature and hence a competitive processing industry, which is 100% dependent on the life cycle of products. The impossibility of comprehensive use of market measures to regulate economic activity in relation to natural capital does not rule out the use of environmental certification because such a procedure has a set of advantages, such as those mentioned in [53, 54].

Therefore, such a synergistic system (web resources, GIS-technologies, online resources from the vegetative index, metrological support, environmental standardization and certification) is not a simple set of interrelated sciences that form a certain integrity, but a set of coherent, informational and historical processes that are developing. Consequently, such sciences and activities in the 21st century are the result of globalization, informatization of the world and arose as a result of an increase in anthropogenic influence on the environment, the deterioration of its quality and the overall social development of civilization.

At the same time, the need for the development of metrological support as a highly technological industry that will provide a comprehensive ecological and economic effect, environmental standardization and certification is also confirmed by the number of now known chemicals of which more than 10 million. Approximately 70 thousand of them are often used, about a thousand new chemicals from 'is on the market annually. For the year the world produces 300-400 million tons of harmful waste [55]. It follows that taking into account even existing maximum permissible concentration, temporarily permissible levels of influence and other norms requires considerable expenses, namely: availability of metrological support, time, methods of conducting measurements, etc. It should be noted that not all substances have norms for their safe use, not to mention the possible variants of their joint (amplifying) action. Therefore, metrology and information support on the basis of NDVI indices, ground methods of bioindication are simple, modern and competitive methods of management in the agrarian economy and environmental management in general.

So, in particular, ecological certification, helps to identify the causes and prevent the emergence of problems, solve them with the least cost in the shortest possible time due to system information about the objects under study through the environmental audit procedure. The conceptual framework for the emergence, establishment and development of environmental audits and certification in agrosphere and environmental areas takes place in the context of system management and planning of complex ecological and economic systems: sustainable development, adaptive management, green economy, information economy, ecological management, system approach, public control, strategic environmental assessment, collective approach and socio-environmental responsibility, which require the development of conceptual, methodological theoretically, law the seller of normative provisions, information provision of all areas of activity to minimize risks.

It is now economically feasible, ecologically sound, to introduce quality management of environment and their tools:

environmental auditing, certification and standardization; web resources, provisions of the information economy, management systems including integrated and their certification. Environmental certification in Ukraine is not documented by law - there is no Ukrainian law.

The internationalization of the economies of the countries is determined by the scientific and technological development of world production and the spread of innovation. There is now a supranational information space that needs information about economic, environmental, social and other realities in particular regarding administrative formations (towns, regions, regions, regions), complex natural and human-made complexes, and so on.

The development of the theoretical and practical principles of environmental audit and certification as a holistic and systematic methodology of ecological and economic appraisal of the agrosphere and environment territories in the context of the green economy and the fulfillment of the requirements of world standards and the EuroNorm should be directed towards reflecting the unity of the indicators necessary for the economy, social sphere, population health, etc. Conducting the environmental audits in the agro-sphere, territories, environmental sites, assessing its quality for certification purposes is necessary to provide an informative database of regions, their natural and resource potential, and separate territories, which are the primary source for developing the options for innovation and investment development.

The objectives of environmental audit and certification are: systematic and ecological analysis of information on the status of environment facilities and in general of natural capital for the purpose of its certification in order to ensure the harmonization and effective functioning of environmental management systems and self-government bodies; the development of independent, reliable information on territorial-economic objects and administrative entities in general; effective solution of existing environmental problems, as well as prevention of their occurrence in the future; the implementation of the ecological imperative of the development of the national economy, the formation of a socially oriented market economy, which will guarantee citizens high quality of life support

and environmentally safe environment; forecasting changes in the environment at different development options and optimizing agrarian nature use; the transition to a noosphere model of interaction between society and nature; creating a positive image of the regions and providing information to attract investment.

Certification of the quality of objects and territories of the environment as a holistic methodology can be used for the development and harmonization of legislative and regulatory documents, ensuring the safety of consumers for the quality of food and industrial products, living conditions, and guaranteeing the provision of the Constitution of Ukraine regarding safe environment for each citizen of the state.

This tendency is due to ecologization of virtually all spheres of society's life, the globalization of world economic processes, the formation and development of environmental management, ecological and information economics, the theory and practice of sustainable development. These tendencies determine the relevance of the development of a new ecological and economic concept for the development of environmental audits and certification, the realization of which in practice by legislative and executive structures will promote the ecologization of the branches of the national economy, revision and improvement of methodologies of environmental management, harmonization of legislative and regulatory documents in accordance with the requirements of the International Organization for standardization (ISO), EU, etc.

The continuation of economic reforms in our country and the course on European integration, innovation and investment development of the economy in general and its individual components implies observance of ecologically-oriented economic development. Decisions of world summits and conferences confirm the priority of developing the criteria for assessing the quality of environment in the integral concept of product quality management, service and environment. Such trends are reflected in the ISO and European directives, as geo-management is an economically viable regulator in virtually all areas of the economy and the protection of environment.

The introduction of such scientific developments has a complex effect, which corresponds to modern trends in economics, ecology, social sphere. In particular, economic - investment attractiveness, economic preferences, growth of production in the ecological-economic specialization of agricultural enterprises or the district. Ecological - methods of stabilizing the quality of environment in general and land resources in particular, the ecologization of all spheres of human life. Social - harmonization of economic conditions of agricultural production and ecological characteristics of the quality of land resources and, as a result, positive impact on the social sphere of society in the context of modern values of the world community.

Hence, environmental audit and certification in the agro-industry, territories will use the benefits of all scientific developments and in particular: the system-ecological approach to solving sustainable development issues; an innovative model of development with ecological-economic, social substantiation; development of the theory and practice of environmental management and web technologies; taking into account environmental requirements for products in virtually all spheres of production and consumption.

Therefore, introduction of environmental audits and certification is assigned to the state's urgent tasks in the following areas: functioning of the economic complex; integration of Ukraine into the European Union; international cooperation in the field of environment protection. Thus, the system of environmental certification aims to ensure protection not only of consumers from poor-quality products, but also the environment itself from the harmful effects of both these products and destructive human activities.

Environmental audit and certification of environment quality are formed as a holistic methodology on the basis of which it is rational to create legislative and regulatory documents, methods of quality certification in the agro-sphere and environment facilities, including administrative units (district) and branches of economy. That is, ecological certification extends to more and more environment facilities (land and water resources, biosphere

changes, biodiversity, etc.), and in the long run, the system-ecological approach (requirements of the standards of the DSTU series ISO 14000 «Environmental Management») will apply more and more agrosphere, whole landscapes, territories, administrative units, etc. As well as certification of products, services, management systems and territories is voluntary, and: creates investment-innovation attractiveness; will be at the level of the agreed world standards; will contribute to the formation of an information environment on the ecological, economic, social status of the territory (administrative unit); combines state and market mechanisms in the economy; purpose, procedure, methods of ecological certification are logically subordinated to the methodological principles of quality of life support; combines regulators of stimulation, compensation and coercion.

Methodology, concept, legislative and regulatory documents, and methods allow to certify ecological safety of territories, including, for example, agricultural lands for the production of organic products, production technologies, the implementation of the requirements of international standards for environmental safety and the quality of products or services, which is a prerequisite the exit of enterprises into international markets and gaining the competitiveness of the country as a whole.

The introduction of environmental audits and certification as effective tools for environmental management is also conditioned by the presence and development of information and communication technologies in the country that create effects of the first order (the growth of the market of information and communication technologies, new activities, increase of investments in such technologies), the second (development of new financial markets, the emergence of new types of efficiency) and third order (changes in the context of the «green» economy). Stages of development of territorial economic systems (the state or its regions) are presented in [56].

Therefore, ecological audit and further certification of territorial economic systems in modern conditions should be considered as a spatial assessment of combinations that cover all existing interactions of natural, social and economic components,

united by a unity of certain activities, for example, agrosphere and (or) territories and objectives of diversified development. Such an assessment helps to take into account natural capital and its trends in a single system of performance (gross regional product), the functioning of the economic system in our time only through information and communication platforms, web resource management and the «green» economy.

Therefore, in our opinion, the ecological-economic, social indicators of the functioning of administrative units (regions, territorial and economic systems) can be estimated as - the costs of natural capital for the functioning of territorial economic systems; II - economic return from functioning of territorial-economic systems.

$$P = GRP - LNK \qquad (2.1)$$

where P - functioning indicator; GRP – a gross regional product; LNK - loss of natural capital, (losses caused by natural capital).

In some cases, for example, improving soil quality, reducing soil contamination by radionuclides, reforestation, fish breeding to the value of the GRP should be added to the cost of improving the quality of the soil, etc.

The main tasks of the assessment of natural capital are specified depending on the types of resources and the directions of their use: due to the difference in the quality of natural resources (their placement) belonging to different natural resources, implementation of differentiation of payment for the use of natural resources is necessary; determination of the efficiency of the use of natural resources is especially important when this resource is out of circulation and it is necessary to estimate the losses of society; economic assessment of natural capital for planning, development of complex scientific and technical, economic and social programs; economic evaluation of natural resources is required for inventories of natural resources; the consideration of natural resources in the composition of the social product, national income, real and potential national wealth of the country is important because, in modern conditions, deterioration of the quality of the environment, which will require significant costs in the future; evaluation of resources in order to compare different types of them among

themselves, which makes it possible to form natural and territorial complexes, to determine their optimal branch structure, to calculate their natural resource potential; estimation of natural resources in transactions (purchase, sale of natural objects, etc.).

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2.2. Legislative and regulatory preconditions for geo-management of land resources

The Ukrainian state is undergoing a period of social reforms, economic transformations, harmonization of legislative and regulatory base without which it is impossible to increase the competitiveness of agricultural products and food products, both within the state and on external markets. Such processes take place all over the world, and therefore economic relations are characterized by the development of globalization processes. Globalization, first of all, affects the institutional environment, laws, standards and the biggest changes are taking place in agrarian production, as land resources are an extremely important resource for food production and bioenergy. Globalization is the result of the development of world markets for a variety of goods, services, capital, labor, and information. Highly developed countries, using economic mechanisms, first of all, the WTO, expand the markets for the sale of their own products to re-engage participants, mostly exploiting their natural resources. Therefore, it is important to uphold national interests in all fields of activity and, above all, to a balanced market relation with respect to land resources. For a decent position in international markets and survival in the period of globalization, one must take into account the objective conditions of domination post industrial countries in the agrarian market, where there is a high efficiency of using 2 main resources: labor and land (i.e the value of labor productivity and landlord). The last indicator is still far behind the importance of the leaders of the agrarian market, but tends to increase. However, this increase is mainly due to agricultural enterprises, but farms considerably slow down the effect of using land resources. For example, indicators of rural development farms with project calculations on the basis of further intensification of agrarian production of Ukraine for the period 2015-2030 (Table 2.1).

One of the factors of the internal and external environment of Ukraine is the improvement of modern land management and land use, making use of innovative and informational resources, which are usually combined into a single resource - web platforms. The effectiveness of land use management is determined by the degree of implementation of government functions through the following priority areas, which are given in (Table 2.2), taking into account author's development [1].

Table 2.1

Dynamics of gross production in Ukraine per 100 hectares of agricultural land, thousand UAH, [1]

Year	Products farm				Crop Production				Livestock products			
	all categories of households	including:			all categories of households	including:			all categories of households	including:		
		agricultural enterprise	farms	farmstead		agricultural enterprise	farms	farmstead		agricultural enterprise	farms	farmstead
1990	351	260	-	1703	160	128	-	636	191	132	-	1067
1999	176	82	60	709	88	50	51	301	88	32	9	408
2005	249	157	98	409	145	96	89	224	104	61	9	185
2008	284	246	149	358	177	158	132	209	107	88	17	149
2009	279	241	126	360	168	142	109	211	111	98	17	149
2015	388	355	199	475	217	180	165	272	171	175	34	203
2020	513	511	301	573	283	243	243	338	230	268	58	235
2030	580	596	335	632	314	274	262	373	266	322	73	295

Qualitative and quantitative indicators of agricultural production depend on the degree of development of agro-industrial production [1].

At the present stage of development of agriculture in Ukraine, there should be implemented an integrated approach to agricultural production based on innovations taking into account

Table 2.2

Realization directions of innovative management functions in agro-industrial production of Ukraine [57]

Regulation through	Directions of functional management
1	2
1.Modern management of agro-industrial production	1. State policy, interest and regulation. 2. Information and legal support 3. Modern infrastructure 4. Web resources (geo-management)
2. Organization and planning of land management and land use	1. The rates of land tax and the amount of land payments. 2. Land security measures. 3. Budget support for land users. 4. Standards for the justification of economic regulators of the land management system
3.3. Realization of land use	1. Online mode informatization. 2. Monitoring in the resource and environmental aspects. 3. The balance of socio-economic interests of landowners and land users.
4. Economic stimulation of land users and landowners	1. Responsibility for non-rational use of land under the conditions of state online monitoring. 2. Influence on economic, social interests of landowners and land users through economic stimulation. 3. Land payments (land tax, lease). 4. Penalties for violation of the law.
5. Monitoring of land conditions, land use efficiency	1.Unified platform for the use, monitoring, consulting and taxation of landowners and land users. 2. Monitoring of land conditions and land use efficiency. 3. Regulation of measures for the rational use and protection of land.
6. Modern information provision on the basis of web resource	1. Sufficient information for landowners and land users on one portal (platform).

economic, energy, logistical and environmental conditions, supplemented by information support and services of online web resources. For Ukraine it is typical to be «embraced» by the internal cardinal reforms, and the processes of globalization. Therefore, our agricultural production requires in-depth informatization and introduction of innovations земельные отношениясuch as geo-management in agrarian production.

The problems of legal support of land use and reforms in particular, are devoted to scientists who define the policy of regulating land relations. In the writings of A. Danilenko, M. Sydorenko, L. Novakovskyi, D. Dobriak, A. Tretyak. I.Tomich, M.Hvesyk and I.Myhasyuk, the current legal environment of land use are analyzed, indicated its shortcomings, identified the reserves of improvement, and also proposed ways to eliminate those manifestations of legal nihilism that promote irrational and exhausting use of land-resource potential. In the field of land relations, more than 24 legislative acts were prepared, which basically provided the necessary legal and regulatory framework.

Land resources are an utmost important part of national wealth, and redistribution should not take place under the influence of exclusively market mechanism. Taking this into account, the state is forced to form relevant institutions that will implement its policy through the use of both direct and indirect levers of influence on land users. The question of the formation of a mobile system of state management of land resources was reflected in the writings of A. Danylenko, B. Danylyshyn, D., Dobryak, L. Novakovskyi, P. Sabluk, M. Sydorenko, V. Krivova, M. Stephen, J. Kulakovskyi, I. Karakash, M. Shulga, G. Sharoy and I. Manko [1-8].

According to P. Sabluk, it will be impossible to eliminate the negative phenomena, if the function of controlling the sales of land is entrusted to State Committee for Land Resources, since it manages the state land ownership fund, and has the right to buy land and maintain the price policy of land, and it can make it a monopolist in the land market [1]. The land management system requires large-scale modernization and revision of certain basic principles in order to eliminate a number of negative phenomena associated with the redistribution of land ownership. One of the

solutions to the crisis in the land management system is the development of land management.

The main sources of land legislation are:

The Constitution of Ukraine - the organic law of the country, which has the higher legal force, and its norms are legal norms of direct action. The fundamentally important norm of the Constitution is that the land is under the special attention of the state, and the use of land should not impair its natural fertility.

The Land Code of Ukraine, which is a general industry act, forms the basis of the land legislation. The Land Code of Ukraine regulates all land relations regarding the use of reproduction and protection of all categories of land.

Legislative acts and legal documents of the system of land law and others [9-21].

Particularly important for the development of the land management system are developed norms of soil protection agriculture. They contain indicators of fertility losses, norms of all technological cycles, values of MAC substances, tools and mechanisms for preserving the quality of land. However, information technologies and web resources that can be combined with one term of geo-management using land resources are becoming relevant today and in the future.

At this stage of the land reform, which, with the reform of ownership to a large extent, becomes a land registry cadastre reform, it is necessary to consider the land as a limited, degradable natural resource, without rational use.

Land legislation requires a profoundly scientifically grounded rethinking, built on the state ecological policy of Ukraine and the strategic course of the state on state industrialization, export of finished products and state policy on preserving the quality of land and rural settlements. After all, the state policy of Ukraine can only be effective when it is formed from systems of branched perfect policies (ecological, agrarian, land, water, export, etc.).

In this regard, it will be fair if the formation of land legislation will be carried out in conjunction with the ecological code of Ukraine, the formation of the National Environmental Fund, the system of environmental audit and insurance, state

environmental monitoring, interactive web sites for consulting services and promotion of products etc. This will help resolve the issue of the structure of land law in Ukraine, as the existing legislative provisions are scattered among many other legislative acts and normative documents, and most of them act as recommendatory. It should take into account the following main legal institutions: transfer and acquisition of land; control and monitoring; state land cadastre; land management; responsibility for violation of land legislation; lease of land; seizure and redemption of land; ownership of land; land use rights; state regulation of land relations and management in the field of use and protection of land; legal regulation of land use; legal protection of land; compensation for losses to land owners and land users, etc.

The analysis of the structure of the existing land legislation made it possible to conclude that the lack of legislation in the field of responsibility for exhausting land use remains a serious problem, due in the first place to the lack of consistency and coherence in the legislative activity of the Supreme Council of Ukraine, a comprehensive approach to legislative regulation; lack of approbation of legislative development in the land sector; by agreeing to the provisions of the development with all levels of the land management system, as well as involving a wide range of land owners and land users in discussing these issues. A set of legal norms that represent the system, which includes the conceptual and organizational provisions of the land reform, legislative and regulatory acts, which have been created over a short period of time, require significant updating, substantive improvement and legal deepening.

The first step towards solving this range of tasks is the adoption of the Law «On Land Management», which defines the key principles, strategy, tactics, functions, methods, mechanisms, forms and structures of land resources management in Ukraine that can ensure the implementation of land policy of the state and the organization of environmentally sound land use. For the effective existence of a land management system, it is necessary to expand the base of legislative acts and regulatory documents.

An important step towards the effective development of the land management system is the process of large-scale inventorization of land of all categories by purpose, regardless of the ownership of land. The last have a fundamental importance, since in a market economy full information on their quantitative and qualitative status will solve the existing problems of economic regulation of land relations. Especially actual is the introduction on new methodological basis- the repeated soil survey (the last survey took place almost 40 years ago). On the basis of land inventory and soil survey materials, it is necessary to develop for each landowner or land user a plan for the conservation and reproduction of soil fertility, which should be controlled by the state land monitoring system on the basis of new cartographic and analytical materials and with connection to web resources and platforms.

In the conditions of the active development of globalization processes that create conditions for the transnationalization of agrarian production and form the single world food market, the efforts of the national commodity producer should be concentrated on the foundation of competitiveness through ensuring the conditions for the sustainability of economic activity in the long-term. In this case, the development strategy is based on the formation of the most safe conditions of activity using synergistic action of resource supply of production. The use of land resources in the formation of an informational agrarian economy should be based on:

- informatization and open access to cartographic, agrochemical, legislative and normative documents on web-services;
- ensuring environmental safety through the formation of economic conditions, in which the proper conditions for the preservation and development of biocenoses are created;
- provision of economic conditions and appropriate legal framework;
- online access to cadastral and GIS maps, «e-calculators» of the efficiency of agrarian production;
- legislative introduction of a system of scientifically grounded crop rotation, which will promote, in the absence of funds

for protection and restoration of land to increase productivity of land use. In this regard, it is necessary to provide strict reporting and statistical accounting to the state about the development of crop rotation, legally oblige economic entities to conduct records «Field Story», passports, land plots, etc.;

- availability of algorithms for preservation of land fertility in the National Program of Land Conservation in Ukraine, etc.

Another methodological issue is the transition to a market economy, which has led to fundamental changes in the forms and methods of public administration in the use and protection of land resources and its content. During this time, economic methods of influence on entities of land legislation became widely used, as the provision of tax and credit benefits, allocation of state or local budget, exemption from payment for land compensation from the budget reduction in income landowners and land users as a result of temporary conservation degraded and unproductive lands, etc.

In the context of the widespread implementation of land reform, the role of land management in reformed agricultural enterprises is growing. In particular, the Law of Ukraine «On Land Management» provides:

- drawing up plans of land use of newly created agricultural enterprises within village councils;

- work on inventory of land, renewal of soil and geo-botanical surveys of the territory of reformed agricultural enterprises;

- Identification of agricultural lands that are used irrationally by owners and land users and taking measures for their redistribution;

- consolidation of the reserve fund lands and lands of the reserve in order to ensure their effective use by leasing on a competitive basis;

- afforestation and conservation of degraded and unproductive agricultural lands;

- development of land management projects with agroecological justification of the territory of newly created agricultural enterprises;

- land borders with the establishment of boundaries in territories with a special mode of use (nature conservation, recreation and conservation).

Conducting the state land cadastre is one of the functions of state administration in the field of land use and land protection. Its value lies in the fact that it is a state information resource. Purpose of the state land cadastre is to provide the necessary information to public authorities and local governments, interested enterprises, institutions and organizations and citizens to regulate land relations, rational use and protection of land, determine the size of the land tax and the value of lands in the framework of natural resources, control over the use and protection of land, economic and environmental justification of business plans and land management projects [21].

During the community reform, the land market, changes in mechanisms and tools in the socio-economic area, strategic planning and environmental auditing of the territories are gaining in weight. These include:

- the purpose and the grounds for the development of strategies, land use plans and business organization;
- descriptive-analytical part - detailed in the document with geographic, historical, demographic, economic, social characteristics, in which the analysis and evaluation of the actual state and prospects of the region's development are carried out;
- landscape features of the relief, soil characteristics and hydrology, and in general the natural-resource potential;
- features of socio-economic development in the dynamics over the past 10 years;
- ecological situation in the region;
- living standards of the population and its business activity.
- a description of competitive advantages and limitations of perspective development of the region (SWOT-analysis);
- strategic goals and phases of action - a set of strategic goals and phased action plans to achieve all strategic and operational objectives with a detailed description of the activities, sources of financing;
- mechanisms for implementation of the strategic plan [22].

It is in the process of preparation, implementation of such strategies that it is expedient to use informational web resources that include GIS technologies, cartographic materials, a set of geographic and economic maps and schemes; cadastral maps of all kinds; special schemes and drawings; bioindication or vegetation indices for territories and individual objects thereof.

The development of legislation in economically developed countries of the world is now being pursued through agro-ecological programs, for example, in the European Union. The system of stimulation and financial encouragement of the ecological management of farming by farmers in the European Union originates from the adoption in 1992 of the special concept «Council of Regulation 2078/92 on agricultural production methods compatible with the requirements of environmental protection and management in rural areas.» According to this, a possibility arises of providing joint financial assistance to the European Union for programs that encourage the environmentally sound management of agriculture.

Reducing the use of pesticides in these countries is based mainly on technical solutions (for example, on the establishment of an integrated plant protection system). In addition, in some countries, the application of various economic instruments (for example, pesticide taxes) is practiced. In Denmark, for example, restrictions on the use of pesticides are stimulated by a 37% tax on pesticide retail prices. In particular, the upper level of payments that encourage farmers to participate voluntarily in agro-ecological schemes in accordance with the Concepts of Regulation 2078/92 and 746/92 is established on the basis of three criteria - costs; expected income; stimulant element (set at a level that does not exceed 20% of expected income). In this case, the Commission stipulates that the premium should be considered as compensation for the costs of providing the environmental public good, and not as a subsidy in its economic sense.

Within the limits of individual national and regional agro ecological programs, the size of the premium is fixed by the relevant agricultural ministries or local authorities. As a result, a rather complicated system of payment levels with significant

variations both between and within the EU states. The EU member states are also members of the Organization for Economic Cooperation and Development (OECD), within which there is a special program on pesticides. Since 1994 p. The OECD has started implementing the Pesticide Risk Reduction project, which aims to provide support to countries that are members of this organization to reduce risks.

The project covers three groups of activities: the collection information on risk mitigation measures conducted in different countries; the organization of working groups to which the state and others interested in reducing pesticide risk groups can address their issues to; developing risk assessment methodologies that assist the government in policy-making to reduce risk. For example, in Sweden in 1998, within the framework of this project, a voluntary company for the safe use of pesticides was conducted by farmers, as well as a program for determining the indices for assessing the level of pesticide risk reduction.

Agroecological programs and strategy implemented in Ukraine to reduce the environmental risk from the use of agrochemicals, on the one hand, comply with established regulations and rules for the use of pesticides and agrochemicals, taking into account their negative impact on human health and NPS, and, on the other hand, financial and technical encouragement of agricultural producers to reduce the use of agrochemicals and, accordingly, reduce environmental risk. Thus, it can be characterized as a compensatory and regulatory strategy to reduce environmental risk. The specific procedure for the use of pesticides and agrochemicals is determined by the state executive authorities in the field of safe circulation of pesticides and agrochemicals taking into account the phytosanitary, sanitary and environmental situation.

In the United States, there are programs that provide financial and technical incentives for farmers to reduce their environmental risk. The basis of the programs is an approach based on the awareness of farmers that the benefits from reducing the cost of chemicals and the resulting environmental benefits compensates for the risk of loss of crop.

One of the elements of geo-management is the landscape-biosphere models of land and nature use as elements of geo-management of territories.

Geoecological forecasting is called the development of representations about the natural complexes of the future and their changing conditions, including those caused by anthropogenic activity; This is a set of actions that make it possible to reflect on the state of the natural systems. The main task of geoecological management and forecasting is to assess the possible reaction of the NPS to direct or indirect human influence and to prevent adverse processes caused by the impacts of various types of nature management. The object of geoecological forecasting - natural systems, agroecosystems, landscapes and their territorial connections. It is necessary to study the changes in factors and sources of external influence. Geoecological forecasting consists of three blocks, which are combined with the intended purpose: natural-landscape (structure and natural potential of the landscape), socio-economic (anthropogenic influence and capacity) and a block of environmental problems and situations [23].

For example, the complex effect of renewable processes in the basins of small rivers requires unconventional approaches to the implementation of broad reclamation measures in each element of the landscape [24].

The basic principle of landscape-biosphere models consists in imposing on each element of the landscape the matrix of agrotechnical, engineering, reclamation and phytomelioration measures, taking into account the technogenic influence on the landscape. This does not complicate the problem, but, on the contrary, in each particular case, directs to the fulfillment of the specific, inherent precisely for this element of the landscape, technologies.

For example, despite the diversity of relief in the basins of small rivers, the following basic structural elements have been identified in Polissya: 1) land roots with average soil fertility indices; 2) low-yielding land - clay-sandy soils and boron terraces in natural biogeocoenoses in cultivation; 3) dried mineral and rubber (on peat) land; 4) marshes, drained and natural; 5) channels,

as well as the floodplain of small rivers (meadows); 6) surface waters - lakes, ponds, reservoirs (natural and artificial origin); 7) forests and afforestation.

Structural elements of the landscape of the Forest-Steppe, Northern and Central Steps include: 1) technological groups of erosion forms of relief: I - mostly flat lands with a slope of 30, II - lands with a slope of more than 30 and III - with a slope of more than 70; 2) girder-beam systems - land cultivation and natural phytocoenosis, settlements; 3) floodplains of rivers and meadows, mostly degraded and depleted in useful vegetation; 4) channels of small rivers, mostly polluted, cluttered and blackened; 5) ponds, lakes and reservoirs - with traces of eutrophication, sedimentation and pollution; 6) forests and forest belts, which in their mass need renewal and repair.

The technological block of environmental matrices consists of a set of reclamation and agronomic measures that are characteristic of all natural and climatic zones. They include:

1) selection of contours in nature and formation of landscape systems, cartographic material;

2) Improvement of the software and structure of sown areas, the regulation of natural lands and water objects. In the future, such services will be on an online platform for drafting technical documentation, business plans, system management, etc;

3) The organization of cultural works is an obligatory element for all forms of relief, which provides for differentiated cultivation of soil, as well as cultural works on sloping lands, in accordance with the program of contouring-reclamation organization of the territory. In terms of capital investments, this is the most time-consuming and voluminous work that takes the lion's share of total funding. Their execution is possible at high technical equipment with digging machine, hydraulic engineering and transport mechanisms, which will serve as a significant stimulus for the development of domestic industry;

4) Chemical melioration and biotechnology - in farming systems is the main factor of the deficit-free balance of humus, nutrients, maintenance of soil solution reaction on acidic, saline and salinizationed soils in optimal values for plant development;

5) Integrated protection of objects and reproduction of natural resources - is practically and mainly a new type of economic activity associated with the industry of biological methods of plant protection, combined with the use of savings, if necessary, artificial pesticides. Obviously, the fields will have to leave the natural vegetation striped for the breeding and maintenance of natural entomophagous. To the integrated protection of objects should be added the introduction of relic vegetation, destroyed by previous use, and reorientation of hunting farms for the breeding of wild fauna in order to return it to renewable natural entities. It is supposed to recreate fish farms, especially with the incubation of valuable fish species for natural and artificial reservoirs;

6) Forest-meadow measures - for the reproduction of meadows and pastures in Ukraine there will be a huge need for seeding meadow and fodder grasses; expansion and formation of new nurseries will be required for growing seedlings of forest crops, bushes, fruit trees. The productivity of meadows and pasture lands should be raised to the average European level, and the forests of all regions of Ukraine should meet the established standards.

Factors for reducing productivity and destabilizing landscapes are a factor that should be taken into account in the design documentation, business plans, as such, which is not allowed in the process of engineering and cultural engineering work. These documents are developing ways and technologies to avoid undesirable effects.

Management of the system of renewable land - and the use of natural resources should be based on information flows that contain a database of natural resource support, the integration of environmental information with economic indicators and vice versa. For management in the agrarian sector and in general for environmental use, it is advisable to use different techniques that take into account the levels of anthropogenic impact on NPPs [21].

For example, the score scale assumes a zero level of disturbances and contaminations, which is only possible in an ideal situation. Therefore, for a point of reference, 1 point is taken with weak or very low manifestations of degradation processes, 2 points

corresponds to the average level, 3 - strong and 4 - very strong, which borders on ecological catastrophes (Table 2.3, 2.4).

Table 2.3

The scale of degradation processes and anthropogenic filling on the small rivers area

Balance level infrigment and pollution	Degradation processes					Anthropogenic processes					
	Erosion		The ecological state of small rivers	Degradation of forest areas	Reduced fertility of soils	Acidification, salinization of soils	Air pollution	Chemical pollution of the environment	Radioactive pollution	Disruptions of landscaping	Environmental dependence of the population
	Water	Wind									
	Rinse of, %	Wind erosion index, units	Point	Destruction of flood, times	Humus content decrease, relative, %	pH	Point	Point	Ki/km²	% to square s.-g. land	%
0	Missing 0	Missing 0	Good	Missing 0	Missing 0	Missing 6,5-7,0	Mis-sing 0	Clean 0	Minor <1.0	Within the limits of the standards	Very low <15
1	Weak <10	Weak <1.0	Middle 1	Weak <1.5	Weak <3%	Weak 5.0-5.5 7.1-7.5	Weak 1	Relatively clean 1	Living Area 1.0	Low <65	Low to 15
2	The average is 20-50	Average 1,7	Satisfactor y 2	Average <1,7	Average <10%	Average 7,5-4.5-5.0	Average 2	Contaminat ed 2	Voluntary resettlemen	Average to 70	Average 20-22
3	Strong 51-70	Strong to 3,5	Unsatisfac tory 3	Strong <2,5	Strong 14%	Strong 4.0-4.5 8-9	Strong 3	Very dirty 3	Obligation to resettle	HIgh 80-85	High 23-30
4	Very strong>70	Very Strong >3,5	Very bad 4	Very Strong>2,5	Very Strong> 14%	Very Strong <±5 >9	Very strong 4	Ecological catastrophe	Ecological Catastrophe	Very Strong 85-90	Very Strong >30

The overlay of the environmental assessment scale for 11 types of degradation and contaminations covering natural climatic zones and sub-zones showed that almost all types of environmental imbalances correspond to the average of the scale or «above average, unsatisfactory, strong and very strong». The total degradation index in the Polissya area (except for territories contaminated with radionuclides as a result of the Chernobyl

nuclear disaster) is 2.4 points, in the northwestern region of Polissya and Forest-steppe (ecologically safe) - 2 points, in the zone of the Forest-steppe 2.2, in the regions of the northern and centralSteps - 3,0 southern Steps - 2,6 points, depicting the ecological characteristics of the main natural and climatic zones of Ukraine.

Table 2.4

Environmental assessment of degradation and anthropogenic impact on the natural environment on the small rivers' areas, points

Natural Climatic zones	Degradation processes					Anthropogenic processes						The general stage of pollution	
	Erosion		The ecological state of small rivers	Degradation of forest areas	Reduced fertility of soils	Acidification, salinization of soils	Air pollution	Chemical pollution of the environment	environment pollution	Disruptions culture	dependence of population health	Sum	Medium
	Water	Wind											
Polissya	1	1	3	2	3	3	2	2	3	2	4	26	2,4
Forest-steppe	2	1	3	2	2	2	2	2	2	4	2	24	2,2
Degree of degradation and pollution in Ukraine	Close to the average	Close to weak	Poor and very bad	Strong and very strong	Close to the average	Above average	Close to strong	Polluted and very contaminated	Close to the average	Close to very high	High		Close to strong

Consequently, the complex solution of economic and environmental problems is to develop an ecologically-biosphere concept of renewable land and natural resources, which is most common in the natural conditions of Ukraine. Such information will serve in simulating situations and final decision-making in the state geo-government system.

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2.3. Conceptual structure and model of geo-information and analytical systems of managing the organic agricultural production on the basis of the system approach

In modern conditions of farming, traditional agriculture is characterized by high efficiency, but over the past 100 years of its implementation it leaded to the decrease of soil fertility in 3.4 times and deterioration of the ecological state of the environment, which is primarily due to the use of pesticides and agrochemicals. Also, the biological characteristics of final products' quality, which should be evaluated according to its influence on the health of human, are not given proper attention. Therefore, the problems of ecologization of agriculture and the strengthening of the requirements to the environmental friendliness of the received products today are the main priorities of Ukraine's ecological and economic security. Solving of these problems can be realized by stabilizing and improving the ecological state of countries' territory, protection, rational use and reproduction of land resources. Foreign experience proves the importance of producing organic products, which stimulates its comprehensive support in the advanced countries of the world.

The global organic market for about two decades has been characterized by positive dynamics, which indicates the promising export orientation of organic production in Ukraine, and is an important component of the agrarian sector, its development will contribute the growth of national economy of the state and the ecologization of agriculture in accordance with Council Regulation (EU) No. 834/2007 on organic production and labeling of organic products [1], Commission Regulation (EU) No 889/2008 «Detailed rules on organic production, labeling and control over the

implementation of Council Regulation (EU) No. 834/2007» [2], Law of Ukraine No. 5448-d «On basic principles and requirements for organic production, circulation and labeling of organic products» [3], Strategy of development of agrarian sector of Ukraine's economy on the period up to 2020 [4].

According to the Ministry of agrarian policy of Ukraine, on August 20, 2017, there were registered 485 enterprises in Ukraine with the status of organic producers, among them 244 (50.3%) enterprises are engaged in crop growing, with a total land area 421.5 thousand hectares, 48.1% of these lands are used for growing cereals, 16% - oil crops, 4.6% - bean crops, 2% - vegetable crops, 0.6% are used for gardens. The organic products market in Ukraine is in the stage of formation and needs objective information on changes and the current state of soil fertility, as the main precondition for the management and development of organic agriculture.

This task cannot be realized without a sole geoinformation and analytical system with the use of modern, powerful tools and data processing methods for the support of agricultural producers in the transitional period and continuous support for their development. Management of information and its synthesis is proposed to carry out on the basis of systematic using: multidimensional statistics for a detailed analysis of retrospective data; neurotechnologies for a nonlinear forecast of changes in the state of soil fertility; geoinformation systems and remote sensing technologies for a spatial modeling and determination of heterogeneity of soils distribution according to its fertility.

The formation of organic production under conditions of development of the agrarian sector is studied by Ukrainian and foreign scientists, this is stated in the scientific publications of the authors. In particular, V. Vovk [5] noted that organic agriculture is essentially a multifunctional agricultural-ecological model of production and is based on the thorough management of agro-ecosystems, which, in the field of agrarian production, should ensure the implementation of the «sustainable development» concept, this, in the long term, will help to coordinate and harmonize economic, environmental and social goals in the field of

agriculture. V. Artysh [6], while determining the essence of organic agriculture, considered it as a system of interconnections of the complete cycle of production, realization and utilization of organic products. R. Kantemirov [7] emphasized that organic production is a certified by the corresponding organs ways (methods) of agricultural production, without using of genetically modified organisms, synthetic chemical fertilizers and means of protection, and all processes of production provide a closed cycle, which leads to a natural and resource-saving effect. N. Buga [8] draws attention to the fact that organic agriculture is a certified system of agrarian production that uses energy and resource-saving technologies and is based on the minimum use of mechanical processing of soils and synthetic substances, excludes genetically modified organisms and is aimed at providing society with safe and high-quality food products, as well as preserving and improving the state of the environment.Significant attention to the importance of conducting organic farming was paid by N. Stovolos [9], N. Berlach, [10], Yu. Slavgorodska [11], N. Tikhonova [12], L.M. Vieira, A. Hoppe [13], J.M. Wachter, J.P. Reganold [14], P. Gélinas, C. David [15]. Particular attention is paid to the advantages and necessity of creating geoinformation portals for all spheres of management, first of all - the agrarian sector. Bernard L. [16] and Maguire D. [17] emphasized that creating a geoportal would ensure consistency with many state institutions through online access to spatial data and thematic services to create an effective mechanism for their interaction. Significant possibilities of using a geoportal based on geoinformation and analytical systems in the agrarian sector are presented in the paper by Tait M. G. [18]. However, an analysis of scientific works dedicated to organic production showed that this sphere of production, despite the existing significant potential, has not yet gained a strong development in Ukraine, and there is no mechanism for the implementation of a sole GIAS of organic farming.

At different levels of state government, it is necessary to develop unified systems of requisites for mandatory documents: state standards of documentation workflow, forms of documents, coding system of statistical, accounting, financial reporting and

other documentation. In the agricultural enterprises it is necessary to adapt the individual structure of indicators and the relevant requisites for their further use in GIAS.

The state structure of GIAS of organic farming (Fig. 1) has to represent the hierarchy three-level structure, which includes local (enterprise), regional and national (state) levels or, respectively, operational, tactical and strategic levels of government.

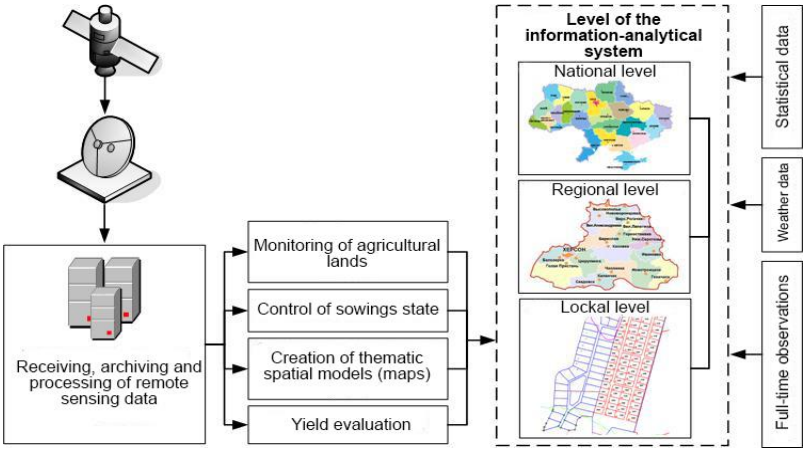


Fig. 2.1. The structure of the national GIAS of organic farming

At each level of management adaptive data processing systems are used, they are divided into subsystems of maintenance and functioning of organic farming. The component parts of the subsystem for providing the GIAS are informational, technical, software, mathematical, organizational and legal support. The subsystem of functioning takes into account the individual specificity of agrarian production and the managerial principles of interaction between structural subdivisions of an agrarian enterprise.

It was determined following prerequisites for the creation of GIAS of organic farming, in particular:

1. Geoinformation provision of the development of new farming and agriculture systems taking into account local natural

conditions, organizational, financial and agro-technological capabilities of individual enterprises for conducting organic farming. The basis for its realization is using of spatial-temporal information of the conditions of agrarian enterprises activities applying appropriate database management systems, knowledge bases, geoinformation systems, technologies of remote sensing of the Earth, neurotechnologies.

2. In the conditions of significant spatial heterogeneity of soil fertility and harvests of agricultural crops, agro-technological techniques require differential application and continuous processes of controlling their impact on the dynamics of organic production. Therefore, it is necessary to create GIAS for continuous and operational monitoring of the state of agrophytocenoses, adaptation and application of agro-technologies in accordance with local agro-ecological and climatic conditions of each field.

3. Multi-factority of processes in agrarian production requires operative high-precision spatial-temporal determination of the trend of changes in their properties on the basis of field and contactless researches on the use of modern GIS technologies, aero and cosmic images of high resolution up to 0.5 m.

4. Digital management of large technological cards, taking into account the spatial patterns of processes and operations for growing crops, recommended list of machines and tools with a description of technological settings, conditions for their maintenance and repair.

5. Forecasting of complex dynamic processes in organic farming should be carried out with the use of adaptive mathematical methods and neurotechnologies for obtaining high-level reliable situational information on possible changes in the activities of the agrarian enterprise in order to develop scenarios for the development of organic agriculture.

6. The differentiation of organic producers requires the creation of easy-to-use analytical systems with varying degrees of detailing information on the volumes and structure of agricultural production, resource availability, level of skills of specialists, the possibility of operative access to new developments, etc. GIAS should have expanded functionality based on the integration of modern analytical modules and information dissemination systems.

7. The agro-knowledge and innovation system has a considerable amount of interdisciplinary and complexly-formalized knowledge systems and spatial-temporal data, synthesis of which requires the use of powerful GIAS with the corresponding methodological apparatus.

8. Information support for the management and development of organic farming, taking into account state of soil fertility, the tendency of changes in their properties, history of farming, compliance with the characteristics of organic agriculture in a particular physical-geographical zone, etc.

9. Determination of an optimal direction of organic farming development taking into account the results of ecological audit and development of scientific-practical principles of production of organic products for particular soil-climatic conditions.

10. Development of a technological project on ecologic-economical justification of expenses for the transition period, information support for its implementation, and periodic auditing of agro-ecological status of soils in accordance with the requirements of organic farming.

11. Information support of agricultural products certification using preliminary results of ecological audit and product quality in accordance with the requirements of Council Regulation (EU) No 834/2007, Commission Regulation (EU) No. 889/2008.

Creation of GIAS of organic farming on the basis of systematic use of subsystems for managing databases, geoinformation and neurotechnologies, expert systems for decision-making support with the use of appropriate agricultural production knowledge bases and systems of mathematical models will ensure the effective management of modern organic agribusiness.

The conceptual structure of GIAS of organic farming developed on the basis of the system approach is presented in figure 2. GIAS inputs are tasks that it solves on the basis of existing problems in agricultural production of organic products; the outputs are concrete measures to improve the efficiency of the operation and competitiveness of the enterprise in specific agricultural production conditions.

Fig. 2.2. Conceptual structure of geoinformation-analytical system of organic farming management

Purpose of GIAS of organic farming:

- collection and systematization of data on the activities of an agrarian enterprise;
- generalization of specific agricultural production conditions for conducting organic agriculture;
- creation of knowledge base on the basis of normative and referential information;
- analysis of the actual state of agricultural production of organic products and planning of technological process on the basis of technological maps;
- modeling and forecasting of agricultural production processes of organic products using modern geoinformation systems and neurotechnologies;
- provision of support for the decision making in organic agricultural production based on expert systems;
- provision of users with remote access to geoinformation-analytical information using Web-based architecture and the Internet.

Section of collecting and systematizing of data is based on the management subsystem of database, which provides the introduction, systematization and saving of spatial-temporal data (attributive and cartographic), data on the state and activity of the agrarian enterprise.

Sectionof agricultural production conditions is supported by subsystems of databases and knowledge bases management, providing input and definition: assortment of agricultural crops and varietals composition; consistency and structure of land; crop rotation based on existing norms; structure of sowing lands; recommended agrotechnologies taking into account the planned indicators and quality of organic products; soil suitability groups for growing crops; input of agrochemical characteristics of soils; creation of fields passports; data on air temperatures and precipitation; amount of active and effective temperatures; reserve of productive moisture, etc.

Operation of *section of normative and referential information* is provided by the knowledge base subsystem, which systematizes regulatory and legislative documents, reference information about

crop varieties, agrotechnologies and relevant economic norms, recommended norms of permitted fertilizers, bacterial preparations, seed rates, etc.

The main part of *section of planning and analysis* is realized on the basis of the subsystem of geoinformation systems and neurotechnologies, which provides operative planning of the crop harvest, creation and updating of technological maps of crops with an appropriate link to the fields (spatial models) in accordance with crop rotations, determination of transport need, materials need, labor need, product cost planning, actual analysis of performed work, factor analysis, etc.

The modeling and forecasting section with the use of subsystems of geoinformation and neurotechnologies will provide spatial-temporal modeling of non-linear patterns of formation of soil fertility indicators and organic farming efficiency: ecological-agrochemical and ecological-reclamation state of soils, biological capacities of agricultural crops and their yields, taking into account the NDVI index, growth etc.

Section of decision making support based on expert subsystems provides the opportunity to develop rational solutions for the effective management of organic agribusiness on the basis of acquired knowledge and situational mathematical models.

The final section is *the provision of remote access*, the task of which is to provide permanent access to relevant users (manager, administrators, operators and other users) to GIAS for continuous updating and obtaining the necessary information about the organic farming activities of the enterprise.

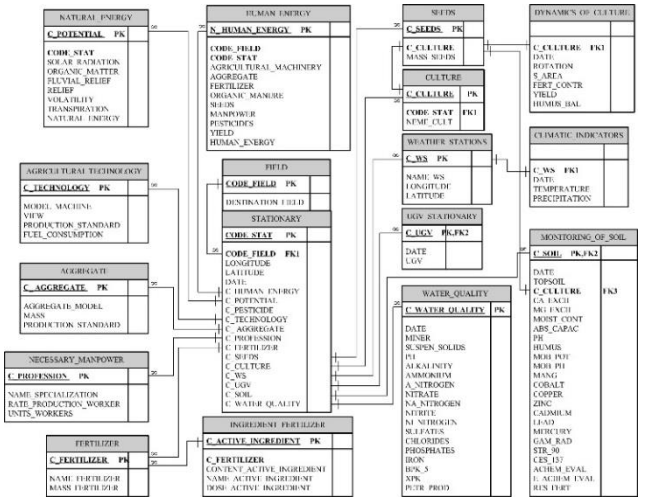
The basis of the information support of GIAS is the local level of research through the accumulation and systematization of field research data and data of remote sensing of the Earth. The creation of a universal integrated GIAS of management of organic farming at the local level includes nine main stages. The approbation of the GIAS of organic farming model was performed on the example of the Institute of Rice NAAS (about 2.5 thousand hectares, Antonivskaya village council, Skadovsky district, Kherson region).

At the *first stage*, based on the results of semantic modeling, a project of system of database management is created. Diagram «essence-link» (ER-Entity-Relationship) of the database structure and the fragment of the system of database management are presented in Figure 2.3.

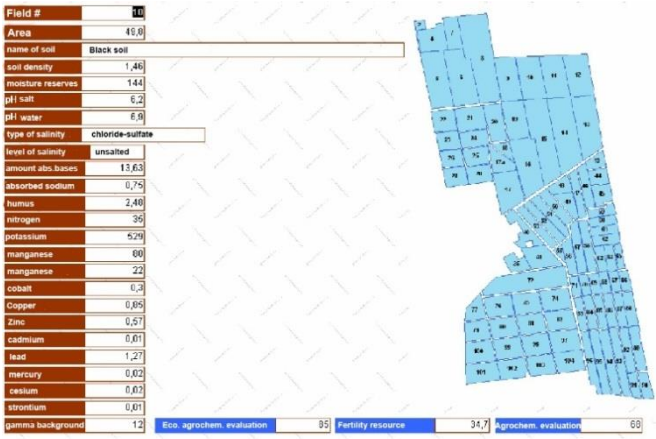
The database includes attributive data of the natural and anthropogenic energy conditions of the territory and the production of a particular agrarian enterprise. The natural energy potential is determined by the parameters of solar radiation, climate energy (air temperature, amount of atmospheric precipitation), relief energy, energy of organic matter in the soil, energy of transpiration and evaporation.

Anthropogenic energy potential is determined by the indicators of available labor, agricultural machinery, crop rotation, crop varieties and its yield, using mineral and organic fertilizers. The database includes retrospective and forecast data on the changes in soil fertility properties by agrochemical and ecological-toxicological indices, types and subtypes of soils, hydrochemical regime of irrigation water, dynamics of groundwater levels, salinization of soils.

Structure of DBMS GIAS of organic agriculture includes main tables of links such as: NoFIELD» – the table for the description of agrarian enterprise fields includes identification code and field assignment»;STATIONARY» – the table of description of stationary facility includes: the coordinates of stationary facility placement, the period of research; «HUMAN_ENERGY» – the table for the description of anthropogenic energy includes: energy potential of agricultural machinery, fertilizer, sowing material, labor force, crop yield, total value of anthropogenic energy»;NATURAL_ENERGY» –the table for the description of natural energy potential of the territory includes: the distribution of the balance of solar radiation, the energy potential of organic matter in the soil, the energy in the eroded part of the soil, the energy of the relief, the energy of evaporation, the energy of transpiration, the total natural energy potential; «AGRICULTURAL TECHNOLOGY» – the table for the description of agricultural machinery includes: the make of the machine, the type of machine,



a



b

Fig. 2.3. Database management system of GIAS of organic agriculture: *a* – ER-diagram; *b* – fragment of DBMS

production norms, fuel consumption; «AGGREGATE» – the table for the description of aggregates includes: the make of the aggregate, the mass of the aggregate, the norm of production; «NECESSARY_MANPOWER» – the table for determination the required labor force includes: specialization of an employee, the

output norm for the employee, the number of employees; «FERTILIZER» –the table of fertilizers list includes: the name of the fertilizer, the amount of fertilizer; «INGREDIENT_FERTILIZER» –the table describing the active substances of fertilizers includes: the content of the active substance in the fertilizer, the name of the active substance, the proportion of the active substance; «SEEDS» – the table for determining the amount of seed material includes: the seeds variety code and seed hybrid, the number of seeds; «CULTURE» – the table of description of crops includes: the code and the name of the cultivated agricultural crop; «DYNAMICS_OF_CULTURE» – The table describing the dynamics of sowing agricultural crops includes: date of observation on sowing, type of crop rotation, sowing area, amount of introduced fertilizers, yield, balance of macro and microelements; «WEATHER STATIONS» – the table of description of meteorological stations includes: the code and name of the meteorological stations, their location coordinates; «CLIMATIC_INDICATORS» – the table describing climatic indicators includes: meteorological station code, observation date, air temperature, amount of precipitation; «UGV STATIONARY» – table of dynamics of groundwater levels includes: well code; date of observation, groundwater level; «MONITORING OF SOIL» – the table describing the agro-ecological state of soils includes: code of the type and subtype of the soil, date of research and the layer of soil, depth of mechanical cultivation of soil, code of agricultural crop, agrochemical-ecological and toxicological properties of soil condition»;WATER_QUALITY» – the table describing the quality of irrigation water includes: irrigation source code, date of observation, hydrochemical state of water.

The database management system is used for the comprehensive evaluation of activities (modeling of production processes) and the obtaining of information (spatial-temporal modeling and forecasting) for the effective management of organic farming.

At the *second stage*, a mapping basis of the distribution of agricultural land is created and each field is assigned a unique identifier in accordance with the nomenclature of the State service

of Ukraine for geodesy, cartography and cadaster and the internal typing of the fields according to their purpose. Topographic base is created on the basis of geodetic surveys, aero and space images of the satellite device Landsat-7, Landsat-8 with a spatial resolution up to 15 meters. An example of the distribution of agricultural lands of the Rice research institute of the National Academy of Agricultural Sciences of Ukrainian is presented at Fig. 2.4

a *b*

Fig. 2.4. Map of the distribution of lands of Rise research institute of the NAAS of Ukraine: *a* – space image; *b* – vector (digital) models

At this stage, a digital model of relief as one of the factors influencing the redistribution climate energy is created (Fig. 2.5).

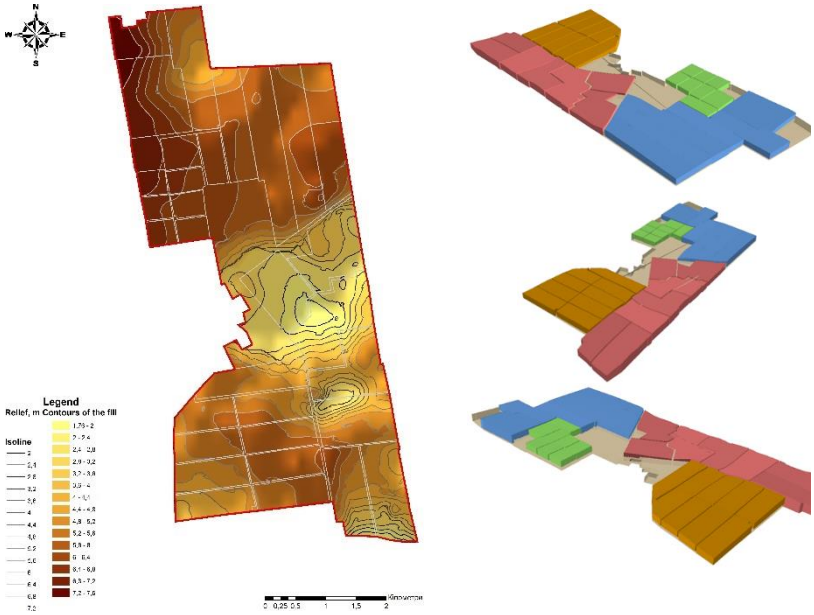
At the third stage, the link of database by a key field (universal code) to specific land or stationary facility is carried out. Then the necessary retrospective and recent data are collected using preliminary statistical reports, field studies and sources of ground-based monitoring (remote sensing technologies) for the entire territory of the agricultural enterprise (Figure 2.6).

The *fourth stage* identifies and exploits neural networks for time analysis and forecasting of possible changes in agro-climatic conditions of the agricultural enterprise. To create neural networks (NN) the software tool STATISTICA Neural Networks (SNN) is

used. Creating of neural networks for forecasting proceeds in an appropriate sequence:

4.1. Definition of input and target (output) empirical data on which the neural network will study, the training takes place with the «teacher», it means input and output signals are identical.

4.2. Formation of the training, control and test samples. Researches have determined that the best quality for the forecasting



a *b*

Fig. 2.5. Relief of the territory of agricultural lands of Rise research institute of the NAAS of Ukraine: *a* – 2-D relief, *b* – 3-D relief

of a multilayer neural network is achieved when the sample size is correlated: training - 50%, control - 25%, test - 25% of the time series of studies. The accuracy of the correct decision depends essentially on the representativeness of the training sample.

Field studies

4.3. Selection of neural network architecture and neuron activation functions. The multilayer perceptron (MLP) has some advantage over other types of neural networks; it consists in the fact

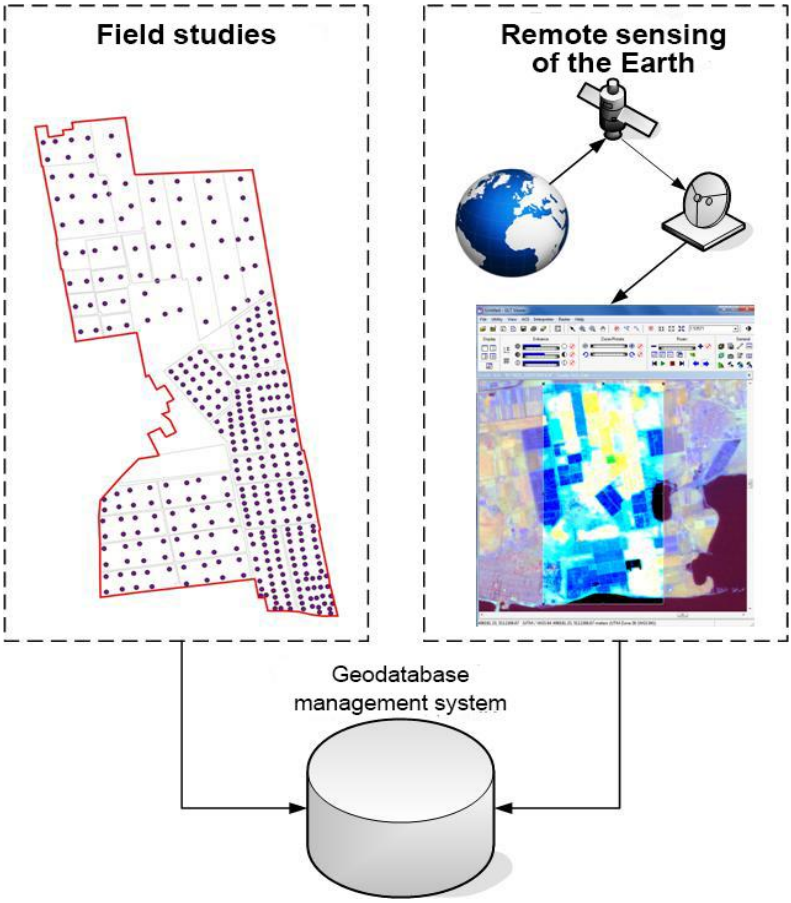


Fig. 2.6. Researching the territory of the agricultural enterprise and integrating the data into the management system of geodatabase

that MLP determines the nature of the development of studied objects and systems on relatively small training samples with rather high reliability. When creating a multilayer neural network to forecast agro-climatic conditions, it should be used the neurons activation functions - sigmoid and sinusoid-hyperbolic tangent.

4.4. Choosing of estimation method, the interpreter of answers, and the method of optimization and determination of their

parameters. After defining the architecture of the NN, randomly assigned uniformly in the interval [-0.01; 0.01], weighted coefficients of adaptive aggregators of neurons, then the method of training of NN is determined. Its task is to find the correct vector of output signals. The most common training algorithm for forecasting time series is the algorithm of the inverse distribution of the error.

4.5. Determining the conditions for finishing network training. The finishing of the training process occurs when one of the conditions is fulfilled: the network error in the training sample, obtained by the chosen method of evaluation, does not exceed the level specified by user; the reduction of the network error does not exceed the specified value. The neural network is considered trained after reaching the given (small) value of the evaluation function, that is when performing the first stop condition.

Researches have determined that the use of one method of neural network training can lead to local extremes (errors), which often do not provide the necessary quality of training. Therefore, three approaches are used to ensure that a global minimum is found:

– systemic application of teaching methods of NN, for example: on the first stage NN is trained using the algorithm of the inverse distribution of the error, and on the second it is corrected by the method of bound gradients;

– increasing the coefficient of training inertia - the procedure of «shock». In case of termination the reduction of network's error during the learning process, the addition of a uniformly distributed random variable to the weight coefficients of links in network (inertia) is performed and training continues. If, as a result of the use of the largest inertia, the network error has not diminished, the learning process of the network of this structure is discontinued;

– using of a Gaussian distribution - the addition of noise helps to «escape» from the local minimum (the output from the minimum is more likely, the smaller the size of its area of attraction), and increase the probability of finding the global minimum of the target function of the NN.

4.6. Neural network learning. A direct training of the neural network according to previously set parameters takes place.

4.7. Determining the criteria for choosing the best neural network. Qualitative assessment of the created neuromodels by analyzing the possibility of generalizing the results of studies, the level of sensitivity of NN, comparing of empirical and approximating data by statistical criteria. The ability of NN to generalize the input data enables to obtain a reasonable result on the basis of new data that was not used in the training process.

The final statistics of the NN training results to forecast agro-climatic indicators is determined by the following criteria: mathematical error expectation, standard error deviation, mathematical expectation of absolute error, correlation value of the input (actual) data with the estimated in the training and test sample. Based on the above statistical criteria, the selection of the best neural network is carried out.

4.8. Hardware realization (identification) and use of neural network model for forecasting. The forecasting of agro-climatic indicators and the formation of the database (actual and forecast data) on individual stationary facilities of monitoring platforms, which are then imported into the GIS application for the creation of thematic maps.

At the *fifth stage*, the spatial modeling of the changes in the properties of agro-climatic indicators is carried out with the help of instruments and methods of GIS-technologies, which includes:

5.1. Creation of spatially-coordinated vector models of stationary facilities of monitoring platforms (type of objects «point») within the agricultural land (type of objects «polygon») on the basis of topographic surveys using the GIS program (ArcGIS). Geographical coordinate system - WGS 1984. Vector information is stored in a separate layer, the file type*. «Shp».

5.2. Assigning attributive data (actual and forecast data) on the agro-climatic indicators of the agricultural enterprise's territory in the system of stationary facilities of monitoring platforms in the Attribute Table shp-file.

5.3. Creation of thematic digital models (visualization) using geostatistical methods of the Geostatistical Analyst of ArcGis working module - a global and local polynomial, radial basis function, kriging, and cokriging.

Creation of an interpolation model includes three main stages:

– data research, which is a set of tools and statistical methods that allows to determine the optimal method for constructing an interpolation surface of spatial modeling of changes in the properties of agro-climatic indices. At this stage, the spatial distribution of empirical data is analyzed using graphic methods of variograms and covariance, trend and autocorrelation;

– selection of the model for constructing an interpolation surface: at this stage, the selection of the best method and the adjustment of its parameters for constructing an interpolation surface taking into account the spatial patterns of agro-climatic conditions is carried out;

– the diagnostics of spatial models - a cross-check is carried out, which makes it possible to make a final decision on which of the models most precisely interpolates spatially distributed values. For a model that performs precise interpolation, the average error should be close to 0, the mean square error should be close to 1, the mean square error of the calculations should have minimal values.

5.4. Construction of thematic maps - the scale of thematic mapping of the properties of agro-climatic indicators of the territory of agricultural lands is determined and the spatial change of the calculated feature of the investigated territory is shown for the spatial-temporal estimation of its heterogeneity.

The *sixth stage* is aimed at creating the necessary expert systems for making managerial decisions in the management of organic farming.

The *seventh stage* is aimed at creating expert systems based on best practices in organic farming.

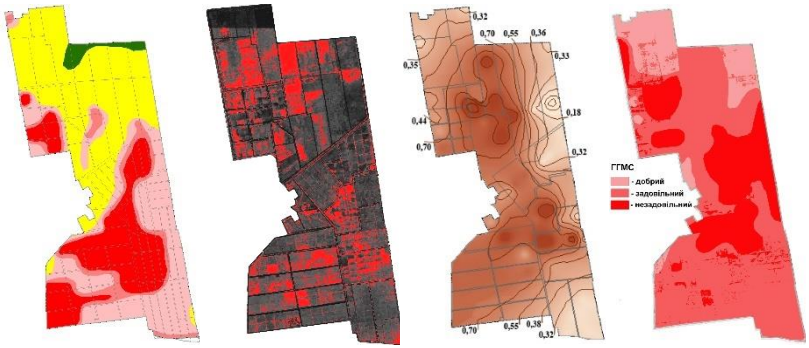
The *eighth stage* includes the establishment of a management system and the introduction of development into the production process of organic farming.

An introduction of GIAS of organic farming will allow specialists and managers of agricultural enterprises to receive complete and reliable information on the structure of land and crop rotation (their area, target use, quality status, etc.); get information about the location of any facility and the distance between them

with an error of no more than 1.0-2.0 m (for example, determine the length of the race on a digital map); determine the volume and area of work performed for the purpose of calculating wages using satellite navigation receivers and digital maps; control fuel consumption during fieldwork;promptly take into account the introduction of organic fertilizers; carry out constant control of the amount of seed spending during the period of sowing and harvesting; adjust the structure of crop rotation taking into account the relief, slopes and their expositions on any plot of arable land; determine soil moisture content for irrigation management; optimize mechanized soil treatment; conduct electronic books of fields history on crop rotation in a digital map; carry out adjustments of agronomic measures in the fields and individual plots of land due to the availability of integrated agronomic soil survey data in the digital map (Fig. 7); take measures to improve the ecological and land reclamation of agricultural land (Fig. 8); assess the energy potential of external factors on the effectiveness of organic farming; simulate and predict the state of organic farming using artificial neural networks, geoinformation systems and remote sensing technologies of the Earth.

a *b* *c* *d*

Fig. 2.7. An example of microelements distribution map in the soil of Rise research institute of the NAAS of Ukraine (layer 0…20 cm): *a* – humus; *b* – nitrogen; *c* – phosphorus; *d* – potassium



a *b* *c* *d*

Рис. 2.8. An example of ecological and reclamation state map of the soil of Rise research institute of the NAAS of Ukraine Приклад: *a*- groundwater level; b - land with signs of salinization according to the space image; c - degree of salinization of lands; d - the ecological-reclamation state

At *the ninth (final) stage* the training of specialists in agricultural enterprises and technical support of the geoinformation and analytical system of organic agriculture (collection, systematization, processing, analysis, evaluation, modeling, forecasting, presentation of research results, development of measures and management decisions) are carried out.

Conclusions and perspectives of further research**.** For the information provision of the transition period and support for organic farming, a model of the geoinformation and analytical system (GIAS) of organic agriculture at the state level has been developed and the main stages of its implementation at the level of individual agricultural enterprises are proposed, which include: designing and creating a geodatabase, developing a mapping ground, their informational saturation with field data of researches and spatial data of remote sensing of the Earth, creation of expert systems on the basis of advanced experience of organic farming. GIAS should include such components as information, technical, software, mathematical, organizational and legal support. Further

practical implementation of the model of the structure of the geoinformation and analytical system of organic farming at the local and regional levels is necessary for activation and continuous support of informational and consulting work on the issues of implementation and support of the organic farming system. The introduction of GIAS of organic farming will: support and increase the soil fertility within each field; yield forecast with high accuracy; operatively plan and manage the agrotechnological, reclamation and other measures; increase the yield and quality of organic products; receive information about the state of the fields; optimize the work of agricultural machinery; start with precision farming of organic agriculture; reduce costs and increase the ecological and economic efficiency of agricultural production, etc.

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2.4. Guidelines for geographic information system implementation in organic land use

Organic farming is supposed to be environmentally friendly due to abandonment of external inputs such as mineral fertilizers or pesticides. Albeit conversion to organic farming frequently comes

along with a decline in crop yields, proponents of organic farming emphasize the sustainability of that system particularly because of improving organic matter-related soil quality. Based on recent research on mechanisms driving soil organic matter turnover, however, it rather appears that low-input agro ecosystems may convert to smaller efficiency in terms of substrate use by heterotrophs which may affect soil organic matter storage in the long run. A compilation of field data confirms an inferior use efficiency in some organic soils and thus questions the claim of an overall sustainable use of the soil resource in organic farming systems [1-3].

On the other hand, the rapid development of the agritech startups ecosystem has led to the emergence of a number of geographic information system (GIS) solutions that have already succeeded in the global market: Adapt-N, Agrieye, DroneUA, SmartFarming, OneSoil [4-7]. These information systems helps farmers to analyze their fields and provide necessary analytical information for effective management [7; 8]. But none of them touches the question of organic farming.

Furthermore, assessment of soil suitability for sustainable intensive agriculture is an appropriate tool to select the land suitable for agricultural production with the least economic and environmental costs. Remote sensing and GIS can play an important role in the identification of the suitable zones for the development of organic farming in more facile manner.

Interesting approach was proposed to couple HYDRUS-1D computer modelling system with well-known ArcGIS software to estimate pesticide accumulation and leaching risk on regional basis [9]. Also, in agricultural soils, the contamination of heavy metals has become a major source of soil pollution in the world because of intensive agriculture practices. Paper [10] aimed to assess the heavy metal contamination in the Beni Amir irrigated perimeter in Tadla plain, Morocco, using various geoaccumulation index and Geographical Information Systems (GIS). Study [11] was conducted to evaluate the agricultural soil quality in the northeast area of Tadla plain (Morocco) using geographic information system (GIS) and analytical hierarchy process (AHP). Six soil quality

indicators, i.e., pH, organic carbon, cation exchange capacity, texture, salinity and slope were considered and performed in 60 subsurface soil samples. AHP method was utilized to identify the weight of each indicator from the pairwise comparison matrix. The weighted sum overlay analysis was then used to generate the soil quality map in a GIS environment, by overlaying both indicator weights and sub-indicator weights. The studied area was classified into four soil quality categories, i.e., poor, medium, good, and excellent.

In paper [12] a methodology is proposed to identify the suitable zones in the state for the development of the organic farming in the northern part of India using Analytical Hierarchy Process (AHP) and Geospatial techniques to boost rural economies and promote rural tourism to make self-sustainable villages.Similar study was done to determine a suitable lands for agricultural use in the Yusufeli district of Artvin (Turkey) [13]; for ecotourism using in Thailand [14].

In this chapter, we will provide necessary guidelines for geographic information system implementation in organic farming in the context of the agricultural sector of Ukraine [15].

Ukrainian scientists claim that the voluntary certification of agricultural land for the purpose of growing the organic products are effective instruments for controlling and stimulating the efficient use of agricultural land, and at the same time - a guarantee of food safety of the population. Organic production is a fundamental factor in the implementation of the concept of steady countryside development. The role of organic agriculture in the system of ensuring the environmental safety of the agrosphere is to create the «production» in the natural agroecosystems and consider the introduction of organic agriculture as one of the methods of economic rehabilitation of agricultural land.

We propose to create an information and communication platform for modelling the development of organic products from the selection of land to the organization of product sales as a more practical solution of geo-information control. This approach will collect all information on a web resource with a goal of increasing the total area of organic production and provide the most optimal

way of land use, rehabilitation and increasing the agricultural land price.

The main aim of this platform is to solve the problem of the development of the organic land-utilization system as well as to solve tasks of the UNO Environment Program on the implementation of the Global Green Course in Ukraine. The course aims to develop environmentally-friendly and stable development, to create an appropriate infrastructure and provide the necessary information in the agricultural sector of the economy. Such approaches are based on synergy and methodological principles: economics of nature use, information technologies in the agrarian sector and the use of geo-information systems, implementation of the world experience for Ukraine and promotion of the competitiveness of the national economy.

The essence of the project is in the urgent need for informatization of agro-industrial production to ensure the objectivity of the economic assessment of the natural resource potential and quality of land resources for organic production. The export ratio of agricultural products in the structure of Ukraine's (gross domestic product) GDP ranges from 30% to 50%. However, high-tech organic production makes it possible to get identical results from tradition-bound production in areas less than 30% of agricultural land. Therefore, informational support for the agricultural production starts «growth points» as well as provides information and diversification of production.

The result of the current scientific development will be a new product and significantly improved services for the creation of an information and communication platform for the selection of land, the online calculation of the ecological and economic efficiency of organic and (or) traditional land utilization, calculation of costs for organizing organic agriculture, organization of land rehabilitation, modelling the options of the transition to organic production, substantiation of the water resources use in the organic production of Ukraine using innovative methodologies (e.g. «water trace» and «virtual water»), ecological expediency and economic viability of the establishment and maintenance of organic crop production on the principles of business planning through an e-calculator, online

consulting systems for bioindication of plant condition (using images from Earth's satellites) and production development needs for businesses of different levels, communication with processing industry and exporters of products, online monitoring of the organic market and consumer demand, the development of modern innovative technologies of cultivation and processing of organic products, the requirements of existing international standards, the wider use of new distribution channels for organic vegetable production in the domestic (regional) market (including the use of Internet technologies).

A synergistic socio-ecological and economic effect will be provided for society due to the implementation of the platform. Specifically: the selection of land for organic production via an e-calculator based on the long-term data of the state public organization «Institute of soil protection Ukraine», the use of an online decision making system that will provide on a phased basis formation economically advantageous and ecologically sound decisions on the organization of the transition period to organic land use, the choice of optimal agricultural crops according to land quality (e-library and e-business planning), water usage and their geographic location, online counseling for economic justification efficiency of cultivation of crops on these lands with the use of organic technology.

The platform will provide informational and consulting support for economic entities that want to work in the organic agricultural production sector. This will reduce the risks and financial expenditures at the stage of the transition and the introduction of organic production standards. At the same time, it will increase the number of organic producers in the region and will expand the range of organic products as well as reduce their price.

At the same time, the online community will not only unite various materials of organic production into one resource but also will create a community of like-minded individuals (consumers, producers, traders, scientists) to form a business environment for its development. It will contribute to the expansion of knowledge and the promotion of organic in society.

The idea of an information and communication platform consists in the creation of a universal capable instrument for integrating ecological, economic and agricultural information at different levels of production, and presenting relevant information to the consumer in the form of ready-made solutions (economic and agrochemical substantiation of profitability of certain land-use methods, plants and (or) berry crops bioindication issues, access to web resources on the subject of organic production, e-calculators for selecting the correct type of organic business, access to relevant web resources management and marketing of organic products).

The problems of global competitive organic farming and later processing of raw materials (food production) occur because of the requirements for additional expenditure and greater risks in the initial (transitional) period. This may be solved through the online information service of our communication platform. For example, the e-calculator of the choice of the method of transition to organic production (planning of rotational cropping based on the agrochemical characteristics of the land and financial ability of the farmer in order to stabilize the quality of the soil and achieve breakeven result production); use of open data (cadastral map of Ukraine, maps of the agro-chemical status of quality agricultural land, etc., use of innovative material on bioindication of vegetation and soil cover in order to prevent mass diseases of plants and their prompt nutrition (economic effects range from thousands to several thousand uah per hectare depending on the agricultural crop) ; e-library information base for solving organizational, production, marketing and formation of pricing issues for organic products; use the modern methodological developments in the field of ecological standardization, metrology and certification as requirements of the system and process approaches of agricultural production innovations (for example, creation own standards for the enterprise for original production in accordance with the Law of Ukraine «standardization», including innovations on geographic marking and requirements of ISO standards The urgent need for an information and communication platform involves provide management of agrarian production on the basis of modern information requirements and at the same time «green» economy to ensure the highest product quality queries on world markets.

The indicated information technologies of the agro-industrial complex and the objective factors of the development of a market economy for the 21st century will increase the export potential of our country and protect the main national capital - land resources. Also it helps to do the practical implementation of the Laws of Ukraine («About the production and circulation of organic agricultural products and raw materials», «About the quality and safety of food products and food raw materials», etc.), EU Directives 889/2008 «Detailed rules on organic marking ... « and other government programs and decisions that are instruments of the information and communication platform of organic production.

From the practical point of view the platform implements socio-ecological and economic benefits from the introduction of organic production; gives online environmentally-economic and, in the long run, a banking assessment of the value of the land; substantiates variants of differentiated use of agricultural land for different cultures and methods of agrarian production; define opportunities for improving agricultural co-operation and cluster formation; substantiates the use of methodological approaches to the systematic use of natural capital and biodiversity, including - virtual water in organic production; implements the global experience in geoinformation technologies and implements the provisions on harmonization of innovation-investment approaches in governing document EU and Ukraine ; will be the focal point for business development at different levels, will enable to form an effective business environment for the development of organic production in Ukraine, etc.

The platform solves the problem of modern informational, consulting, business, marketing, advisory and socio-ecological and economic support of agricultural production. The platform contains system and processed information about: opportunities and practicality of ways of effective use of natural resources; commercial viability, effective directions of specialization in land use; ecological and economic substantiation of practicality and expenses for transition to organic production in the inquiry mode (online); online business planning variants for efficient organic

production, depending on the quality of agricultural land and the conditions for certain crops and products; possibility of sensors installation and monitoring control as well as other functions; possibility of selecting a place based on the analysis of agro-chemical rate of soil and rate of nutrients supply of plants, etc.

Tasks implementation of the information and communication platform activity in the future will ensure the updating of information in the form of specific online solutions for land with economic substantiation of the efficiency of cultivating specialized crops; assistance in assessment of the quality of land resources (prices) for an agricultural land prospective market; cooperation and integration work with other information platforms (e.g. Onesoil, EOS Platform); calculation of the balance of land fertility, which is extremely important for the land market; online selection of cost-efficient business options in accordance with the principles of ecological compatibility, social responsibility, profitability with geographical markings; customers choice for products sales; the ability to control land fertility status and use motivational and punitive instruments in the state management of land use mechanisms; promotion of water resources rational use in the agrarian sector; greatest added value production stimulation in the agro-industrial sector; assistance in the conservation of rural community; improving health and reducing mortality; forming the image of Ukraine as a country that can be one of the leaders in agro-industrial production in the world.

The platform is aimed at ensuring the management of agrarian production on the basis of information and analytical systems, introduction of advanced technologies of the agro-industrial complex, taking into account objective factors of the development of a market economy and increasing the export potential of the country , practical implementation of the Laws of Ukraine («About the production and circulation of organic agricultural products and raw materials» , EU Directive 889/2008 «Detailed rules for organic production, marking...» and other EU Directives, programs and decisions of the Government).

Organic portal development algorithm includes the implementation of the following paragraphs:

1. The first stage involves information system database structure designing and creating it using specific software (QGis or/and ArcGIS). A cartographic basis for an information management system (land resources) is creating. Open data services such as the public cadastre map of Ukraine, Google Maps services, Open Street Maps, the system of administrative boundaries of Ukraine, the OneSoil platform, cartographic material about land quality, various layers of information, images from space images, etc. are used as basic material and automatically integrating into the system for future use.

2. Purchase, install and set up the physical server. Transfer data to the new server platform.

3. Agrochemical data of the quality of land are purchased initially in the State Institution «Soils Protection Institute of Ukraine». Data purchase is made in a state organization which is specialized in monitoring land quality, and its laboratories are accredited for conducting such analytical research. Such data is properly processed and included in the system. Information on the map should be stored in layers. The main layers of the map are: soil pH, organic matter, nitrogen (N), phosphorus (P), potassium (K), manganese (Mn), sulfur (S), zinc (Zn), copper (Cu), boron (B) Cobalt (Co), Cadmium (Cd), Lead (Pb), Mercury (Hg), Cesium (Cs), Strontium (Sr).

For each land area, two additional indicators are introduced that generally characterize the land parcel - this is an agrochemical assessment and ecological and agro-chemical assessment. The list of layers with their names can be specified and expanded.

At this stage, the attribute information of the objects contained in the corresponding layers is entered. That is the binding of the filling and (or) control of the records in the database responsible for the agricultural fields (fields) by the key field (universal code) of the database to the specific objects of the digital map (fields, hospitals).

4. Systematized and processed information for loading in the sections of the analytical part (e-calculator, analytical, resources, technology, standardization and certification, marketing, e-library, online solutions, etc.) of the platform and its updating. Each section should have an analytical and methodological content that serves the general purpose - the most environmentally appropriate and cost-effective start-up and management of organic crop production.

5. The issue of purchasing, installing and setting server hardware and software is solved. Data from systems is transferred to the server platform, and the issues of data access rights are solved. The issues of organization of backup of information are solved in order to prevent its loss.

Web-oriented information system using ASP.NET MVC as a software application single-page application is created. User interaction with the system will be on one page using the web browser, without page updates and asynchronous mode. Includes development of backend and frontend components. In addition, the software should have a closed and open part. The closed part should be accessible to system administrators and specific users of the information system. The open part should be accessible to all unauthorized users. However, the frontend part of the information and communication platform containing the coding and design of the site is in accordance with the pre-prepared templates PSD format and is a coding of HTML/CSS files and filling the frontend with the necessary JavaScript scripts in accordance with the best practices of User Experience (fig. 2.9).

The user will observe the main page of the information and communication platform of the site after downloading the web page. The main element of the main page is an electronic map, which contains a map of the area, data from the cadastral map of Ukraine (enabled by default), and land plots in the form of the various area previously entered to the system by authorized users in the previous stages of the development process. The data are transmitted into the web-system via the WMS protocol from a pre-set QGis server.

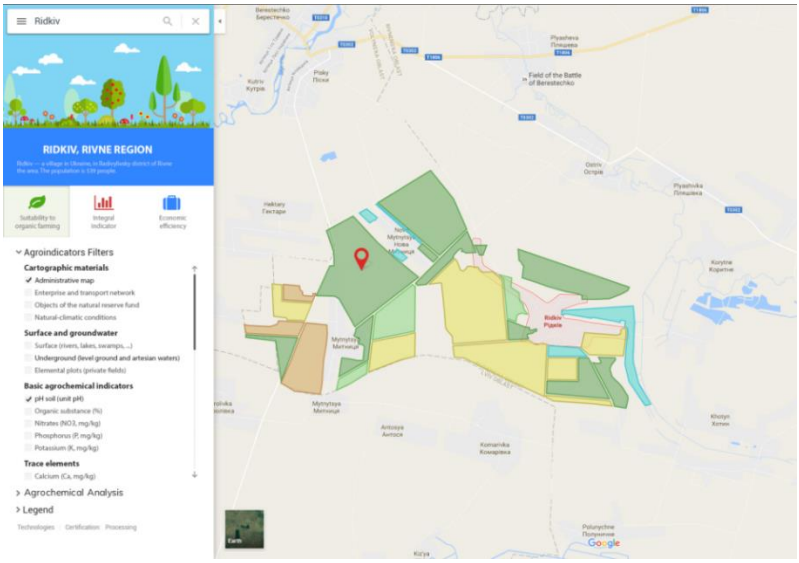

Fig.2.9. General user interface for organic portal

The application will respond dynamically to the user's actions during scaling or moving to a new location (by dragging a map or finding a new location using the location lookup). The corresponding AJAX query is sending to the server, which finds exactly the areas that satisfy the parameters. Then from the inquiry information about the geometric structure and location of the places in the GeoJSON format is selected, and the Leaflet is displayed in the form of polygons (or testing area) on the map.

The site will have an item for searching for the location. The item uses the Google Places API functionality, which allows giving user prompt when searching for a particular place. When choosing a place from the proposed list, the information about the corresponding place is returned to the search item, from where it can be obtained by the software application.

The «Analysis of Indicators» section of the «E-calculator» section is intended for displaying all agrochemical indicators of a particular land plot (of polygons), which was pre-selected by clicking on it on the map (Figure 2.10). This category contains the

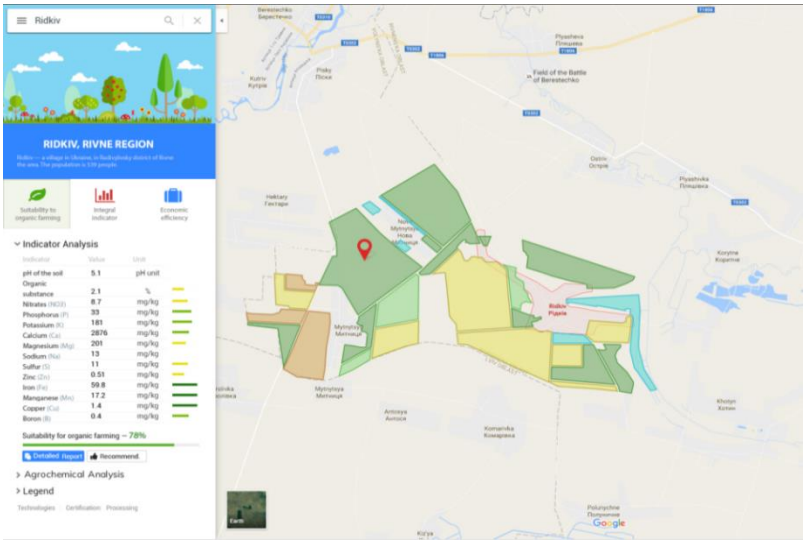

Fig. 2.10. Analysis of agrochemical data for specific selected polygon

name of the agrochemical indicators, that should be analyzed and its specific value and unit of measure. Each indicator has its limit values - the minimum and maximum. At the moment, the system can appraise the land plot by the following parameters: soil pH, organic material, nitrogen, phosphorus, potassium, manganese, sulfur, zinc, copper, boron, cobalt, cadmium, lead, mercury, caesium, strontium.

The «Indication filter» category of the «E-Calculator» section includes an option to select cartographic materials (either Open Street Map or several Google Map types), enable/disable the cadastral map data of Ukraine, and select a filter according to one of the main agrochemical indicators. One of the extensions of the Leaflet library, called Google Mutant, was used to implement the functionality of the choice of cartographic materials.

This extension allows adopting Google Maps to work with the Leaflet library and provides a mechanism for choosing different types of cartographic materials from Google. The map layer which is responsible for displaying data from the cadastral map of Ukraine

uses the free data provided by the Public Cadastre Map of Ukraine. The presentation of these data become available through an external WMS service - a special Internet protocol, which is intended for the displaying geographically attached images via the Internet.

The selected filter effects to the display of the land plot on the map. Depending on the specific value, the color of the plot changes accordingly to the specification displayed in the modal window in the lower right corner of the map, as well as in the «Legend» category of the «E-calculator» section.

7. At this stage, the design and development of the section of the e-calculator of the organic production efficiency substantiation are done. Information is formed for making ecological and economic calculations of the efficiency of the transition to organic agricultural production, the calculation is made for different variants of the efficiency of land use during the transition period and for organic agriculture in the future. If necessary, thematic maps and graphic material of the agro-ecological state of agricultural land of the producer are created. Information is presented in the form of flowcharts, description of the algorithms, excel files, that are suitable for future programming.

This calculator contains programmed analytical algorithms, which automatically perform calculations that allow to define a certain category for the land and to define whether it is suitable for organic agriculture, depending on substance content represented by the agrochemical indicator in the specified area. After that, the system automatically learns and extends its own electronic base of knowledge.

Also this calculator include algorithms which have been verified according to mathematical and computer scientific modelling of mass and heat transfer processes in underground area [16; 17].

Filling and updating sections of the platform in special windows to comprehensive assessment the efficiency of the transition to organic agricultural production and substantiation the ecological practicability and cost-effectiveness of starting an organic business or diversifying existing ones, including on-line information (with continuing innovation). The sections will have all

the necessary information for decision making by the owner plot of the land regarding land use options and internet resources for consultation and monitoring of the organic market.

Creation of an e-calculator for calculating the efficiency of growing previously selected agricultural crops (plant growing) and complex information in the online mode for modelling different agricultural options. For such a service, a complex of information provided in the form of tables, charts, online services for an assessment of options and final decision-making will be developed. Also, a complex of information in the section «Marketing» will be offered regarding standardization and certification of products, it's packaging, geographic marking, a search of business contacts, the anticipation of profits depending on the market conditions in the world and regional markets for organic products.

Creating a business plan uses all other sections of the platform, as each section should have analytical and methodological content, which serves the general purpose - the most ecologically appropriate and cost-effective beginning and introduction of organic agricultural production, and manufacture of products at later stages.

According to the system described above and recommended for the selection of managerial decisions. The manufacturer implements the main rule of organic business - success will be provided by step-by-step integrated solutions: the quality of land resources and the geographical and natural climatic bond with the business for the simultaneous implementation of domestic and world markets.

10. Designing and filling of the section «Marketing». Additional layers should be programmed for information about suppliers of organic products. Users and system moderators can enter this information through their cabinets. Also, the page-calendar is programmed, which moderators fill with thematic events.

11. A Microsoft Windows server is set up for optimally handle a large number of IIS Web server activity. The IIS web server publishes the latest information and communication platform. The domain name system and SSL certificates also installed. Also implemented Quality Assurance and Quality Control

operations. All issues should be fixed. Parallelly the documentation for both the user and for programmers is written.

In general, the entire development process can be represented as the next UML activity diagram (figure 2.11). Activity diagrams are intended to model both computational and organizational processes (i.e., workflows). Tracks are parts of an activity diagram and intended to split the activity in accordance with the responsible for actions.

During the development process software engineers are responsible for rule «simplicity over complexity» execution. Everything should be made as simple as possible, but no simpler. When you are creating a new system and have the choice between two development models, always select the one which leaves the system simpler unless you have a compelling reason to introduce the complexity. This compelling reason should be documented in such a form as to make sense to whomever inherits your code.

Unfortunately, it sounds like your specific case is an existing system that has become more complex over time. This leads you into the opposite principle, specifically If it isn't broke, don't fix it. A system that works should be left as-is, until it either breaks or a replacement is ready. The question as to when you should replace vs. simply continue on is a management one.

Thus, the platform using allows to:

- provide users with recommendations on the economic efficiency of doing business in the field of the organic agricultural business from the idea to the stage of its implementation with long-term marketing recommendations (for example, in cases of planting up to 5 years, berries under 8 years old, peanuts up to 50 years old);
- achieve economic, ecological effects of organic farming at different levels and depending on the proposed business in the Polissia and Forest-steppe zone (under conditions of expansion of the experience of the information and communication platform in other regions of the state);
- make effective decisions of optimal options for the transition of farms to organic production at the stage of the idea and depending on the agricultural crop to 50 years;

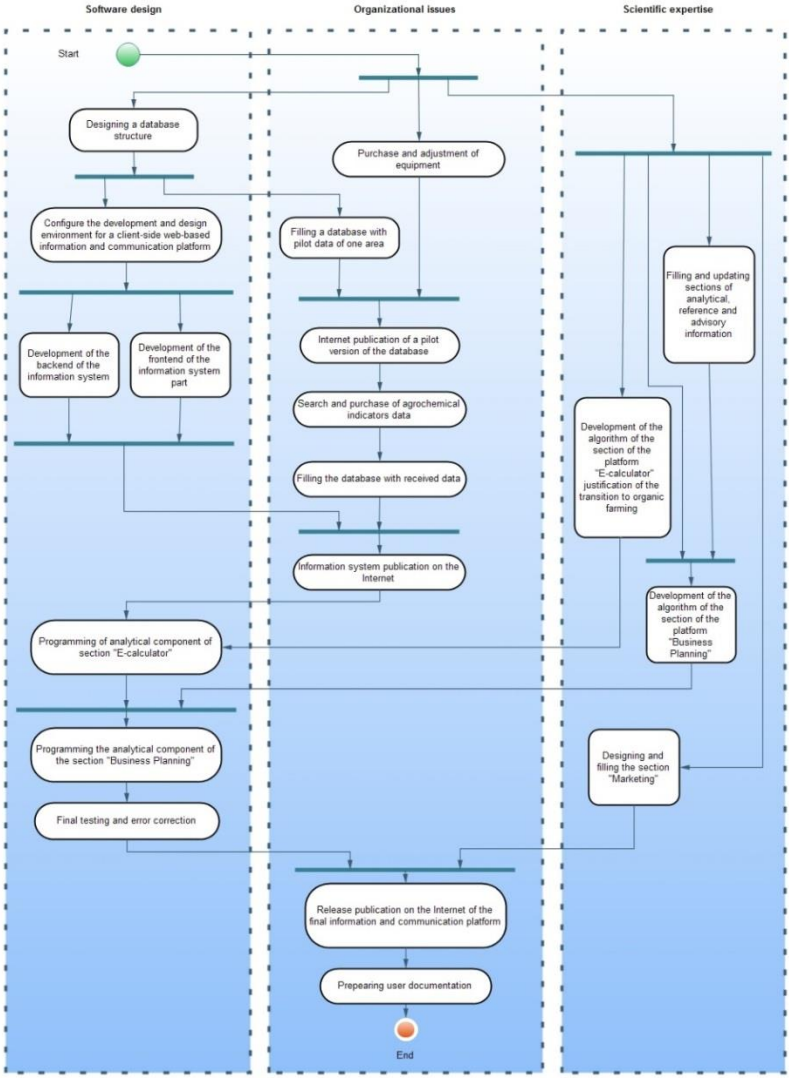

Fig.2.11. Activity diagram for organic portal development process

- make an ecological-economic and marketing assessment of the expediency of growing certain organic crops;

- make electronic consultation and receive back recommendations for agricultural producers;

-create a coordination center for informative support of farmers for organic production (seed production, transplant, seedlings preservation, logistics and product marketing);

- use e-library (world and national experience, online web resources, printed information materials);

- receive recommendations of the predictive cost-effectiveness of agricultural production of certain crops selected in the project. For this purpose, the project separates on two natural zones: Polissya and Forest-steppe;

- promote products and services on the market through communications between manufacturers and the formation of larger batches of products (with the view to providing a mechanism for open API that allows the connection of third-party applications, including mobile);

- use electronic calculators of cost-effectiveness in growing various crops, etc.

- handle on-site open and closed communication of users;

- create users own information base (e-cabinet), which can constantly change and contain information about its own land plots, agrochemical indicators, recommendations, business plans, communication messages, etc.

- make an automated information distribution of business offers;

- create other additional automatic services inside the system: for example, VIP-packages of services can be created;

- use databases of land quality, fertilizer producers and pest control, production technology, certification schemes, processors and other relevant sources of information.

Hence, each section of the information and communication platform has an analytical and methodological content, which serves the general purpose - the most ecologically valid and cost-effective start-up and management of organic agricultural crop production and further processing of raw materials. An important achievement of the project will be the informatization of organic production in general and the formation of a system of socio-

ecological and economic benefits for the farmer community of the region and later the country.

In particular:

Ecological effect. Reproduction of soil fertility (the cost of reproduction of 1 hectare of soil in the Rivne region starts from 26 to 177.5 thousand UAH in the 2018 year prices) and reduction of losses from degradation and protection of soils; protection of biodiversity; preserving natural landscapes and reducing the negative impact of climate change by binding atmospheric carbon (CO_2); stabilization and preservation of the environment and other effects are proved by the authors of the project in their publications.

Economic effect. The effect of grain cultivation in prices in 2017 is more than 10 thousand UAH/hectare (under the condition of stabilization of the quality of land (comparison for the Polissya area 2.5 thousand UAH/hectare). The level of profitability of grain production is 34% (data by 2011-2017 years on average based on «Galex-Agro» - an organic firm in Zhytomyr region and for the milk - 31%). For comparison: the traditional sector for grain 19% and for milk - 12% (Zhytomyr region.). The information for each producer of organic products will be different, as they sell it mostly in a foreign country.

Social effect.Using correlation-regression analysis, it was proved that there is a direct connection between the application of mineral fertilizers per 1 hectare of land and the level of the digestive system diseases and morbidity caused by neoplasms in the population, for example, Radyvyliv district of the Rivne region. The initiation of organic land use and the reduction of the number of mineral fertilizers by 10%, in the next 5 years, it is possible to achieve a reduction in the burden of disease rate of local residents of the digestive system by 18% and caused by neoplasms by 42%. As a result, the reduction of expenditures in the field of health care for the treatment of diseases of the digestive system and diseases caused by tumors is 13.828 thousand UAH; cost saving from the social insurance fund for the period of temporary disability of patients 710.4 thousand UAH; prevention of losses of gross production during the illness of

workers employed in material production 272.179 thousand UAH. Moreover, free access to information and awareness of the population in the way of organic agriculture contributes to the development of the business environment and the creation of additional jobs in rural areas.

The scientific and practical results: informational (informing producers and consumers about the effectiveness of organic production), economic (increasing the profitability of the industry), organizational (improving mechanisms, methods and management systems), social (raising the level of employment, cope with seasonal problem), resource (rational use of natural resources by agrarian resources) and ecological (creation of agro-ecoregions, organic farming) outcome from its implementation.

Project implementation will increase overall production of all types of organic products, will be innovative in the field of agrarian management and the economy of nature management, will lead to systematic preservation of the quality of land resources and the environment. Also, the improvement of plot lands condition will increase its price. The fulfilment of the requirements of the European directives on the ecological economy modernization and the implementation of the HACCP control systems requirements (ISO 22,000, ISO 14000, the Codex Alimentarius) are important factors as well. Such production ensures the export of agricultural products and the receipt of currency in the budget of the country. The information and communication platform will provide the opportunity to create new databases and to constantly modernize and use them to the general public.

Informatization of organic production will lead to efficiency and improvement of working conditions (reduction of selecting soil samples, choice of correct managerial decisions for the entire technological process, effective use of authorized medications through recommendations on bioindication and so on). The provided services will correspond to world innovations in the field of agrarian production, agricultural production informatization and ecological management. There are no

environmental risks according to the positive characteristics of organic farming,

The next results will be gained: theoretical and practical developments on the substantiation methods and organic production effectiveness evaluation methods; methods, schemes and substantiation of expenses for the transition of traditional farms to organic land use. The economic expediency of the project implementation is that the making of business and management decisions by state administrations, farmers, and academics will be with the ecological and economic substantiation for making decisions on the development of a competitive sector of the state's economy.

The information and communication platform will be implemented in public practice through:

- a specialized law on organic production in Ukraine;
- the steady growth of the organic products market in the world to 10% and in Ukraine to 2%. The annual increase of organic market operators in Ukraine by 2018 will be more than 380 firms and farms. Compared to 2017, the growth was up to 50 operators of organic production;
- the constant demand for organic raw materials, products in the EU countries. Statistics show that more than 85% of organic products from Ukraine are exported;
- the establishment in Ukraine of organic services market: tourism, «collect yourself», upbringing, excursions «communication with nature», etc;
- asignificant annual growth of consumers for environmental goods, food;
- all developed economies in the world are developing and modernizing existing information and communication services in all types of activities: agricultural production, innovations and computerization, geo-information systems and online services, performance calculators for various topics, etc.

Taking into account the constant growth of the organic sector of the economy in Ukraine and the world the platform will solve the issues of informatization and computerization in organic production, which will simplify the making business and

management decisions by state administrations, farmers, scientists and boost the development of a competitive sector of the state's economy.

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3. METHODOLOGY AND SYNERGY OF ORGANIC PRODUCTION

3.1. Methodology, mechanisms and tools for substantiation of socio-ecological and economic benefits from the implementation of organic production

Successful and stable development of society is impossible without the proper use of natural resources in the process of social production to meet the material, spiritual and health needs of people. Ukraine is developing in the direction of European integration, which requires the provision of appropriate standard of living, including food safety and nature conservation, policy and legislation improvement, the formation of proper social and managerial institutions and economic development on the basis of international cooperation. The basic guidelines for the development of the world community are sustainable development due to the implementation of sustainable nature management into practice. European Spatial Development Perspective Towards Balanced and Sustainable Development of the Territory of the European Union (ESDP, Potsdam, 1999; Principles of Sustainable Spatial Development, Hanover, 2000) states that its implementation can contribute to the protection, effective management and development of landscapes. This requires close interaction at international and interregional levels between programs concerning natural environment (NE) protection, development of culture, agriculture, social and economic policies. The exchange of experience and cooperation in conducting research in specific local and regional conditions on the improvement of landscape development should be strengthened. This requires the reorientation of the economy from classical principles into EU (96/61/EEC; IPPC Directive) principles of ecological and economic (integrated) system management with the obligatory consideration of the environmental component when using natural resources and the desire to harmonize the economic benefits with minimizing negative impact on NE and human health [1]. However, as shown by the analysis of international institutions supporting the

implementation of these goals, achieving this coordination of social, economic and environmental interests is rather difficult as a result of a number of contradictions in axiological, social, political, legal, economic and other senses [2-4].

In the program of National Academy of Agrarian Sciences of Ukraine (NAAS), the priority tasks for 2016-2020 are sustainable nature management in the agricultural sphere, as well as scientific and methodological support of the organic production development in Ukraine. It is important for increasing the ecological safety of agrarian production. Currently, most studies of anthropogenic changes in landscape ecosystems are devoted to certain structural and functional components, and not to the entire ecosystem, which makes it impossible to assess the fullness of the negative effects. Still, this problem has not been sufficiently studied at the synecological level: distribution of the consequences human activity's negative influence on the structural components of the ecosystem, taking into account its type, characteristics and ecological background [2, 5]. It does not allow effectively regulating anthropogenic impact on natural objects, which are industry resources, as well as on NE, to establish interagency cooperation on the methodological basis of sustainable development. Therefore, it is relevant to define and substantiate effective measures for harmonizing classical principles of agriculture with principles of sustainable nature management, norms of ecological and economic management, including organic production of food and livestock feeds, the formation of environmentally sustainable territories taking into account regional peculiarities of existing social, economic and environmental risks / threats, challenges of the present and changes in the demands of society.

Organic agriculture is an important component of the harmonization between two institutions of Ukraine – the agrarian sector of the economy and the Ministry of Ecology And Natural Resources Of Ukraine, which have different and usually contradictory goals (respectively, economic and environmental). And within the framework of the Ministry of Ecology And Natural Resources, the same contradictory motivation and activity strategies

are observed between two sub-institutes of environmental policy – between the environmental safety which well-developed and supported by management (in anthropocentric society oriented towards the humans) and the protection of the NE (biocentric approach). Organic production should contribute to a certain harmonization of people's interests with activities to preserve biota of natural ecosystems, as well as the economic interests of various adjacent industries among themselves and with the institutions of ecological safety and the protection of nature.

The state and prospects of the agrarian sector development are an integral part of the activity of this ecological-economic system as a sub-system of two interconnected national systems – «economy / nature management» and «protection of NE».

Methodological bases of the complex approach to land use problems and environmental protection at the regional level, elements of the transition to sustainable development of regions, as well as methodology algorithm of ecological and economic assessment of the agricultural activity's impact on the state of resources in agrosphere to a certain extent have already been developed within the framework of constructive and socio-economic geography, agroecology and other areas of scientific knowledge [6]. However, the main obstacle to implementing the principles of organic production in agriculture is the lack of completed programs and scientific and methodological recommendations at the national, regional and local levels that would ensure the harmonization of economic, social and environmental interests and cooperation with adjacent natural resources and environmental protection institutions.

Prerequisites for organic agriculture. The sustainable nature management plays a leading role in maintaining the constancy of total natural capital as the basic criterion for sustainable development, as well as ensuring the vital needs of mankind. Soil is a non-renewable spatial resource, and its fertility provides the population of any area with food. At the same time, it is the non-adherence to the scientifically grounded norms in agriculture (excessive intensification of production, focusing only on market demand and economic benefits, the use of pesticides and GMOs,

degradation of soils, their pollution, etc.) was almost the most significant factor of the negative impact on the natural environment, deterioration of the adjacent natural ecosystems conditions, the quality of human life, the threat to the safety of its existence [7-14]. In these conditions, the risks of contamination in food chains, the decline in the quality of agricultural production have increased significantly. Therefore, during the last 30 years, the increase of safety and quality of food has become especially relevant. These indicators are currently one of the main factors of internal and external competitiveness of agricultural production, its compliance with international principles of sustainable development. Eco friendly products, first of all, are necessary for children's, medical and preventive nutrition. Therefore, an increasing share of society, especially in developed countries, is converting into consumption of only these products, the logo of which rapidly conquers the information space. According to the International Federation of Organic Agriculture Movements (IFOAM), in the global food market, the segment of organic production grows on 20-25% each year, forecasting that in 2020 it can reach $200-250 billion, although the cost of organic products on 20-30% higher compared to traditional and intensive agronomic products [15].

Consequently, due to the growing demand for organic production in the world and internal markets, there is a need for the development of efficient technologies for the cultivation of organic crops.

The essence of organic production, potential environmental, social and economic risks / threats, the potential to overcome or minimize them. By IFOAM «Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved». [15].

In Ukraine organic production is regulated by the law: The Law of Ukraine «On the Production and Circulation of Organic Agricultural Products and Raw Materials» No. 425-VII dated

September 3, 2013 (this Law is valid in Ukraine until August 2, 2019); The Law of Ukraine «On general principles and standards of organic production, circulation and labellingthe organic product» No. 2496-VIII dated July 10, 2018; the Decree of the Cabinet of Ministers of Ukraine «On Approval of the Detailed Rules for the Production of Organic Products (Raw Materials) of Plant Origin» No. 587 dated August 31, 2016; the Decree of the Cabinet of Ministers of Ukraine «On Approval of the Detailed Rules for the Production of Organic Products (Raw Materials) of Animal Origin» No. 241 dated March 30, 2016; the Decree of the Cabinet of Ministers of Ukraine «On Approval of the Detailed Rules for the Production of Organic Products (Raw Materials) of Beekeeping» No. 208 dated March 23, 2016; the Decree of the Cabinet of Ministers of Ukraine «On Approval of the Detailed Rules for the Production of Organic Marine Algae» No. 980 dated September 30, 2015; the Decree of the Cabinet of Ministers of Ukraine «On approval of the Concept of the State target program of development of the agricultural sector for the period 2020» No. 1437-p dated December 30, 2015, etc. Ukraine also uses the EU legislation: Regulations 834/2007, 889/2008 and others.

The motivation, potential and prospects for the organic production development in the world and in Ukraine is that organic agriculture provides a harmonious social, economic and environmental effect: the use of natural mechanisms of soil formation and fertility, the ecologically coherent use of land resources, their preservation from depression, enhancement the quality of food, the creation of additional jobs in the countryside, etc. [16-19]. Organic production uses materials and technologies that improve the ecological balance in agrarian and adjacent ecosystems and promote the creation of a favorable interaction between them, the formation of sustainable agro-landscapes, and in general – of the agro-landscape sphere [3, 12, 13, 14, 20-26]. Due to better use of natural mechanisms of soil formation, refusing from pesticides, lower using of fuel, expensive fertilizers, optimization of plant protection systems and agrotechnical methods, organic production ensures reproduction of soil fertility and stable development of cultural agrocenoses [16, 27-29]. That is, it allows

one to achieve simultaneously greater economic, social and environmental effects, which is one of the basic goals of sustainable nature management [2, 4, 6, 13, 18, 20, 30-32].

The concept of organic agricultural production is based on three principal building blocks. The social block is driven by the rapid increase in consumers' demands for food quality, especially for children, medical and preventive food in the conditions of everyday pollution; ecological consciousness of society; improving the well-being of the rural population by diversifying this activity; increase of employment level and creation of proper conditions for developing rural regions. The ecological block consists in activating natural mechanisms and increasing the soil fertility; more effective use of agro-climatic potential of certain territories (ecotope); biological methods of plants and animals protection from harmful organisms – pests (insects, diseases and competitors of plants – weeds); the desire to preserve biodiversity of the ecosystem, which increases their ability to self-regulation, self-improvement and self-development; protection of agro ecosystems and NE. The economic block focuses on the potential capacity of developing effective and sustainable ecological and economic technologies of organic production and the forecast of increasing market demand for organic products, increasing its competitiveness in conditions of improving people's living standards and their purchasing capability. When refusing to use pesticides in the system of plant protection, the exclusion of chemical fertilizers, GMOs and preservatives, it is possible to significantly reduce the expenditure of production resources, production costs and at the same time to reduce the negative impact on agroecosystems, NE, and promote their conservation. This coordination of economic and environmental components of technology meets the principles of the social request for environmental safety and environmental nature management; it prompts consumers to the willingness to pay a higher price for organic products gained with the harmonized adherence to the norms of human safety and conservation standards [3, 13, 18, 21, 30-32].

Thus, organic farming is an environmentally-friendly, multifunctional and integrated model of organic production that is

based on a parity and sustainable compliance with environmental, economic and social interests and requirements and provides a dynamic balance of the structural components of the agro-sphere, its sustainable development (Fig. 1). The importance of organic production for sustainable development is also considered by other researchers [4, 13, 21, 31-39].

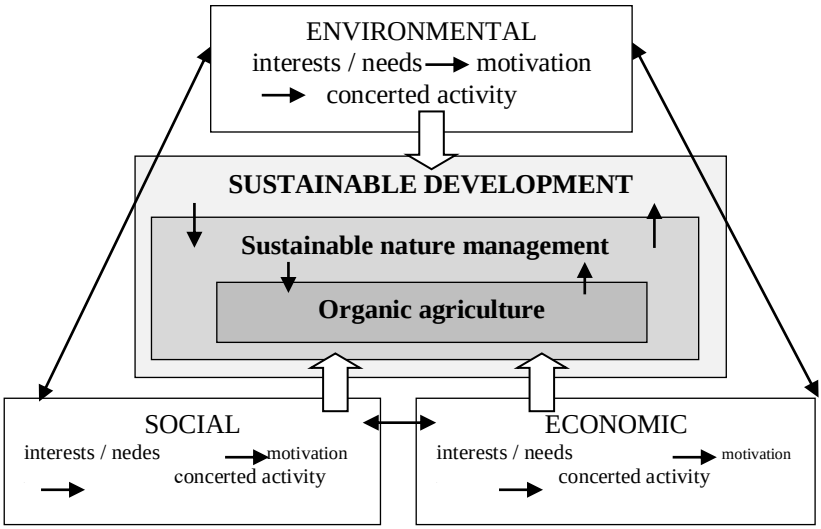

Fig. 3.1. Organic agriculture as an important component of sustainable nature management and sustainable development of the agrosphere

Organic agriculture harmoniously ensures an increase in the efficiency of the agrarian sector of the economy, raising the level and life quality of people by preserving the development and maintenance of the state and ecological role of agro-ecosystems and NE. These principles of organic agriculture require the appropriate restructuring of technological cycles of agricultural products, system of agro-technical measures and the replacement of intensive management by integrated. For organic farming, there are three groups of potential risks (environmental, social and economic threats, Fig. 2) [40, 41]. Economic risks / threats are an integral consequence of social and environmental factors [19, 42].

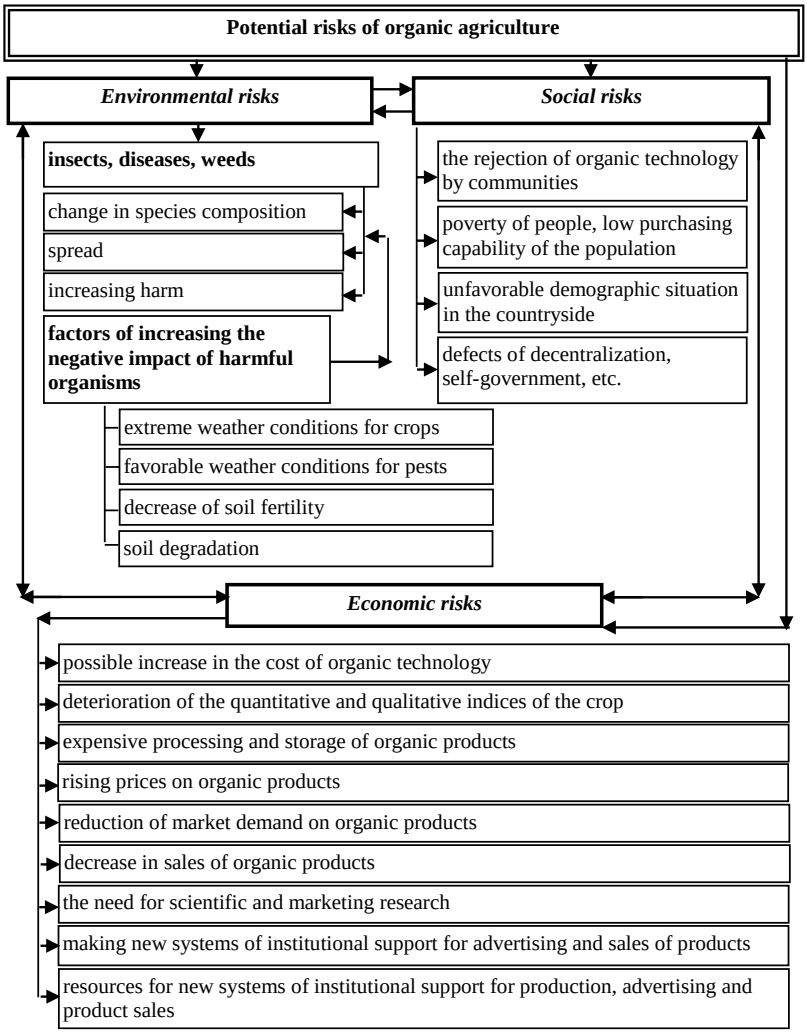

Fig. 3.2. Factors of environmental, social and economic risks of organic agriculture and their interdependence [social and economic risks – taking into account 18, 19, 36, 42-45]

An analysis of the available practices in Ukraine shows that there is a scientific and methodological potential and practical

experience in overcoming or minimizing the mentioned risks [9, 10, 13, 17, 18, 24, 25, 30, 36, 37, 42, 44, 46-48].

Currently, there are selection and genetic methods for increasing the competitiveness of varieties and hybrids of agricultural crops relative to weeds, biological resistance to phytophages, pathogens and adverse abiotic factors [12, 49]. There are known principles for replacing plant protection chemical methods on biological, using special agrotechnological measures (crop rotation, fertilizer system, sowing date, cultivating soil and agrocenoses, mechanical care, selection of stable varieties and hybrids) [50, 51]. It is likely that the biological and economic efficiency of these measures can be greatly improved with systemically agreed time and space of application, taking into account the effects of summation and synergy [52].

An important and complex issue of organic production is the supplying agricultural crops with sufficient quantities of nutrients without the use of synthetic mineral fertilizers. Renewable resources, siderates, by-products of plant growing, organic fertilizers, etc. can play a leading role in this [53]. Siderates, cover crops, as well as bacterial preparations and growth stimulators are used to suppress and displace weeds, pests and pathogens. To do this, adjustments must be made in the management of soil fertility, taking into account their biological activity, the degree of the soil biota pool's transformation / depression, the unbalance of nutrients, the natural conditions and the intended use [54]. Equally important is the search of new biological preparations with fungicidal and insecticidal properties, the combination of their use for pre-sowing seed treatment and croptreatment during vegetation.

So far, the potential of optimizing the biological nutrition of crops, achieving the proper balance of NPK, other nutrients in the soil, and the content of microelements has not been fully exploited [55]. Such coordinated use of these environmental techniques with promising biological and agrochemical means can not only reduce the cost of production and obtain quality organic food and eco-friendly feed for livestock with a rich variety of valuable herbs, it will also contribute to the reproduction of soil fertility.

Consequently, the development of organic agricultural production is now one of the most promising agrarian sectors in the world. The switchover agriculture to the principles of organic production in many developed countries already has the appropriate regulatory framework, proper resource and institutional support. Therefore, Ukraine should use existing experience on the basis of international cooperation.

Status, problems and perspectives of Ukraine regarding the development of organic agriculture. Ukraine has good natural conditions for organic production – a favourable climate and fertile lands, which have created a high agroecological potential and provide high yields of agricultural crops. The society already has a widespread motivation to switch to organic food and demand for it [17, 18, 30, 44, 56].

According to the most methodological principles, the concept of organic agricultural production corresponds to the current legislative framework of Ukraine. Nowadays agrarian policy in Ukraine is aimed at ensuring food security of the country, creating favourable conditions for the development of competitive agricultural production, and transferring it to market principles. As stated by the Strategy for the agrarian sector of the economy for the period up to 2020, food security is given a leading place among the priority activities. It is based on promoting the development of organic agriculture as a solving a number of environmental problems, creating additional capital, increasing the investment attractiveness of the state and its competitiveness in the foreign market. Environmentally safe areas that can be used for organic production have already been allocated on agricultural lands. However, to ensure the successful development of organic agriculture, a systematic approach to inter-industries cooperation is required on an agreed methodological basis.

Our country takes an active part in the EU programs to implement the principles of sustainable development, its spatial, landscape-ecological, environmental strategies, ecological and economic management in the agrarian sector, including organic production. However, agricultural production in the prevailing territory of Ukraine is still carried out on a classic basis of

traditional and intensive production using a plant protection system, which contains pesticides, synthetic mineral fertilizers, which is contrary to the requirements of organic farming. Abandoned premises of fertilizers and pesticides storage in former collective farms increase potential environmental hazards for humans and NE.

It should be emphasized that environmental land use is one of the prerequisites for sustainable development of the agrosphere and society. Unfortunately, nowadays in Ukraine, as in most countries of the world, the ascendancy of material values (in comparison with environmental and spiritual) makes economic priorities dominated other motivations that destroy the foundations of nature and human's life. In societies of a market economy, they are the determining benchmark for choosing the priorities of the certain industries development, targeting consumers' demand. Compared to demand for food, demand for environmental functions of natural objects, including land (which the world community has already recognized as a commodity), as well as other non-raw values of natural resources, is scanty or absent at all. This is based on the lack of proper methods for assessing non-raw materials, including ecological resources due to the complexity of this work, insufficient public demand and weak motivation of the governing bodies. This is a negative background for the formation and development of organic agricultural production.

To reduce the intensity of land degradation and other related disadvantages, the implementation of the sustainable land use principles, NAAS of Ukraine identified the priority tasks of agrarian science for 2016-2020. Among them are sustainable nature management in agro-sphere, the formation of sustainable agro-landscapes and scientific and methodological support for the organic production development. Selection of special raw-material zones in the land fund, territories suitable for organic production, improvement of the regulatory and legislation, the institutional support system, and the growth of proper motivation of the management subjects should facilitate the acceleration of the organic agriculture distribution.

According to statistics [57], Ukraine has significant potential of organic agricultural production, as well as growth of its

consumption in the internal market and exports. This is evidenced by the 24th place that Ukraine has among the world's organic leaders by the volume of certified agricultural lands (289 thousand hectares). The share of these areas (in 2017) is 0.67% of the total agricultural lands in the country.

According to the Ministry of Agrarian Policy and Food of Ukraine, this branch will become one of the priorities mentioned in the Strategy for agriculture and rural development 2015–2020. Ukrainian organic products, in particular, cereals, juices, syrups, jam, honey, meat and dairy products are already actively filling the internal market and beginning to win European markets. Organic Federation of Ukraine states that Ukraine produces more than 400 organic products, 90% of which are exported to 40 countries, mainly to the Netherlands, Germany and the United Kingdom. These are cereals – corn, wheat, barley; oil – sunflower; as well as beans, wild berries, mushrooms, nuts and herbs. According to FiBL and IFOAM [57, 58], in 2017 organic exports from Ukraine reached 264 thousand tons for $ 90 million. In 2018, 300 tons of organic honey and more than 400 tons of frozen raspberries were exported; export of organic sunflower oil was increased. Deddens Agro Ltd is already dominated the Ukrainian market producing organic sugar (more than 800 tons).

Until February 2019, for the certification organic products from Ukraine, 18 international bodies have been accredited (EU Regulation 1235/2008). Most organic operators in Ukraine are certified according to EU Regulations 834/2007 and 889/2008, which are used both for export and for the internal market [58].

Methodological (scientific and methodical) principles and problems of organic production. Nowadays world agrarian production is based on the concepts of innovative, competitive organic agricultural products, adaptive agriculture and sustainable spatial development that require transparency, responsibility and co-ordinated cooperation. Organic farming to some extent meets these requirements, because it is oriented on harmonious observance of the principles for preserving the people's health, environmental management, equity of interests (distribution of benefits) and the principle of care. This dynamic system of

interdependent components of management and control is the ethical basis of activity. Therefore, foundations of sustainable development should be the methodological basis for the implementation of organic production (see Fig. 3.1).

On the basis of cooperation between FIBL, Institute of Agroecology and Environmental Management of NAAS (Skvyra research station for organic production) and Bila Tserkva National Agrarian University in the framework of fundamental research 03.03.00.05F (SR No. 0111U003790) during 2016-2020 we develop scientific and methodological approach for the formation of sustainable organic agro-ecosystems. The research is made on the main groups of agricultural crops in the conditions of the Right Bank Forest-Steppe. From 2013 Skvyra research station for organic production is the only one in Ukraine certified testing ground among the institutions of NAAS for demonstration organic production technologies and educational process.

Organic agriculture has ecological properties as it should be based on the principles of natural ecosystems, their productivity and sustainability, and the cycles of their development, ensuring coexistence with them and supporting them by environmental production and anthropogenic load within the limits of norms (nature resource potential and the limits of environmental sustainability of a certain ecosystem, landscape or territory). That is, production should be based on the ecological processes of certain types of ecosystems (agroecosystems, hydroecosystems, ecosystems of farms, etc.) and processing should be as close to nature as possible.

To ensure the harmonization of the economy and environmental requirements, organic agriculture management must be adapted to the ecological conditions of territories (taxa of territorial and administrative division, local landscapes, agroecosystems, and artificial production premises). The problem of harmonizing social, economic and environmental requirements is that the taxonomy of the administrative division of territories (including the territory of certain enterprises) does not coincide with the territories of certain landscapes, catchment areas or ecosystems, but they are only their share. This greatly complicates

ecosystem management and minimization of negative impact on the natural environment [2, 6].

State should also focus on the social aspects of changing agricultural technology and its environment, since local communities, especially rural and village, are currently at the initial stage of self-identification, formation and development program's activities in a context of decentralization, negative effects of changing land ownership patterns (shortcomings of land reform, land market, etc.), lack of qualified specialists and high-quality management.

The current unfavourable demographic situation in the countryside (unstable political situation, loss of motivation for development at the place of residence, departure of young people, reduction of senior citizens, etc.) led to a sharp decrease in labour resources in rural areas, which complicates the development of communities and the introduction of new ideas including the implementation of organic food production. Therefore, it is to be expected that the indicated changes in the norms of agricultural technologies can be perceived ambiguously – as a consequence of modern processes of demographic, socio-economic and ethno-social nature, especially in depressed regions (for example, Polissya, Carpathians). It would be desirable to expect that the implementation of organic land management will contribute to the solution of these problems in the countryside, but executive authorities and non-governmental organizations that are involved in this activity should take an active part in its implementation.

To create favourable conditions for biological, organic and other environment oriented agricultural methods aimed at efficient and sustainable use of land resources, their protection, preservation and reproduction of land fertility, it is necessary to put into practice the landscape and environmental principles of nature management, to ensure that the owners respect the classical principles of agriculture (contour, adaptive-landscape), stable functioning of agro-ecosystems and agro-landscapes. In Ukraine, there is already groundwork for strategic directions and mechanisms for implementation principles of sustainable nature management, integrated solution of food safety problems by means of

conservation of land resources, increase of soil fertility, optimization of agricultural technologies, formation of environment stable agro-landscapes, landscape-ecological optimization of protective forest plantations, harmonization of environment-users and environment-guards interests in catchment areas and transition of agriculture to sustainable development as a mechanism of system implementation these standards into practice and cooperation on these issues.

However, under the anthropocentric paradigm of rational nature management, conflicts of social, economic and especially environmental values, relevant motives of activity, regulatory and legal bases and action of social activity at different hierarchical levels of management and cooperation are still occurring. They are particularly exacerbated in competitive market conditions under the economic interests' globalization on the background of degradation values of the society development, in the transition period of state formation, imbalance of legislation branches, ignoring subjects of legislative requirements regarding the activity, ineffective use of existing regulatory mechanisms of governance, etc. [2, 6]. So far, some issues are still without due regard: problems about increasing the number and intensification of environmental, economic and social risks in organic agriculture; the dynamics of these threats in space (from agrarian lands to agrosphere) and time; identification and evaluation the effects of their overlay (summation, synergy) and their environmental, economic and social consequences; characteristics of potential changes in agroecosystems at different levels of their organization in farms, agrolandscapes, ecotones between them and ecosystems; biodiversity conservation, etc. [42].

The refusal from an important component (the classical system of plant protection) in organic farming results in at least five risk groups: harmful insects' activation, crop diseases, weeds, change in the quantity and quality of yield, production efficiency [40]. These problems will be manifested differently, depending on the weather conditions, the type of crops and their cultivation technologies. To solve them requires research on the basis of sustainable development (system harmonization of social, economic and environmental imperatives/interests/principles), systemology

(interdisciplinary approach and analysis). In order to align various interests, integrated management is needed: inter-industrial and inter-sectoral cooperation, economic and natural resource management on ecosystem basis.

At present, the theoretical and practical problems of successful implementation of organic production are actively being studied by scientific and expert groups of Ukraine. There is criticism about the lack of scientific substantiation of organic farming, the total prohibition of almost all synthetic fertilizers and pesticides [59]. There are still debates regarding the full value of yield in organic production, the protection of agricultural crops from insects, diseases and weeds, the selection of resistant varieties and hybrids to changed environmental conditions, etc. Lack of knowledge on these issues significantly inhibits the spread of organic movement in Ukraine, implementation of organic agricultural production for food and feed for livestock.

Implementation principles of organic production into practice should be carried out when developing regional (at the district level) and local programs of socio-economic development, following the «Concept of Sustainable Development of Agro-Ecosystems in Ukraine for the period until 2025». Social, economic and environmental interests need to be harmonized on the basis of system analysis of the situation on specific territories, the conditions of the activities of certain enterprises, the principles of mutually beneficial and transparent cooperation, environmental and economic management of natural resources and the associated social, economic and environmental threats.

Thus, organic production of food and feed for livestock is a strategically important direction for Ukraine, which it implements in the context of European integration and harmonization of social and economic standards. Therefore, organic agriculture should be considered not only as a new direction of activity of the agrarian sector, but also on the methodological basis of sustainable development and sustainable nature management, defined by international documents ratified by Ukraine and corresponding commitments. From this perspective, organic agricultural production is an important component of the harmonization of the

agrarian sector of the economy and the Ministry of Ecology And Natural Resources Of Ukraine, as well as the human security and the protection of NE. The motivation, goals, programs and methods of these institutions are significantly different and often contradictory. Therefore, under the prevailing anthropocentric paradigm in Ukraine, implementation of the sustainable nature management principles and greening the economy are inhibited, which hinders the implementation and programs of organic production.

Ukraine is currently in the first stage of the formation proper legislation, institutional and resource support for the implementation organic farming standards into practice. There is a hope that it will promote a certain harmonization of the man's interests and the economic interests of various adjacent to organic farming sectors among themselves, as well as with human security and environmental institutions. To achieve this goal, it is necessary to reorient the model of the agrarian sector of Ukraine from the economic bases to the environmental-economic, wider implementation of the integrated management principles in agriculture. Effective development of the agrarian industrial complex in this direction is still hampered by the lack of favourable motivational atmosphere in the relations between consumers of organic agricultural products and land use subjects, between organic enterprises and environmental institutions, between the central and local executive authorities, and between adjacent farms. The basic obstacle to establishing an agreed co-operation between these subjects is a deep conflict of social, economic and environmental interests that manifests itself in all sectors and levels of governance in the «society-nature» relationship for a number of reasons: the consequences of a system crisis in the transition period of state creation; negative consequences of land reform; deterioration of the social structure of the rural population; disadvantages of the agricultural product market; the contradiction between the impoverishment of the population and the increase in the cost of the subsistence minimum, including prices for organic products; current unfavourable social-political processes, etc.

In order to achieve proper and qualitative implementation organic agricultural production into practice, there is a need in harmonization normative documents, norms and rules with international standards, veterinary and sanitary requirements, which determine or extend the requirements for organic products and raw materials, as well as instructions and recommendations for food products and conformity assessment procedures. It is worthwhile to start with the creation of an optimal structural-functional organization and spatial-temporal structure of agro-landscapes – to optimize the ratio of land plots which have special purpose use (arable land, natural fodder, wetlands and protective forest plantations), as well as to adhere already tested positive practices of adaptive-landscape, landscape-ecological nature management on ecosystem-based inter-industry cooperation with parity agreement of social, economic and environmental interests.

In general, to create favourable conditions in Ukraine for transition agrarian sector to the organic production framework, it is necessary first to create the proper regulatory, managerial and legislative basis for the transfer to sustainable development of the agrosphere, which would increase the motivation for the expansion and development of such activities and increase the flow of necessary innovations and resources. The following tasks must be solved: adoption of the Concept and Strategy of Sustainable Development of the State and the branches of the economy (taking into account organic production), as well as creation of a coherent system of legislation in this area; reduction of poverty, outflow of youth from village to city and abroad, minimization of other processes concerning to society development degradation; decentralization and promotion of the civil society formation; partnership between the branches of power at the local, regional and state levels; implementation of an effective economic mechanism for systematic harmonization of nature, land use and environmental management; improvement of procedures for access to information on state and dynamics of NE and people's health; ensuring cross-sectoral and interagency harmonization of actions taking into account interests of all social groups on the basis of partnership between the authorities, citizens and public associations, and the private sector.

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3.2. Rent approach to ecological and economic assessment of the value of organic land

The socio-ecological and economic development, in particular, the agricultural sector, depends on the process of building land relations, which is one of the decisive factors in land transformation and land system.

The new land use model needs to take into account the integral potential of the territory, conservation, rational use and reproduction of all resources in the corresponding area. Land use should be considered in accordance with the considerations of A.M. Tretiak, which invests in the concept of «land» the whole ecological system in which the land is located, namely the complex of factors of the environment, natural conditions of production, which determine the growth and development of plants, the conditions of agricultural land use [1, p. 94].

The main objective of the current stage of land reform is to strengthen the stimulating and regulatory function of the economic mechanism of agrarian land use, the main components of which are rental relations, economic evaluation of land, land payment,

increase its efficiency and transition to an ecologically oriented model of land use.

Environmental resources need to be used most rationally and profitable, while preserving them for the future. This use should be based on the understanding of both natural conditions and types of land use. Achieving such an understanding and comparing the most promising types of land use is a function of land valuation.

Land quality evaluation is the basis of economic and cadastral evaluation. Land evaluation - definition of land productivity for its use for these purposes. It implies the implementation and interpretation of fundamental research on climate, soils, vegetation, pollution and other aspects of land in terms of requirements of alternative forms of land use, as well as the obtaining of a comprehensive land characteristics according to their level of fertility and production efficiency based on standard land characteristics.

The basis for valuation the quality of land is the information on natural land characteristics (natural vegetation, soil, climatic, relief properties, etc.) contained in soil, geobotanical and other materials of surveys and surveys, as well as in other sources.

Land valuation goals. The valuation of the land may be due to the current productivity of the land. However, this often entails changes and their consequences: in the use of land, and in some cases in the land itself.

The valuation takes into account the type of management of the enterprises concerned, the social consequences for the population of the region and country, the favorable or unfavorable state of the environment. Thus, the valuation of the land should include the following issues:

– the current state of the land plot;
– types of land use that are physically possible, economically and socially meaningful;
– adverse physical, economic and social consequences associated with the use of land;
– possible and necessary changes in the state of land;
– necessary measures to achieve the desired production and minimize the negative consequences;
– the benefits of each form of ownership for land use.

– costs for implementing changes.

The economic valuation of land masses on the basis of the account of the qualitative state of soil, its functions serves as a basis for assessing a more realistic price for soils, which due to the inefficient use of these natural resources is significantly lost.

A valuation of the ecological state of the land should include the study of all options for reducing the level of soil productivity and accordingly, based on the processed data, influence the value of the monetary valuation of land use.

The evaluation process provides information on which decisions can be made. The environmental and economic valuation should include the calculation of potential costs that may include:

- the cost of lost products as a result of pollution, depletion and use of natural resources, as well as the costs of disinfection and control of pollution;

- additional expenses, which are caused not by the complex use of raw materials, insurance and health care.

The cultivation of organic products is carried out on agricultural lands, which implies that the analysis of the cost of lease/purchase and sale of land under this type of alternative farming takes place on the basis of the calculation of land rent. Land rent is an expression the a certain amount of money, which the landowner annually saves from the proceeds from the lease of land [2, p.172-173].

Land rent of organic land and lands transformed into organic includes the calculation of income based on the taking into account:

a) Absolute Rents – a form of land rent, which is must payed to the owner for any plot of land, regardless of its fertility and location. In absolute rent, the landlord receives income as a result of the permission to capitalize on the land plot, regardless of the soil fertility;

б) Differential rent I introduced by K. Marx, which determines the production of the product by the investor on more productive lands (organic land, by its characteristics, is already more productive than the usual land plot) and the receipt of additional profits or leases on this land. This rent, of course, varies depending on the general supply and demand for agricultural crops and the ruling market price of the products. As for land plots that are only planning to be transformed into the organic category, the differential rent and type should be

clearly used in calculating their value, due to the emergence of different levels of suitability of land for transformation. And of course, better quality land, less contaminated, will require less costs to bring them to a natural state;

в) the actual amount of additional costs invested in improving the quality of the land parcel and called the Differential rent II, which determines the increase in production, avoiding changes in the size of land plots. Thus, the process of improving the qualitative components of the soil cover on the land massif, resulting in the average costs of production in such areas are reduced and creates a profit;

г) Ecological rent, which significantly affects the quality and safety of products and, accordingly, depends on the ecological cleanliness of the land mass, in particular the environmental quality of the indicators determined by the agrochemical passport. However, all indicators can not be taken into account, as a result of which it is necessary to determine a typical list of pollutants, which will allow the assessment of eligible land to be converted into organic.

An analysis of the rent formation mechanism after the calculation of the land plots comparison of different quality was presented in the monograph by L.Ye. Kupinets [3, p. 352], proceeding from the demand for organic products and insignificantly undoing the production costs of low quality land and organic land. The rent of the latter far exceeds the rent of other types of plots. Similar indicators testify to the need to introduce environmental rent as such.

The methodological approach, taking into account the quality of land, which provides an valuation of the soil-climatic conditions, can also be seen in the researches by Sharyi G.I. [4, p. 93]. This methodical approach adequately carries out a classification division between lands and their quality. The underlying factors in the assessment are soil factors that affect fertility. Otherwise, the formation of land rent occurs in relation to the cost of production and transport, as a result of the existence of restrictions that lead to the emergence of marginal costs. It is determined that to use the appropriate approach it is necessary to have a factor (criterion) in order to characterize the mechanism of cost formation.

The elaboration of criteria for calculating environmental rent may include both the data of agrochemical passports and indicators

of environmental risks, degree of pollution, which can also bring significant changes in the future use of the land, the yield fluctuations and, accordingly, the income from the resulting products [5, p. 481, 6, p. 46].

The degree of contamination of the territory included in the ecological component of the rent can be estimated separately for each of the pollutants by the following indicators: the concentration factor or the MPC, with the fact that the concentration coefficient K_c, according to experts [7, p. 110], it is possible to calculate relative to the natural regional-background content of a certain chemical element in the corresponding component – soils, waters, etc.

In calculating the rent of land masses, which are only subject to conversion to organic, the necessary condition is the inclusion of the cost of measures of transitional period of creation from the ordinary land to the organic. These include: surveying, pre-planting soil preparation, removal of contaminated substances with the help of innovative technologies, consolidation of homogeneous quality characteristics of land masses, reducing the risks on the land mass, waiting for a three-year transition period of the «rest» of the land, planting of crops, caring for crops, plant protection, other work and costs.

The best option for the assessment of organic land is the methodological approach, which is based on the capitalization of rental income and the most effective use, that is, physically possible and economically expedient use of land and/or land improvements in accordance with the law [8, p. 11].

The rent generated by the use of land of better quality and location will be the difference between the expected income from production, production costs and the profit of the producer and will be the source of the land tax.

Land price is a capitalized land rent, which is characterized by the ratio of the value of land rent and the loan interest rate. The ecological rent is identified as part of the land rent as part of the additional income received by the land user from the ecologically safe land [9, p. 352-360]. It follows that the growth of land rent, including ecological, will lead to the equality of other conditions to increase the effective indicator, that is, the price of land. Calculation of land rent of

organic land (LR_{ol}) and land subject to transformation into organic (LR_{tol}) can be represented as follows:

$$LR_{ol} = ДР_{(I+II)}, \quad (3.1)$$

$$LR_{tol} = AR + DR_{(I)} + DR_{(II)}, \quad (3.2)$$

where DR – differential rent; AR – absolute rents.

The valuation requires comparing the benefits and resources needed for different types of land. Land itself requires the production potential, and conservation of nature requires the adoption of measures to protect it. Suitability for separate use of land use is valuated by comparing the benefits: environmental, land use, land costs, environmental costs, reimbursements, fines, costs for social improvement, reimbursement, treatment, labor, fertilizers and road construction and requires the use of a land improvement factor $К_{improvement\ of\ land} = К_{environmental\ improvement} \cdot К_{economic\ improvement} \cdot К_{social\ improvement}$ (table 3.1):

$$К_{improvement\ of\ land} = К_{environmental\ improvement} \cdot К_{economic\ improvement} \cdot К_{social\ improvement} \quad (3.3)$$

$$К_{economic\ improvement} = S_{benefits\ from\ land\ use} / S_{costs\ of\ land\ maintenance} \quad (3.4)$$

$$К_{environmental\ improvement} = S_{monetary\ assessments\ of\ environmental\ benefits} / S_{monetary\ assessments\ of\ environmental\ costs,\ reimbursement,\ fines} \quad (3.5)$$

$$К_{social\ improvement} = S_{monetary\ assessments\ of\ the\ improvement\ of\ the\ habitat} / S_{monetary\ cost\ estimates\ for\ basic\ costs} \quad (3.6)$$

Based on this, the environmental rent can be calculated according to the formula:

$$ER_{ol} = (DR_{(I+II)}) \cdot К_{improvement\ of\ land} \quad (3.7)$$

$$ER_{tol} = (AR + DR_{(I+II)}) \cdot К_{improvement\ of\ land}, \quad (3.8)$$

Since it is a question of organic land massifs or of land that is subject to transformation into organic, it will not interfere in the evaluation, to distribute land by classes of purity on the basis of a ballpoint valuation of the ecological purity of the site (P_{ec}) [10], which includes levels of contamination by radionuclides, pesticides and other organic substances, heavy metals and other harmful substances with respect to

Table 3.1

Example of calculation of land improvement coefficients

Formulas for calculating the coefficients of improvement of land	$S_{benefits\ from\ land\ use}$, UAH.	$S_{cost\ of\ land\ maintenance}$, UAH	Coefficient
$K_{economic\ improvement} = S_{benefits\ from\ land\ use} / S_{costs\ of\ land\ maintenance}$ (The effect of improving product quality)	122400,00	27592,00	4,44
$K_{environmental\ improvement} = S_{monetary\ assessments\ of\ environmental\ benefits} / S_{monetary\ assessments\ of\ environmental\ costs,\ reimbursement,\ fines}$ (The effect of increasing the profitability of production)	$S_{monetary}$ assessments of environmental benefit, UAH.	$S_{monetary}$ assessments of environmental costs, reimbursement, fines, UAH.	Coefficient
	246500,80	717392,00	0,34
$K_{social\ improvement} = S_{monetary\ assessments\ of\ the\ improvement\ of\ the\ habitat} / S_{monetary\ cost\ estimates\ for\ basic\ costs}$ (The effect of increasing employment, which is reflected in the cost of jobs)	$S_{monetary}$ assessments of the improvement of the habitat, UAH.	$S_{monetary}$ cost estimates for basic costs, UAH.	Coefficient
	1865,00	2115,00	1,13
$K_{improvement\ of\ land} = K_{environmental\ improvement} \cdot K_{economic\ improvement} \cdot K_{social\ improvement}$	1,73		

Notes: Sbenefits from land use – expected income from products UAH/ha; Scosts of land maintenance – production costs, UAH/ha; Smonetary assessments of environmental benefits – the profit of the producer from the receipt of products from the organic site; Smonetary assessments of environmental costs, reimbursements, fines – producer costs, calculated on the total area of the plot; Smonetary assessments of the improvement of the habitat – the cost of creating additional jobs; Smonetary cost estimates for basic costs – basic costs for existing jobs.

their maximum Permissible values. Point of environmental cleanliness of the site (*Pec*) can be calculated (table 3.2) by the formula:

$$P_{ec}=K_1 \cdot K_2 \cdot \ldots \cdot K_i, \qquad (3.9)$$

where K_i – the coefficient shows the ratio of the reference value to the actual value of the pollution indicator.

Different types of land use have different requirements. For example, alluvial floodplains can be well suited for rice cultivation, but not for other crops. The notion of land suitability makes sense only

from the point of view of specific types of land use with its requirements, for example, soil moisture, depth of the root system, etc. Properties of each type of land, such as the presence of moisture or the possibility of flood, are compared with the requirements and use as organic and suitable for such. Thus, the necessary condition for land valuation is the introduction of a point of

Table 3.2

Example of calculation the point of environmental cleanliness of the site

	Pollutants	The content of pollutants	MPC	MPC/content on site
K_1	Cd	0,33	2	0,17
K_2	Pb	11,65	60	0,19
K_3	^{137}Cs	0,072	0,15	0,48
K_4	^{90}Sr	0,007	1	0,01
K_5	ДДТ	0,001	0,1	0,01
K_6	2,4 D-amine salt	0,002	0,25	0,01
P_{ec}	1,00			

Source: calculated using [11].

eligibility of a land plot for use as an organic (P_e). Point of eligibility the land plot for its use as organic consists the product of the coefficients of the degree of loss of humus and nutrients, recoil, swelling and peeling, water erosion, acidification, waterlogging, wind erosion, salinity, degradation, salinization, silting, reduction of surface, deformation of the earth's surface by wind, irrigation soils and etc. (table 3.3).

$$P_e = K_1 \cdot K_2 \cdot \ldots \cdot K_i, \quad (3.10)$$

where K_i – the coefficient shows the ratio of the reference value to the actual value of the indicator of the optimal qualitative state (ground quality, climatic conditions, relief conditions, etc.).

The size of the price of land closely depends on the level of capitalization established in the economy, as a discount rate, bank interest on a long-term loan (for today 17 %) [12, p. 93].

Then the normative price of the land plot, which is suitable for transfer to organic forms (table 3.4):

$$PL_{tol}=LR\cdot T=[(AR+DR)+(ER\cdot P_e\cdot P_{ec})]\cdot \frac{1}{r}, \quad (3.11)$$

where T – term of capitalization; r – the rate of capitalization of net income.

Table 3.3

Example of calculation the point of eligibility of the land for use as an organic

No.	Definition of the coefficient	Current values	Standard values	The ratio of the reference and the current value
K_1	ground quality, points of bonitet (p)	46	55	0,84
K_2	climatic conditions, minimum temperatures of ecotope (◦C)	20,0	17,5	0,88
K_3	relief conditions, distribution of solar heat on the exposure slopes (%)	75	100	0,75
P_e	0,55			

Source: calculated using cartographic materials

The result of such a calculation may be the formation of differentiated scales and rates of valuations of the existing classification of land, land tax rates and rent taking into account the environmental component, which are formed on the basis of land rent.

Table 3.4

Example of calculation of normative monetary valuation of a land plot subject to transformation into organic, UAH

LR	26720,00
AR	640,00
$DR_{(I)}$	10240,00
$DR_{(II)}$	15840,00
$ER_{tol}=(AR+DR_{(I+II)})\cdot K_{\text{improvement of land}}$	46187,88
r	0,17
$ER\bullet P_e\bullet P_{ec}$	25350,85
$PL_{tol}=LR\bullet T=[(AR+DR)+(ER\bullet P_e\bullet P_{ec})]\bullet 1/r,$	213122,63

Ecologically oriented reformation of land relations to the development of various forms of property, in particular lease relations, must have an appropriate economic and environmental justification. The regulation of lease relations is based on the rental theory of evaluation, which should take into account both the quality and location of the sites, and the costs and results of their use. In order to justify rent, as well as land tax rates, it is necessary to conduct qualitative ecological zoning of territories in accordance with the certification of oganic lands, as the basis of accounting and auditing of agricultural enterprises.

The analysis of land characteristics, lowering the qualitative background, which leads to lower yields and increases in costs, allows us to determine the economic value of land as a natural resource and a monetary valuation of organic land plots. It is logical to assess the market value of agricultural land, taking into account the environmental (ecological) rent, as part of the additional income received by the land user in the environmentally sound land. The accounting of the ecological component in the value of land will depend on the class of purity and suitability of natural conditions for a particular type of agricultural crop.

Consideration of the ecological component in the assessment of land will provide an important practical result – to formulate zonal recommendations for economic entities, respectively, their main specialization and serve as a basis for establishing rental rates for land plots.

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3.3. Analysis on the system of certification and marking for organic commodities

At present, commodities with low quality is growing on the consumer market. Worse quality of raw materials, low technical, technological and sanitary levels of production, the weakening of commodities quality control, inadequate certification and standardization contribute to this issue [1].

That is the reason why the last ten years are characterized by increasing the consumption and, accordingly, production of environmentally friendly foodstuffs, by which we mean products grown on a safe area without the use of pesticides, various fertilizers, etc.; or it is a commodities obtained from natural raw materials under new, more modern technologies that ensure minimum other substances in the product.

Organic farming is one of the most modern trends that is gaining momentum all over the world. In the past 16 years, its areas have increased by 4 times; over 2 million organic producers have been certified, more than three quarters of which are located in developing countries. Nowadays, about 1% of the world's agricultural land is involved in organic production.

Trends in organic production are relevant in more than 170 countries in the world, and this figure is increasing annually due to the fact that organic commodities are becoming popular among many social groups for various objective reasons. The development of organic production in Ukraine is at the active formative stage. According to Organic Federation of Ukraine, since 2002 (when the organic direction began to develop in the country), the number of certified farms has increased by more than 100 times, and the total area of certified lands has tripled. It gives the experts a reason to assert that organic agricultural production has become one of the most promising direction in agrarian business**.**

According to the International Federation of Organic Agriculture Movements (IFOAM), the area of domestic certified organic farmlands in 2016 accounted for only 0.9% of the total area of agricultural land. In general, there were 294 organic farms in Ukraine.

Table 3.5

Organic farming: key indicators and leading countries [2, 5]

Indicator	World	Leading countries
Countries with certified organic farming	178 countries	
The total area of agricultural land under organic production	57.8 million hectares	Australia (27.1 million hectares) Argentina (3.0 million hectares) China (2.3 million hectares)
Producers	2.7 million producers	India (835.000) Uganda (210.352) Mexico (210.000)
Organic market	Billion 89.7 USD (more than billion 80 EUR)	Switzerland (304 USD - equivalent to 274 EUR) Denmark (252 USD- equivalent to 227 EUR) Sweden (218 USD - equivalent to 197 EUR)
Consumption per capita	12.1 USD	Switzerland (304 USD - equivalent to 274 EUR) Denmark (252 USD - equivalent to 227 EUR) Sweden (218 USD - equivalent to 197 EUR)
Number of countries with legislation in production and turnover of organic commodities	87 countries	

Grain crops were cultivated at almost half of the lands with a total area up to 400.000 hectares, about a quarter of which were under oilseeds and grain legumes. Vegetable plantations, gardens and various agricultural crops occupied the other territory. In addition, 550.000 hectares of wild crops are certified in Ukraine.

According to the U.S. Commercial Service in Ukraine, the average return on investment in Ukrainian organic farming is about 300%; it makes it one of the most attractive areas for investment in Ukraine. As the enterprise «Organic Standard» reports, as of

August 20, 2017, 485 entrepreneurs received a certificate on organic production in Ukraine. Most of them (244 pcs) are engaged in plant production. However, production of raspberry and other berries has made up the greatest number of new certifications this year. Thus, Ukrainian farmers combine organic production with the niche one, increasing the profitability of business.

The true driver of domestic organic farming is and will be an export market. That is not surprising - the European market is more solvent than Ukrainian one, especially when it comes to the implementation of expensive organic products. In 2017, the total exports of organic products from Ukraine exceeded 65 million euros, according to theOrganic Federation of Ukraine. Grain crops, legumes, oilseeds and berries were dominant in the export structure. Although oil, grain cereals, dairy products, etc. were also exported.

According to the experts of the APK Inform-Agency, in 2017, about 170. 000 tons of organic grain and pea were exported from Ukraine, which significantly exceeded the figures for 2016 (150.000 tons) and almost twice as much as for 2015. Wheat and corn have become the main grain crops; EU countries and Switzerland - key buyers. Only 2% of shipments took place to the Middle East, USA and Canada.

The Netherlands was the leader in purchasing Ukrainian organic grain - 72.300 tons were shipped in 2017, three quarters of which was sweet corn. Nine Ukrainian enterprises imported organic grain to the Netherlands. In particular, Kherson company«Firm Alef» LTD, which provided 63% of total exports, can be considered as a leader.

The second largest importer of Ukrainian organic grain is the United Kingdom (21.000 tons in 2017 year), which predominantly buys cheap raw materials for feed production. Wheat prevails in the supply chain (more than 60% of all exports), and only three Ukrainian companies worked on shipment to the United Kingdom. However, «Regional Grain Trading Company» provided about half of the realization.

Germany is also the strategic market for organic producers in Ukraine. This country bought almost the whole organic nomenclature last year; wheat came first among grain crops (more

than 60%). It is with Germany that the largest number of Ukrainian companies (21), specializing in the organic direction, are working; that shipped more than 20 000 tons of grain in 2017. The leader among them was the «Ritter Bio Agro» LLC, which provided 22% of all exports.

Austria is an important and solvent market, which has demonstrated a dynamic increase in imports of organic commodities from Ukraine for the past two years. «According to APK-Inform, the country purchased 18.600 tons of Ukrainian organic grain corns in 2017,» says Drusz. - Traditionally, organic wheat and corn, which accounts for almost 90% of shipment, dominated in the structure of exports to Austria».

The top five buyers of Ukrainian organic products is closed by Italy, which imported 14.500 tons of Ukrainian organic grain last year. The undisputed leader of sales was sweet corn (over 75% of exports); organic wheat and barley constituted the rest.

However, people in Ukraine consume much less organic food than residents of EU countries. This indicator is € 3 per capita, while in the EU - € 53.7. Ukraine ranks 25th by the volume of the internal organic market: the products from organic farming land per hectare amounted to € 50, while € 2345 - in Europe.

The production of all organic products begins with the land certification. Even if it refers to dairy products or meat, the fields and pastures used for animal farming must receive the organic status first. Cows that give organic milk should be pastured. The land should be certified as organic one to prevent the possible pesticides, dioxins and other chemical additives in the grass and, consequently, milk or meat.

The farm has a right to receive a certificate on animal farming upon receipt of an organic land certificate. Animals that have not consumed growth hormones and antibiotics give organic meat and dairy products.

The term «certification» was invented by the Certification Committee of the Council (SERTICO) of International Organization for Standardization (ISO). A certificate is a permit that confirms the standard, that is, the quality of goods. Standardization is a work on development, issue and use of

standards as for establishment of norms, principles and characteristics in order to guarantee the safety of commodities. The standard should be understood as a normative and technical document that establishes a set of norms, regulations and various requirements for the product.

Any products must comply with the requirements of the state standards and technical specifications declared by the manufacturer. Any goods, product, material or unit with improved environmental characteristics can be considered as eco product. Such characteristics are determined by environmental criteria (standard), which products must meet in order to be marked legally. The ecological certificate and marking confirm the competitive advantage of products in the national and foreign markets. The overwhelming majority of consumers tend to choose the most safe and high-quality products to satisfy their needs. According to psychologists, people's tendency to natural and environmental goods or services is explained by the desire to control their lives better, which is becoming more dynamic, unpredictable, stressful and technogenic. When choosing safer products, the consumer wants to be sure that the «environmental friendliness» declared by the producer is true. Therefore, he will give preference to the certified products. First of all, the consumer is interested in the product itself, its quality and satisfaction of own needs. The selection criteria related to the safety and product's impact on health or environment are among the priorities. Therefore, the environmental criteria under the certification scheme in accordance with ISO 14024 necessarily contain criteria for evaluating safety indicators, components and finished product, unit or material. It is one of the most dynamic markets, which has shown annual growth of up to 4% from 2010, even under economic downturn, and has the largest potential for growth. The development of ecological services in tourism, leisure and beauty requires more and more ecological production. Green building requires innovative solutions and environmental building materials.

By the beginning of 2017, the global eco-label market was estimated at billion 4.200 EUR with an EU share of 21%. It increased by 40% in the USA from 2004 to 2009. At the same time,

the demand for ecologically certified real estate assets increased annually by 5-10%, ecotourism services (including hotels, campsites) - by 5%, ecological goods made from timber (furniture, parquet, paper, stationery, etc.) - by 20-30%.

France was among the European countries that presented the AB state symbol, Agriculture Biologique (Ecological products) for food. It was a logo that replaced the multiple marking methods and is currently owned by the French Ministry of Agriculture and Food. Companies that are going to apply this logo to their product shall sign a contract (agreement) with the owner of the logo and comply with all the norms established by EU law.

Also nearly 4,900 French organizations - processors of environmental products have been certified. 32 COSMEBIO (BIO sign) is an association of manufacturers, which, together with ECOSERT, have precisely designated official regulations in France. They created and approved items not only about harmless products, but also on product certification.

The only accredited control organization KRAV is responsible for the quality control of bio-products in Sweden. It is more stringent model than the inquiries established in European legislation; and is issued by the Swedish Society for the Control of Agricultural Products. This logo can be found on commodities produced outside of Sweden.

Bioland, Demeter and Naturland are the most commonly used logos in Germany. In European countries, the model of environmental safety is Council Regulation No. 2092/91 of 24 June 1991 on Organic Production of Agricultural Products. In order to give the final product an «Environmentally Safe» position, regulatory bodies control the whole process: from agricultural land and seed grain to packaging. National (certifying) organizations monitor compliance with the provisions of the Agreement on Environmentally Friendly Production.

Such country as a Finland can be singled out among the world's leading producers of environmentally friendly commodities, where the experience has reached the optimal balance of prices, high quality and compliance with world food standards.

There are different national logos worldwide that indicate on the compliance with all requirements for the certification of environmentally friendly products (Table 3.6).

Table 3.6

List of accredited certification bodies operating in Ukraine (as of 01.01.2017) [3, 5]

Logotype (marking)	Name of the certificated body	Country
1	2	3
	Organic Standart	Ukraine
	Ekolojik Tarim Kontrol Organizasyonu (ETKO)	Turkey
	Ecoglobe LLC	Armenia
	Istituto Certificazione Etica e Ambientale (ICEA)	Italy
	Austria Bio Garantie GmbH	Austria
	Bioagricert S.r.l.	Italy
	Lacon GmbH	Germany
	Abcert AG	Germany
	BCS Oko-Garantie GmbH	Germany
	IMO Swiss AG	Switzerland
	Control Union Certifications B. V.	Netherlands

continuation of tabl. 3.6

1	2	3
	Suolo e Salute srl	Italy
	Agreco R.F. Göderz GmbH	Germany
	Ecocert SA	France
	IMO-Control Sertifikasyon Tic. Ltd ti	Turkey
	SGS Austria Controll-Co. GmbH	Austria
	Bio.inspecta AG	Switzerland
	Biokontroll Hungária Nonprofit Kft.	Hungary

Four certification bodies among the aforementioned ones are from Germany, three - from Italy, two - from Austria, Switzerland, Turkey, and one from France, the Netherlands, Armenia and Ukraine. Most of them certify plant industry, animal farming and agricultural products as a food, only three - certify agricultural products as a foodstuff, and three - planting material and seeds.

Considering the lack of official statistics at the state level regarding the carrying on organic production, one of the reliable sources is the annual edition of the FiBL - «Organic Business Directory of Ukraine». It contains information on 160 business entities that benefited from the services of 11 accredited certification bodies. Thus, at the beginning of 2014, Organic Standard (63.1%) is the leader in organic certification, which closely cooperates with one of the world's leading IMO (Switzerland) companies, which increases the opportunities for entrepreneurs in the international market (4.4%).

ETC organization is rather trustworthy among Ukrainian farmers (16.3%) (Fig. 3.3). In addition, the abovementioned organizations certified 160 operators according to the standard equivalent to Council Regulation (EC) 834/2007 and Commission (EC) 889/2008, while 53 operators were trained with NOP standards and 6 operators - according to Bio Suisse standards.

Today, the Law of Ukraine «On Basic Principles and Requirements for Organic Production, Turnover and Marking of Organic Products» determines basis for organic producers. 2496-VIII, valid, - Adopted on 07/10/2018:

1) requirements for places where organic commodities and raw materials are selling;

2) procedure and requirements for the marking of organic commodities;

3) detailed rules of production:

- unprocessed organic products (raw materials) of animal and vegetable origin, incl. mushrooms;

- organic products (raw materials) of beekeeping and aquaculture;

- organic seaweed;

4) detailed rules for the collection of wild plants and forest products;

5) the procedure for assessing the suitability of land (soils) and the establishment of production zones for organic products and raw materials, criteria for the quality of land (soils), their suitability for the production of organic commodities and raw materials, and the suitability for the production of individual crops. According to the above-mentioned resolutions, organic products planned for implementation should be located in places that must be labeled with information.

In addition, commodities should have a state logo that is necessary for consumers to identify it during its circulation.

For today, a unique logo of organic marking has been created in Ukraine (Fig. 3.3).

Under the logo, the code number of the controlling body should be indicated, which consists of an acronym, which identifies the country, where the certified operator is located; a term

Fig. 3.3. The State Logo of Organic Marking (Ukraine) [6]

indicating a method that provides a reference to the organic production method and code of certification authority [4]. It is allowed to use additional non-governmental (private) logos introduced by economic entities, or their associations, engaged in the production or sale of organic products (raw materials) [2].

If the production of the commodities was carried out in accordance with the standards of the European Union, the following information should be described on the label of the organic product [6]: the EU «Euro Leaf'« logo (Figure 5), the code number of the controlling body, the country of origin of the raw material.

The above labeling is allowed only upon availability of a certificate of conformity received at any privately certified body. It should be noted that the prevailing number of agrarian enterprises are ordering certification in the following areas: crop production, processing and sale, animal farming, procurement of wild products, beekeeping, aquaculture, plant, and fertilizer protection products. In addition, there is a possibility of marking commodities in the stage of transition to organic production. This procedure is carried out using «product in a transitional period» state logo at the request of the producer, but such a logo has not been developed in Ukraine for today. The previous layout of the marking should be agreed with the organizations that certify it. When marking organic products (raw materials) it is required to indicate the following: the country of origin (the country of importer), producer and address of its facilities. If the production is at the request of another organization, both companies should be indicated. The reference to the organic production method is marked only in relation to the organic

components [2]. It is important to note that the Commonwealth logo cannot be used for products in a conversion state. According to European standards, only the indication «product in the process of transition to organic production» is possible; provided that the product is of vegetable origin and contains only one ingredient of agricultural origin, the transition period to the harvest is not less than 12 months and the indication is visually no more noticeable than the product description.

The analysis on the legal field regarding certification for commodities of organic agricultural production allows to suggest that wide range of international and private standards for assessing the quality of these products are widely used in Ukraine.

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4. SCIENTIFIC-METHODOLOGICAL AND APPLIED JUSTIFICATION OF VIRTUAL WATER' CONSUMPTION FOR ORGANIC PRODUCTION

4.1. Virtual water as an ecological and economic tool for justifying the use of water resources in organic production

The availability of fresh water in sufficient quantities and in good quality is a prerequisite for the development of human society and natural ecosystems. In many parts of the world, excessive intake of fresh water and human-induced pollution are immense pressure on the availability of water resources, as well as on food security, environmental quality, economic development and social well-being of the population. Today's problems related to freshwater scarcity may increase in the future due to increased demand for water resources, reduced availability and quality. Scientists say that in the future, humanity's dependence on water resources will increase, which will break the food security and the ecological sustainability of natural resources [1-4].

A key role in the global trends of the water trace's study is attributed to the Food and Agriculture Organization (FAO) and the Water Footprint Network. The Water Footprint Network is an alliance that brings together researchers and disseminates knowledge of the consequences of shortages and water pollution in order to change the way of using and distributing fresh water within the Earth. The water footprint network promotes the assessment of the water trail to help companies, governments, small producers and individuals understand their own water uses and get the most effective, practical advice to make their waterbody sustainable.

Visualization of the hidden use of water over the life cycle of products will help to understand the global nature of the quantitative assessment of the impact of consumption and trade in fresh water on the qualitative and quantitative indicators of water resources and to take the right stratigraphic decisions to increase the level of water resources management both within the context of a separate production process and at the regional, national and global level.

For the first time, the concept of virtual water was introduced by British ecologist John Allan [5], which understood the amount of water needed to produce goods or services. A similar concept was proposed by the professor at the University of Twente Hoekstra - The Water Footprint (WF) [6]. This tool, besides the quantitative assessment, gives an opportunity to evaluate and qualitative indicators.

There are three types of virtual water or water footprint:

1) «green» water resources are a rain water, which, as a rule, evaporates during production, including in crops cultivation;

2) «blue» water resources are a surface or groundwater, which evaporates in the products production;

3) «gray» water resources are an amount of water needed to breed pollutants entering the natural aquatic ecosystems during the production process, to obtain water quality that meets the relevant standards [6].

Structural elements of virtual streams are shown in Fig. 4.1 [6].

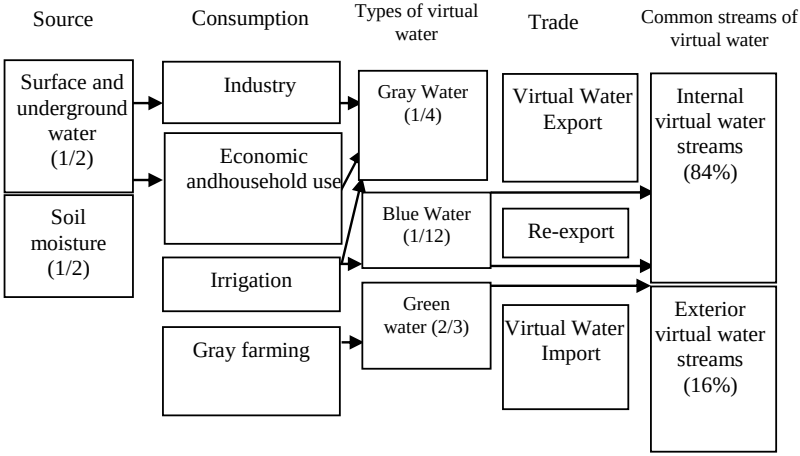

Fig. 4.1. «Water footprint» components [6]

The ecological and economic tool «Virtual Water» is a simple concept that allows to: assess the efficiency of water use: consumption and pollution; determine the sustainability of water

use: for example, water shortages, levels of water pollution, social and economic problems; identify the most appropriate strategic actions to increase sustainability, efficiency and accountability in the area of water use.

Thus, virtual water is a tool that enables a better and wider assessment of the consumer / producer's relation to the use of freshwater systems. It represents a comprehensive indicator that allows us to estimate the volumes of water consumption and pollution of water resources by all qualitative components. It is not an indicator of local environmental impacts, water consumption and water pollution, as this impact depends on the vulnerability of the local water system and the amount of water consumed by consumers and contaminants of the freshwater system. The «virtual water» tool provides accurate information on how water is used for various purposes. It is the basis for drawing conclusions about the sustainable and equitable use of water resources and its distribution, and also serves as a basis for assessing environmental, social and economic impacts.

Virtual Water is an analytical tool that plays an important role in understanding the correlation of business activities and products with water scarcity and environmental pollution, and analyzes all possible consequences and formulates solutions that promote the sustainable use of fresh water. The total assessment of virtual water flows is carried out in four separate stages (Fig. 4.2), [6-8]:

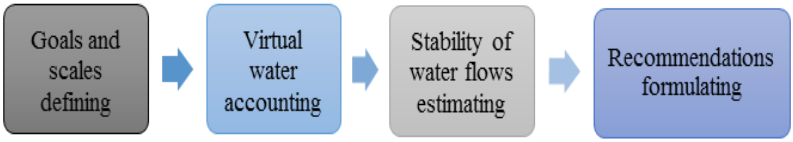

Fig. 4.2. Stages of evaluation of virtual water streams

In order to ensure the transparency of the research during the assessment of the water trail, it will be necessary to start with a clear statement of the objectives and scope of the required research. Virtual water research can be aimed at identifying many different

causes. For example, the government may be interested in establishing dependence on external water resources or it may be interesting to establish the sustainability of water use in a region where water-intensive products, including organic ones, are intensively imported. Companies may be interested to discover the dependence on scarce water resources in the logistics chain or to determine how it can help reduce the negative impact on aquatic ecosystems during the production cycle within its own operations.

The second stage involves the collection and conduct of all calculations. The extent and degree of detail of accounting depends on the decisions taken at the preliminary stage. After the accounting phase, the stage of assessment of stability comes at which the volume of virtual water is estimated from the environmental, social and economic point of view. At the final stage, they develop responses, which are then taken into account when forming a water strategy or developing an appropriate policy.

The assessment of virtual water does not necessarily include all the steps described above. Depending on the goals and scales, you can concentrate only on accounting or staying on the assessment of sustainability, leaving open the issue of identifying bottlenecks in the freshwater system.

Blue water resources, as a rule, are scarce and characterized by higher costs compared with green water, which led to the fact that most scientists focused their attention only on the calculation of blue water. However, green water may be replaced by blue water, in particular in organic production. Consequently, a complete picture can only be obtained as a result of taking into account both components. An argument in favor of accounting for green water use is that historically the emphasis on blue water has led to underestimation of green water (Falkenmark, 2003; Rockström, 2001) [9].

Analysis of methods for the virtual water evaluating, depending on the scale and location, is given in Table 4.1, [11, 12].

Table 4.1

Analysis of methods for the virtual water volume evaluating

Level	Spatial explication	Hourly explication	Data on water use	A typical technique for evaluating virtual water
1	2	3	4	5
Level A	global	annual average	literary sources and databases on typical water consumption and pollution levels in the production of the product	awareness raising; rough identification of virtual water components; conducting global forecasts of water consumption
Level B	national, regional, concrete catchment	annual in months	literary sources and databases on typical water consumption at national, regional or water intake levels	rough identification of the distribution of water resources in space and time; identification of key identification points; making a decision on the distribution of water resources.
Level C	small drainage or a specific field	monthly in days	empirical data; A database of water costs and environmental pollution levels in a specific location	knowledge base for determining the volume of virtual water, assessment of water resources sustainability; Formulation of a strategy for reducing the volume of virtual water due to local influences

Note: These three levels can be distinguished for all forms of virtual water accounting (e.g., product, national, corporate calculations).

4.2. Virtual water' consumption and trade on the global level: trends, markets, emerging risks

According to experts, annual access to less than 1700 m^3 of water per person is characterized as «water stress». Statistics also indicates that 1.7 billion people live in regions where this figure is

1,000 m^3 or less. According to the World Commission on Water for the 21st Century, 31 countries, most of which are still developing, suffer from a lack of water, and by 2050 they can be 55 [7].

China and the USA use the largest volumes of virtual water in industrial production, in particular, 22% of world-wide consumption of virtual water (WF) is associated with industrial production in China and 18% in the United States. Belgium is a country in which industrial production occupies the largest share in the total WF in the country [6].

The global average annual WF associated with the production of agricultural, industrial and household water supply in 2005 was 9087 Gm^3/year (74% green, 11% blue, gray 15%). Agricultural production accounts for the largest share, accounting for 92% of the world's WF. Industrial production accounts for 4.4% of the total WF and domestic water supply - 3.6%.

Most of the virtual water is consumed by residents of such countries as the USA, Greece, Malaysia, Italy, Thailand and others. (2100-2500 m3 of water per year per capita). A number of states from this list of countries are forced to import water in order to keep water consumption at the last level. So high consumption of virtual water per capita is provided by import of water from the USA by 19%, Greece by 35%, Malaysia by 28%, Italy by 51%, Thailand by 8% [13]. Kuwait and Malta (import of water is 87%), the Netherlands (82%), Bahrain and Belgium (80%) [14] are among the countries most dependent on imported water.

The richest countries in renewable resources are Brazil (which spends 8 233 km^3 of water per year), Russia (4507 km^3/year), the USA (3 069 km^3/year), China (2 896 km^3/year) and Indonesia (2,838 km^3/year) [9]. For the estimation of the total volume of virtual water use in production, the data used for each country in the report «Living Planet-2008» was used. In this case, the groupings are made according to the level of profits: high (24 states), average (62), low (41). Generalized information [8] is illustrated graphically in Fig. 4.3, 4.4.

Most virtual water is consumed by countries with an average (45.9%) and low (34.2%) income level. Highly developed

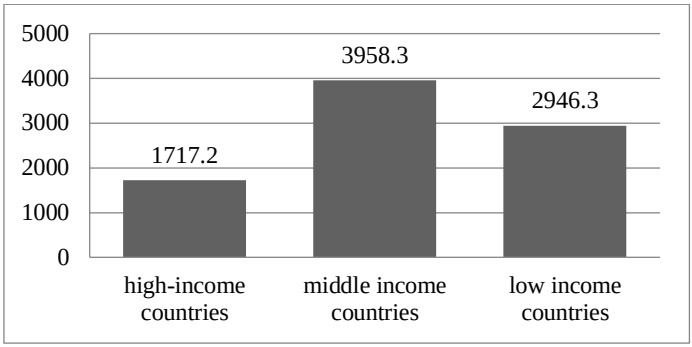

Fig. 4.3. Virtual water' consumption in the world, km^3 / year

countries, using innovative technologies in technological processes, use twice as much water while maintaining the same production volumes.

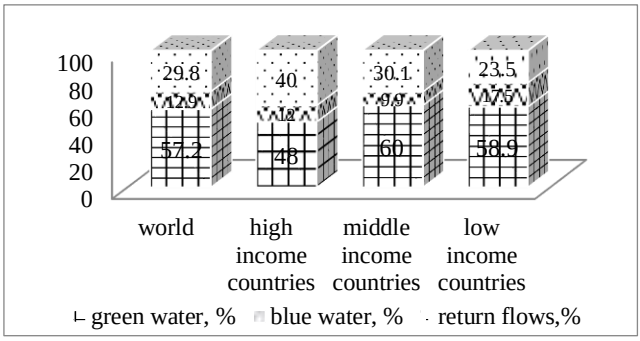

Fig. 4.4. Typization of consumed virtual water in countries according to its profit level, km^3 / year

In addition, in high-income countries, the production system returns 1.7 times more virtual water than in low-income countries, which indicates the effective use of water resources. WF per capita in developing countries varies much faster than in developed countries and is in the range of 550-3800 m^3 / year per capita. The Democratic Republic (DR) of the Congo is least significant – 552 m^3/year per capita, and most notably for Bolivia (3468 m^3/per capita), Niger (3519 m^3/year per capita), and Mongolia (3775 m^3/year per capita) [8, 15].

The largest blue WF per capita is typical of the countries of Central, Southwest Asia and North Africa. Consumers in Turkmenistan also have a large blue WF, namely 740 m^3/year per capita. Other countries with large blue WF are (in descending order): Iran (589 m^3/year per capita), United Arab Emirates (571 m^3/year per capita), Egypt (527 m^3/year per person) of the population), Libya (511 m^3/year per capita), Tajikistan (474 m^3/year per capita), Saudi Arabia (447 m^3/per capita), and Pakistan (422 m^3/per capita)) [15].

The global average blue WF consumption is 153 m^3/year per capita, which is 11% less than the total WF. So, for the household, industrial, and agricultural needs, the world used 8621.7 km^3 of water, 57.2% (4934.86 km^3) evaporated from the agricultural crop area, and blue water was irrevocably removed for irrigation in the agro-sector (over 1000 km^3). So, we can state that almost 60% of virtual water is used in the agrarian sector.

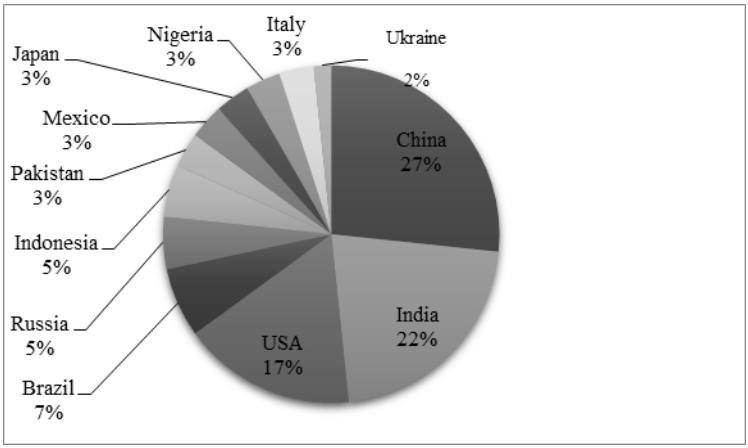

Fig. 4.5. Contribution of countries to the global consumption of virtual water [15]

In Ukraine, the average rate of virtual water consumption is 1575 m^3/person/year, while the average world index is

1385 m^3/person/year. 6.7% of virtual water streams goes beyond the country [15, 16].

In general, China is the country with the largest WF consumption in the world, where the total trail amount is 1368 Gm^3/year, then India and the United States from 1145 and 821 Gm^3/year, respectively. Obviously, countries with large populations have a significant WF. So, it is necessary to consider WF per capita [10, 17].

The ranking of countries shows that industrialized countries should have WF per capita in the range of 1250-2850 m^3 / year. The United Kingdom, with WF = 1258 m^3/year, is on the verge of the limit, while the United States with WF 2842 m^3/year is in the extreme polar position. Differences can be partly explained by differences in the structure of consumption. In the United States, for example, the average consumption of meat from bovine water-based products was 43 kg per capita per year, which is 4.5 times higher than the world average, while in the United Kingdom this figure was on average 18 kg / year per capita, approximately twice the average world average. The general trend is that industrialized countries have a larger WF associated with the consumption of industrial goods than developing countries [15, 18].

Consumption of agricultural products largely determines the global WF. So the WF of the agrarian sector makes up 92% of the total. In the world, the largest amount of virtual water is spent on the cultivation of cereals WF (27%), meat (22%) and dairy products (7%). Analysis of the total consumption of water resources in crop production, depending on the agricultural crop, is presented in Fig.4.6 [10].

WF consumption in a country depends on two factors: what and how many consumers consume. The latter depends on the production conditions in the regions where the goods are produced. The same product, which is available on the shelves of stores within the country, has different origins coming from different places, with different production conditions, and thus characterized by different values of WF in each region. All this is clearly illustrated in Fig. 4.7.

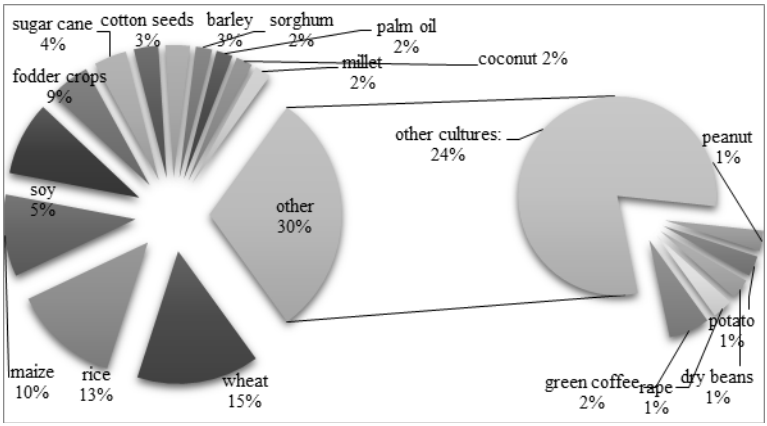

Fig. 4.6. The share of crops in the total consumption of virtual water in crop production (1996-2005) [13, 15]

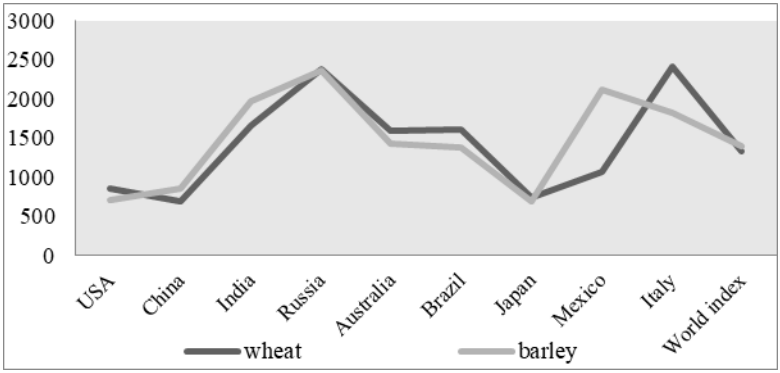

Fig.4.7. The virtual water content in agricultural crops in the context of individual countries (period 1996-2005)

* compiled based on data from the official site of the water footprint: http://www.waterfootprint.org. [15]

On average in the world to get 1 kg of grain requires 1.70 m^3 of water. Exporting countries use 1.23 m^3 of water, and importing countries - 2.05 m^3 per 1 kg of grain. Thus, agricultural importing countries, along with it, actually buy the water resources of the exporting countries, that is, they save the water they need to grow the crop of the crops they purchase. For example, Mexico imports

US wheat, corn, sorghum from the USA, which consumes 7.1 gm^3 of water in the United States. If Mexico were to grow them at home, it would have taken 15.6 gm^3 of water. The total water savings resulting from the international trade in virtual water in the form of agricultural products is equivalent to 6% of the total volume of water used in agriculture [9].

The global amount of international flows of virtual water associated with trade in agricultural and industrial products in 1996-2005 was 2.320 Gm^3/year on average (68% green, 13% blue, and 19% gray). The largest share (76%) of virtual water belongs to flows between countries that are associated with international trade in agricultural crops and products of their processing. Trade in products of livestock and industrial goods accounted for 12% of global flows of virtual water [9].

The major gross virtual exporters of water, which account for more than half of the world's virtual water exports, are the United States of America (314 gm^3/year), China (143 gm^3/year), India (125 gm^3/year), Brazil (112 gm^3/year), Argentina (98 gm^3/year), Canada (91 gm^3/year), Australia (89 gm^3/year), Indonesia (72 gm^3/year), France (65 gm^3/year), Germany (64 gm^3/year).

The USA, Pakistan, India, Australia, Uzbekistan, China, Turkey are the largest exporters of blue virtual water, accounting for 49% of world exports of blue virtual water. All these countries are partially water stressed, raising the issue of assessing the explicit or implicit consumption of limited national blue water resources for the production of export products from the point of view of sustainability and efficiency [15, 21].

The main gross virtual importers of water are the United States of America (234 gm^3 / year), Japan (127 gm^3/year), Germany (125 gm^3/year), china (121 gm^3/year), Italy (101 gm^3/year), Mexico 92 Gm^3/year), France (78 Gm^3/year), the Netherlands (71 Gm^3/year), [15, 22]. As most grain exporters (the USA, Canada, EU countries) grow rainwater harvest, and many importers would have to use water for irrigation, trade saves water usage in the global volume of 112 km^3, which corresponds to 11% of the total water volume for irrigation.

The largest share of international flows of virtual water refers to the sale of oil crops (including cotton, soybean, palm oil, sunflower, rape and others) and products derived from them. This category represents 43% of the total amount of international flows of virtual water. More than half of this amount relates to the sale of cotton products; about one-fifth belongs to the soy trade. Other products with a large share in the world's streams of virtual water are cereals (17%), industrial products (12.2%), coffee, tea, cocoa and (7.9%) and meat products (6.7%). Countries distribution for the export and import of virtual water is given in Table 4.2, [22, 23].

Table 4.2

Export-import of virtual water

Country	Provision of resources of full river runoff, thousand m3 per capita	Volume of virtual water, billion m^3
Export		
USA	20,0	758,3
Canada	115,0	272,5
Thailand	4,3	233,3
Argentina	17,0	226,3
India	5,0	161,1
Australia	26,0	145,6
Vietnam	23,0	90,2
France	5,0	88,4
Guatemala	24,0	71,7
Russia	28,5	47,7
Brasilia	48,0	45,0
Ukraine	**1,1**	**21,0**
Import		
Sri-Lanka	5,0	428,5
Japan	2,0	297,4
Netherlands	0,7	147,7
Korean Republic	5,0	112,6
China	3,0	101,9
Spain	4,2	82,5
Germany	2,0	87,9
Ukraine	**1,1**	**4,2**

Presented information shows that countries that import virtual water are not adequately equipped with water resources.

Countries with sufficient and superfluous provision, that is, with provision of more than 25 thousand m^3 per capita, export virtual water in the form of agricultural products and industrial goods; also, the group of the largest exporters of virtual water includes countries with average security (from 5 to 25 thousand m^3 per capita). Allocated only India, France and Thailand with the provision of up to 5 thousand m^3 per capita [23].

In this way, the problem of water scarcity can be solved by taking advantage of the global economy. International trade can provide a global scale of water saving if you sell water-based products from countries with high water supply to countries with lower.

Although the water saving potential of trade may seem significant, it should be borne in mind that trade is not related to virtual water, much of the trade is and will continue between countries that do not experience water scarcity. To date, not all water «economy» is effective. Moreover, the reduction of global water use refers to the difference in the productivity of importers and exporters, and not to a shortage of water. And, finally, trade affects not only the deficit, but also political and other factors.

4.3. Justification of the virtual water' consumption and trade at traditional agricultural production in Ukraine

Ukraine is an agrarian country. Last year it ranked 5^{th} place in the number of exports of grain crops. Natural-climatic, soil conditions, water supply contribute to the sustainable development of the country's agro-industrial complex. In the long run, Ukraine has every opportunity to take leading positions in the production of agricultural raw materials and products for the manufacture of food products, biomass and biodiesel, technical raw materials for various sectors of the economy.

The general water trace of agricultural production in Ukraine is mainly due to the consumption of green water, and in industrial production and water supply and drainage - gray and blue. In Ukraine, the largest amount of water is spent on the production of strategic crops such as wheat (28 × 109 m^3/year), forage crops (22 ×

109 m^3/year), sunflower (6.8 × 109 m^3/year), barley (11, 0 × 109 m^3/year), corn (5.7 × 109 m^3/year), potatoes (6.4 × 109 m^3/year), sugar beet (3.1 × 109 m^3/year).

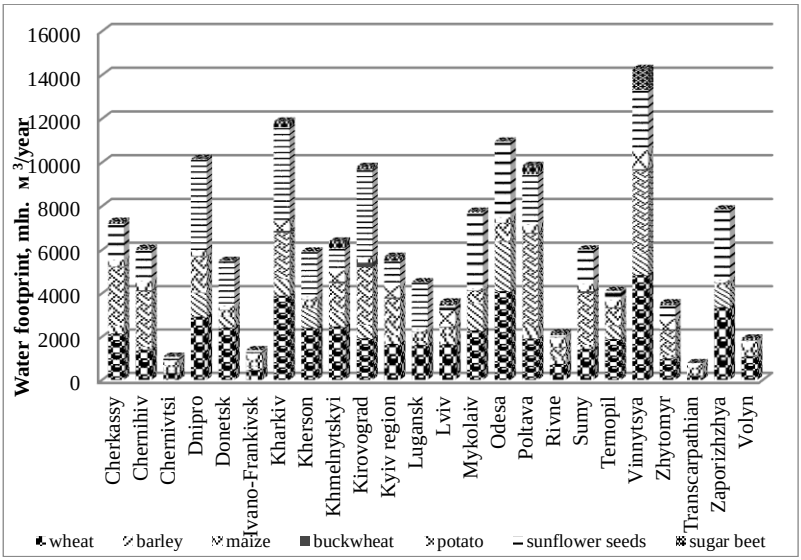

Fig. 4.8. Dynamics of the water trail of main crops in the administrative regions of Ukraine in 2016

The largest water footprint of crop production is formed at the expense of such regions as Vinnytsia, Kharkiv, Odesa, Dnipropetrovsk, Kirovograd, Poltava, Zaporizhzhya, Mykolaiv, precisely those regions of Ukraine that require a detailed assessment of the use of water resources at the river basin level, etc.

The cost of virtual water tends to grow annually. So, in 2016 they increased by 2.35 times compared with 2000. This trend will be observed in the future. So, it is predicted that in 2021, the cost of virtual water in the agro-industry will reach 272 109 m^3/year, which is 3.5 times the 2000 population.

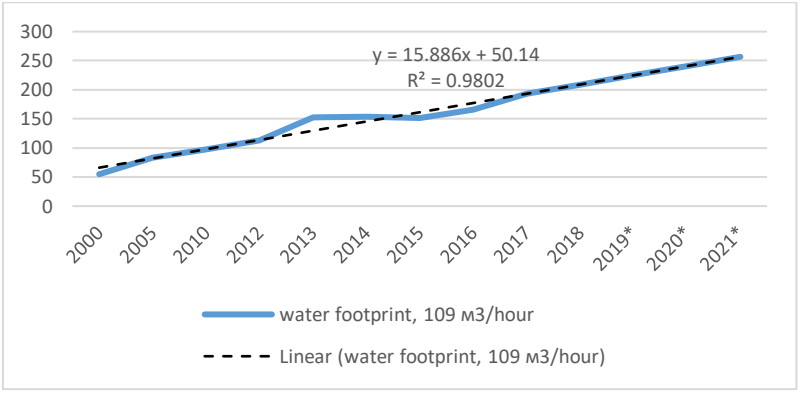

Fig. 4.9. Forecast of virtual water consumption from crop production in Ukraine for 2000 - 2021 gg., 109 m^3/year (* forecast data)

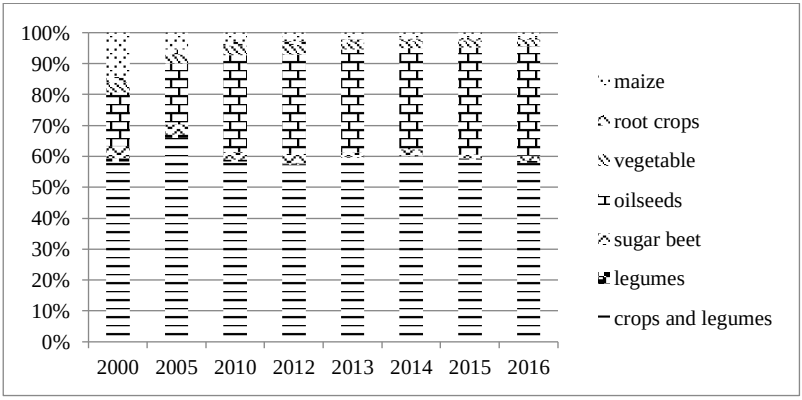

Fig. 4.10. Dynamics of the cost of virtual water for the cultivation of main crops in Ukraine for 2000 - 2016 years, 109 m^3/year

During all years of production monitoring, cereal, leguminous and oilseed crops, a significant part of which are exported, are dominated by production.

Since, in Ukraine, the largest amount of virtual water is consumed and exported with cereals and sunflowers, we forecast the dynamics of changes in the flow of virtual water for their cultivation (Fig. 4.11).

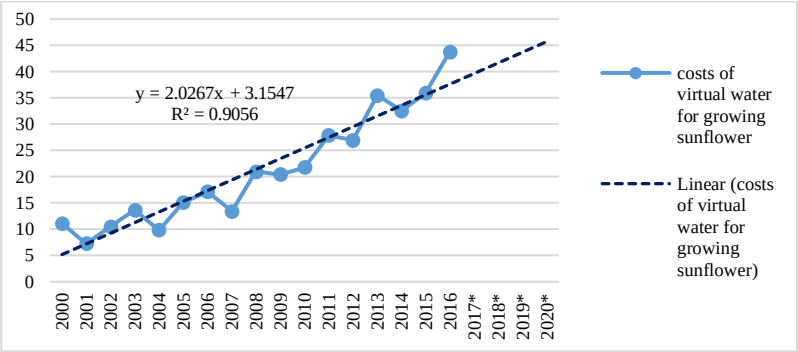

Fig. 4.11. Dynamics of virtual water consumption for sunflower' growing in Ukraine, 109 m^3/year

In 2021 year, the growth of virtual water consumption is projected to more than 2 times, both for cereals and sunflowers, which requires the development and application of preventive measures in agrarian and aquacultural spheres.

An alternative to saving water consumption in Ukraine can be a strategy for minimizing consumption by importing water-based products, both agricultural and industrial. The situation with water in the scarcity region can be greatly improved by importing products that require large volumes of water to produce instead of their own production, that is by means of virtual water imports. But the formation of virtual water flows in Ukraine is summarized in the table. 4.3.

Table 4.3

Analysis of the virtual water flows' formation, million m^3/year

Indicator	**Ukraine**
1	2
Import virtual water	
Plant production, including:	
green water trail	4585.8
blue water trail	677.3
gray water trail	347.6
Livestock products, including:	
green water trail	349.3
blue water trail	26.1

continuation of tabl.4.3

1	2
gray water trail	19.3
Industrial production, including:	
blue water trail	154.6
gray water trail	2750.0
Virtual Water Export	
Plant production, including:	
green water trail	15289.2
blue water trail	545.6
gray water trail	691.4
Livestock products, including:	
green water trail	2303.6
blue water trail	227.5
gray water trail	78
Industrial production, including:	
blue water trail	292.5
gray water trail	5888.6
Total Virtual Water Flow	
Imports	
green water trail	4935.1
blue water trail	858.1
gray water trail	3116.9
Export	
green water trail	17592,8
blue water trail	1065.7
gray water trail	6658.0
Net import virtual water	
green water trail	-12658
blue water trail	-207
gray water trail	-3541.1

* Based on [13, 15]

With the rapid expansion of Ukraine's export potential, further research is also needed to assess the current virtual water flows due to the export and import of agricultural products and their impact on the stability of individual river basins in Ukraine.

4.4. Estimation of virtual water' consumption in the organic products production in Ukraine

Ukraine, having considerable potential for organic agricultural production, its export, consumption in the domestic market, has achieved certain results in developing its own organic production. So, the area of certified agricultural land in Ukraine involved in the cultivation of various organic products, is already more than four hundred thousand hectares, and our state holds an honorable place among the world leaders of the organic movement.

The organic market in Ukraine is constantly evolving. Due to the size of the country (603600 km^2, including 42.7 million hectares of agricultural land (according to the State Statistics Service of Ukraine)), geographic location, proximity to potential international buyers and widespread fertile black soil, Ukraine has favorable conditions for organic agriculture. The dynamics of the main indicators of organic production in Ukraine in 2001 - 2016 is given in Table. 4.4 [24-26].

According to the Research Institute for Organic Agriculture (FiBL) and the International Federation of Organic Agricultural Movements (IFOAM), Ukraine ranks 11^{th} place in Europe in terms of organic farmland. Over the past 5 years, they have increased by 54%. However, in terms of the volume of organic products, Ukraine is only 25th in Europe.

Of every hectare of organic farmland in our country, the products reach only 50 euros on the domestic market. The «return» of the European organic hectare is 47 times higher: in Europe, 1 hectare has an average of € 2345 in the domestic «clean» market [2, 4, 25].

As we can see from Table 4.4, organic agriculture is developing at a rapid pace, as evidenced by the annual growth of organic areas, producers and volumes of organic products sales.

In 2017, the Support Office for Reforms under the Ministry of Agrarian Policy and Food of Ukraine collected operational monitoring data on the main indicators of organic agriculture among certification bodies that certified organic production and trade in organic products in Ukraine in accordance with the organic

Table 4.4

Dynamics of the main indices of organic production in Ukraine in 2001 - 2016

Year	Organic area (agricultural land) [he]	The share of organic agricultural total area - governmental land [%]	Organic producers	Organic retail sales [mln. euros]
2001	164449,00	0,40		
2002	164449,00	0,40	31	
2003	239542,00	0,58*	69	
2004	240000,00	0,58*	70	
2005	241980,0	0,59*	72	
2006	242034,00	0,59*	80	
2007	249872,00	0,61*	92	1.0
2008	269984,00	0,65*	118	1.0
2009	270193,00	0,65*	121	1.2
2010	270226,00	0,65*	142	2.4
2011	270320,00	0,65*	155	5.1
2012	272850,00	0,66*	164	5.1
2013	393400,00	0,95*	175	12.2
2014	400764,00	0,97*	182	14.5
2015	410550,00	0,99*	210	17.5
2016	381173,00	0,89*	294	21.0
2017	289000,00	0,67	304	90.0

legislation of the EU. According to these data as of December 31, 2017 [24, 25] the:

- area of agricultural land with an organic status is 201000 hectares;
- area of agricultural land of transition period is 88000 hectares;
- total area of agricultural lands with organic status and transitional period is 289000 hectares;
- share of organic land from the total area of agricultural land is 0.67%;
- total number of market operators is 504, including 304 agricultural producers;

– total number of certification bodies within the framework of this monitoring is 18.

According to the survey of all Ukrainian exporters of organic products conducted by the Organic Standard certification body, the volume of exports was about 300 thousand tons worth more than $ 65 million in 2016. Its lion's share goes to the EU, Switzerland, the rest - the USA, Australia, Canada, and Asia. In parallel, the domestic market is developing. The basis for its formation is the certified organic production of 381 173 hectares of agricultural land. Of these, 335,000 hectares are occupied by arable crops. On these lands agrarians mainly grow cereals, oilseeds and legumes. On small volumes, vegetables and fruits are also cultivated. In addition, 550 thousand hectares of wild animals are harvested with berries, mushrooms, nuts, herbs, noted in the Ministry of Agrarian Policy and Food. With such an area and proper diversification it is quite possible to develop not only organic crop production but also animal husbandry. In the domestic market over the period, products sold at € 21 million, which is roughly equivalent to € 0.5 per person [26].

These indicators point not only to the low purchasing power of the population, but also to the fact that our country has not yet formed the proper philosophy of organic production and consumption, as well as state policy regarding their development. Above solution ' Liabilities problems the last two governments are represented by the Agriculture Ministry and the Office formed him directly support reforms of organic production and niche crops and NGOs organic sector, many international projects and programs.

According to the leading organ of certification Organic Standard, in 2017, the main organic products (in volume), which were exported by its customers from Ukraine, were corn, wheat, soybean, barley, spelled wheat, sunflower, millet, rape, blueberries (frozen), oats, millet, lupine, apples (fresh), buckwheat, mustard, elderberry (fruit), pumpkin seeds, birch juice, flax, flakes, rye, walnut (core), sea buckthorn (frozen), blackberry (frozen), wild rose (frozen), coriander, peas, elderberry flower (frozen), strawberry (frozen), cranberry (frozen) (frozen), chamomile (dried), hemp, raspberries (frozen) and sunflower oil.

The organic market attracts entrepreneurs to the fact that the profitability of business in almost any of its segments is significantly higher than that of traditional agrarian ones.

According to the commercial service of the US Embassy in Ukraine, the average return on investment in Ukrainian organic farming is approximately 300%. Therefore, it is «one of the most attractive areas for investments in Ukraine», - it is stated in the special report of Americans «Summer 2017».

Organic production, in addition to providing high quality agricultural products, also contributes to reducing the cost of water resources by reducing the size of the gray water tract, which is equally important for the sustainable development of the agrarian sector and the economy of Ukraine as a whole.

Using the above methodology, data on the gross collection of basic crops according to the FiBL statistics and the specific water consumption for the production of a particular crop, Table 4.5 shows the costs of virtual water due to the production of the main types of organic crop products.

So, the main volume of implicit water resources in organic production were used for growing sunflower seeds, wheat, corn, sugar beet and barley.In overall water footprint, the largest share of virtual water belongs to the green component, which is often neglected when accounting for costs.

In 2014-2015, the consumption of virtual water was due to the production of organic sunflower seeds. In 2016 there is a significant decrease in the consumption of virtual water as according to statistical data there is no data on the gross collection of this crop. Main about ' connectors implicit resources spent on producing wheat, fruit and vegetables, corn, root crops, oil crops, barley and so on.

Information on consumption and trade in virtual water will make it possible to take the right management decisions in the area of water and land use and partially solve the problem of water shortages especially at the global level due to the sale of water-based products from countries with high water availability to countries with low, but it is appropriate to take into account the impact of foreign economic activity on the sustainability of

Table 4.5

Virtual water' accounting for basic organic crops on 2015-2016's.

Culture	The volume of virtual water, 106 m3 / t							
	2015 year				2016 year			
	green water	blue water	gray water	together	green water	blue water	gray water	together
Barley	1626.2	22.01	20.39	1668.59	1473.78	19.94	18.47	1512.20
Bean	24.92	0.34	0.31	25.57	0.00	0.00	0.00	0.00
Berries	58.02	0.79	0.73	59.54	0.00	0.00	0.00	0.00
Crucials	39.68	0.54	0,50	40.72	0.00	0.00	0.00	0.00
Buckwheat	67.32	0.91	0.84	69.07	91.40	1.24	1.15	93.78
Fodder beet	215.50	2.92	2.70	221.11	0.00	0.00	0.00	0.00
Maize	2528.4	34.22	31.70	2594.31	2604,28	35.24	32.65	2672.17
Grape	45.30	0.61	0.57	46.48	41.66	0.56	0.52	42.75
Technical cultures	15.14	0.20	0.19	15.53	44.90	0.61	0.56	46.07
Lentil	14.82	0.20	0.19	15.20	39.63	0.54	0,50	40.66
Linen	43.55	0.59	0.55	44.69	60.55	0.82	0.76	62.13
Oat	151.67	2.05	1.90	155.63	178.10	2.41	2.23	182.74
Oil crops	65.45	0.89	0.82	67.16	2211.30	29.93	27.72	2268.95
Pea	280.69	3.80	3.52	288.00	0.00	0.00	0.00	0.00
Potato	239.04	3.23	3.00	245.27	269.42	3.65	3.38	276.44
Pumpkin seeds	400.95	5.43	5.03	411.41	0.00	0.00	0.00	0.00
Rape	545.68	7.38	6.84	559.90	0.00	0.00	0.00	0.00
Roots	240.42	3.25	3.01	246.68	2099.26	28.41	26.32	2153.99
Rye	343.27	4.65	4.30	352.22	164.44	2.23	2.06	168.72
Soy beans	160.28	2.17	2.01	164.45	0.00	0.00	0.00	0.00
Millet	134.29	1.82	1.68	137.79	250.61	3.39	3.14	257.15
Sugar beet	1547.41	20.94	19.40	1587.75	0.00	0.00	0.00	0.00
Sunflower seeds	106852,1	1446	1339	109637,6	0.00	0.00	0.00	0.00
Vegetables fruits	266.81	3.62	3.35	373.78	2183.00	29.54	27.37	2239.90
Nuts, with a shell	34.77	0.47	0.44	35.68	0.00	0.00	0.00	0.00
Wheat	4702.42	63.64	58.95	4825.00	3612.21	48.88	46.24	3707.33

water resources and the state of the environment in the exporting country. We will calculate the water trail of organic plant growing in Ukraine (Table 4.6).

Table 4.6

Dynamics of virtual water of the main groups of organic crops in Ukraine for 2001 - 20 21 years.

Year	Virtual water of the main organic crops, $10^6 m^3$/ year						
	crops	legumes	fruits	grape	oilseeds	vegetables	other
2001	324.2	12.8	5.5	1.0	104.4	14.6	248.8
2002	351.0	13.9	6.2	1.1	106.1	15.8	265.5
2003	535.6	21.2	11.3	1.6	157.1	25.5	414.3
2004	561.0	22.2	12.4	1.6	159.9	27.5	431.7
2005	639.4	25.3	13.4	1.6	161.2	30.0	455.6
2006	644.5	25.5	14.3	1.6	170.1	30.6	460.5
2007	670.4	26.5	15.7	1.7	182.1	32.2	461.0
2008	729.9	28.9	17.4	1.9	182.4	35.4	498.1
2009	736.0	29.1	18.3	2.0	208.1	36.1	498.5
2010	738.8	29.2	18.4	2.0	211.0	37.1	498.5
2011	1016.5	40.2	20.0	2.5	258.9	41.6	702.2
2012	865.2	34.2	21.3	2.2	234.3	42.9	527.0
2013	1595.3	63.1	35.4	4.1	444.3	62.1	977.1
2014	1780.0	70.4	33.2	4.8	404.7	65.8	1009.7
2015	1715.0	67.8	37.3	4.6	461.6	66.8	1050.9
2016	1785.9	70.6	33.8	4.1	444.4	63.4	1078.6
2017	1644.14	157.2 4	20.5 1	3.4 2	553.7 5	68.36	3418.18
2018 *	1732.39	165.68	21.61	3.60	583.47	72.03	1022.87
2019 *	1820.64	174.12	22.71	3.79	613.19	75.70	1074.97
2020 *	1908,89	182.56	23.81	3.97	642.91	79.37	1127.08
2021 *	1997,14	190.99	24.91	4.15	672.63	83.04	1179.19

In organic production, as in the traditional one, there is a predominance of water consumption for growing cereals (more than 50%) and oilseeds (12.7%). At the same time, the main sown areas of these crops are located in the southern and eastern regions of Ukraine, where there is a shortage of water in the shallow periods of the year, which necessitates additional research and the formation of an appropriate strategy that would ensure the food, ecological and water safety of these regions.

Consequently, there is a rapid increase in the cost of virtual water from organic crop production in Ukraine from 711, 4 * 10^6 m^3/year in 2001 to 3480.8 * 10^6 m^3/year in 2016. It is predicted that in 2021 the cost of virtual water for growing organic crops will increase by 19.3% and amount to 4,152.06 x 10^6 m^3/year, which

requires an assessment of water resources in organic production on a regional basis and basin with a view ensuring their sustainability.

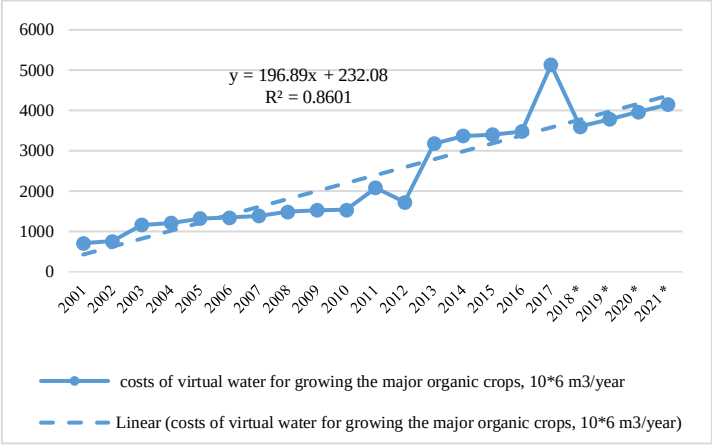

Fig.4.12.Forecast of the cost of virtual water from organic crop production in Ukraine for 2001 - 2021 gg

In 2017 exports from Ukraine due to 170 thousand tonnes of cereals and peas with a mark of their organic origin formed about virtual water flows ' in volume 359.21 x 10^6 m^3/year, which significantly exceeded the export streams in 2016 (316, 95 *10^6 m^3/year) and 2015 (190,17 * 10^6 m^3/year). For the rest of the region, sales of this product in 2015-2017 were EU countries – 93-95% of total exports, as well as Switzerland - about 5% annually. Such a rapid expansion of Ukraine's export potential also requires an additional study to assess the current virtual water flows due to the export and import of organic agricultural products and their impact on the stability of individual river basins in Ukraine.

All existing approaches to assessing the use of water resources for the production of agricultural products do not take into account the specifics of organic production. The proposed method will allow to justify water use in organic farming using modern world approaches and thus will provide food,

environmental security against ' the object of research and improve the competitiveness of the industry as a whole.

In organic production, as in the traditional one, there is a predominance of water consumption for growing cereals (more than 50%) and oilseeds (12.7%). At the same time, the main sown areas of these crops are located in the southern and eastern regions of Ukraine, where there is a shortage of water in the shallow periods of the year, which necessitates additional research and the formation of an appropriate strategy that would ensure the food, ecological and water safety of these regions.

The obvious reduction of water resources and the growth of their use for both daily needs and for the production of agricultural products. In the next 10-15 years, this will inevitably lead to «water hunger», the consequences of which can exceed the shortage of food.

In order to address the environmental problems of water use and water supply in Ukraine, it is necessary to create an effective mechanism for water use and implementation of environmental protection measures, improvement of the existing system of management of protection and use of water resources.

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5. ECOLOGICAL AND ECONOMIC INNOVATIONS OF ORGANIC BUSINESS' ORGANIZATION

5.1. Cooperation in the economy's organic sector

Cooperatives as an organizational form of manifestation of the cooperation of commodity producers are an important element of the institutional environment of the agrarian economy. In France, about 520,000 workers (3,500 agricultural cooperatives) are employed in cooperatives, and sales account for about 60% of agricultural production. At the expense of processing cooperatives in France, 40-45% of total production is covered [1]. Almost 90% of dairies in the European Union and North America are cooperative. Through cooperatives, farmers sell more than 72% of fruits and vegetables in Belgium, 95% of cultivated flowers in the Netherlands, more than 50% of grain in France and Austria is kept on cooperative elevators belonging to their producers.

In modern conditions, cooperation is widely recognized in the world as an effective tool for solving the complex of social problems. It is needed primarily by small producers of agricultural products, thatprovides stability to the globalization challenges in all spheres of society and economies. At present, such problems in Ukraine should be dealt with in parallel with the reform of the rural communities.

V. Andriychuk, O. Borodin, V. Zinovchuk, V. Goncharenko, O. Krisalnyi, M. Malik, L. Moldovan, V. Mesel-Veselyak, V. Yurchishin and others made a significant contribution to the development of cooperative themes in agrarian science [2 - 6].

Theoretical and practical aspects of selling the agricultural products and products of its processing, functioning the market of products of organic origin are disclosed in writings of such scientists as V. Artich, R. Bezus, N. Borodachev, V. Gontarenko, A. Rudnytska, N. Novak, L. Marmul, O. Maslak, O. Popov, O. Skidan, M. Fedorov, O. Shubravska, Yu. Ushkarenko, A. Khodus, K. Holger, M. Yusefi and others [7 - 10].

The problems of agricultural cooperation and ways of its further development were devoted to works of such scholars as

V. Andriychuk, A. Gutorov, F. Gorbonos, M. Drahomanov, V. Zinovchuk, O. Chrysalsky, M. Kisil, L. Klymuk, G. Podlesetskyi, V. Messel-Veselyak, N. Morozyuk, E. Khraplyny and others.

At the same time, certain problems that hinder the further development of cooperation in the domestic market of organic agricultural products remain unsolved [8, 11-19].

In our time, the problems of forming a network of rural development on the principles of mutually beneficial cooperation remain unresolved. As a result, the system of sale and sale of organic agricultural products on the basis of the cooperation of commodity producers remains unresolved. This primarily concerns various aspects related to the increase of the efficiency of agricultural cooperatives, among which the profitability of cooperative formations, as well as the revival of service cooperation in a market economy.

The development of the agrarian economy and the united territorial communities is based on the existence of cooperation, processing enterprises, the cultivation of niche crops and other innovations not specific to agroholdings.

Therefore, agricultural cooperatives which are subjects of agricultural relations in a market economy occupy an important place among agricultural enterprises of various organizational and legal forms. The number of service cooperatives that are extremely needed by small producers tend to increase. As of January 1, 2017, there were registered in Ukraine 2014 cooperatives (997 production and 1017 servicemen), and at the beginning of 2018-2069 cooperative structures (996 production and 1073 servicemen) [7].

World experience confirms that cooperation enables to compete in the tough economic and political conditions of today with large agrarian companies. This is especially true for farmers and private farms. This is quite actual in the organic sphere, since in recent years there has been an increasing number of small producers who have a desire to sell it in the domestic market.

As of January 1, 2018, there were 45,035 farms in Ukraine, while for the same period last year they were 44,409. That is, during 2017, the number of farms in our country increased by 2% (or 626 farms).The number of agricultural cooperatives has also

increased. If by January 1, 2017 they were 2014 (997 production and 1017 servicemen), by the beginning of 2018 there are already 2069 of them in Ukraine (996 production and 1073 servicemen).That is, 55 cooperatives or 3% more [20].

As it is specified, in comparison with January 1, 2018, from 735 operating agricultural service cooperatives: milk producers - 186 (+44), for the cultivation of land and harvest - 162 (+16), meat - 35 (-16), fruit and vegetable - 113 (+34), cereals - 41 (+1) and other services - 198 (+46). The number of active agricultural service cooperatives in 2018 has increased by 125 units, and today they account for 735 [21].

In recent years, exports of traditional and organic products have grown in Ukraine. Each year the structure changes, the demand for certain products changes, it's clear that globalization is taking place, which does not give Ukraine chances in the agricultural sector.

For the most part there is a request for cheap raw materials or high-quality products with highly organized logistics, etc. According to Ukrsadprom, according to the results of 2018, Ukraine exported fruit and berries worth $ 229 million, which is 17% more compared to 2017. By the end of 2018, the value of fruit exports was the highest for Ukraine during all years of independence [22].

According to the results of 2018, our country exported fruit and berries worth $ 229 million, which is 17% more than in 2017. It should be noted that last year the value of fruit exports turned out to be the highest for us since independence. The main products of this commodity group were walnuts ($ 117 million), frozen fruits and berries ($ 78 million), apples and pears ($ 15 million), and their total share in the export of horticultural products reached almost 92%. The most noticeable was the increase in the value of exports of apples and pears - more than doubled. In addition, an increase in the quantitative indicators of exports of all the listed groups of products: walnuts - from 31 thousand tons in 2017 to 41 thousand tons in 2018, apples and pears - from 24 to 43 thousand tons, as well as frozen fruits - from 42 to 48 thousand tons, respectively. By

the way, such an export of frozen fruits and berries also became an absolute record for domestic entrepreneurs [22].

Therefore, such important legislative and regulatory acts about the area of activities in cooperation, for example, in our time there are: Law of Ukraine «About the general safety of non-food products» which establishes the legal and organizational principles for the introduction into circulation of non-food products in Ukraine and ensuring its safety; Resolution of the Cabinet of Ministers «About approval of the procedure for the Issuance of operating permit, forms of operating permit and recognition as invalid, some resolutions of the Cabinet of Ministers of Ukraine» and others [23, 24].

The EU's hygiene package for all food products today includes the following regulations, directives and guidelines:

- Regulation 882/2004 «About official control, carried out in order to ensure checks on compliance with legislation on food and feed, and rules on health and welfare of animals»;

- Regulation 852/2004 «About Food Hygiene»;

- Regulation 853/2004 «About the hygiene of food products of animal origin»;

- Regulation 854/2004 «About the organization of official control of products of animal origin intended for human consumption»;

- Regulation 2073/2005 about the microbiological criteria of food products;

- Codex Alimentraius «Recommended International Code of Practice» General principles of food hygiene «. By the way, the Ukrainian legislation does not require the certification of HACCP systems, but in the case of final contracts, this is almost always a condition of the contract.

In addition to these, there are several voluntary standards in Ukraine that the manufacturer can apply in addition to complying with legal requirements. These include the standard DSTU 4161-2003 «Food Safety Management Systems. Requirements «, and ISO standards series 22000:

- DSTU ISO 22000: 2007 «Food Safety Management Systems - Requirements for any food chain organizations»;

- DSTU-P ISO / TS 22003: 2009 «Food Safety Management Systems. Requirements for the authorities that carry out the audit and certification of food safety management systems»;

- DSTU-N ISO / TS 22004: 2009 «Food Safety Management Systems - Guidelines for the Application of ISO 22000: 2005»;

- DSTU ISO 22005: 2007 «Traceability in feed and food chain. General principles and guidance for system design and development».

For all years of independence, state policy does not protect small and medium-sized producers, which has already led to negative results in the agro-industrial sector of the economy, but most of all in livestock production, lack of jobs in rural areas, the development of niche crops and the lack of significant processing of products on the ground, etc. As a consequence, catastrophic decline of the rural population and the migration of the population against the backdrop of monopolization of land resources by holdings and various organizations not only from the agro-industrial sector.

Cooperation of the economy's agrarian sector becomes acute due to: the inability of small and medium-sized entrepreneurs and farmers to compete on the market in Ukraine; monopolization of agrarian business; the lack of long-term plans and programs, the responsibility of officials of all levels for the state of the agricultural sector in front of the population of the state, access to adequate financial resources; not effective legislative and normative base; the globalization of the world economy and, as a consequence and eventually, the mentality of the population, the precautionary change in the course of the state, etc.

Therefore, one of the interesting directions of development of cooperation is organic products, which ceased to be a luxury item in many countries, and can bring together small certified manufacturers to achieve higher goals.

Annual growth of organic produce consumption in the world is 8-11%.This is the most promising direction of agriculture. Currently, 437 million hectares of land worldwide are used for organic production, and in Europe, over 82 million hectares. This theme is gaining popularity in the world and in Ukraine. According

to FAO, cooperatives operate in several sectors of the economy, numbering more than 800 million members and providing 100 million jobs worldwide, 20 percent more than multinational companies. In the agricultural sector, cooperatives play a critical role, accounting for about 50 percent of world agricultural production. Given the diversity of forms and the reproduction of different roles - from production to marketing or supply of materials, the number of agricultural cooperatives in the world is increasing. Cooperatives provide farms with new opportunities and numerous benefits.

Particularly in the organic agrarian sector, the reputational responsibility of the end consumer becomes relevant. In addition, cooperatives benefit from joining together for joint action within marketing groups and organizations to cooperate, agreeing to keep one price, brand, standard, demonstrating solidarity responsibility.

The reputational responsibility of the end consumer becomes relevant, particularly in the organic agrarian sector. In addition, cooperatives benefit from joining together for joint action within marketing groups and organizations, to cooperate, agreeing to keep one price, brand, standard, demonstrating solidarity responsibility.

Global trends in the agrarian business are based on the creation of a common value, such as the policies and actions of the company, which increase the competitor's ability to organize, while improving the environmental, social and economic conditions of the communities and territories where they operate. The implementation levers of such direction in traditional and organic agroindustrial production are:

- increasing the productivity in supply chains;
- organization of clusters in united territorial communities, districts and (or) in the region;
- supplying the products and services needed by consumers in an efficient, ethical and intelligent way from the point of view of environmental protection (p.15, «Green Book», a global UN agreement), [25];
- co-operation - as a business with the formation of academic and research institutions, public experts, trade unions, suppliers and other organizations in the stage of their «life» cycle.

Organic production is accompanied by the implementation of laws, directives, regulatory documents. That is, from the idea to the status of organic production will take 2-3 years, depending on the quality of the land and ways to use it before. Consequently, in organic production in our time there is a transition to: «additional voluntary» reporting, a gradual transition to the information and experience necessary for investors; projects that go in the direction not only «for the community», but «with the participation of the community». Such voluntary and mandatory information, documents, and reporting positively affect and reduce the cost of future certification and not only the status of «organic». Such information is used by ISO 22000 and Global GAP, HACCP systems and other requirements from different countries and even individual retail chains. Such processes are facilitated by:

- requirements of world markets and investors' pressure;
- requirements of consumers, internal factors of entrepreneurship development;
- ability to reduce costs and, consequently, greater profitability;
- guarantee by food industry operators that raw materials are protected from pollution;
- measures to control pollution by producers who are subjected to risks in the production of raw materials and related activities, for example, taking into account the standards of «Environmental Management Systems. Guidelines for the introduction of environmental design (ISO 14006: 2011), clause 6.2. «Thinking by categories of life cycle», that is, the consideration of the relationship between environmental aspects at different stages of the life cycle.

That is why ahead of the development of normative documents of organic agricultural production and production, the development of regional brands should be components of the implementation of advanced standardization, the introduction of cleaner industries, the diversification of products and services. At the global level, it is appropriate to compare such trends with «Geographical Indicators» (GIs), which is a protection against the desire of transnational companies to monopolize the production of food products through patent law.

Currently, another feature of the implementation and implementation of organic production is the adaptation of legislative and regulatory documents of Ukraine and a number of EU directives through the proclaimed course on European integration. Therefore, it is necessary to develop local trademarks as a means of protecting and promoting ecological, cleaner, organic production in the regions, for example, Directive 2003/35 / EU on public participation in the preparation of individual plans and programs relating to the environment. Such practices may relate to an environmental impact assessment; strategic environmental assessment (plans, programs, strategies, procedures) at the national and regional levels; information on the environmental impact assessment inventory; information portals; electronic databases; public participation in the development of plans and programs, etc.

Taking into account the volatility of prices for beer products and nuts, Ukraine still has good chances in the markets: China, India, Brazil, the United Arab Emirates, Mexico, Spain. Not for nothing, almost the whole range of berries that grow or grow in Ukraine, predict the export future. The world market for fruit and berry produce is 800 million tons, and this segment will grow every year: fruits - by 4-5%, berries - by 8-10%.

It is important that the share of professional producers of Ukrainian berries in the harvest of 2017 barely exceeds 11%. The rest was grown by small producers. Most of them relate to quality and marketing issues. So, single farmers and small farmers have something to think about. In particular, the benefits that they bring to the association in the cooperative, and the most important of them - the formation of commodity lots of homogeneous products.

In parallel, consumers are demanding new tastes, unusual products are gradually coming to the world markets, very slowly, but still reducing the share of consumption of such popular strawberries (strawberry garden), and domestic producers have a number of advantages to offer them.

Work in cooperatives allows us to solve with a lower expense the following main tasks of berry business, organic plant growing, niche crops: freezing and drying of raw materials; making powders or snacks; balance the decrease in the average purchase price and

increase export volumes; participate in conferences and exhibitions in promising for export countries (Asia, China and India); meet the requirements of standards and logistics to «rich» markets in countries such as Germany, Great Britain, Holland, Singapore and the United Arab Emirates, USA, etc.

Unlike households, industry enterprises are more flexible to market conditions and try to improve their technical and technological equipment. The level of their maintenance by equipment is stable, which is 80%. About 300 enterprises have the opportunity to use their own or leased equipment for sorting and packaging products. Slowly, but the situation with the construction of new fruit stores is improving. According to our information, last year the total capacity of commissioned fruit storage facilities was about 20 thousand tons. However, most fruit storage sites still remain low-yielding with a very long life (over 30 years). Currently, more than half of the farms use frutillas, and refrigerators with regulated gas environment - every third [22].

A successful example is demonstrated by the «Faina Poliana» and «Yagidnyi Krai» cooperatives, and united by single-breeders and created a viable community that successfully implemented the first steps and understand where to go. «Fayna Polyana»united 26 families from the Koziv and Zboriv districts of the Ternopil region. «Faina Poliana» built a shop frozen berries in 2018, and «Yagidnyi Krai» is looking for ways to dry. Also, there are good prospects for the «Yagidnyi lan Sumshchyny» and the «Malynove selo», that formed around the cooperative idea of a team of like-minded people.

People need to understand that once business is integrated, an entirely different approach to business is needed. It will be necessary to grow the same varieties, to introduce quality control, to work out contracts, including foreign economic ones. About these, those who now simply give into cooperatives commodity products from their several hectares or hundreds, they have not even heard. It must be understood that such people must be part of the cooperative, and they must have those skills and knowledge.

It is worth noting the experience of GSC «Horikh Prychornomoria» (Odessa region), which received certificates of

quality and grade on walnuts. This was announced by Pavlo Tulba, president of the cooperative on his Facebook page. He also wrote that buyers of seedlings into a cooperative will be able to submit documents for receiving state support from now.

According to the European Commission, Europeans were the most organized producers of vegetables and fruits in 2016: in Belgium (86% of all producers), Ireland (75%), Italy (65%), Spain (62%) and Austria (56%) and Denmark (56%). On the one hand, the berries are produced on small plots, and economically feasible, there are farms operating on 5-10 hectares, - summarizes Irina Kuhtina, - on the other hand, they do not have enough volumes to effectively export grown. Therefore, manufacturers are united. It's real around the world - this business involves co-operation. France, Spain, United Kingdom, Canada, Chile, and the United States - all of them have their own berry potential thanks to the cooperator. There are such cooperatives that even own a variety of varieties are well-known varieties, and they are also united, including for the introduction of new varieties. and then cooperatives have ownership of those varieties. That is, it's not about growing - there is a much more complicated relationship.

Numerous evidence and figures show that in traditional agricultural production, cooperation is a success factor for small and medium-sized farmers. It is worth noting that cooperation is possible at the level of regions, settlements, while branch associations in the areas of: berries, nuts, apples, etc. will have and will in the long run solve union issues and do not contradict cooperation - and vice versa - protect its interests, for example, prospects 2019 confirms the tendency that next year, domestic gardeners begin without a clear idea of the development of the industry even in the short term. Moreover, it concerns many issues: limited financial resources, difficulties with the adjustment of sales, unfavorable price situation in the domestic market. In addition, despite significant industry efforts, it was not possible to achieve a reduction of the VAT rate for producers to 7%. However, domestic and international markets do not stand still, and their challenges will have to react. In recent years, domestic exporters managed to consolidate into the European Union market and gradually expand

the geography of sales, but a new wave of competition with world industry leaders, especially with regard to price and quality of products, can not be avoided.

The development program for agricultural cooperatives from 2018 is favorable for the development of agrarian businesses, united communities and cooperatives. One of its points is the compensation of 70% of the cost of equipment purchased by them. Consequently, some elements to the development of cooperation are made.

Therefore, it is necessary to solve the problems of the development of cooperative formations in Ukraine, among them: monopolization and oligarchization of the agrarian market; lack of proper state support; limited access to credit resources; low level of knowledge or lack of information about the benefits of cooperation; lack of shared resource management experience; lack of skilled workers

The way to launch real development of cooperation is the state policy through the program of development of the agro-industrial sector. But the main implementation of such a program and its proper financing is the only way of forming the cooperation so necessary for the state. Such directions need to be implemented through transparent and long-term rules of the game and the motivation of the population: demonstration of the benefits of joint activities; openness to investors; real loan rates; government orders and open tenders; learning and engaging in innovation; help in communication on cooperation; informing about legislative and normative documents; orientation towards consensus and transparency, etc.

Given this, we can conclude that the existing organizational, economic and legal conditions in Ukraine do not provide a full-fledged development of cooperation in the countryside. To solve these problems it is necessary, first of all, to apply preferential taxation and lending to cooperatives, to provide cooperatives with advisory activities at the level of separate territorial communities and their interaction with educational institutions and leading economic entities with the aim of training employees and improving their qualifications.

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5.2. Analysis of the process of settlement and receipt of land payments in traditional and organic agricultural landsman in Ukraine

By the end of 2018, land payment as a component of the property tax in the consolidated budget of Ukraine accounted for only 3 % of the total tax revenues, and in local budgets – for 12 %. Revenues from land payment in 2018 amounted to 27.3 billion UAH, which is 0.9 billion UAH more than in 2017 and 14.7 billion UAH more than in 2012 (fig. 5.1). The share of land payments in the consolidated budget tax revenues decreases, provided that the dynamics of growth in actual revenues is maintained. The exception, which showed a decrease in tax revenues, was 2014 [1]. In 2018 it decreased by 0.6 % compared to 2012, and amounted to 2.9%.

Revenues from land payment include land fees of all categories, and it is not possible to single out separately tax payments for the use and ownership of agricultural land, including organic ones. Therefore, an analysis of the revenues from land payment in the context of counterparties was carried out.

Ukraine occupies the first place in Europe by the area of agricultural and arable lands. The agrarian sector takes one of the leading places in the national economy of Ukraine. As of January 1, 2017, the total area of agricultural land of Ukraine amounted to 42.7 million hectares or 70 % of the total land fund, of which 289,551 hectares or 0.89 % was allocated to organic land.

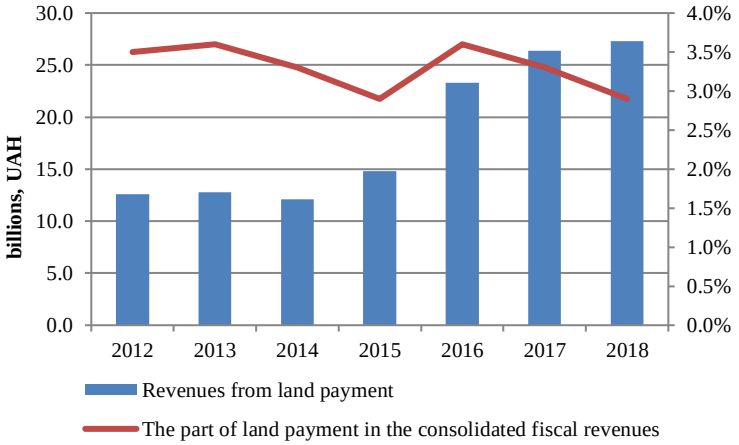

Fig. 5.1. Dynamics of land payment revenues to the Consolidated Budget of Ukraine in 2012-2018

Source: compiled by the authors based on the data of the State Treasury of Ukraine [2].

Figure 2 shows the land payment receipt in 1992-2015.

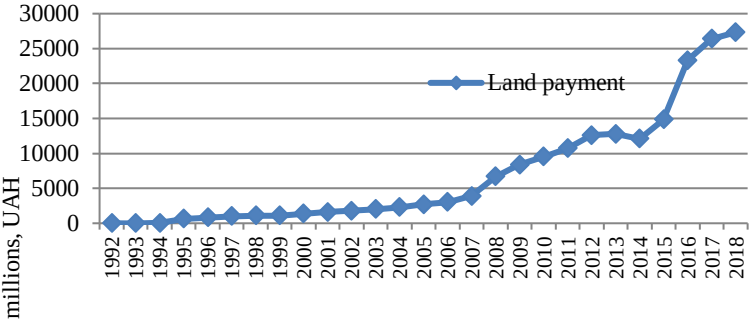

Fig. 5.2. Revenues from land payment in 1992-2018

Source: compiled based on the data of the State Treasury of Ukraine [2] and the Information Resource [3]

Table 5.1 shows the changes in land tax revenues to the consolidated budget of Ukraine in 2012-2018 in terms of its components: land tax for legal entities and individuals and lease-land payment for legal entities and individuals. It should be noted that the amount of land tax receipts from legal entities increased from 3211.0 million UAH in 2012 to 8241.2 million UAH in 2018; from the land tax imposed on individuals – from 403.4 million UAH in 2012 to 1629.4 million UAH in 2018. Similarly, the amount of revenues from land rentals for legal entities increased from 7816.9 million UAH in 2012 to 15288.1 million UAH in 2018 and from the land rentals for individuals – from 1150.4 million UAH in 2012 to 2162.4 million UAH in 2018.

Table 5.1

Revenues from land payment in 2012-2018

Indicator, UAH million	2012	2013	2014	2015	2016	2017	2018
Land payment	12581.7	12802.9	12083.9	14831.5	23323,6	26384.5	27321.1
Land tax from legal entities	3211.0	2950	2776.4	3558.8	7061	8262.3	8241.2
Land rent from legal entities	7816.9	8232.3	7819.7	9413.9	13351.4	14701.6	15288.1
Land tax from individuals	403.4	416.1	384.9	501.1	1032.3	1387.4	1629.4
Land rent from individuals	1150.4	1204.5	1102.9	1357.7	1878.9	2033.2	2162.4

Source: summarized by the authors on the basis of the data by the State Treasury Service of Ukraine [2]

The tendency of land payment revenues growth during the analyzed period can be observed. In 2014, however, the amount of revenues decreased by 719.0 million UAH, including that from the land rentals from legal entities by 412.6 million UAH, in comparison with 2013 due to the economic and political situation in Ukraine (table 5.2). In 2015, the amount of revenues increased by 2,747.6 million UAH as compared to 2014, of which the rentals from legal entities increased by1594.2 million UAH. In 2018, the amount of revenues increased by 936.6 million UAH in comparison

with 2017, including land rentals from legal entities by 586.5 million UAH. During the analyzed period, the amount of land payment revenues increased by 14739.4 million UAH.

Table 5.2

Absolute deviations of revenues from land payment in 2012-2018

Indicator, UAH million	Absolute deviations, millions, UAH						
	2018-2017	2017-2016	2016-2015	2015-2014	2014-2013	2013-2012	2018-2012
Land payment	936.6	3060.9	8492.1	2747.6	-719	221.2	14739.4
Land tax on legal entities	-21.1	1201.3	3502.2	782.4	-173.6	-261	5030.2
Land rentals from legal entities	586.5	1350.2	3937.5	1594.2	-412.6	415.4	7471.2
Land tax on individuals	242	355.1	531.2	116.2	-31.2	12.7	1226
Land rentals from individuals	129.2	154.3	521.2	254.8	-101.6	54.1	1012

Source: compiled by the authors based on the data of the State Treasury Service of Ukraine [2].

Respectively, the structure of payment for land has also undergone certain changes in 2012-2018 (fig. 3). In 2012 the land tax from legal entities and individuals accounted for 28.7 % of the total amount of land revenues, and in 2018 this figure was already 36.1 %. Income from the land rent in 2018 amounted to 63.9 % of total land revenues, and in 2012 it was 71.3 %. The changes in tax legislation that are being implemented within the framework of decentralization reform have led to an increased share of land tax in the structure of land payments.

Figure 5.4 shows the structure of land payment in the context of taxpayers. The largest amounts of revenues from land payment to the consolidated budget in 2018 were received from legal entities – 23529.3 million UAH, i.e. 86.1 % of total revenues. Income from individuals accounts for only 13.9 % of total land payment revenues.

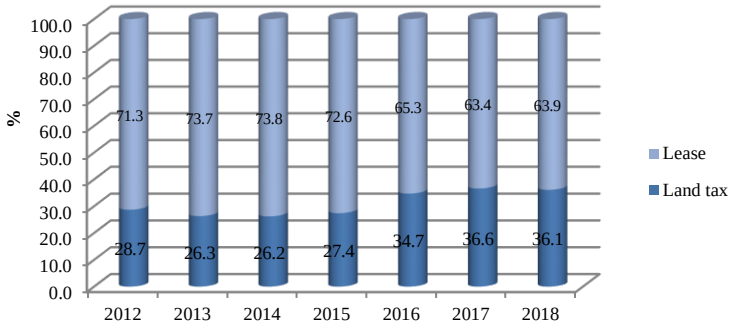

Fig. 5.3. Ratio of land tax to lease (land rent) in 2012-2018

Source: compiled by the authors based on the data of the State Treasury Service of Ukraine [2].

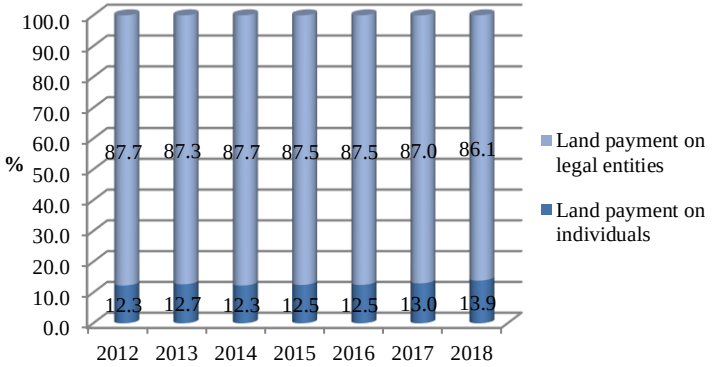

Fig. 5.4. The correlation of land payment received from legal entities and individuals in 2012-2018

Source: compiled by the authors based on the data of the State Treasury Service of Ukraine [2].

Lease is the only legitimate type of use of agricultural land. *Lease of agricultural land* is a paid use of a land plot for

agricultural purpose or a land parcel (share) under the terms of a contract drawn up in accordance with the current lease legislation, with preservation of its intended purpose.

According to the StateGeoCadastre (State Service of Ukraine for Geodesy, Cartography and Cadastre)[4], out of 6.8 million citizens who received certificates acknowledging their right to a land parcel (share) or a state act of ownership of a land plot, 4.8 million farmers exercise their right through lease relations. In 2015, 4781.9 thousand of land parcels (shares) lease agreements were registered, of which: 33.1 % concluded with homesteads or their successors, whose land plots were used for leasing;14.7 % concluded with farming enterprises**;** 52.2 per cent – with other economic entities. About 17.2 million hectares of land parcels (shares) were leased.

Lease agreements on land plots and land parcels (shares) can be concluded for different periods. It should be noted that in 2015, the largest number of lease agreements were made for the period of 6-10 years (table 5.3). Such lease terms allow tenants to invest in land improvements in order to generate profits in the future. By 2012 there was a tendency for contracts to last for 4-5 years.

Table 5.3

Conclusion of lease agreements in Ukraine as to their duration period

Agreement term	At the beginning of the year, per cent					
	2001	2005	2010	2012	2014	2016
1-3 years	45.7	26.2	10.0	6.5	4.0	2.7
4-5 years	41.2	61.4	49.0	42.9	37.7	33.8
6-10 years	11.3	10.2	30.6	38.1	43.7	48.0
more 10 years	1.8	2.2	10.4	12.5	14.6	15.5

Source: compiled by the authors based on the data of the StateGeoCadastre [4].

In a number of countries, minimum land tenures are set: in Denmark it is 30 years, in Japan – 20 years, in Italy – 15 years, in France – 12 years, and in the Netherlands – 6 years. Consequently, the world experience also shows that long-term land lease (for over 10 years) is common in the developed economies. On the contrary,

a short-term lease (up to 5 years) has been wide-spread in Ukraine for a long time. However, a short-term lease does not encourage rational land use and preservation of land in a single array. Tenants are not interested in using mineral and organic fertilizers, in doing various kinds of reclamation work and spending their own funds, as the returns from the measures taken can be seen after the lease agreement expires[5]. But there are some advantages of land lease relations, such as exclusion of speculation with land, state control over land using, replenishment of local budgets at the expense of state and communal land rent payments.

From January 1, 2019, the period of use of a land plot, which is in state, communal or private property, for agricultural purposes (emphyteusis) cannot exceed 50 years.

The amount of lease payment is set in the agreement, but according to the law, it cannot be less than 3 % of the normative monetary valuation of land, which is annually indexed. 122.6 thousand agreements stipulating up to1.5 % of rental were made in 2013; 848 thousand agreements provided for the rental of 1.5 – 3%; 3796.9 thousand – of 3 % and more. There is a tendency to the increase in the number of contracts with the percentage of rentals from three and more in comparison with the previous years. The total amount of payments for the lease of land parcels (shares) in 2015 was 13832 million UAH (table 4).

Table 4

Lease payment for land parcels (shares) in Ukraine

Indicator	At the beginning of the year						
	2001	2008	2010	2012	2014	2016	2018
Total payments according to the concluded lease agreements, UAH million.	1589	2438	4547	6052	10705	13832	
by the forms of lease, per cent							
money	14.0	18.9	24.6	31.7	41.7	43.6	
natural	77.4	76.5	71.6	65.2	55.1	53.6	
workforce	8.6	4.6	3.7	3.1	3.2	2.8	
Payement for 1 hectare per year, UAH	140	140	260.2	348.5	616.5	832.0	1369

Source: compiled by authors based on the data of the StateGeoCadastre of Ukraine [4].

It should be noted that there are positive changes in the structure of payments for the leased land parcels. If at the beginning of 2010, 71.6 % of lease was a natural form of payment, and only 24.6 % was the monetary one, at the beginning of 2016, the monetary form of payment increased to 43.6 %, while the natural form of payment went down to 53.6 %. Therefore, it can be concluded that the lease payment in monetary form is increasing whereas the amount of rental paid in natural and work-off forms is decreasing.

According to the StateGeoCadastre, the average cost of land lease in Ukraine at the beginning of 2018 was 1369 UAH/ha per year. The highest leaserates per one hectare of agricultural land (Fig. 5) are in Cherkassy (2962 UAH/ha), Poltava (2553 UAH/ha) and Kharkiv (2111 UAH/ha) regions. The lowest rental rates are in Zakarpattia region, where the average land rental is 719 UAH/ha. In general, rental rates in Ukraine differ depending on the region by a factor of 4.1or by 2000 hryvnias per hectare.

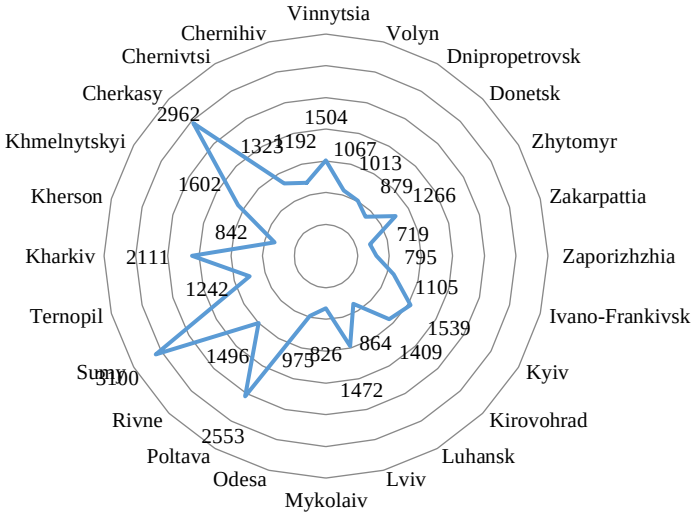

Fig. 5.5. The average rental rates for using agricultural land in terms of regional make-up in 2017, UAH/ha
Source: based on the data of the StateGeoCadastre of Ukraine [6]

The analysis showed that the growth of land tax revenues and rental fees for the land plots which are state or communal property were influenced by the changes in tax rates, and by the fact, that in order to determine the taxation base for levying this tax the normative monetary valuation of land plots with due regard to the coefficient of indexation is used. However, local budgets are losing significant amounts of revenues through the preferential taxation. Demianchuk O. I. notes that the increase in land payment revenues is restrained by the rental rates that are not in compliance with market conditions. Therefore, the uncontrollable situation with the market of agricultural land does not allow this tax to be the financial basis of local budgets [7].

The analysis of the structure of land payment revenues in their dynamics for the period of 2012 – 2018 was made using the balance method. The set of elements of payment for land was calculated by the following formula:

$$\text{Payment for land} = \text{land tax from legalentities} + \text{rental from legalentities} + \text{land tax from individuals} + \text{rental from individuals} \quad (5.1)$$

The results of consolidated calculations are presented in Table 5.5.

Table 5.5

Indicators for factor analysis of the land payment elements for 2012-2018

Elements of payment for land, UAH million	Absolute deviations						
	2013 - 2012	2014- 2013	2015 - 2014	2016- 2015	2017- 2016	2018- 2017	2018- 2012
Land tax from legal entities	-261	-173.6	782.4	3502.2	1201.3	-21.1	5030.2
Rental from legal entities	415.4	-412.6	1594.2	3937.5	1350.2	586.5	7471.2
Land tax from individuals	12.7	-31.2	116.2	531.2	355.1	242	1226
Rental from individuals	54.1	-101.6	254.8	521.2	154.3	129.2	1012
Payment for land	221.2	-719	2747.6	8492.1	3060.9	936.6	14739.4

Source: based on the data of the State Treasury Service of Ukraine [2].

For the period from 2012 to 2018, the amount of land payment revenues to the consolidated budget of Ukraine was gradually increasing, although in 2014 these revenues were decreasing. Thus, in 2013, land payments increased by UAH 221.2 million, in 2015 – by 2747.6 million UAH, in 2016 – by 8492.1 million UAH, in 2017 – by 3,060 UAH, in 2018 – by 936.6 million UAH, and in 2014 – decreased by 719 million UAH. It caused the total growth of the indicator under investigation by 14739.4 million UAH (= 27321.1 – 812581.7 or = 221.2 – 719.0 + 2747.6 + 8492.1 + 3060.9 + 936.6). On the other hand, payment for land has increased due to the increased revenues from the rental of legal entities, land tax paid by private individuals, the rental of private individuals, land tax paid by legal entities respectively by 7471.2 million UAH, 1226 million UAH, 1012 million UAH, 5030.2 million UAH (7471.2 + 1226 + 1012 + 5030.2 = 14739.4). Thus, by analyzing the dynamics of changes in the elements of the payment for land, it was investigated, how far each particular element influenced the change in total revenues.

Table 5.5 and Fig. 5.6 show that in 2014, the revenues from payment for land decreased. The total sum of its elements decreased by 719 million UAH as a result of the reduction of land tax from legal entities by 173.6 million UAH, rental from legal entities by 412.6 million UAH, land tax from individuals by 31.2 million UAH and rental from individuals by UAH 101.6 million UAH.

Table 5.5 and Fig. 5.6 show that the greatest land payment increase was observed in 2016. The total growth by 8492.1 million UAH was the result of positive change of all elements of the payment for land. The most significant impact on the change in land revenues in 2016 was made bythe increase of rental from legal entities by 3937.5 million UAH, and the increase of land tax from legal entities by 3502.2 million UAH. In 2014, the reduction in land payment revenues was also caused by a decrease in the rental from legal entities by 412.6 million UAH.

On the other hand, in 2012-2018, elements of the payment for land taken all together have increased. However, in 2014 there was a reduction in all elements of the payment for land due to economic andpolitical problems in the country. The smallest

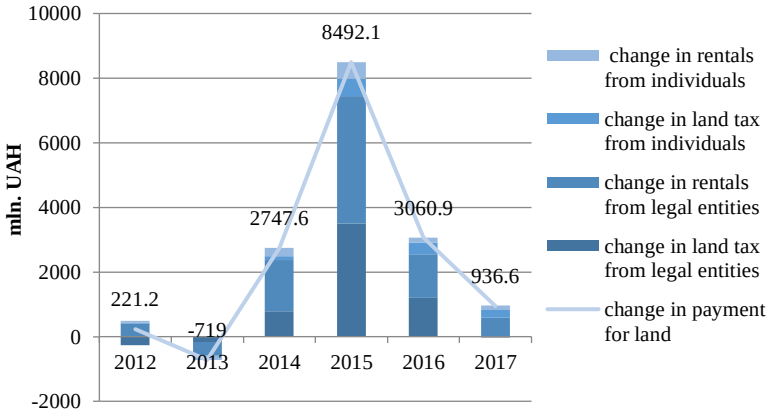

Fig. 5.6. Growth of payment for land in Ukraine in terms of its elements
Source: compiled and calculated on the basis of the data of the State Treasury Service of Ukraine [2]

changes can be observed across the rental of individuals, which increased by 1012 million UAH during the analyzed period. The biggest fluctuations were observed in the legal entities rental indicator, the total increase of which was 7471.2 million UAH.

The dynamics of growth of land revenues can be observed (Fig. 5.7). In 2018, local budgets received 27321.1 million UAH, which is 936.6 million UAH more than in 2017. Due to changes in the tax legislation, namely the transfer of payment for land into local tax payment and the improvement of normative monetary valuation of land, a rapid increase in the level ofland tax revenues to local budgets can be predicted. These measures are of great importance because decentralization reform is being carried out in the state.

It should be noted that there is no tax regulation of agricultural land use in its pure form. We share the opinion of Krysak A. that a fixed agricultural tax (now, *single tax of the fourth group*), is the tax regulator for the use of agricultural land. This tax is a synthetic fiscal instrument, because it includes, in addition to payment for land, a number of financial levers that do not relate directly to the extent of involvementof land resources into

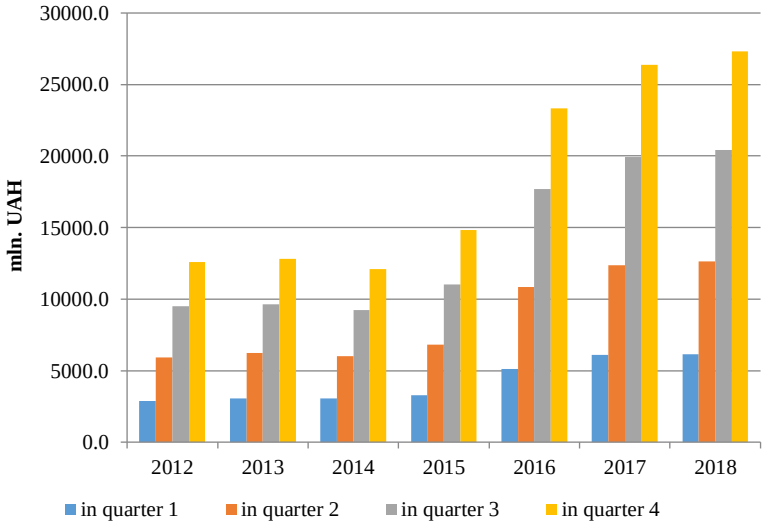

Fig. 5.7. Dynamics of land payments revenues to local budgets
Source: compiled on the basis of the data of the State Treasury Service [2]

economic turnover**,** but to the results of economic activity of agricultural producers [8, p. 8,9]. Organic farmers can also pay a single tax of the fourth group if more than 75% of their income is derived from agricultural activities.

The receipt of a fixed agricultural tax for 2012–2018 did not change and amounted to about 0.1 billion UAH. The amount of revenues to the consolidated budget in 2015 amounted to 2024.2 million UAH, which is 1901.3 million UAH more than in 2009 (Fig. 8). This is due to the fact that for calculating the tax base for imposing this tax by 2015, the standard monetary value of one hectare of agricultural land as of July 1, 1995 had been used. This tax is not related to the scale of agricultural land's development.

Income from the single tax (fixed agricultural tax) in 2015 increased by a factor of 17, compared with 2014. This is due to the introduction of annual indexation of the tax base for agricultural enterprises. In addition, from January 1, 2015, the rates of the special regime of direct taxation for agricultural enterprises have been increased threefold. Accordingly, if in 2014 the average size

of the FAT per hectare of farmland was less than 6 UAH/ha, in2015 the corresponding mandatory payment exceeded 115 UAH /ha.

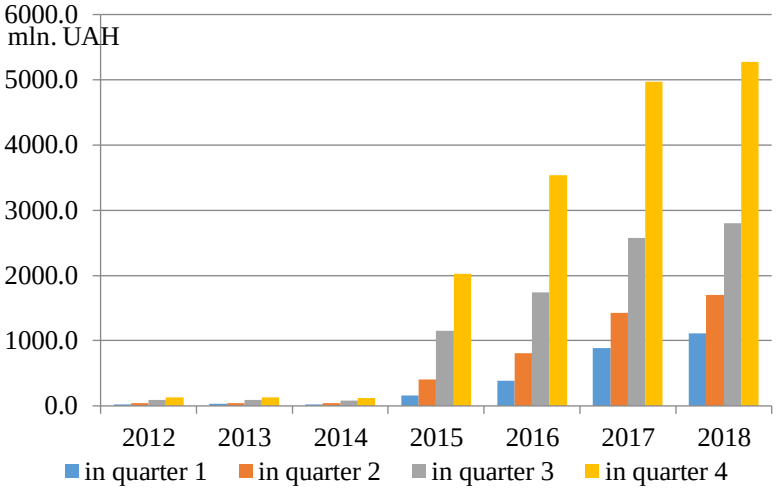

Fig. 5.8. Dynamics of revenues of the group four single tax (formerly FAT) to local budgets
Source: compiled on the basis of the State Treasury Service data [2]

Such innovations make it possible to transform the single tax into a significant source of pumping up local budgets. In 2018, local budgets received 5272.2 million UAH from the payment of a single tax from agricultural commodity producers, which is 307 million UAH more than in 2017.

As is known, the rates of the group four single tax depend on the categories of land (arable land, hayfields, pastures, perennial plantings, water fund lands) and their location (in mountainous areas, on the Polissia territories, under coverage).But agricultural lands with organic status are not isolated in a separate group when calculating the amount of tax. Therefore, in our opinion, the Tax Code should specify the tax rates for the land used for organic farming, and the tax should be renamed into a group four single tax for agricultural and organic producers [11].

In 2017, the Ministry for Agrarian Policy and the StateGeoCadastre had to develop a mechanism to stimulate the production of organic products through specialized land auctions. It

was supposed that the participants will be offered land plots for the production of organic products at preferential rental rates. Privileges will come into force only after the actual realization of the investment project – the laying of plantations, beginning of the certification process, that is, after confirmed and fixed intentions [12]. However, this project was not put into operation.

As Lupenko Y.O. notes, the tax load on agricultural enterprises within the framework of the application of the simplified taxation system, which began to operate on January 1, 2015, does not exceed the corresponding indicators for other tax systems – simplified (on income) and total (on profit). Such a load, taking into account the actual profitability of agrarian business in recent years, isnot supposed to be a critical one for the industry [9]. If the rates of land tax payments were higher, then, according to Holian V. A. and Bardas V. M., the land user would make maximum use of internal reserves and external borrowing for the implementation of innovative technologies, since this would be the only way to secure a foothold inthe market and gain competitive advantages [10].

In order to ensure stable revenues to local budgets and stimulate the effective use of land resources, a number of measures are needed, including the implementation of a full inventory of agricultural land, the use of rising factors for irrational use of agricultural land, and others. In addition, in order to increase the area of organic agricultural land and expand the range of products grown on this land, it is necessary to reduce the rates of land taxes and grant benefits to owners and users of organic agricultural land.

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5.3. The research of possibility of using sewage of urbosystem in forage crop rotation for organic livestock farming

Modern development of society is characterized by significant negative changes in water environment, which is caused by uncontrolled use of water resources. Continental surface water is the most unprotected element of hydrosphere, therefore, the overall scarcity, gradual depletion and intense pollution of surface waters may be observed in many countries of the world. At the present stage, humankind has faced the problem of the limited quantity and quality of this strategic resource. Despite the fact that the total volume of water on the planet is 1385 mln m^3, only a small part of it is suitable for human use [1]. This volume depends on the total amount of water resource stocks and the recovery rate of a source of freshwater in the process of global hydrological cycle.

The matter of quality of the aquatic environment becomes particularly important due to the intensive development of urban agglomerations. Since the functioning of urban ecosystems is a powerful factor in the destruction of hydro ecosystems, which is intensified due to the influence of wastewater and surface sewage during snow melting and rainfalls. This matter of pollution of water course is particularly acute in the lower areas of the flow of the Dnieper river, where almost all natural and human-made components of the river runoff, which change the hydrological and hydrochemical regime of the reservoir, are accumulated. Man-made reservoirs in the middle and lower parts of the Dnieper, which constitute an intensive source of secondary detritus production of organics, cause additional matter for local hydro ecosystems.

Considering low water supply with local water resources (1 thous. m^3 per year per inhabitant) and discharge of sewage, which is purified and treated to standard quality, to the waters of the Dnieper river within Kherson city, we offer water protection measures for polishing treatment and reuse of surface sewage of Kherson city for subsurface irrigation of agricultural crops in urban and suburban lands. World and domestic practice of applying sewage in agriculture shows a constant increase of its proportion in irrigation,

which provides increase of crop yielding capacity, improvement of the environmental status of rivers due to elimination of discharges of urban sewage, and saving fresh water.According to data of the International Water Management Institute (IWMI) irrigation with sewage covers about 20 million hectares of land, which constitutes 7.1% of the total irrigation area. The example of effective use of sewage in irrigation of agricultural crops is Israel: 90% of 500 mln m^3 of the generated sewage is purified to the intermediate and high level for irrigation of vegetables, forage crops [2].

Kherson region has a great potential of land and climatic resources for growing environmentally safe agricultural products and developing organic farming. The ecological and economic analysis of the current state of development of organic agricultural production indicates increase of certified land areas to 92.1 hectares, increase of the domestic consumer market and volumes of sales of manufactured products, rise of consumption culture of food products and growth of interest in their quality. Such a situation of intensive development of organic farming is caused by the improvement of soil fertility due to refusal of using mineral fertilizers, pesticides and herbicides, reduction of propagation of pesticides and disease of population [3]. In addition, the development of organic farming coordinates environmental social and economic directions in the agrarian sector of economy; it is a priority factor of constant development of urban and suburban areas. However, despite significant benefits, organic farming is a water industry. Agricultural production accounts for 86% of water footprint. At the same time, the volume of water required for growing organic agricultural products is received due to:

- green water resources are the indicators of use of rainwater that evaporates and is absorbed by crops during growing;
- blue water resources are the indicators of use of surface or ground water for growing agricultural crops, the volume of which should not exceed the amount of available local water resources;
- grey water resources are the indicators of water use for dilution of pollutants, which enter the natural aquatic ecosystems as a result of anthropogenic activities, to get water quality criterion

that meets the established international, national standards and regulations.

Under conditions of growing of organic yield of crops the figures of the grey water footprint will be minimum due to use of only organic fertilizers, the main pollutant of which will be natural nitrogen [4].

High figures of water footprint are the indicators of irrational use of water resources and its distribution in terms of space and time. They are caused by the lack of material resources for use of water-efficient technologies and unfavourable pricing policy for water. The condition required for trade of virtual water is the value of the water scarcity index (I_{ws}) that is calculated by the formula [4]:

$$I_{ws} = \frac{V}{V_n}, \quad (5.2)$$

where V- the total volume of fresh water used in the region, m^3/year;

V_n - the need for water for various purposes, m^3/year.

At the same time, the resources of the local river runoff are not always the priority indicators of obtaining water-containing organic products. The green footprint is the most commonly used in organic farming. It depends on the average annual rainfall and available moisture for agricultural crops. Its figures are less than the total amount of rainfall due to evaporation, infiltration into the soil and formation of surface water of the territory. Therefore, the necessity for irrigating agricultural crops is defined as the difference between the volume of water required for growing organic crops and the potential amount of rainfall that is absorbed by plants [5]:

$$IR = CWR - Peff \quad (5.3)$$

Surface water is most commonly used among the types of virtual water in the studied region. In this case, it is necessary to use large volumes of water, the source of which is mainly the Dnieper River. Only 50 % of the total amount of surface water taken for the needs of agriculture in the amount of 913.8 mln m^3 is returned to

the environment. It is restored in the process of the global hydrological cycle. However, the high rates of export of virtual water (95.6 mln m^3) are observed despite the limited water resources, low water availability and dry climatic conditions in the Kherson region. The crops with the largest need for water footprint are the main agricultural products that are exported. So, 1000 m^3 of water that is removed beyond the boundaries of the studied area is required for growing 1 kg of cereal crops, herewith a tendency for negative water balance is formed. About 10 % of virtual water comes to other countries and the import of virtual water is only 0.02 %.

Therefore, the development of organic agriculture in conditions of dry climate and limited water resources is be aimed at reducing water dependence through import of water-containing products, use of the latest water-efficient technologies and alternative sources of irrigation. Implementation of management of rational use of water resources will ensure development of the water sector and organic agricultural industry, improvement of quality of life of society, rational use and preservation of water resources of the Dnieper River [6]. In this case the effective direction of agricultural industry is the provision of reduction of the content of virtual water in organic products through optimized rotation and application of resource-saving crop irrigation regimes. We offer application of surface sewage that is treated to regulatory standards. It will increase ecological, social and economical effects in organic farming, increase the volumes of virtual water content without changing the indicators of water consumption during growing of organic products, as alternative sources of irrigation (Fig. 5.9).

The water suitability for irrigation is determined by mineralization, calcium indicator, pH, toxic alkalinity, total chlorine content, chemical compounds, rate of ion exchange and pathogenic microorganisms. According to the standard DSTU 2730:2015 «Environmental protection.The quality of natural water for irrigation. Agronomic criteria» the water for irrigation has three degrees of suitability:

1st degree: suitable, accompanied by changes in the ionic-salt composition of soils, but these changes do not lead to increase of

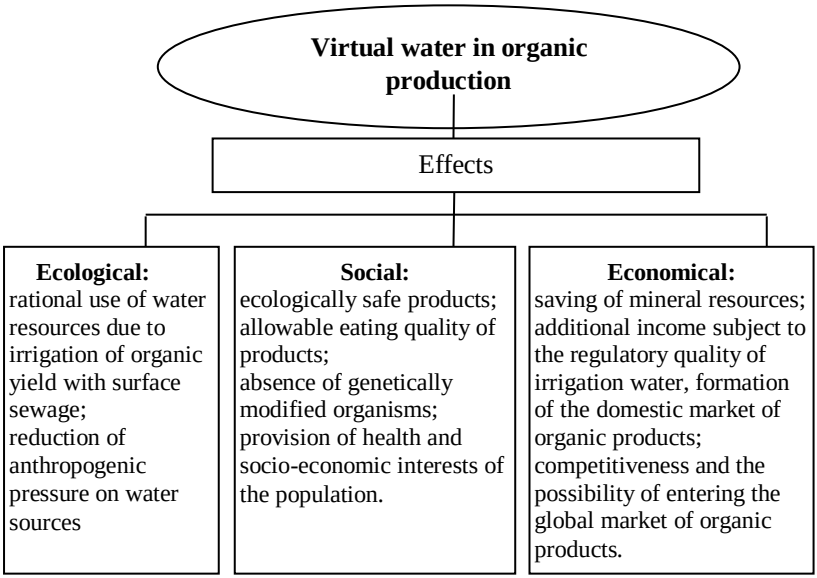

Fig. 5.9. Possible effects of application of surface sewage under the conditions of organic farming development

salt content, the sum of exchangeable sodium and potassium, alkalinity;

2nd degree: limited suitable water is available subject to constant monitoring of directions of soil processes and if a complex of agro-amelioration measures is applied;

3rd degree: unsuitable for regular irrigation, even if a complex of agro-amelioration measures is applied. At the same time, assessment of water for irrigation according to agronomic criteria is important for systems and sources of artificial irrigation, which are aimed at preserving soil fertility and quality of agricultural plants.

Sewage having amelioration and fertilizing value due to contents of 15-88 kg of nitrogen, 16-18 kg of potassium, 12-16 kg of phosphorus, 20-150 kg of calcium and magnesium in 1000 m^3 of sewage facilitates increase of crop yielding capacity with limiting nutrient elements, improve the qualitative characteristics of soil and organic agricultural products, provides obtaining of additional

income in growing of winter wheat in the amount of 154.7 UAH/ha, spring wheat - 108.8 UAH/ha, maize grain - 186.5 UAH/ha, forage maize - 816.3 UAH/ha, sugar beets - 184.9 UAH/ha, sunflower - 202.1 UAH/ha [7]. It is determined in the direction of studying the possibilities of irrigation with such waters that the volume of annual formation of sewage surface urban runoffs of urban system Kherson of is 20.5 mln m^3.

The matter of reduction of the negative impact of runoff through collecting and using purified sewage for subsoil irrigation in the organic farming system is quite important. The expediency of application of sewage in agriculture in Ukraine is confirmed by the results of researches in the 90's of the last century. 1% of their volume was used in such a way. According to the preliminary data of the researchers, it is established that due to the deficit of local water resources the use of sewage surface runoff, which is purified according to the regulatory requirements, will allow to irrigate up to 1 mln ha of land for farming [8].

It is appropriate to use water prepared for irrigation near big cities and villages. According to the quality assessment of sewage runoff based on DSTU 2730:2015, it is established that water is suitable for irrigation subject to obligatory preliminary improvement (Table 5.6, Table 5.7).

Table 5.6

Salt composition of sewage of Kherson city

Years Season	Salt composition, mg/l						
	Cl	SO_4	HCO_3	Ca	Mg	Na+K	mineralization
May2016	378.0	145.0	118.5	117.0	5.0	215	1170
June2016	381.0	159.0	517.9	211.0	3.0	270.0	1390
July2016	376.0	141.0	448.7	179.0	5.0	265.0	1040
August2016	290.0	165.0	738.4	205.0	4.0	302.0	1090
$\overline{x}$	356.2	152.5	455.7	178.0	4.2	263.0	1172.5
June2017	325.0	185.0	593.3	135.0	4.0	360.0	1470
July2017	390.0	190.0	403.2	89.0	7.0	380.0	1340
August2017	420.0	190.0	480.0	116.0	3.0	405.0	1500
$\overline{x}$	378.3	188.0	492.0	113.3	4.6	381.6	1436

Table 5.7

Suitability assessment of purified sewage according to agronomic criteria

Years season	Assessment as per indicators of DSTU 2730 : 2015					
	Na+K	Mg	Cl	overall alkalinity	toxic alkalinity	Quality degree
	Na+K+Ca +Mg	Ca		HCO_3	HCO_3-Ca	
May2016	60	0.07	10.66	1.94	3.91	2
June2016	52	0.02	10.74	8.49	2.06	2
July m2016	55	0.05	10.60	7.36	1.59	2
August	55	0.03	8.18	12.11	1.86	2
$\overline{X}$	55	0.04	10.04	7.47	1.43	2
June2017	69	0.05	9.17	9.73	2.98	2
July2017	77	0.13	10.00	6.61	2.16	2
August 2017	74	0.04	9.84	7.87	2.07	2
$\overline{X}$	73	0.07	7.67	8.07	2.40	2

The change of the hydrochemical properties of sewage runoff is characterized by distinct seasonal dynamics that is caused by change of volume of water use in household activities of population. Removal of the dry residues (salts, soil and sand components, biogenic-detrital particles) through the treatment systems in the autumn period is by 1.4 times lower than in summer period. Therefore, the efficiency of the treatment systems in Kherson city is 50.0-97.0% according to the difference in the parameters of the hydrochemical properties regarding entering and discharge of sewage. The results of the analysis of the hydrochemical characteristics of the status of purified sewage runoff at the discharge spot indicate significant reduction of pollutants that enter the treatment systems with the sewage water.

It is established that water belongs to the second degree of suitability according to the performed assessment of the suitability of sewage water according to agronomic criteria for irrigation of cereal forage organic products. At the same time it is necessary to carry out polishing treatment through engineering infiltration facilities of a constructed wetland. The effectiveness of such biological polishing treatment is 80%. In order to avoid

emergencies, it is necessary to build an emergency discharging containment pond that is able to accumulate and contain 5-7days city's runoff under insignificant daily volumes of sewage (45-50 thousand m^3). The emergency can be eliminated and the operation of the city's treatment system can be resumed during this time. After that, the sewage of constructed wetland is to be redirected for polishing treatment. It is also proposed to construct local treatment plants for mechanical treatment with the subsequent directing of surface rainfalls for polishing treatment at the municipal wastewater treatment plants, and afterwards - to a constructed wetland.

The prevalence of Na^+ and Cl^- in sewage indicates alkalinization and salinization of soil, so it is necessary to apply gypsum. In addition, the matter of choice of crop rotation using resource-saving irrigation regimes is quite important. It will reduce the environmental pressure on soil and save local water resources.

Tabl.5.8 shows the cereal and forage crop rotation, resource and energy-saving irrigation regulations that are adapted to local conditions.

Table 5.8

Cereal and forage crop rotation of agricultural crops with subsequent verification of their quality for organic livestock farming

No.	Rotation of agricultural crops	Irrigation rate m^3/ha
1	Alfalfa	3000
2	Alfalfa	2700
3	Winter wheat	1050
	Grass-legume mixture	1150
4	Grain maze	1250
5	Grain maze	1250
6	Spring wheat	1150
	Additional sowing of alfalfa	900

In addition, the structure of sown areas and the principles of crop rotation of irrigation systems with sewage differ from crop rotation of systems that use water from natural sources for irrigation. Alfalfa and forage agricultural crops are the most productive and resistant toharsh environment. Therefore, organic

agricultural crops are to be grown subject to complete decontamination of biological components contained in sewage, and the animals are fed with plant products after silage making or heat treatment.

Forage crops constitute 33% and cereal crops constitute 67% in the offered structure of crop areas. At the same time, soil is additionally enriched with organic matter due to field residues. The average weighted net irrigation requirement is 2079 m^3/ha, considering the efficiency of the closed irrigation system ($\eta = 0.96$, gross rate considering water losses - 2165 m^3/ha.).8314 ha may be irrigated according to the established volume of sewage water (18 mln m^3). The irrigated area can be increased to 9468 hectares, considering the additional surface rainfall runoff in the volume 2.5 mln m^3 per year.

The use of resource-saving crop irrigation regimes is one of the methods of optimization of irrigation. It is appropriate under conditions of water resource deficit and insufficient natural humidification of the studied territory. It provides effective absorption of nutrients and decomposition of pollutants within 20 days [2].

Considering the large capacity of virtual water in organic production in growing of agricultural crops with limited number of local water resources, the use of surface sewage water for their irrigation is a favourable alternative source. It is established that water belongs to the 2nd degree of suitability according to the performed assessment of suitability of surface sewage that is treated at urban wastewater treatment plants as per agronomic criteria. Therefore, it is necessary to improve its qualitative characteristics based on implementation of environmentally effective measures - biological polishing treatment of surface sewage on constructed wetland for the practical use of sewage in organic farming. Grown organic forage products can be used in livestock farming upon condition of thermal processing and silage making, which will allow to preserve quality of livestock products.

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6. APPLIED FUNDAMENTALS OF GEO-MANAGEMENT IN ORGANIC AGRICULTURE

6.1. Organization of organic crops cultivationusing GIS-technologies

Organic products cultivation in Ukraine today has a promising and investment-attractive direction for agricultural development. At the same time, it remains more risky than traditional production. Some of the risks are temporary and involve changes in technology (temporary decline in crop yields due to the transition to the use of biologically safe plant protection products and organic fertilizers) and the development of new markets. There is a constant risk of losing the status of organic products (desertification of a batch of products (a crop) or an organic producer (desertification of land) due to the smallest deviation from the requirements of organic technologies to any process (production, storage, transportation, sale). That automatically leads to a loss of expected revenues because of the inability to sell products at higher prices.

The concept of organic cultivation is adapting production to all available resources' rational use. That is why the priority for the development of organic production is the natural agroecosystems. Indeed, the expediency and volume of future investments on the cultivation of organic crop production will directly depend on this.

Taking into account all risks and leveling up its negative effects, adopting optimal and effective management decisions, requires full and reliable information provision of the investor (farmer) about all resources with spatial reference. Such awareness is provided by remote sensing data from the land, which, after decoding, are processed in geographic information systems. The introduction of computer technology allows not only to significantly simplify the formation of information databases and reduce the likelihood of errors, but also to introduce new methods for supporting the adoption of managerial decisions on the basis of data analysis.

For example, in terms of leveling the limiting factors for the organic cultivation in whole or in separate crops in the territory of a separate region (district, territorial community), it is possible to identify land that is investment-attractive for organic production.

First of all, for the cultivation of high-quality organic products, it is necessary that land is not contaminated with toxic and dangerous substances (heavy metals, polychlorinated biphenyls, dioxins, pesticides, radionuclides, etc.) (Table 6.1).

Table 6.1

Indicators of the most environmentally friendly and economically viable land for organic production

No	Indicators	Criteria standards	
		suitable	unsuitable
	Land placement relative to sources of pollution		
	from industrial enterprises and objects that can pollute the environment, km	> 15	< 15
	from international, national and regional highways of state importance, m	> 300	< 300
	from metropolitan areas, cities and airports, km	> 5	< 5
1.	railways, settlements, small businesses and intensive agricultural land, m	> 300	< 300
	The content of pollutants in the soil		
	density of contamination by radionuclides:		
	cesium-137, Ci / km2	< 5	>5
	strontium-90, Ki / km2	< 0,05	> 0,05
	the content of pesticide residues relative to the MAC	< 1,0	>1,0
	content of moving forms of heavy metals:		
	copper, mg / kg	0,5-3,0	>3,0
	cobalt, mg / kg	1,5-5,0	>5,0
	zinc, mg / kg	1,0-23,0	>23,0
	mercury, mg / kg	< 6,0	>6,0
	manganese, mg / kg	10,-80,0	>80
	nickel, mg / kg	< 4,0	>4,0
2.	chromium, mg / kg	< 6,0	>6,0
Made by the author according to the requirements of organic production			

The Ukraine's peculiarity, especially its northern regions, is a risk of contamination of agricultural land with radionuclides, as a result of the Chernobyl nuclear power plant accident. According to the certification body of Organic Standard LLC, Ukraine has examples of organic production in the fourth zone of pollution. However, the crop must be checked for the content of radionuclides and in case of confirmation of their availability, the product will be desertified and loses the status of organic. And this additional risk is borne by the farmer.

The peculiarities of growing crop production in conditions of possible radioactive contamination are connected with the necessity of planning and implementation of a complex of agronomic measures aimed at obtaining radiologically pure products, and their harmonization with organic standards. This complicates the process and increases the production of organic products.

In addition, the investor will need information such as:

- placement of the plot - distance from settlements (labor force), communications, power lines, roads, logistics;
- area, the boundaries of the plot, the purpose and the form of ownership;
- information on tenants (owners) of adjacent plots, terms of lease and methods of their use. In organic production, neighboring farms using intensive farming methods are considered as a potential source of pesticide and herbicide contamination of certified lands;
- history of the use of the plot - to organic production, try to attract primarily land that has not been processed for a long time (pastures), where the prohibited organic products are not used. If this fact is documented by the local authority (rural council), the certification authority may take a decision which has a retroactive effect in regard to recognition as part of the transitional period of any prior period of time;
- level of groundwater (for the cultivation of berry crops is of critical importance);
- relief of the terrain, the presence of protective plantings (forest belts), forests, rivers and open water reservoirs. Rules for conducting organic production require the implementation of measures to prevent contamination of the fields, maintenance of

soil fertility, anti-erosion measures. That is, simultaneously with the production on the agricultural territory must be stored natural ecosystems. Ecologically stabilizing lands (forests, meadows and pastures, water bodies, swamps) prevent the emergence and development of water and wind erosion, degradation of land, they are the habitat of a useful fauna, populations of certain species of plants and animals. The result is a higher economic result from the use of arable land, as natural ecosystems contribute to the increase of soil fertility;

- agrochemical state of soils.

The current Law of Ukraine «About the production and circulation of organic agricultural products and raw materials» provides for an assessment of the suitability of lands (soils) for the production of organic products and raw materials to be carried out by a central executive authority that implements the state policy for the implementation of state supervision (control) in the field of environmental protection, in the field of land protection.

However, the State Regulatory Service refused to approve the draft resolution of the Cabinet of Ministers of Ukraine «About approval of the Procedure for assessing the suitability of land (soils) and establishing zones for the production of organic products and raw materials and the criteria for the quality of land (soils), their suitability for the production of organic products and raw materials, suitability for the production of individual crops «.

According to the decree, the land was divided into 3 groups of suitable, limited and non-suitable land for organic production. In the future, this mechanism has not been worked out.

On April 19, 2018, the Supreme Council of Ukraine adopted in the first reading a draft law «About basic principles and requirements for organic production, turning and marking of organic products». No. 5448-d, which removed provisions for assessing the suitability of land for the production of organic products, which contradicted international practice. In any international or national standards, there are no restrictions on agrochemical indicators for the certification of land as organic. That is, organic may be land containing humus and 4%, and 2%. And here's what to grow on them, the investor decides himself.

Therefore, in our opinion, these criteria (Table 6,2) can be used to classify the land as such that:

- suitable for growing a wide range of crops (cereals, oilseeds, vegetables, berries);
- suitable for growing a limited list of crops;
- can be used to grow individual crops under additional investment.

Table 6.2

Indicators of suitability of lands (soils) for economically efficient organic production according to soil-agrochemical criteria

Indexes	Suitable for a wide range of crops	Suitable for a limited list of crops	Suitable for individual crops under additional investment
1	2	3	4
Humus content,%:	> 2.0	1.0-2.0	<1.0
Depth of humus horizon, see	> 40	20-40	<20
Granulometric composition content of physical clay,%: Polissya Forest Steppe, Steppe	 16-35 21-70	 6-15 11-20	 <5 <10
Soil solution reaction (pH): pNsol pH H_2O	 > 5.5 <7.5	 4.6-5.5 7.6-8.5	 <4.6 > 8.6
Amount of absorbed bases (Ca + Mg), mg-ek / 100 g	> 20	10-20	<10
soil density, g / cm^3: sandy soils	1.3-1.5	> 1.5 but <1.7	> 1.7
medium and heavy granulometric composition	1.1-1.3	1.3-1.5	> 1.5

continuation of tabl. 6.2

1	2	3	4
Content of mobile phosphorus compounds, mg / kg of soil: - by the method Kirsanov, Chirikova - by the method of Machigin	> 100 > 30	50-100 15-30	<50 <15
Content of mobile compounds of potassium, mg / kg of soil:			
by Kirsanov's method	> 120	80-120	<80
Chirikova	> 80	40-80	<40
Machigina	> 200	100-200	<100
Content of moving forms of trace elements, mg / kg of soil: - by the Krupsky-Alexandrova method:			
manganese	10-100	<10	> 100
zinc	1-23	<1	> 23
copper	0.5-3	<0.5	> 3
cobalt	0.15-5	<0.15	> 5
boron(by the method of Pochenka) :	> 0.33	> 0.33	-
- Molybdenum (by Grieg method) :	> 0.1	<0.1	-
Nitrogen content that is easily hydrolyzed, mg / kg of soil: - by the Cornfield method - by Tyurin-Kononov's method	> 150 > 40	100-150 30-40	> 100 > 30
Nitrogen content by nitrification capacity, mg / kg of soil	> 8	5-8	<5
The content of mobile sulfur, mg / kg of soil	> 6	1-6	<1

The State Land Cadastre contains a part of this information. It is the only state geoinformation system of land information. It

contains such information as: location; area; data on the qualitative state of the earth and the development of soils; intended purpose (category of land, type of land use within a certain category of land, normative monetary valuation, information on owners).

The legal base for its forming and constant updating is the Law of Ukraine «On State Land Cadastre» dated July 7, 2011, No 3613-VI, and the Resolution of the Cabinet of Ministers of Ukraine dated October 17, 2012 No 1051 «On Approval of the Procedure for the State Land Cadastre».

The law providesthat during the conduct of the State Land Cadastre, the subjectareas(separate administrative-territorial units,terrain, economic and normative monetary land's valuation etc.) or integrated maps (plans) may be created.

But in practice, it is far from perfect and does not always contain a complete and accurate information about ground sections. So, for example, areas can be planted one at a time, have a completely different configuration than in the initial project of land management. And passes on the cadastral map does not mean that in these places the land does not belong to anyone. Simply the owners have on their hands the primary technical land documentation, but there are no cadastral numbers of state registration, since they were executed mainly until 2004, without reference to the national system of coordinates. In rural areas, ground sections in State Land Cadastre are basically land parcels or land owned by a private peasant farm whose owners simply did not make land management projects on them and did not file them for registration. The financial component plays a role in this, as all costs for the development of technical documentation and state registration are covered by the owner of the land plot. The same situation is observed with the lands of village councils and united territorial communities (hromadas).

In order to investments'attract and development of socially responsible business, for farmerwho plan to start or develop organicproduction,it is necessary to provide a full range of information on land resources using GIS-technology.

The proposed algorithm for determining the investment-attractive land using GIS-technologies (Figure 6.1) involves the

gradual layering ofthematic maps, that will allow to take into account all the risks during organizing theproduction of organicproducts.

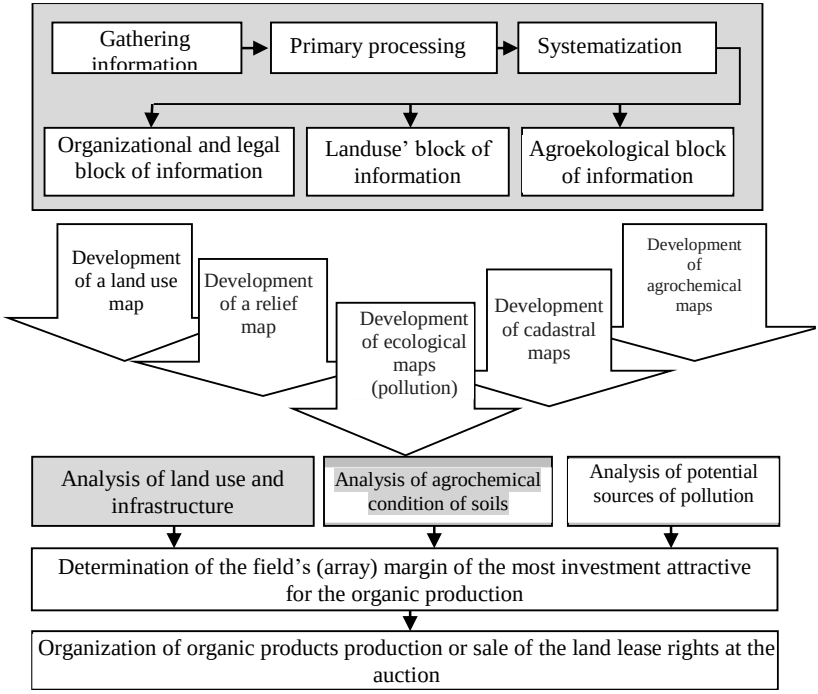

Fig.6.1.Algorithm for determining the investment attractive lands for the organization of organic products' production using GIS-technologies

Consequently, development of such information bases at the level of district or settlement councils (united territorial communities), will allow to sell the right to lease on such land at auction much more expensive; to supplement the community budget; to promote the development in the region of business, which will help create new jobs, ensure sustainable development of the region.

References

1. Law ofUkraine»On the Production and Circulation of Organic Agricultural Products and Raw Materials« 425-18 from 2014

2. Draft Law»On Basic Principles and Requirements for Organic Production, Circulation and Marking of Organic Products»dated March 30, 2018No5448th

3. Law of Ukraine «On State LandCadastre» of 07.07.2011 No3613-VI

4. Decree of CabinetofMinisters of Ukraine from17.10.2012 No 1051»On Approval of the Procedure for the State Land Cadastre»

6.2. Methodology of organization of organic crop production using GIS-technologies

Organic production in the world is already more than a trend. This is a socially responsible business that cares about the future of future next generations and the planet. Agrarians who are ready to invest in the innovation direction of agricultural production and consider it promising and profitable are also emerging in Ukraine. It's a small farms with an area of 10-50 hectares, and a large producers (agroholdings), cultivating from the several hundred hectares to several thousand hectares of land. The reasons for the transition of agricultural producers to organic technologies are different in each of them (Fig. 6.2).

According to the results of the SWOT analysis (Fig. 6.3), it has been established that organic land use has more threats and weaknesses than traditional ones. Among additional risks, it is worth highlighting the temporary decline in crop yields, as a result of the transition exclusively to organic fertilizers and the use of biologically safe pest remedies. At the same time, the smallest deviation from the requirements of organic technologies will lead to the loss of the status of organic products, which will lead to a loss of expected revenues.

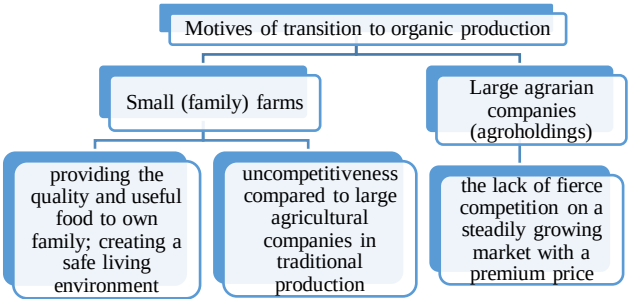

Fig. 6.2. Motives of agricultural producers' transition to the organic technologies [1]

The farms have a local location and they are often tied to the farmer's place of residence, which is not typical for investors (agroholdings). The latter, very often, begin to grow organic raw materials in order to load their own production facilities for processing (storage), the formation of large commodity batches with subsequent export abroad. Typically, their land bank may consist of large arrays that are located in the territory of several areas at once. Therefore, at the planning stage for the introduction of organic land use, each will have its own algorithm of action (Figures 6.4, 6.5) [1].

Investors are trying to attract land that has not been processed for a long time (overpasses, pastures). As a result of such natural involvement, the agrochemical state of lands is stabilized or improved naturally without human intervention. This option reduces the payback period of investments, as the transition period can be reduced to 6 months. The disadvantage of using reflows is the obturation and the large number of pests that have lived and propagated safely for many years. Quite often, floodplains or pastures begin the process of natural flooding, which complicates and increases the cost of commissioning the site.

Whereas, as for small farmers, the indicators of agro-chemical state of soils, after using (leasing), may not correspond to optimal values. These can be the consequences of growing 2-3 commercial crops in the crop rotation, without using any organic fertilizers that only deplete the soil.

STRENGTHS	WEAKNESS
1. Premium price. 2. Annual growth of the organic world market by 10-15%. 3. Availability of appropriate land resources and natural and climatic conditions for organic production. There are relatively large areas of land that have long been not used in agriculture. 4. Proximity to the EU and Asia.	1. Rigid requirements for the production, processing and marketing the organic products. 2. Additional costs for annual certification. 3. Mandatory transition period of 2-3 years, which increases the payback period of investments. 4. Restricted list of authorized for use of protection means grew and fertilizers. 5. Lack of narrow specialists, exhausted technology, experience. 6. Strict accounting and document management on the farm. 7. A higher export price is given on the condition of stable supply, quality homogeneous products. 8. Absence of direct state financial support of organic producers in Ukraine 9. Incomplete land reform. 10. Absence of national standards for organic production. 11. High price of products in the domestic market.
OPPORTUNITIES	**THREATS**
1. Absence of tough competition in the market. 2. Development of internal market for organic products and changing the society's attitude to the quality and safety of food products. 3. Development of science in the region, improvement of technologies. 4. Financial support of organic producers at the regional level. 5. Settlement of processing in cooperation, which will generate additional profit. 6. Exchange of experience. Ukraine has examples of successful organic producers.	1. Additional requirements for checking the quality of each consignment of products intended for export. 2. A large number of sources of organic land's potential contamination (industrial objects, adjacent intensive farms, etc.). 3. Radioactive contamination of products by radionuclides. 4. Absence of seasonal workers due to the substantial labor migration of the population. 5. Termination or non-renewal of the land lease agreement. 6. The least violation of the rules of organic production will lead to the desertification of land and products. The renewal of the certificate will have to undergo a transitional period of 2-3 years. 7. Problems with sales of products when entering a new market.

Fig. 6.3. Matrix of organic production characteristics in Ukraine based on SWOT-analysis [1]

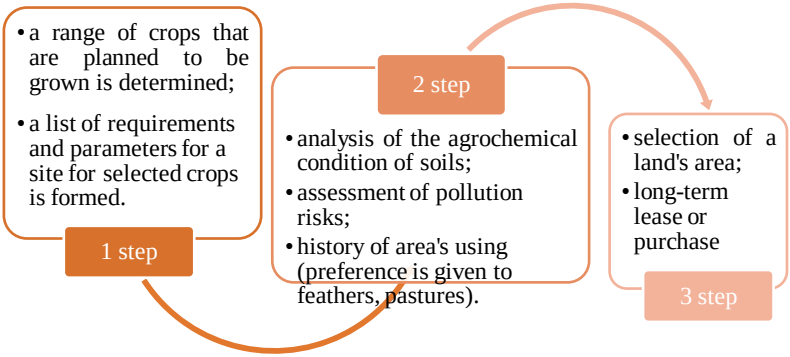

Fig. 6.4. Algorithm of the investor's actions at planning the stage for the introduction of organic land use

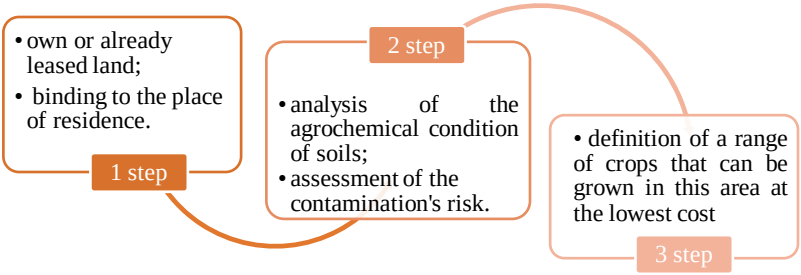

Fig. 6.5. Algorithm of actions of a small (family) farmer at the stage of planning the introduction of organic land use

In organic production, natural factors have a much greater impact on the quantity and quality of the crop compared with traditional agricultural production. Therefore, the content of humus in the soil is one of the main criteria for assessing the suitability of the site for the introduction of organic land use. Its role is not limited to a source of nutrients for plants. The content of humus affects the structure, water-retaining ability and thermal properties of the soil, promotes the development of useful soil microorganisms, improves the physiological processes of plants.

In order to minimize crop losses during the transition period, it is expedient to carry out a complex of agro-chemical and land

reclamation measures aimed at eliminating the negative consequences of previous land use and improving or stabilizing the quality of soil conditions.

This option of introducing organic production requires additional time and money. However, this is a necessary step on the lands that have been affected by uncontrolled economic activities of agrarians. The duration of such a stabilization period depends on the peculiarities of the occurrence of natural processes, the required volume of fertilizers and the justified dosages of their introduction.

The development and substantiation of measures that are able to optimize the basic agrochemical indicators while not violating the rules of organic production will allow for time alignment of stabilization and transitional periods. Thus, reduce the payback period and increase the efficiency of the project. In fig. 5 depicts a model of the development of an organic berry that involves preliminary holding of stabilization measures during the transition period.

Organic land use is aimed at maintaining the natural fertility of the soil. Plant nutrition should pass through the soil ecosystem. In this case, the use of fertilizers and non-renewable sources of plant nutrition should be minimized.

The main measures for the accumulation of organic substances in the soil that do not contradict organic standards are:

– introduction of organic fertilizers (biohumus, compost, pouring of siderates);

– other substances of natural origin authorized for use in organic production standards (products of animal origin (blood and bone fish and meat meal, horn and hoof flour), sawdust, cod and wood ash, bark, crude potassium salt, peat (locally), calcium phosphate and aluminum, phosphorous flour, chalk, kisserite, marl, limestone flour, gypsum, sapropel, sodium chloride, magnesium carbonate and calcium, defecate);

– regular cultivation of legumes or a mixture of herbs in the crop rotation, which ensures the systematic accumulation of valuable forms of humus through a greater number of root remains;

– use of biopreparations;

– fight against erosion and water reclamation, which improves the air-water regime, which creates conditions for the formation of humus; chemical melioration, which reduces the acidity of soils and simultaneously enriches them with calcium, suppressing the synthesis of fulvic acids, destroying, washing organic and organo-mineral compounds;
– correct soil tillage system, etc.

In the matter of obtaining the proper quantity and quality of organic crop products, the selection of varieties and hybrids of crops most adapted to specific soil-climatic conditions is extremely important.

The technical support should be based on selection of unified equipment, which can timely and qualitatively perform technological operations on soil cultivation and weed destruction in a rather short time, with a minimum cost of fuel and lubricants.

However, the correct selection of crops in crop rotation will reduce the possible risks associated with natural conditions and market conditions. A thorough crop rotation will allow you to save significantly on fertilizers, will allow you to fully use your own crop potential and restore the structure of the soil.

Due to the diversity and effectiveness of the action on the soil and the plant, the crop rotation factor is dominated by other equally important measures. Its influence relates to many soil processes and a variety of aspects of plant growth and development. The crop rotation is planned in such a way as to support biodiversity, provide reliable protection against pests and diseases, help preserve the basic properties of the soil, manage the structure of the soil and increase its natural fertility. The composition of the crop rotation includes cereals and technical crops, perennial grasses and necessarily siderates.

Under the rules of organic farming under the crops of perennial legumes - clover, alfalfa, esparzette, turbot etc. must be at least 35-40% of the sown area. They determine the possibility of introducing an oversight. Green fertilizers in the main and intermediate crops should belong to 20-25% with the obligatory application of chopped straw cereals and legumes, crushed stalks of corn and sunflower, beans hanks.

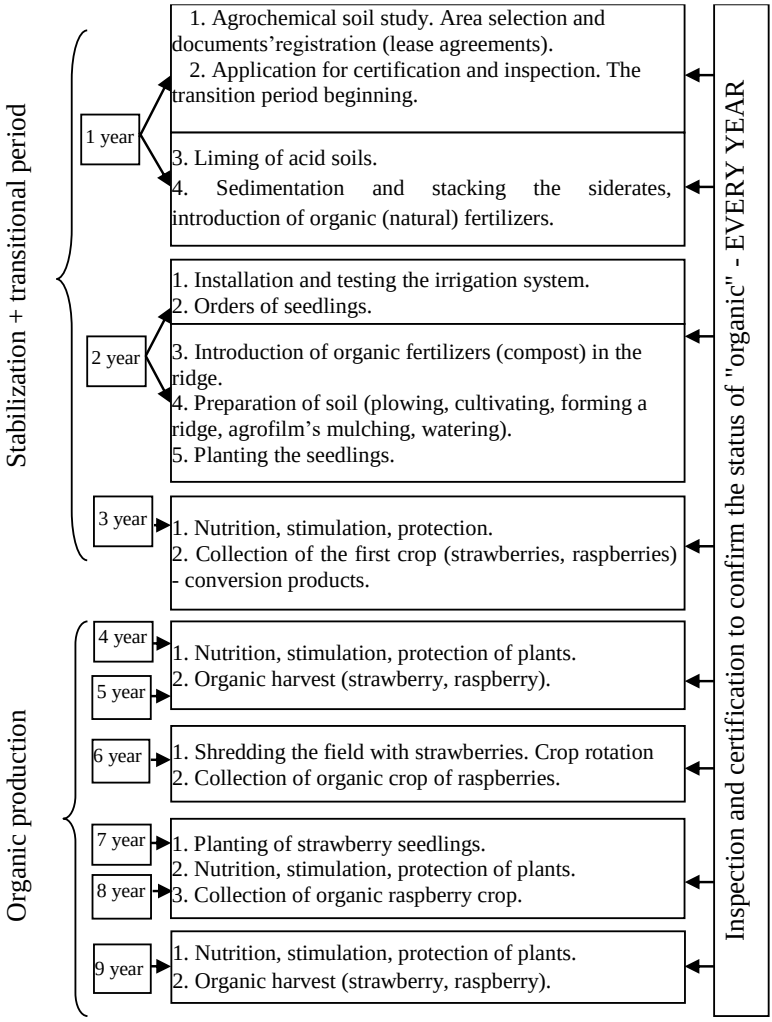

Fig. 6.6. Model of organic berries' development with stabilization period

The importance of crop rotation as an agronomic event, which contributes to the proper level of productivity of crops, is also highlighted by domestic scientists who have studied this issue in detail. Among them are: Litvinov D., Kalchun T., Gordienko T., Yermolayev M., Boyko P. [2, 3].

According to prof. Boyko P. [2], planning a crop is worth considering natural areas. For the Polissya zone, some variants of crop rotation have been developed:

1) 1 - lupine on siderates, 2 - winter rye, 3 - potatoes, 4 - maize on early silage or green fodder, 5 - winter rye, 6 - lupins on corn with straw staling, 7 - winter rye.

2) 1 - clover (otava for sideration), 2 - winter rye + sifted on siderates, 3 - potatoes, 4 - corn for silage, 5 - oats + clover.

3) 1. Lupine with oats on green fodder, 2-winter rye + sifted on siderates (non-fat), 3 - early potatoes, maize on green fodder, 4 - winter rye + squash on siderates, 5 - flax fungus (0, 5), potatoes (0,5).

4) 1 - lupine on green fodder and silage (otava for sideration), 2 - winter wheat + sifted (non-fat) on siderates, 3 - potatoes, 4 - flax fungus, 5 - winter rye + sifted on siderates (non-fossil), 6 - oats for grain.

For conditions of sufficient humidification of the forest-steppe zone:

1) 1 - clover of meadow (otava on sideration), 2 - winter wheat + sown (non-fat or mixture), 3 - sugar beets, 4 - maize on silage, 5 - barley + clover.

2) 1- clover of meadow; 2 - winter wheat + sifted on siderates (non-fat or mixture), 3 - corn for grain, 4 - barley, oats + clover.

3) 1 - peas, 2 - winter wheat + shrubs on siderates (non-fat or mixture), 3 - oats + sifted on siderates, 4 - corn on grains, 5 - barley + poppy (non-fat) on siderates.

Specific theoretical and practical aspects of using the siderates in crop rotation are dedicated to the domestic scientists' works. In particular, Balyuk S., Degodyuk E., Berdnikov O., Volkogon V., Litvinova O., Shevchuk M., Medvedev V., Plisko I. [4-8] and others.

Berdnikov O. and Volkogon V. emphasize the fact that siderates are a source of carbon and energy with minimal cost (for seeds and technological operations related to cultivation and soil littering) [6]. According to Balyuk S.A. etc. [7], the effectiveness of siderates in the synthesis of humus compounds is equivalent to 25% of the impact of litter manure. Instead, Litvinova O., based on the

results of field studies (on soddy podzolic soils), argues that the prolonged use of trench siderate increases the yield of organic matter by 32%, carbon - by 58%, and for the use of straw straw, the carbon content increased to 87 % The combination of straw and siderates in agrotechnical measures prevents excessive losses of nitrogen and organic matter as a result of intensive mineralization and reduces the C: N ratio to optimal values, providing better conditions for the humification of organic matter [5]. As a result, the scientist proposed variants of mixtures of organic crops for organic farming (Table 6.3).

Today, there are more than 60 crops used in organic farming as green fertilizers. However, experts from the «Institute of Agriculture of the NAAS» indicate that when choosing siderates, it is necessary to take into account

- type of soil - for the restoration of the required complex of trace elements on depleted soils it is recommended to sow the legumes' crops. To fill the soil with humus, winter rape from the family of crucifers, as well as cereal siderates: wheat, rye and oats;
- moisture soil's content - if moisture levels are high, then siderates that consume a lot of moisture, such as lupine and rye, should be planted. And on sandy soils and dry areas to grow plants that are resistant to lack of moisture - feces or rape;
- protection from illnesses - for sanitary purposes, for the elimination of diseases of main crops, specialists recommend sowing radish, flowers of calendula and blackberry, and also mustard.

To understand all the subtleties of planning a crop rotation for a farmer who does not have a special agronomic education, it is rather difficult to independently, and calculate the balance of humus the more. The similar computer program «Balance of humus and nutrients in agriculture of Ukraine» was developed by the laboratory of modeling and management of chemistry. It allows to calculate the balance of humus and nutrients in the soil of the region, district, economy, crop rotation for traditional production [9].

Table 6.3

Recommended mixtures of organic crops in organic farming

Mixture composition	Sowing rate kg / ha	Mixture composition	Sowing rate kg / ha
Summer and intermediate sowing crops			
Winter rape + mustard	6 + 5	Sunflower + peas fodder	8 + 70
Rape (feed rape) + mustard + chuckle)	5 + 5 + 2	Winter rape + mustard	6 +60
Ryegrass + rape	10 + 10	Rape + mustard + vicia sativa	5 + 5 + 35
Vicia sativa + Phacelia	100 + 6	Vicia sativa + Phacelia	80 + 6
Peas fodder + vicia sativa + mustard	80 + 60 +5		
Winter intermediate crops			
Ryegrass + vicia villosa+ trifolium	20 + 50 + 20	Winter rape + vicia sativa + ryegrass	10 + 40 +20
Winter rice + winter rye	5 + 120	Ryegrass + vicia sativa	20 + 100
Vicia villosa + rye in winter	50 + 110	Peas fodder + vicia villosa + winter rye	50 + 50 100
Sedimentation			
Ryegrass + trifolium repens	14 + 9	Winter rape + Ryegrass	6 +22
Ryegrass + rape (turnip feed)	12 + 8	Ryegrass + trifolium repens+ rape	12 + 3 +4
A mixture for low-fertility soils			
Medicinal burdon (biennial)	25	Vika villosa + lupine + hazel	20 + 60 +10
Trifolium incarnatum + ryegrass perennial + winter rye	20 + 10 + 30	Diaper + trifolium incarnatum + winter rye	100 + 15 +40

Organic farms are mostly small and medium-sized farmers, who cannot always afford to invite an agro-consultant or hire an agronomist, especially at an early stage. Therefore, we have developed an on-line e-calculator for organic land use on the example of the Rivne region.

The main task of the e-calculator for organic land use is the planning of crop rotation and the volumes of introduction of organic fertilizers (biohumus) for stabilization (improvement) of the qualitative state of soils, by ensuring a positive balance of humus

each year in order to produce crop yields not less than traditional technologies. and calculating humus balance for it.

To calculate the humus balance, the methodology for calculating the balance of humus and nutrients was used by scientists of the NSC «Institute of Soil Science and Agrochemistry named after A. Sokolovskyi» [7]. Biohumus has been selected as an organic fertilizer for several reasons. First, according to the requirements of organic standards, waste and by-products of plant and animal origin must be processed for further plant nutrition. Biohumus is a product of the processing of organic waste by rainstorms.

Secondly, it is a highly concentrated fertilizer, which, in content of humic substances, outgrows manure and compost in 4-8 times, contains a large number of enzymes, vitamins, soil antibiotics, plant growth hormones and other biologically active substances. Based on the results of research, Gorov A., Skvortsova T., Lysitska S., argue that the timely application of vermicompost (biohumus) together with a complex of agrochemical measures, provides the maximum transformation of organic fertilizers introduced into humus substances and their fastening in the humus profile. It has a positive effect on the humus state of depleted and degraded soils, which is not always ensured by the introduction of traditional organic fertilizers (fresh litter manure, litter or peat) [10].

Therefore, the biohumus humification coefficient is higher than in conventional manure (Table 6.4)

Table 6.4

Humidity coefficients

Indicator	Polissya		Forest-steppe	
Humification coefficient	manure	biohumus	manure	biohumus
	0,042	0,767	0,054	0,99

Among the disadvantages of biohumus' using is the rather high cost and insufficient volumes of production for use on large areas.

To obtain a result, the user needs:

- indicate in which area the area is located;

- the content of humus according to the agrochemical certification of the site;

- select the amount of organic fertilizers (from 1 to 4 t / ha);

- select from the list of cult that is planned to grow.

After entering the data, the calculator immediately provides information on the humus balance, the expected level of humus, additional costs for biohumus, the cost of grown products (Table 6.5).

Table 6.5

Layout of the e-calculator for organic land use

District of Rivne region		*given*				
Humus content, %		*given*				
Years		1	2	3	4	5
Organic fertilizers (vermicompost) t / ha		*given*				
Culture		*given*				
Humus balance, t / ha +/-		calculated				
level of humus, %		calculated				
Additional costs for biohumus, thousand UAH / ha		calculated				
Additional costs for certification (up to 10 hectares), ths. UAH / hectare		1,5	1,5	1,5	1,5	1,5
Life cycle	Applying	*Transition period*		*Organic products*		
Product						
Yield, c / ha						
Price, thousand UAH / t						
Cost of production, ths. UAH		calculated				

Using the development, the farmer will be able to:

- develop a strategy for the restoration of soil fertility in its area;
- calculate the forecast humus balance depending on the given conditions: the culture and volume of organic fertilizers;
- determine the necessary amount of organic fertilizers to ensure a positive balance of humus;
- plan the crop rotation with the requirements of organic production;
- calculate the costs of organic fertilizers and the expected income (revenue);
- assess the risks and weaknesses of its production;

- determine the predicted level of humus content (in%) depending on the selected crop rotation structure and the amount of organic fertilizers introduced;
- analyze the results and make the decision: to ensure the restoration of soil fertility at a faster pace but with higher costs (due to the introduction of a maximum dose of organic fertilizers, in particular biohumus) or at lower costs, but for a longer period of time;
- adjust the actions of the next season.

Table 6.6

An example of calculating the e-calculator for organic land use for the Forest-steppe zone

District of Rivne region		*Goshcha*				
Humus content, %		*2,31*				
Years		1	2	3	4	5
Organic fertilizers (vermicompost) t / ha		*1*	*1*	*1*	*1*	*1*
Culture		*Perennial grasses*	*Perennial grasses*	*Winter wheat (+ straw)*	*Oat (+ straw)*	*Buck-wheat*
Humus balance, t / ha +/-		0,34	0,20	1,47	1,36	0,0604
level of humus, %		2,3198	2,3256	2,3675	2,4064	2,4081
Additional costs for biohumus, thousand UAH / ha		4,2	4,2	4,2	4,2	4,2
Additional costs for certification (up to 10 hectares), ths. UAH / hectare		1,5	1,5	1,5	1,5	1,5
Life cycle	Applying	*Transition period*		*Organic products*		
Product		hay	hay	grain	grain	grain
Yield, c / ha		30	24	45,6	24,4	10
Price, thousand UAH / t		2,5	2,5	6,8	6,5	20
Cost of production, ths. UAH		7,5	6	31	15,86	20

In order to ensure the competitiveness of organic agriculture in Ukraine in the conditions of European integration and ecologization of the national economy, it is necessary at the planning stage of the organic farm to take into account all possible negative factors and level their influence. To do this, it is necessary to carry out a comprehensive study of the agro-chemical status of agricultural land, the definition of land use limits, potential sources of pollution, the study of relief and landscape of the area, the development of infrastructure, etc.

Table 6.7

An example of calculating the e-calculator for organic land use for the Polissya area

District of Rivne region		*Sarny*				
Humus content, %		*2,33*				
Years		1	2	3	4	5
Organic fertilizers (vermicompost) t / ha		*1*	*1*	*1*	*1*	*1*
Culture		*Lupine on siderates*	*Ritot + after harvesting siderates*	*Winter wheat (+ straw)*	*Oat (+ straw)*	*Maize for corn*
Humus balance, t / ha +/-		1,9767	2,44	0,43	0,17	0,87
level of humus, %		2,383	2,448	2,459	2,464	2,487
Additional costs for biohumus, thousand UAH / ha		4,2	4,2	4,2	4,2	4,2
Additional costs for certification (up to 10 hectares), ths. UAH / hectare		1,5	1,5	1,5	1,5	1,5
Life cycle	Applying	*Transition period*		*Organic products*		
Product		hay	hay	grain	grain	grain
Yield, c / ha		-	21	25	20	39
Price, thousand UAH / t		-	6	6,8	6,5	6
Cost of production, ths. UAH		-	12,6	17	13	23,4

Today, the environmental monitoring function is distributed simultaneously between several departments: the State Land Cadastre, the Department of Ecology and Natural Resources of the Oblast, Basin Regional Water Resources Departments, the Department of Agricultural Development of the Oblast, forestry departments, and others. This complicates the collection of information, and therefore reduces the efficiency and effectiveness of making managerial decisions.

The agricultural sector currently operating in the agrarian sector is mainly based on imperfect, labor-intensive and costly methods of data collection and processing. And the lack of funding of the state agro services restricts the introduction of innovations and does not allow it to fully carry out agro-chemical survey of soils, the more so provide such services on a commercial basis. Instead, private laboratories, including overseas, carry out research on request, for small farms, and for agroholdings.

The solution of this problem, the use of remote sensing data and application of GIS technologies is considerably simpler. Thus

information is easy to process, update, supplement, store, submit in the form of thematic (electronic) maps. The algorithm for overlaying layers of electronic maps for determining the array (field) of the most investment-attractive for organic production is given in Fig. 6.7.

The necessity and efficiency of using information technologies for land monitoring in order to ensure its effective use have been written in writings of such scientists as Baliuk S., Zatserkovnyi V., Bulyhin S., Zholobak H., Solodkyi V., Bespalko R., Lialko V., Medvediev V., Kussul N., Truskavetskyi S., Byndych T.

The results of their research cover many aspects of the problem. In particular, Zatserkovnyi V. has developed a functional scheme of AgroGIS, which enables the use of complex multidimensional and multi-criteria models in the study of land use processes and the assessment of the negative effects of anthropogenic impact [13].

Solodkyi V., Bezpalko R. offer the use of remote sensing and GIS technologies for solving the problems of sustainable development and ecological safety of the Carpathians and create the center of experimental information service «Ecocosmos-Carpathians» [11]. Truskavetskyi S., Byndych T. in the framework of the concept developed by them, propose the creation of an information system for soil monitoring of agricultural land using remote sensing methods [14].

Consequently, using the remote sensing data and using the GIS technologies of remote sensing techniques will allow to:

- identify violations of the legislation on land use and land protection;
- receive up-to-date information on the use of agricultural land;
- change the type of land use within the large natural, economic and administrative regions, visually assess the relief;
- evaluate the spread of degradation processes and develop measures for their elimination;

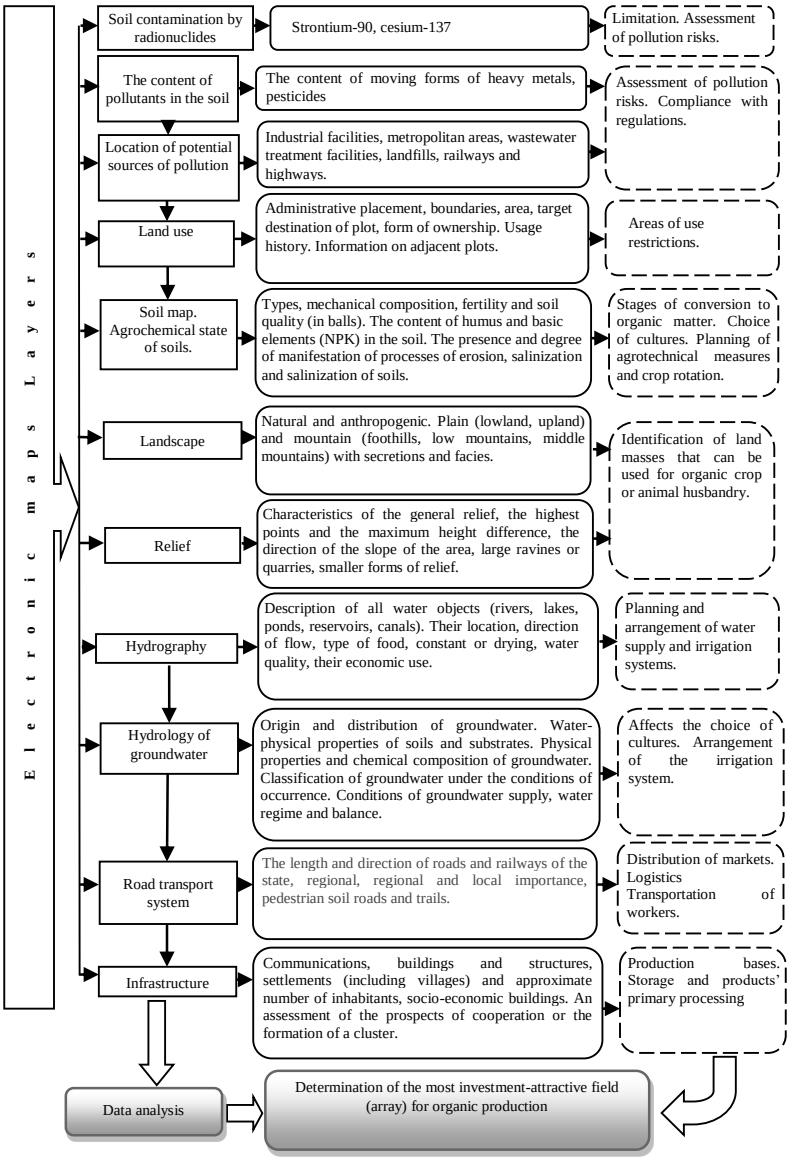

Fig. 6.7. Algorithm of electronic cards' overlaying layers

- plan and evaluate the effectiveness of anti-erosion measures;

- simulate the flooding of the territory during the rise of groundwater;

- determine the area, phases of development of plants, problems and the state of crops and to make a forecast of crop yields;

- identify areas that best fit all parameters for the successful implementation of organic production.

Using the information technology in agrarian production management will help to:

- local authorities, communities to use the best land parcels most efficiently: higher rents, support for the production of organic products with higher added value, mainly for export. It does not harm the environment, and even the opposite;

- farmers and owners of shares - choose the sphere of activity (organics or traditional production, lease or own economy);

- investors decide on the choice of land for the introduction of organic land use. First and foremost, they are interested in a healthy agroecosystem, because it will directly depend on the expediency and volume of future investments on the cultivation of organic crop production.

For all innovations' implementing, it is necessary to improve the ecological and economic mechanism of agrarian land use and create conditions under which it is beneficial for economic entities to comply with environmental requirements. And the control and operational response to the violation, detected in the net through remote sensing data from the land, only increased the law-abiding nature of land users.

Such a mechanism should include economic incentives, environmental management levers, and the safeguarding of environment, economic sanctions, organizational and legal measures, and elements of geo-management. Modern activity of agrarian nature subjects is characterized by rent-oriented behavior, and market relations by themselves cannot independently adjust the cost-effective attitude of business structures to environment.

Taking into account the results of the research, we proposed a functional and objective structure of the organizational and economic mechanism for managing organic land use with elements of geo-management (Fig. 8). Significant components of such a mechanism are regulatory, institutional and scientific information blocks, which are closely interconnected and create conditions for the development of the organic sector of agrarian production.

In our opinion, planning for the introduction and development of organic land use and the internal market for organic products should begin with the development of the state target program. This program should foresee a creation of an information system for monitoring the environment (including agricultural land) by remote sensing methods. Such a system will serve as an information base for identifying the investment-attractive territories for the introduction of organic production. In the future, it will allow rational distribution of state subsidies for the development of organic production between regions, in the future - will help to carry out the control functions of state bodies in the system of certification of organic land, accreditation of certification bodies.

In order to efficiently collect information, it is necessary to establish cooperation between different scientific institutions in order to maximize the effect and use information from existing environmental monitoring systems. For example, the National Space Agency of Ukraine, the Center for Earth Aerospace Studies of the National Academy of Sciences of Ukraine, the Dniprokosmos State Enterprise, the Institute of Agroecology of the National Academy of Sciences of Ukraine, the NSC «Institute of Soil Science and Agrochemistry named after O.N. Sokolovskyi», State Agricultural Agency «Derzhgruntohorona»and others.

During organizing the collection of data, especially agrochemical indicators of the land's condition, it is necessary to reconcile domestic methods of their definition with international, in order to be recognized in the future when passing the certification procedure under foreign organic standards. Also, create a network of laboratories with appropriate international accreditation. And all information concerning the spatial location of organic production, it is expedient to accumulate on a separate geoportal.

Creation and full functioning of the land use monitoring system based on remote sensing data and GIS technologies will provide a favorable investment environment for the development of organic production at the level of regions and the state. The development and filling of the geoportal development of organic production will allow to accumulate all information (scientific developments, legislation, maps, e-calculators, etc.), on one Internet resource. This will help farmers and investors, at the stage of business planning, to take into account all the risks and minimize its negative consequences, and to local authorities to properly manage their resources and develop organic production in the region.

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6.3. Information support of the competitive organic agriculture' development in Ukraine under the conditions of European integration

The issue of using the information technology is given much attention in the publications of domestic and foreign authors, such asI. Borysiuk, O. Borodin, V. Horkavyi, H. Zhavoronkov, T. Kalna-Dubiniuk, M. Kropyvko, I. Kryvoruchko, P. Sabluk, V. Sytnyk, O. Ulianchenko, L. Fedulov, O. Shnypko, V. Medvediev, V. Ushkarenko, M. Romashchenok, F. Lysetskyi and others. The features of using the innovations for farms are presented by such scientists as: Heuvelink G., Pinheiro M., Fagerholm N., K. Eksvärd, D. Gibbon, M. Schermer, Norman E. Breuer, Peter E. Hildebrand and Victor E. Cabrera, Paul Axmann and Christian R. Vogl, Karlheinz Knickel and Sarah Peter etc. Special attention is paid by domestic and foreign scientists on the advantages and necessity of creating the geoinformation portals, using the«green» technologies for all spheres of management, functional features of plants (Garnier and Navas, Martin and Isaac), quantitative assessment of the dynamics of processes in agroecosystems (Weekley et al) [1-8].

Bernard L. and Maguire D., Tittonell P, Giller K.E, emphasize that the creation of a geoportal will ensure coherence with many state institutions through online access to spatial data and thematic services to create an effective mechanism for their interaction [9 -12]. However, there are currently no mechanisms and tools for creating the national and sectoral geoportals, information platforms, communication sites to provide a competitive state system in agrarian production.

The following authors' works are devoted to the study of organic production: Artysh V., Borysova V., Holovchenko N., Zinovchuk N., Dudar O., Kapshtyk M., Kornitska O., Kysil V., Tarariko Yu., Pysarenko V., Shykula M., Jurzhy Urban and others. Their development became a scientific basis for the introduction of organic land use as a way of Ukraine's agriculture ecologization. At the same time, there are no systematic studies on: the social and ecological and economic efficiency of organic land use; variants of its informatization; export opportunities and mechanisms for

forming clusters for the production of batches of organic products for export.

Problems of using the legal and information support of European integration and foreign economic activity of Ukraine were studied by Borodina O., Vlasova V., Halperina L., Haiduchenko S., Yehorov I, Kalyna M., Kovalova O., Shnyrkov O. who considered different aspects of the problem of matching the Ukrainian economy with the European requirements. However, in such publications and in government institutions, there are no grounds for legal regulation of organic agricultural production, including for export. Therefore, the issue of implementation of innovative experience of the countries of the world needs to be developed through the development of mechanisms for development and information provision of the organic agricultural sector of the economy.

Increasing the efficiency of production of organic products in our time requires the development of: information support for the development of organic production; modeling and predicting the state of land fertility using modern geographic information systems and neurotechnologies; development of geoportals, sites for development and consultations on organic agrarian production.

In Ukraine, there are 51.4 million hectares of land potentially suitable for the needs of agriculture, of which 28.1 million hectares are highly suitable (for organic farming). In particular, in the Polissya area, up to 20% of agricultural land is not used and can be used for organic production in a shorter transition period. Therefore, the creation of a universal information platform will allow: to integrate information on agribusiness at different levels of production and to present them in the form of cartograms and charts; Distribute the obtained results using the specialized Web-GIS application; to identify priority land use problems; to increase informality and objectivity of transition of agriculture to organic production on the basis of implementation of modern approaches of geo-management. The information platform addresses the provisions of the Europe 2020 Strategy and sets three interconnected and mutually reinforcing priorities: smart economic growth, based on knowledge and innovation as key elements of

competitiveness; sustainable growth - development of a resource-saving, low carbon and competitive economy; promoting the development of a socially oriented economy with a high employment rate.

Such information and communication resources are aimed at the development of organic land use system and solve tasks of the United Nations Environment Program (UNEP) on the implementation of the Global Green Movement in Ukraine, aimed at environmentally sound and sustainable development, the creation of appropriate infrastructure and information provision in the agro-industrial sector of the economy. The methodological basis of such works is based on synergy and principles: agrarian and economics of nature management, information technologies in the agrarian sector and the use of geoinformation systems, implementation of world experience for Ukraine and promotion of the competitiveness of the national economy.

Informatization of agro-industrial production is necessary to ensure the objectivity of the economic assessment of natural resource potential and quality of land resources of organic production. The share of agricultural exports in the structure of Ukraine's GDP ranges from 30% to 50%. However, high-tech organic production makes it possible to obtain identical results from traditional production in areas less than 30% of agricultural land. Therefore, informational support for agricultural production begins «growth points», provides information and diversification of production.

Hence the processes of informatization of agroindustrial production for ensuring the development of organic agriculture in Ukraine include: scientific and methodological, informational and socio-ecological and economic substantiation of the processes of geo-management and mechanisms of ensuring the competitiveness of organic agriculture in Ukraine and the basis of information technologies; development of tools and mechanisms for substantiating socio-ecological and economic benefits from the introduction of organic production; improvement of the economic evaluation of the value of organic land and the efficiency of exports of organic grains from Ukraine; substantiation of variants of

differentiated use of agricultural land for different cultures and methods of agrarian production; definition of components of the geoinformation-analytical system and mechanisms of management of agrarian production on the basis of the system approach; substantiation of geo-management by competitive agricultural production on the basis of information resources; development and substantiation of principles of geo-management by organic farming and mechanisms for ensuring the competitiveness of organic agriculture; applied justification: virtual water for organic production; innovative and perspective ways of developing clusters of organic agricultural production; innovative-investment approaches to adaptation and harmonization of normative documents; the paradigm of socio-ecological and economic evaluation of the effectiveness of environmental standardization in the context of the globalization of the world economy.

In our opinion, a way out of such a situation is to develop and implement an innovative mechanism for the realization of a multi-level system of geo-management by organic farming in Ukraine. Working hypotheses should be: the possibility of integration of the innovative mechanism of geo-management on the basis of separate economic entities with the aim of further organizing competitive agroecoregions; the development of organic production based on information technology, ensuring the requirements of rational nature management; cluster analysis; provisions of the implementation of world experience in Ukraine for the production of competitive products in accordance with the requirements of international standards for product quality.

The theoretical preconditions for implementing the geo-management are:

1. Methodological and practical principles of using the environmental standardization and certification (concept, mechanisms and tools for its introduction, assessment of the economic effect of exports of organic products, etc.).

2. Ecological and economic preconditions for the establishment and development of organic land use (methodology of ground for the introduction of organic land use, the criteria for the ecological and economic assessment of the suitability of land

for organic land use, the methodical approach to assessing the conditions for the transfer of farms from traditional to organic land use, etc.).

3. Substantiation of prerequisites for creation of innovation formations in the form of clusters.

4. Scientific and methodical approach to the calculation of investments in the production of organic crop production – for functioning organic enterprises.

5. For organic land use in agricultural land that has not been used for a long time, a scientific and methodological approach has been developed, information support and justified socio-ecological and economic efficiency of their use, etc.

Implementation of geo-management will enable: to calculate synergistic effects from the development of the organic agricultural sector; to preserve the quality of land resources as the natural capital of a nation; to increase production of the most competitive high-quality products; diversify agro-industrial production and export of the most profitable crops and finished products; create new jobs; to stop the «extinction» of rural settlements; adhere to the euro integration requirements for the certification of agricultural products for its export.

In our opinion, geo-management on the basis of geoinformation-analytical systems (geoportal) for increasing the efficiency and development of organic agricultural production will provide: rational nature use for the restoration of natural resources and the creation of agroecoregions; identification of needs of the subjects of the agrarian sector and suggestion of their solution. Implementation of innovative geographic information management will allow solving urgent issues of regional and national development of the states by overcoming existing disproportions, will ensure the creation of competitive agro producers and agroecoregions. It is important to develop clusters, which will promote the creation of high-tech associations with a closed cycle of organic production and a high level of value added in the final product, creation of infrastructure in the united territorial communities.

In such projects, a systematic approach will be used to analyze the information support of the functioning of the agrarian sector, which will create an effective management system, develop alternative management solutions. The use of an integrated approach will enhance the quality of agricultural sector management, which will stimulate its competitiveness. The situational approach will be based on the adaptation of geo-management solutions, which will depend on changes in external situations at different levels of management. The geoinformation approach will enable to simulate and analyze the current state and potential of competitiveness of the agrarian sector at different levels of localization and identify the weaknesses and strengths. Application of the integration approach will enable to ensure the efficiency of management and implementation of innovative-intensive production and management technologies. The marketing approach will be used to identify potential opportunities for integrating actors in the agrarian sector of states into international trade.

An important factor in the implementation of geo-management is the fulfillment of the requirements of European directives on ecologization of the economy, implementation of requirements of HACCP control systems, ISO 22,000, ISO 14000, Codex Alimentarius, etc. Such production will ensure the export of agricultural products and the flow of currency to the budget of the country. The geoportal will provide the opportunity to create new databases and to constantly modernize and use them to the general public.

Implementation of geoportal practice will provide the following results: information (informing producers and consumers about the effectiveness of organic production, information support for tracking production from land to finished product); economic (increased profitability of organic production, direct sales of products); organizational (improvement of mechanisms, methods and control systems); social (raising the level of employment, overcoming the problem of seasonality, production of quality products); resource (rational land use, reduction of carbon dioxide emissions, increase of fertility and cost of land); ecological

(stabilization of land quality, restoration of ecosystems, creation of agroecoregions, organic farming); practical (development of the draft national standard and certification systems for organic plant production in order to take into account the experience of the International Organization for Standardization and the Law of Ukraine «About Standardization»); organization of clusters in organic production; formation of a unified information environment for management of spatially-distributed resources (use of land, water, climatic resources on the principle of synergy).

Results of geo-management'simplementation will be aimed at solving a number of tasks identified by the State Target Program for the Development of the Agricultural Sector for the period up to 2020, namely: obtaining environmentally sound and cost-effective agricultural results; motivation of manufacturers for technical and technological updating, introduction into production of achievements of science, etc. The development and implementation of such web resources is aimed at ensuring food security and will play a significant role in the national and global markets.

Information is available for the operation of such web resources and the result of their work. In particular, the project will receive new scientifically-based information, knowledge about geoinformation portals for organic production, which at various levels provide a systematic opportunity to summarize existing information, add it online and use it for various purposes (management, production, environmental audit, pricing lands, forecast of yield, etc.).

Thus, the web resources offered for organic land use and production (information portals, platforms and sites) provide an opportunity: to introduce methods for assessing the cost of conversion to organic production; to calculate the costs of ecological and economic rehabilitation of land and costs of transition to organic land use; to implement in practice the tools, mechanisms for the implementation and promotion of organic agriculture [13, 14]; to form clusters as prerequisites for the competitiveness of the agro-industrial sector of the economy; carry out an ecological and economic assessment of the cost of organic land; to determine the main types of agrarian nature management

on low-fertility land; conduct scientific and methodological substantiation of virtual water for organic production; to develop theoretical and methodical principles for the formation of clusters from organic agro production and others.

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CONCLUSIONS

1. On the basis of scientific and theoretical research, organic production is defined as a priority direction of agriculture's development and a way of ecologization of agrarian nature management. Analysis of the organic production development in Ukraine showed: a significant increase in the area of certified land in Ukraine and in the world. System analysis of organic products market in Ukraine and in the world was carried out. The basic ways of organic production development have been formed, it is proved that because of the low solvency of consumers and the lack of a formed organic market of the organic sector remains export-oriented, and the demand for organic raw materials exceeds the supply.

2. To create favorable conditions for the transition of the agrarian sector to Ukraine on the basis of organic production, it is necessary to create a proper regulatory and managerial and accompanying basis for the transition to sustainable development of the agrosphere, which would increase the motivation for the expansion and development of such activities and increase the receipt of necessary innovations and resources. The following tasks need to be addressed: adoption of the Concept and Strategy of Sustainable Development of the State and branches of the economy (taking into account organic production), as well as creation of a coherent system of legislation in this area; poverty reduction, outflow of youth from village to city and abroad, minimization of other processes of degradation of society development; decentralization and promotion of the formation of civil society; partnership between the branches of power at the local, regional and state levels; the introduction of an effective economic mechanism for systematic harmonization of nature, land use and nature conservation activities; improvement of procedures for access to information on state and dynamics of environment and people's health; ensuring cross-sectoral and interagency harmonization of actions taking into account interests of all social groups on the basis of partnership between the authorities, citizens and public associations, and the private sector.

3. The scientific and practical results of the implementation of the information and communication platform will be: informational (informing producers and consumers about the effectiveness of organic production), economic (increasing the profitability of the industry), organizational (improving mechanisms, methods and control systems), social (raising the level of employment, overcoming the seasonal problem), resource (rational use of natural resources by agrorezurs) and ecological (creation of agroecoregions, organic agriculture) value from its realization her. Implementation of the platform: increase production of all types of organic products, lead to a systematic preservation of the quality of land resources and the environment as a whole.

4. Informatization of organic production will lead to the efficiency and improvement of working conditions, the effective use of authorized drugs through the recommendations on bioindication. It is substantiated that as a result of the implementation of the platform will be obtained fundamentally new results: theoretical and practical developments on the justification of methods and methods for evaluating the effectiveness of organic production; methods, schemes and justification of expenses for transition of traditional farms to organic land use; An example of a national standard and certification system for organic crop production. The economic expediency of the project implementation is that the making of business and management decisions by state administrations, farmers, and academics will be with the ecological and economic substantiation for making decisions on the development of a competitive sector of the state's economy. Taking into account the constant growth of the organic sector of the economy in Ukraine and the world as a whole, the platform will solve the issues of informatization and computerization in organic production, which simplifies the adoption of business and management decisions by state administrations, farmers, scientists and accelerates the development of a competitive sector of the state's economy.

5. Management of renewable land’system and use of natural resources should be based on information flows that contain a database of natural resource support, the integration of

environmental information with economic indicators and vice versa. For management in the agrarian sector and in general for nature use, it is advisable to use different methods that take into account the levels of anthropogenic impact on the environment.

6. To initiate development of cooperation, state policy is needed through agro-industrial sector development programs. Such directions need to be implemented through transparent and long-term rules of the game and the motivation of the population: demonstration of the benefits of joint activities; openness to investors; real loan rates; government orders and open tenders; learning and engaging in innovation; help in communication on cooperation; informing about legislative and normative documents; orientation towards consensus and transparency, apply preferential taxation and lending to cooperatives, provide co-operative advisory and advisory activities at the level of individual territorial communities and their interaction with educational institutions and leading business entities in order to train employees and improve their qualifications.

7. Information on consumption and trade in virtual water will make it possible to make the right management decisions in the area of water and land use and partially solve the problem of water shortages especially at the global level by selling water-based products from countries with high water availability to countries with low, but it is advisable to take into account the impact of foreign economic activity on the sustainability of water resources and the state of the environment in the exporting country.

8. Considering the virtual water in organic production, it is not advisable to calculate the gray water footprint, as the level of surface water pollution will be minimal. In calculating the blue and green water footprint, it is necessary to make calculations according to the average indicators in order to take into account the transitional to organic production period. When establishing the price of organic products in addition to the high quality of products, it is advisable to take into account also the cost of virtual water for its production, in particular, the proposed methodology for assessing the effectiveness of water resources use in organic agricultural production makes it possible in the average world

prices for organic products to take into account the amount of green and blue water used for its production.

9. An alternative to saving water consumption in Ukraine can be a strategy for consumption's minimizingby importing the water-based products, both agricultural and industrial. Trade in virtual water will expand the horizons for the development of water-based industries, taking into account the water supply of the regions. Trade in virtual water will expand the horizons for the development of water-based industries, taking into account the water supply of the regions. The development of water-based products in the context of establishing connections and global interpenetration of economies in the long run can become the starting point from which the formation of the market of high-tech products will begin.

10. Using the e-calculator, farmers will be able to: develop a strategy for restoring soil fertility in their area; to calculate the forecast balance of humus depending on the given conditions: culture and volume of introduction of organic fertilizers; determine the required amount of organic fertilizer to ensure a positive balance of humus; plan crop rotation to meet the requirements of organic production; calculate the cost of organic fertilizer and expected income (revenue); assess the risks and weaknesses of its production; to determine the predicted level of humus content (in%) depending on the selected crop rotation structure and the amount of organic fertilizers introduced; analyze the results and make the decision: to ensure the restoration of soil fertility at a faster rate, but with higher costs (due to the introduction of a maximum dose of organic fertilizers, in particular biohumus) or at a lower cost, but for a longer period of time.

11. The developed organizational and economic mechanism and tools will promote the full functioning of the monitoring system for land use according to remote sensing and GIS-technologies, will provide a favorable investment environment for the development of organic production at the level of regions and the state. The development and filling of the geoportal development of organic production will allow to accumulate all information (scientific developments, legislation, maps, e-calculators, etc.), on one Internet resource. This will help farmers and investors, at the stage of

business planning, to take into account all the risks and minimize their negative consequences, and to local authorities to properly manage their resources and develop organic production in the region.

12. In order to ensure stable revenues to local budgets and stimulate the effective use of land resources, a number of measures are needed, including the implementation of a full inventory of agricultural land, the use of raising coefficients for irrational use of agricultural land, and others. In general, the situation in the field of use of agricultural lands, their protection and the introduction of a system of appropriate payments requires measures for the transformation of land relations, including the transformation of payments for the use of agricultural land.

13. In order to attract investments and develop socially responsible business in the countryside, farmers who plan to start or develop organic production need to provide a complete set of information about land resources using GIS technologies. The development of such information databases at the level of rayon or village councils will allow: to auction a lot more expensive to sell the right to lease on such land; to supplement the community budget; to promote development in the region of business, which will help create new jobs, ensure sustainable development of the region.

NGO «Green Initiatives Rivne»

General information

Non-governmental organization (hereinafter - the Organization) is a voluntary social formation, based on the decision of the founders of the Law of Ukraine «On public associations» and bases its activities on the principles of voluntariness, legitimacy, governance, transparency, equality of Members.

The purpose of the activity is the implementation of ideas and projects of economy ecologization and the implementation of European state vector. The main objectives of the Organization are:

- information support, development, distribution and promotion of the ideas and projects of public, private and other institutions and organizations aimed at introducing the environmental technologies and organic farming; ecologization production and sale of European integration vector of the country;
- assistance in providing and getting the legal, information and other help to institutions, organizations, farmers and private landowners, whose activities help to solve the existing problems in Ukraine of rational land use, growing the ecological and organic agricultural products and forming the ecological culture in society and consumption outlook;
- comprehensive assistance to educational, health, social organizations, agricultural associations and farmers who are engaged or wish to be engaged in ecological and organic farming and processing the products; reclamation of eroded lands; tourism; organization of gardening and berry growing; landscape design; organic aquaculture; collection and cultivation of wild plants; beekeeping; introduction of modern highly ecological cultivation facilities;
- consultancy, development of grant proposals and advisory services in various sectors of economy with ecologization of its development;
- development and implementation of programs and projects in the field of various types of biomass, alternative energy sources, implementation of cleaner technologies to achieving the social, environmental and economic effects;
- organization of permanent courses, seminars and other educational forms of creating the regional center of ecological and organic farming, growing

and processing the raw materials and products, resource and energy efficiency;
- assistance in implementation of patents and copyright certificates in the field of energy saving, highly efficient, environmentally friendly land use technologies, processing, labeling and promoting the products; restoration of land and other natural resources; environmental technology in various sectors of the economy;
- initiating and supporting the scientific, environmental, social, spiritual and other modern studies of human interaction with the environment;
- promoting the development of projects of natural reserves and proposals on the development of environmental affairs;
- promoting the market research, labeling, manufacturing, distribution standardization, certification and use of ecological and organic products consumption to achieve the social impact;
- preparation and publication of materials, articles, books, dedicated to the development of ecological and organic farming, the production of environmentally friendly products, and other economic, environmental and social problems.

VÝCHODOEURÓPSKA AGENTÚRA PRE ROZVOJ n.o.
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Generál poručík ICCOCRIM Dr.h.c. mult. JUDr. Jozef ZAŤKO,
Honor. prof. mult.

Všeobecne prospešné služby agentúry:

Spolupráca s domácimi, európskymi a svetovými inštitúciami a organizáciami /poskytovanie služieb v oblasti vzájomnej výmeny informácií, kontaktov, vzdelávania a rozvoja na medzinárodnej úrovni/.

Rozvíjanie aktivít na podporu rozvoja východoeurópskeho priestoru /podpora zvýšenia konkurencieschopnosti, zamestnanosti a flexibility organizácií a inštitúcií, ako aj pracovnej sily vo východoeurópskom priestore/.

Zvyšovanie mobility pracovnej sily východoeurópskeho priestoru prostredníctvom organizovania stáží a praxe v organizáciách európskeho priestoru.

Podpora študijných stáží a mobility študentov z východoeurópskeho priestoru za účelom zbližovania a spoznávania kultúrnych odlišností jednotlivých regiónov.

Organizovanie medzinárodných kultúrnych a športových aktivít za účelom poznávania multikulturálnych odlišností.

Poskytovanie zdravotnej starostlivosti, sociálnej pomoci a humanitárnej starostlivosti /poskytovaním služieb v oblasti humanitárnej a sociálnej pomoci pre vybrané skupiny obyvateľstva prostredníctvom programov v oblasti ľudských zdrojov, zdravotníctva a iných/.

Služby na podporu regionálneho rozvoja a zamestnanosti /prostredníctvom poradenských, konzultačných, vzdelávacích služieb a aktívnych opatrení trhu práce, ktoré podporia zamestnanosť , ako aj služieb orientovaných na spoločenský rozvoj a spoluprácu medzi regiónmi Európskej únie/.

Ochrana zdravia obyvateľstva, tvorba a ochrana životného prostredia.

Tvorba, rozvoj, ochrana, obnova a prezentácia duchovných a kultúrnych hodnôt. Ochrana ľudských práv a základných slobôd, rovnosti mužov a žien.

Vzdelávanie, výchova a rozvoj telesnej kultúry /organizácia školení, seminárov, kurzov, konferencií zameraných na zvyšovanie úrovne celoživotného vzdelávania, ako aj zvyšovanie fyzického zdravia obyvateľstva/.

Spolupráca s domácimi, východoeurópskymi a svetovými vzdelávacími inštitúciami.

Podpora vedy a výskumu, kontaktov a spolupráce v oblasti vedy a výskumu, popularizácia vedy na verejnosti.

Vydavateľská činnosť.

Využitie obnoviteľných zdrojov energie /služby v oblasti využívania obnoviteľných zdrojov energie, propagácia týchto zdrojov, ako aj možnosti financovania aktivít/.

Trvalo udržateľný rozvoj vidieckych oblastí /prostredníctvom služieb pre vidiecke oblasti, samosprávy, s dôrazom na agroturistiku a zvyšovanie cestovného ruchu v spolupráci s malými a strednými podnikateľmi/.

Podpora regionálneho marketingu a reklamy.

Podpora marginalizovaných skupín a ich integrácia do spoločenského, pracovného a rodinného života.

Podpora budovania infraštruktúry v školskej, zdravotníckej, kultúrnej a sociálnej oblasti v úzkej spolupráci s existujúcimi organizáciami.

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