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CULTIVATION OF NICHE CROPS AND PROSPECTS OF ECO-INNOVATIVE AGRICULTURAL PRODUCTION IN UKRAINE

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ABSTRACT

Aim of the study
The paper is devoted to the investigation of prospects of eco-innovative agricultural production in Ukraine by cultivating niche crops for the protection and restoration of fertility potential of soils, and the development of export potential of a number of niche crops.

Material and methods
At the empirical and theoretical levels of research, sets of general scientific and special methods were used for the purposes of the present paper, in particular: system (structural and functional) analysis, abstraction, synthesis, deduction and induction, comparison, formalization, graphic image (mapping), idealization. These methods were used to: describe the preconditions for agricultural production in Ukraine (natural conditions; soils; the share of GRP formed in the sector of agriculture, forestry and fisheries; exports of certain niche crops to EU countries); analyse the structure of land fund and land use in Ukraine, the EU countries, and European countries in general; study cropping area of agricultural crops by the categories of enterprises in Ukraine; compare selected parameters of cultivation, fruit and berry crops in Ukraine and EU and Eastern Europe as well as exports of some niche agricultural products in Ukraine and in the world.

Results and conclusions
Significant differences in the structure of land fund and land use in Ukraine, the EU countries, and European countries in general are identified. Ukraine has an imperfect land structure, a large share of agricultural land, and a high share of arable land. This trend is accompanied by the spread of degradation processes. Trends in the cultivation of specific crops in Ukraine are identified in terms of types of agricultural enterprises. Assessment of the current state of exports of certain niche crops in Ukraine and the world indicates a high export potential of Ukraine. Given that the added value per unit area directly affects the price of agricultural land, as well as the potential for protection and restoration of soil fertility, it is proposed that agricultural land be used for growing niche crops, and that eco-innovation and eco-modernized technologies be implemented in agriculture, that do not harm human health. Furthermore this will serve to protect biodiversity, eliminate or minimize environmental pollution, facilitate rational (sustainable) land-use and other systems of resources,

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use of fertilizers, microelements and additives for technological purposes in the established maximum admissible quantities, and also their storage in the established equipped places, etc. Agriculture eco-innovations with the production of niche crops are proposed for consideration as a practical implementation of the integrated system the Sustainable Development Goals, which are directly related to agriculture.

Keywords: land use, agricultural land, eco-innovations, export of agricultural crops, agricultural enterprises, Sustainable Development GoalsIntroduction

Ukrainian soil is one of the richest in Europe and, in combination with the continental climate, this secures a potentially high level of agricultural production. However, in recent years, cultivation of single crops in the conditions of climate change, degradation processes, and exhaustion of the available land resources has required diversification of production on agricultural lands (Ackermann, 2021).

Nevertheless, in the world and in Ukraine, increasing attention is paid to organic and non-conventional arable farming. This is prompted by the imperative to supply the maximum rational and effective use of the limited area and productivity of land resources, particularly by means of ecological modernization (eco-modernization) of agricultural production and generally the agrarian sector concerning improvement of the sustainability of soil fertility, and improving the social well-being for the present and future generations (Cabinet of Minister of Ukraine, 2017). In addition, the population has become more concerned about consumption of healthy food of the appropriate quality. Agricultural production is pivotal for sustainable supply of food, fibre, and shelter. However, a complex plethora of biotic and abiotic factors coupled with climatic change pose a major threat to sustainable crop production and global food security (Riaz et al., 2020). That task wholly correlates with the tasks of the United Nations Sustainable Development Goal 2 "End hunger, achieve food security and improved nutrition and promote sustainable agriculture" (UN, 2019). One of the pre-conditions for organic farming efficiency improvement is the respective improvement of agricultural enterprises' management (agricultural management). Adequate provision and proper use of fixed assets, as well as concentration of production, also play an important role in the introduction of organic agriculture. The approach here presented directly minimizes the cost of environmentally friendly agronomic and bioeconomic measures, as well as reducing the cost of production (unit costs) (Bazylevych et al., 2017). In this case, the transition from traditional technology to organic farming will potentially weaken the impact on the environment – by as much as 80% – without reducing economic efficiency (Beltrán-Esteve, Reig-Martínez and Estruch-Guitart, 2017). In the context of sustainable development, the introduction of agricultural adjustment should also include state and local governments' activity aimed at encouraging agricultural enterprises and farmers to use environmental innovations (eco-innovations). These innovations can be quickly implemented on organic farms, but the effects of eco-innovations need to be much more thoroughly assessed (Riaz et al., 2020). It is important to note that the main objectives of the European Green Deal contribute to the support of eco-innovation in food production and processing (Woźniak and Woźniak, 2021). Such an evaluation requires a scientific substantiation of its criteria, and, additionally, performance monitoring indicators. It should be noted that eco-innovation is a relatively new category in economics. Main goals of this type of innovation are: to reduce the negative impact of agricultural activities on the environment, and to produce healthy and widely available food. While introducing eco-innovative production, the producers achieve competitive advantage in the global market. To enter this path, however, requires appropriate legal and investment regulations (Kałuża and Ginter, 2015). The main goal of eco-innovations is to reduce the negative agricultural impact on the environment and to produce healthy nutritious food (Zak, 2016). This indicates another research task in the eco-innovations direction of agriculture, spread of organic farming, and growing niche crops – in order to build a scientific basis for effective legal and investment regulatory tools at various levels of management (Dudek and Wrzaszcz, 2020).

Niche crops are crops that are introduced into a new environment to replace traditional ones, and to

overcome production constraints caused by biotic and abiotic stresses (Pigford et al., 2018). These crops are usually grown in small areas, and their products occupy certain niches. Typically, growers of agricultural produce select niche agronomic crops because of the potential high cost of sales or specialized benefits to the farming system. These benefits may entail both risks and opportunities (Elouafi et al., 2020). The aforementioned risks may include the need for significant investment in bringing or restoring the soil cover of land plots selected for growing niche crops to regulatory requirements after previous land use, a significant time lag in obtaining results, respectively, reduced yields in a transformation period, the need for pest control, and diseases. Given the dynamics of the Ukrainian legislative process in the direction of implementing the Association Agreement between Ukraine and the EU, the risks include changes in the rules of trade in niche crops (certification, etc.). As pointed out by Kuryltsiv et al. (2018), newly established communities face a complicated situation concerning employment of land and other natural resources. It first deals with almost complete lack of information about the rights to land and other natural resources, their potential, and conditions of use. In this study, we consider the cultivation of niche crops, along with organic farming, as a practical embodiment of the eco-innovative agricultural production concept. Such agricultural production process, as well as the agricultural products themselves, require compliance with certain principles and standards, in particular the use of technologies that do not harm human health or plants, prevent environmental pollution or minimize it, rational (sustainable) use of resource systems, first and foremost land-use and water systems, including products of processing of waste and by-products of plants, use of fertilizers, microelements and additives for technological purposes in the established maximum admissible quantities, and also their storage in the established, properly equipped places, etc.

The purpose of this paper is to study the introduction of eco-innovations in the agriculture of Ukraine, prospects of cultivation of niche crops for the protection and restoration of soil fertility potential of Ukraine, development of the market of agricultural products, as well as export potential of a number of particular niche crops.

We consider agricultural eco-innovations with the production of niche crops to be the practical implementation of Sustainable Development Goals (SDGs), adopted by all United Nations Member States in 2015 as a universal concept by 2030. Among other priorities, the SDGs cover areas such as climate change, innovation, and sustainable consumption. The goals are interrelated – the key to success in one is to address issues that are generally related to others. SDG 2 – to end hunger, achieve food security and improved nutrition and promote sustainable agriculture, correlates with 15 SDG – to protect, restore and promote sustainable use of terrestrial ecosystems, sustainably manage forests, combat desertification, and halt and reverse land degradation and halt biodiversity loss. Most importantly, the goals including SDG 13 – to take urgent action to combat climate change and its impacts, SDG 12 – to ensure sustainable consumption and production patterns, SDG 9 – to build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation, collectively contribute to SDG 3 – to ensure healthy lives and promote well-being for all at all ages. Agriculture eco-innovations with the production of niche crops are focused on interlinkages between resource systems, primarily land-use systems, in order to understand how food production, by using innovative technologies and nature-oriented solutions, may contribute to resource (land-use) systems and climate change in the long run, ensuring a high level of environmental safety of agricultural production, safety of agricultural products, and food with strong competitive advantages in the market.

MATERIALS AND METHODS

Study Area

Ukraine is one of the largest countries in Europe in terms of area: 603.6 thousand square kilometres. Ukraine is located mainly in the southwest of the Eastern European Plain, in Central and Eastern Europe. Only a small part of its territory is taken up by the Carpathian Mountains and Crimean Mountains. The territory of Ukraine is located between 44° 23' and 52° 25' north latitude, and between 22° 08' and 40° 13' east longitude. The area of Ukraine lies in the temperate climate zone of the Northern Hemisphere. Within its borders, clearly (as in no other European country) there are three physical and geographical zones – forest, forest-steppe, and steppe, with high-altitude zonation in the mountains. Physical and geographical zones

of Ukraine change significantly from west to east (primarily in terms of climate and soil and plant characteristics). Ukraine has a third of the world's most productive land – black soils (chernozems). Because of this, as well as the convenient, mostly flat terrain, more than 2/3 of the area of our country is occupied by agricultural land. However, in addition to black soils, there are some other types of soils. Sod-podzolic and peat-podzolic soils are characteristic mainly of the north of Ukraine (Polissya). Such soils are well suited for growing conifers and heather crops. Gray forest soils (which are transitional from sod-podzolic to black soils) are found in the forest-steppe and southern regions of Polissya. Black soils are located in the forest-steppe and steppe zones. Black soils are formed mainly under perennial grassy plains and are known to have high humus content (5–15%), a neutral reaction that is ideal for most crops, and a lumpy structure that helps retain moisture. This is the best soil for agriculture. Depending on the location and degree of moisture, black soils are divided into several subtypes: chestnut soils with a low humus content of up to 3%, brown forest soils with a humus content of up to 3–4%, salt marshes – less infertile or infertile soils. Structure of Ukrainian agricultural lands – 41489.3 thousand ha (70.8% of the total area), of which arable land occupies 32544.3 thousand ha (53.9%); fallow lands – 229.3 thousand ha (0.4%); perennial plantings – 894.8 thousand ha (1.5%); hayfields – 2399.4 thousand ha (4.0%); pastures – 5421.5 thousand ha (9.0%); and other agricultural lands – 1218.8 thousand ha (2.0%). The highest indicators of agricultural land development were observed in the steppe zone (Zaporizka, Kirovohradska, Mykolaivska, Odeska), whereas the lowest in Zakarpatska, Ivano-Frankivska and Rivnenska oblasts (regions) (see: Fig.1).

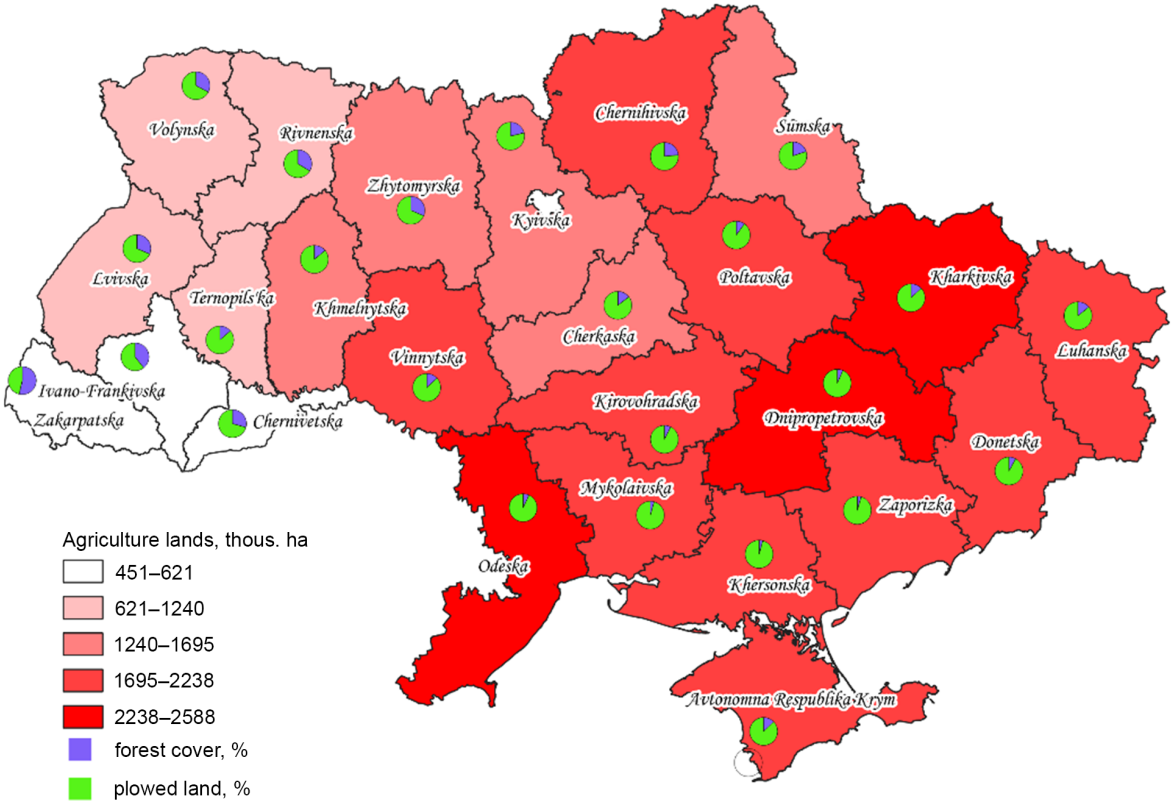

Fig. 1. Agricultural land, arable land, and forest cover in Ukraine, 2020. *Source*: The State Statistics Service of Ukraine.

Note: Data are presented excluding the temporarily occupied territory of the Crimean Autonomous Republic, Sevastopol City, and a part of the temporarily occupied territory in Donetsk and Luhansk regions

According to the State Land Cadastre (2021), given the climatic conditions, crops grown in Ukraine are divided into the following:

- those that in the initial stages of their growth can withstand relatively low temperatures and even frost, and other periods of development take place at elevated temperatures; such crops include wheat, oats, barley, buckwheat, flax (*Linum usitatissimum* L. and *Linum humile* Mill.) sugar beet, sunflower, rye, perennial grasses;
- and those that develop at higher temperatures and they cannot withstand frost; such crops are millet, corn, soybeans, rice, potatoes and some others.

The difference between these plants is that they need different amounts of nutrients. For example, the yield of buckwheat, rye, and flax is quite high on unproductive soils, whereas vegetables, melons, sugar beets, sunflowers will give good yields on fertile soils. Thus, in 2018, 8.0% of sown areas were used for the production of fodder crops, 30.7% for technical crops, more than 6.8% – for potatoes and vegetables, while the largest part (54.5% of sown areas) was used for grain culture. Due to the imperfect system of land use, degradation processes are spreading, i.e., the useful properties and fertility of the soil deteriorate due to the influence of natural and anthropogenic factors.

According to the State Statistics Service of Ukraine (2021) as of November 2021, the population of Ukraine is 41.4 million people. The current average monthly income is UAH 6,003 per person. Nominal average monthly salary of UAH 13,110 per employee. The number of labour force, economically active population is 17.2 million people, the employed population is 15.4 million people, the unemployment rate (according to ILO methodology) is 10.5% of the labour force. Nominal Gross domestic product (GDP) is UAH 1,008.6 billion, or UAH 24,280 per capita. A certain share of Gross regional product (GRP) is formed in the sector of agriculture, forestry, and fisheries (see: Fig. 2). Ukraine also exports a number of agricultural

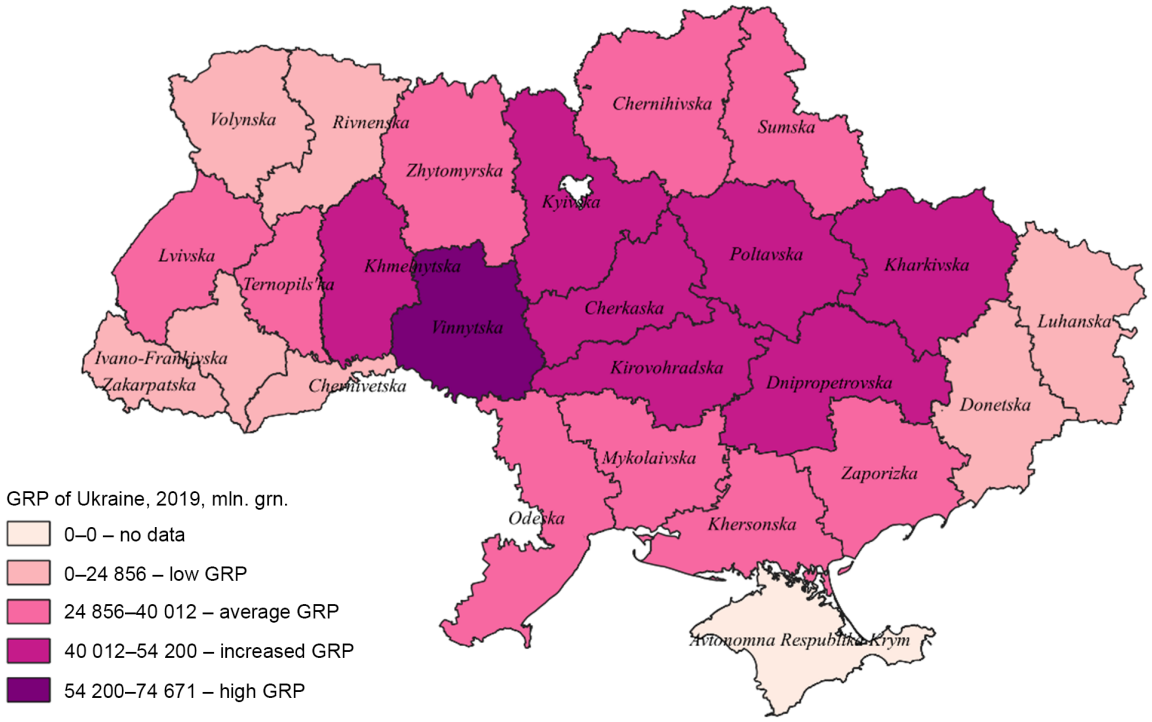

Fig. 2. Gross regional product in the sector of agriculture, forestry, and fisheries in Ukraine, 2019. *Source*: The State Statistics Service of Ukraine.

Note: Data are presented excluding the temporarily occupied territory of the Crimean Autonomous Republic, Sevastopol City, and a part of the temporarily occupied territory in Donetsk and Luhansk regions

products, including to EU countries (see: Fig. 3). The largest exports of crops such as: grain crops were recorded to Portugal (55.4%), Cyprus (50.8%), Spain (43.4%), Belgium (16.4%), UK (17.5%) and the Netherlands (28.5%); coffee, tea – to Ireland (86%); seeds and oilseeds – to Belgium (42.7%), France (17.4%), UK (16.4%) and Germany (16.8%).

The information and statistical base of the research was provided by the official materials and reports, open data sources, particularly of the FAOSTAT, State Service of Ukraine on Geodesy, Cartography and Cadaster, State Statistics Service of Ukraine and regulatory documents of Ukraine and the EU.

To argue the importance of eco-innovative agricultural production in Ukraine, the authors of the work made comparison of the land fund structure and land use in the EU countries, and in Ukraine, as well as analysing Ukrainian export of niche agricultural crops in the EU countries.

The following set of general and specific methods at the empirical and theoretical levels of research were used for the purposes of the present paper, in particular:

- system (structural and functional analysis) – to study the structure of land fund and land use, cropping area of agricultural crops by the categories of enterprises;
- abstraction, analysis and synthesis, deduction and induction, comparison, formalization – for comparative characteristics of the land fund structure and land use in Ukraine and other countries, identification of the most typical niche crops in Ukraine, the condition of its export, and dynamics of the cropping area, production and yield some of crops;
- graphics (mapping) – to present different spatial information;
- and idealization – to study the opportunities and prospects of eco-innovation in agriculture and growing niche crops with the view to protecting and restoring soil fertility, increasing the competitiveness of agricultural enterprises that grow such crops, and in general, achieving a system of interrelated Sustainable Development Goals.

The maps were formed in a specialized program QGIS 3.16.3-Hannover based on a vector layer of the territory of the regions of Ukraine. Projected coordinate system is WGS 84 Pseudo-Mercator (ESPG: 3857). The classification (5 classes) was selected in such a way as to best showcase statistical data from the generated database.

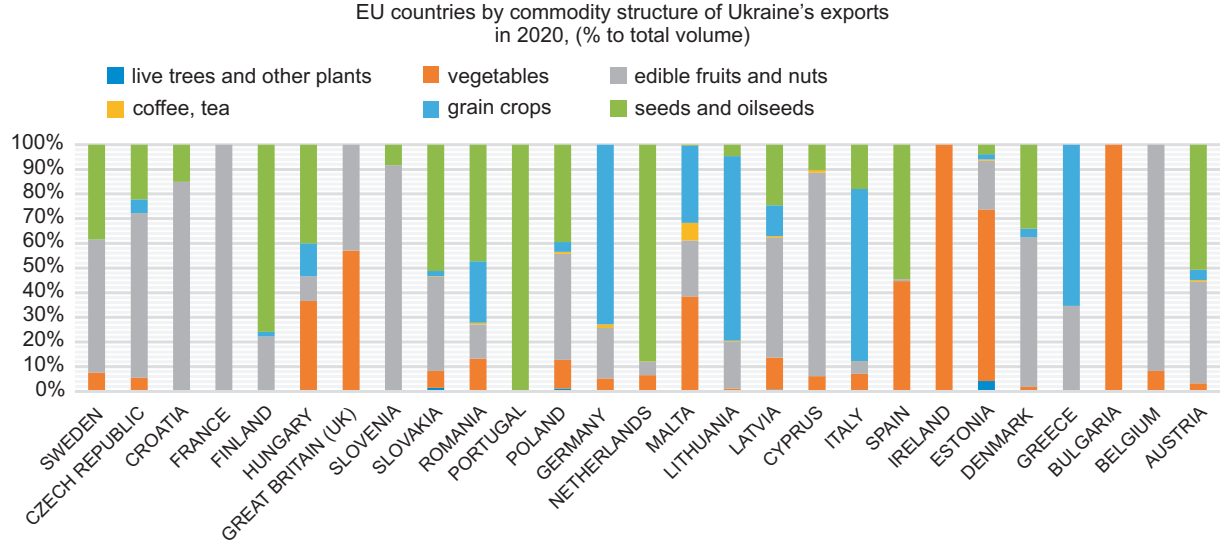

Fig. 3. EU countries by commodity structure of Ukraine's exports in 2020, % to total volume of export. *Source*: The State Statistics Service of Ukraine

Note: [1] Data are presented excluding the temporarily occupied territory of the Crimean Autonomous Republic, Sevastopol City, and a part of the temporarily occupied territory in Donetsk and Luhansk regions.
[2] The chart does not provide export data in excess of 15%

RESULTS

Agricultural lands in Ukraine occupy more than a half of the country's area, i.e., 69% (41.5 million ha), including arable land – 78% that takes 54% of the country territory, whereas in Europe and the EU countries, that index is equal to 27% on average. It is worth noting that Ukraine belongs to the group of countries with the largest area of agricultural lands (State Land Cadastre, 2021).

In Ukraine, the main entities engaged in the production of agricultural products, their processing and sale are producers of all manner of ownership, and various organizational and legal forms of agricultural activity. They are divided into state agricultural enterprises, agricultural enterprises with a collective form of labour organization, business associations, private farms, commercial farms, as well as joint agricultural enterprises with the participation of foreign investment (State Land Cadastre, 2021).

The most popular crops, cultivated by all categories of enterprises (according to the approved statistical reporting, these are agricultural enterprises, including farming enterprises, and private farms) in Ukraine, are cereals and oilseeds (see: Table 1).

Table 1. Cropping area of agricultural crops by the categories of enterprises in Ukraine in 2017

Agricultural crop	Enterprises of all categories		Agricultural enterprises		Including farming enterprises		Farms of population	
	thousand ha	%	thousand ha	%	thousand ha	%	thousand ha	%
Agricultural crops	27,585.2	100.0	19,259.3	100.0	4,299.3	100.0	8,325.9	100.0
Cereals and grain legume crops	14,623.6	53.0	10,573.1	54.9	2,359.9	54.9	4 ,050.5	48.6
Industrial sugar beet	316.1	1.1	296.6	1.5	22.2	0.5	19.5	0.2
Oilseed crops	8917	32.3	7,653.3	39.7	1830	42.6	1,263.7	15.2
including								
sunflower	6,033.7	21.9	4,953.6	25.7	1,253.3	29.2	1,080.1	13.0
soybean	1,999.8	7.2	1 837	9.5	399.6	9.3	162.8	2.0
Winter rape and colza (spring rape)	788.5	2.9	774.3	4.0	159	3.7	14.2	0.2
including winter rape	742.2	2.7	728.8	3.8	150.7	3.5	13.4	0.2
mustard	40.7	0.1	36.5	0.2	7.9	0.2	4.2	0.1
crown flax (oilseed)	47.1	0.2	45.6	0.2	9.6	0.2	1.5	0.0
Potato	1,323.2	4.8	17.8	0.1	5.8	0.1	1,305.4	15.7
Field vegetables	439.2	1.6	30.2	0.2	7.6	0.2	409	4.9
Melon field fruit crops	70.2	0.3	4.1	0.0	2.6	0.1	66.1	0.8
Fodder root crops	205.7	0.7	0.4	54.9	0.1	0.0	205.3	2.5
Fodder maize	286.1	1.0	265.3	1.4	20.8	0.5	20.8	0.2
Annual herbs	353.3	1.3	106.7	0.6	11.3	0.3	246.6	3.0
Perennial herbs	955.1	3.5	269.7	1.4	32.2	0.7	685.4	8.2
Plants of fruit and berry crops[1,2]	225.5	0.8	67	0.3	15.2	0.4	158.5	1.9
Vineland[1]	43.5	0.2	30.6	0.2	2.8	0.1	12.9	0.2
Hop-garden[1]	0.5	0.0	0.5	0.0	0.1	0.0	0	0.0

Source: processed referring to the data of the State Statistics Service of Ukraine

Note: [1] Total area. [2] Excluding the area of berries in the rows of gardens

Table 2 presents a comparative characteristic of the conditions of the land fund in the EU countries, countries of Europe in general, and Ukraine. Data in the Table 2 confirm a considerable under-employed potential of Ukrainian agricultural lands, including 46.4% of fertile black soil, comparing to the countries of Europe (8.3%) and countries of the EU (4.1% of fertile black soil), as well as demonstrating the prospects for the use of eco-innovative agricultural production, particularly organic and non-traditional one.

The above-mentioned can be confirmed by the increasing interest by farmers in the cultivation of marginal niche crops, which exceed the level of profitability provided by sunflower and rape. Particularly, they include such grain legume crops as chickpea, mung bean, lentil, and bean.

Generally, the characteristic of niche crops is that nowadays it is a poorly developed market, where demand exceeds the supply, because of a low level of competition, while reaching rather high purchase prices and high profitability that is vividly manifested on small land area under such crops.

In the Ukrainian conditions, the typical niche crops include flax, garlic, berries, as well as exotic or traditional, but not popular grains (millet, sorghum, spelt wheat, rye, etc.), grain legumes, and organic products (see: Table 3).

Some of the crops mentioned above had been traditional for the domestic agriculture until the middle of 1990s. A clear example of this is the scale of growing fruit and berries (see: Fig. 4). It is also interesting that the tendency to reduction of the area, used for growing of fruit and berries, is characterized by the simultaneous growth of the yield per a unit of area, whereas the volume of production (gross yield) of those crops varies from 1,537 thousand tons in 1991 to 2,119 thousand tons in 2019 (maximum 2,798 thousand tons in 1993 for the period of 1991–2019).

Table 2. Comparative characteristics of the land fund structure and land use in the European countries and Ukraine

Indicator title	Units	Ukraine	Countries of Europe	The EU countries
Land area	million ha	60.4	1,015.6	437.4
	%	100	100	100
Area of fertile black land	million ha	28	84	18
	%	46.4	8.3	4.1
Area of agricultural land	million ha	42.7	474.8	177.7
	%	70.7	46.8	40.6
Area of arable land	million ha	32.5	277.8	115.7
	%	53.8	27.4	26.5
Area of agricultural land, certified as organic	million ha	0.3	11.6	5.3
	%	0.5	1.1	1.2
Area of irrigated land	million ha	0.5	20.8	11.1
	%	0.8	2.0	2.5
Area of agricultural land per one resident	ha/person	0.7	0.6	0.4
	%	1.2	0.1	0.1
Share of leased agricultural land	%	97	62	53
Price of investment, thousand US dollars	for 1 ha	1	4	5.5
Export of grains	million tons	34.8	130	38.5
Price of 1 ha of agricultural land	thousand US dollars	1.0	3.7	7.2

Source: completed with the use of the source (Cabinet of Minister of Ukraine, 2017)

Table 3. The most typical niche crops in Ukraine (Cherevko, 2018)

Legume crops	Fruit and berries	Others
Chickpea, mung bean, lentil, bean, pea	Walnut, plum, raspberry, blackberry, honeysuckle, apricot, wild strawberry, blueberry, bilberry	Flax, hemp, mustard, poppy seed, peanut, spelt wheat, sorghum, garlic

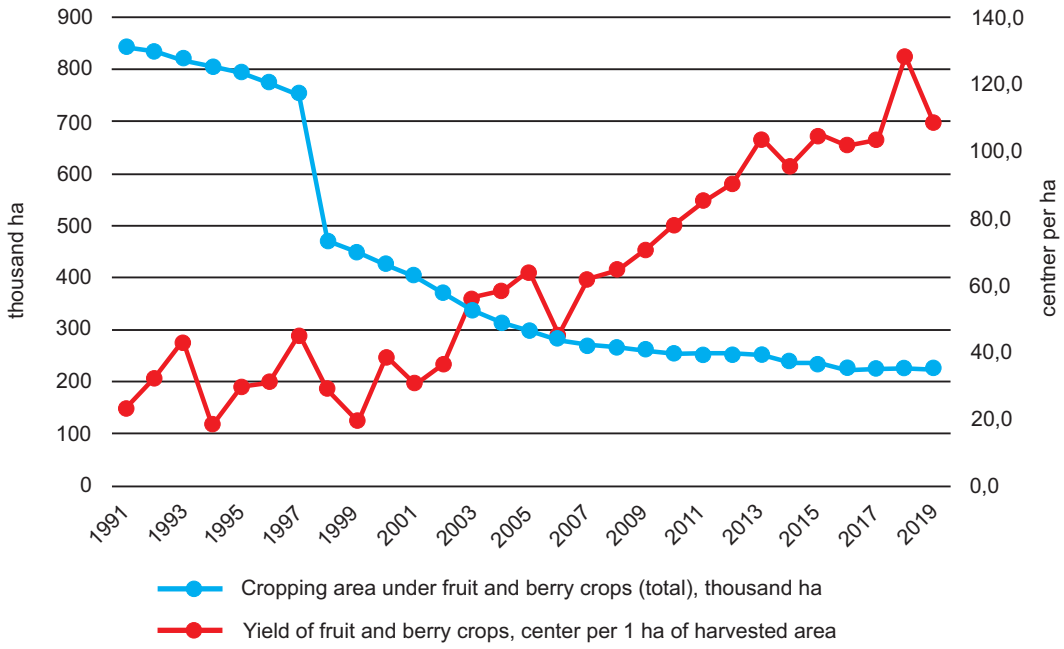

Fig. 4. Dynamics of the cropping area and yield of fruit and berry crops[1] in Ukraine in 1991–2019[2]. *Source*: according to the data of the State Statistics Service of Ukraine.

Note: [1] Excluding the area of berries in the rows of gardens.
[2] Data of 2014–2019 are presented excluding the temporarily occupied territory of the Crimean Autonomous Republic, Sevastopol City, and a part of the temporarily occupied territory in Donetsk and Luhansk regions

The dynamics of the corresponding indicators of berries growing in the countries of Eastern Europe and the EU is slightly different that the corresponding dynamics in Ukraine (see: Figs. 5 and 6).

Having investigated the world market of agricultural production, it is possible to draw conclusions as to a rapid increase of the demand for sorghum, pea, bean, chickpea, garlic, and honey in the recent years (see: Fig. 7).

However, the state of export of the main niche agricultural crops of Ukraine presents differently (see: Table 4) (Udova and Prokopenko, 2018).

Thus, the market of agricultural production demonstrates that the main crops for export include pea, sorghum, and flax seed. However, the purchase price of garlic, chickpea, mustard seed, bean, lentil, and buckwheat is still very high, varying between 580.3 and 1,665.3 USD per ton. Hence the expansion of the cropping area in Ukraine under the crops that are in high demand throughout the world.

Ukrainian experts also define such crops as tomatoes and grapes as the most profitable for agricultural production because of their wide application in cooking. They can supply the profit of above 14.0 thousand

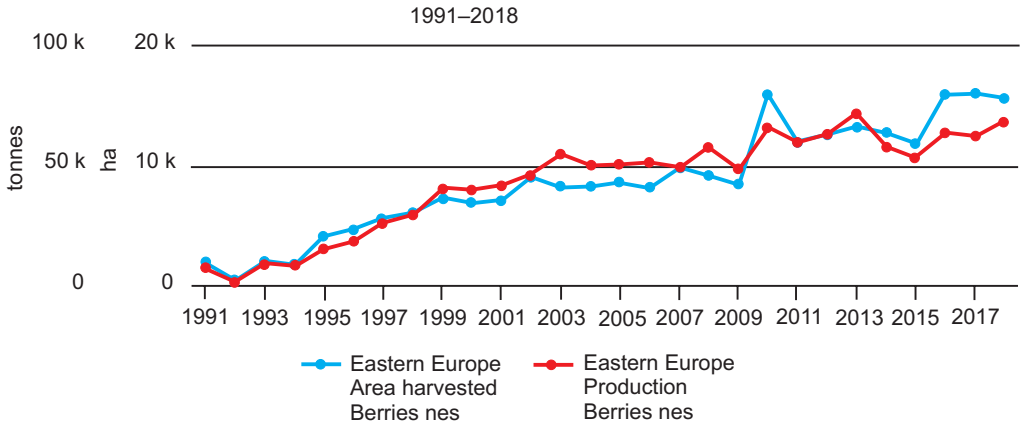

Fig. 5. Production/Yield quantities of berries in Eastern Europe. *Source*: FAOSTAT

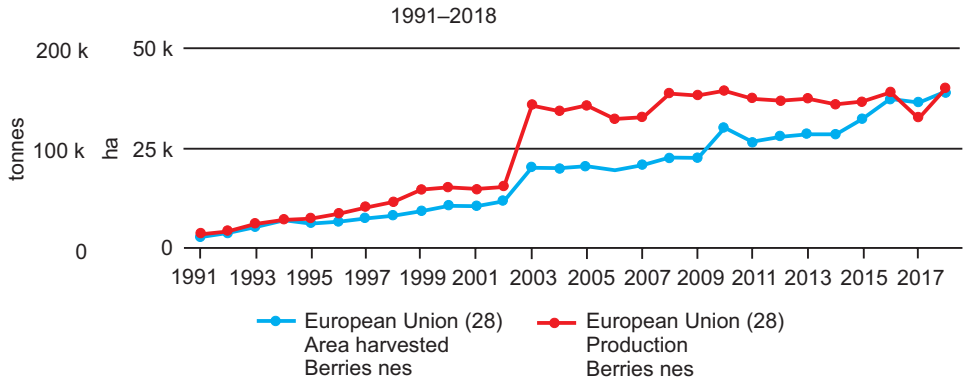

Fig. 6. Production/Yield quantities of berries in the European Union. *Source*: FAOSTAT

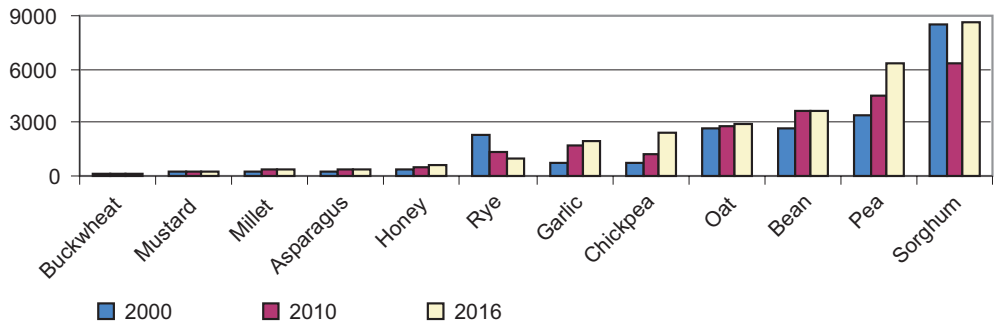

Fig. 7. Export of niche agricultural products in the world, thousand tons. *Source*: FAOSTAT

Table 4. Export of the main niche agricultural crops of Ukraine in 2017

Crop name	Amount, tons	Price, US dollar
Pea	561,300.5	238.7
Sorghum	148,272.6	145.8
Flax seed	56,919.2	340.7
Rye	25,040.9	155.2
Mustard seed	23,029.8	715.1
Bean	11,269.6	582.9
Oat	11,015.7	158.7
Chickpea	7,507.8	757.2
Lentil	1,843.9	580.3
Buckwheat	511.2	573.0
Garlic	238.6	1,665.3

Source: Udova and Prokopenko (2018)

USD per 1 hectare of grown tomatoes and 6.25 thousand USD per 1 hectare of vinelands.

Recently, an increasing popularity of cultivation of medicinal plants has been observed, such as raw materials (root, leaves, flowers) of hawkbit. The sphere of their application is widening.

The profitable medicinal plants, found in Ukraine, include golden root, orchis, woolly-flowered astragalus, potentilla alba, spurge, owl headed clover blue, and rosemary. Their purchase price varies between 10 and 180 USD per kilogram.

Industrial uses of medicinal plants are possible for the following purposes: health food, new drugs, traditional medicines, herbal teas, intermediate products for drug manufacturing, phytopharmaceuticals, galenical, industrial – pharmaceuticals auxiliary products (Raw Materials, Tropical and Horticultural Products Service (ESCR) and Commodity and Trade Division, 2004).

In Ukraine, within the framework of development of the local territorial units/communities, which have been established in the process of power decentralization, there is a great interest in medicinal plants. Although a successful start-up, related to medicinal plants is an innovative practice for the local communities, there are already developed investment projects, for example, construction of the med-bio-techno-industrial park in Zakarpatska oblast.

DISCUSSION

Today, while organizing and managing agricultural land, Ukraine should principally rely on new eco-innovative decisions, which secure not only mandatory improvement of soil fertility, but also supply capitalization of land use (i.e., increase in the price of land plots by applying greening measures) (Sakal and Tretiak, 2015). However, the main characteristic of agricultural eco-innovations is that they are in line with sustainable land management. Insufficiently established land reform in Ukraine, which started in 1991, did not secure the adequate organizational and technological approach to the use and management of productive, low-productive, degraded, sloped, and improved land, having negative impact on the sustainability of agrolandscapes. Consequently, soils have lost a considerable share of the humus, the most fertile black soils have been transformed into soils of medium fertility level, and the deterioration process continues. Sustainable land management in Ukraine should involve implementation of land policy, organization of rational use and protection of land, land improvement, crop-engineering, and anti-erosion measures (Kurylt-siv, Hernik and Kryshenyk, 2018). No less important in the implementation of agricultural eco-innovations with the production of niche crops is the conservation of biodiversity, as well as the formation of "modern agricultural landscapes producing multiple ecosys-

tem services" (Soloviy et al., 2021). As indicated by Soloviy et al. (2021), ecosystem services in agricultural landscapes have social, economic, and environmental value – providing a wide array of benefits to society. That is why values pertaining to ecosystem services should be integrated in land use planning in the future. Unfortunately, today the cultivation of niche crops is not considered in land policy either in terms of biodiversity conservation or ecosystem services.

A successful solution to the problem of agricultural land greening, as well as its capitalization, is possible probably only by changing the model of agricultural production. In particular, it would require transforming the old model (which causes an increase of agricultural production by a large-scale use of chemicals while growing traditional crops) into a new one (use of agricultural land with the involvement of eco-innovative technologies, i.e., non-traditional, more profitable, and ecologically safe crops, particularly cultivation of marginal crops, including niche ones). Moreover, in reference to the research conducted by (Martyniuk, 2019), it has been determined that the comparison of the added value generated per unit of area directly influences the price of agricultural land (thus, land use), and depends on the share of highly marginal crops in the structure of the cropping area. It is worth mentioning that such managerial measures are forced by the eco-innovative scientific and technical progress of production intensification, and they serve to solve the efficiency issues of agricultural land management. They also act as the driving force of rural area development and increase of the social well-being by improving people's health.

Considering the current conditions of social-economic development of Ukraine, crisis recovery of its economic system and transition to the sustainable model of development suggests a complex ecological modernization of all other kinds of economic activity and other activities with application of the appropriate scientific concept of modernization. Ecological modernization is a process of transforming and upgrading the economic organization, culture, and social behaviour, following the environmental principles. It results in the emergence of new systems, equipment, and devices, goods, and services, an increase in the complexity of social and economic organization (growth of the structural and functional differentiation, emergence of new forms of integration), and an improvement of adaptability of the current traditional society that will contribute to the creation of a new environment of living and reproduction, as well as transition to the inclusive growth and sustainable development. The eco-modernization should be implemented in harmony with the structural transformation of the enterprises with the focus on neo-industrialization, rational management of natural resources and environmental protection, consideration of the ecological aspect, and formation of a rational structure of consumption (Kovalenko, 2018).

A successful example of partnership between agriculture and society, as well as between Europe and its farmers, is represented by the EU's Common Agricultural Policy (CAP). The CAP is oriented towards assisting farmers and increasing productivity of agriculture, in order to secure permanent supply of available food products; to protect the appropriate living standards for EU farmers; to contribute to the fight against climate change and to the sustainable management of natural resources; to protect rural territories and landscapes of the EU; to support an effective rural economy by creating jobs in agriculture, agro-industrial branch, and corresponding branches. At the same time, the ecologically sustainable farming is one of the CAP conditions, which will secure successful performance of the farmers' functions in the society (European Commission, 2020).

It is also worth mentioning the European innovation partnership for agricultural productivity and sustainability (EIP-Agri). Its activities are focused on supporting the goals of rural development by introducing innovations in agriculture and rural communities. The main goal of the EIP-Agri is to bridge the gap between the innovative decisions, proposed by the scientific-research and project works, and to introduce such proposed new technologies in rural areas, as well as speeding up technological transformations (European Commission, 2020).

An important socio-economic effect of non-traditional eco-innovative agricultural production lies in its prospects for both large and medium agricultural enterprises and farms. This, in turn, will attract investment from the state. According to (Onegina and Vitkovskyi, 2020) it has been established that the main factors influencing investments in the years 2014–

–2019 were: the rising prices of products; low level of disparity between the prices of products and material/ technical resources; export orientation of production; dynamics of the national currency exchange rate that is favourable for exporters; agro-innovations; and profitability of agricultural production. As part of the result of Ukrainian producers' eco-innovation activities study, it was found that small enterprises and farmers are less environmentally innovative compared to large enterprises. There are also fewer exporters among them than among the large ones, but the exporters are more environmentally innovative than non-exporters (Horin, 2017). Having said that, such conclusions require additional research, because it is necessary to consider how local conditions (the state of land and soil, other agro-climatic conditions that might have changed, etc.) have changed before the eco-innovation activities undertaken by all these producers, and again several years after (3-5-10). Due to the fact that the valuation of the condition of land and soils is voluntary, so it is often not performed; furthermore, it is difficult to compare the activities of different producers, and therefore there may be some errors in the conclusions. The analysis of the technological component in Ukraine's economy, and in the agricultural sector in particular can be determined using the Global Innovation Index (GII). The Global Innovation Index dynamics in Ukraine has slightly improved, but it still remains relatively low. Therefore, it is necessary to introduce eco-innovative production in order to increase the competitiveness of the Ukraine's agricultural sector (Horin, 2017; Kirieieva et al., 2019). A practical example of eco-innovative agriculture in France particular, and in European countries in general, shows positive interaction between technology, regulation, and the market in eco-innovation processes (Galliano et al., 2018; Galliano, Gonçalves and Triboulet, 2019).

The data in Figure 2 show the significant untapped potential of Ukrainian agricultural lands. This can be seen in the fact that there are problems, which hinder the transfer of innovations in the field of the protection and sustainable use of soils in agricultural production. One of the strategic directions of research in the field of protection and rational use of soils should be the eco-innovative approach. Such approach focuses on reproducing soil fertility and increasing soil productivity (Kucher and Kucher, 2017).

In Poland agricultural production is conducted mainly in individual farms (also called family-owned or private farms) (Heldak et al., 2018). In Ukraine the main focus is on the three most common patterns, the functioning of which is reflected in three groups of organizational types and structures of economic activities. These three are classified as follows: agricultural enterprises, farms, and households (Shulskyi, 2017). Thus, given the research data by Heldak et al. (2018), as well as cropping area of agricultural crops by the categories of enterprises in Ukraine (see: Table 1), despite significant differences in agricultural land area in Ukraine and Poland, the latter is characterized by a relatively high share of cereals and sugar beets. Meanwhile, Ukraine is a leader in the production of sunflower seeds (the second largest producer in the world), which has only a small share in the agricultural production of Poland.

Ukraine has an unrealized export potential of a number of agricultural products. In order to tap into that potential, a combination of good practices used abroad, in particular in the EU, should be used. We should consider following active use of marketing tools, state support of the organic sector, and increasing organic production by uniting producers in clusters, also through the creation of cooperatives (Bazaluk et al., 2020). To implement non-traditional eco-innovative agricultural production in a way that makes an impact, it is necessary to study export of Ukrainian agricultural products to the EU, to identify trends specific to individual countries and the EU market as a whole, and to assess niche markets opportunities and prospects (Koliadenko et al., 2020).

The production of the niche crops is a market where demand exceeds supply because of low competition, but there are fairly high purchase prices and high yields. Cultivating these crops would improve the ecological and agrochemical assessment of soils, which translates into significant financial support and competitive advantage. The known results confirm the hypothesis of a positive correlation between ecological and agrochemical assessment of soils, financial support per hectare, and sustainable competitiveness of entities (Kucher, 2020). Hypothetically, niche farming could focus on the so-called "clean" lands, the main purpose of which is to ensure the preservation and functioning of natural ecosystems for their inexhaust-

ible, long-term, and efficient use (Budziak, Budziak and Hrytsak, 2021). Equally important is the justification of the agricultural production risk, assessed at a given profitability level, which is based on comparing the levels of certain products production intensity, and in this case niche crops, which ensures their breakeven (Oliynyk et al., 2021). Growing niche crops is an integral part of the overall human, plant, and animal ecosystem. Access to a variety of crops that fill individual niches in the agro ecosystem improves the ability to control weeds, pests, and diseases, and potentially improves the environmental and agronomic performance of the crop system (Elouafi et al., 2020). Agricultural products are an important component of the global international trade. Despite its great economic importance, ecologically unbalanced agriculture has a negative impact on the environment (Abrhám et al., 2021). There are studies that consider niche production as a method of improving the agriculture sustainability in the conditions of climate change. Reduction of arable land due to climate change makes it possible to expand the area for niche production. Suitability for marginal niches and low-consumption environments provides opportunities for low greenhouse gas (GHG) emissions in terms of agroecosystems, production, and processing (Mabhaudhi et al., 2019).

PRACTICAL IMPLICATIONS

Implementation of the advantages of eco-innovative agricultural production, the potential of niche crops cultivation in Ukraine both in order to protect land and restore soil fertility, and to increase exports identified in the study, allows decision-makers to determine important values. It can also be used by public and local governments for administering the sustainable use of land potential, and for soil protection. No less important is the possibility of using the presented approach for food security in general, in the long run.

Unconventional eco-innovative agricultural production, as well as the cultivation of niche crops can be to some extent identified with organic production – in terms of organizational and managerial procedures, technical and technological requirements. Thus, we can identify the main problems that may hamper the efficiency of non-traditional eco-innovative agricultural production. These are the following: expected increase in production costs and reduced profitability compared to traditional production methods; lack of logistics infrastructure; cost savings on expanded reproduction and improvement of production technologies (Bazylevych et al., 2017). At another point, the Study (Kucher, 2020) reveals that entities, which use organic farming, yield more output per hectare, as opposed to those engaged in conventional (traditional) agriculture. At the same time, labour profitability remains low in labour-intensive organic agriculture, especially in large producers, and organic products remain a low share of Ukraine's agricultural exports (Ostapenko et al., 2020). Today, many research publications are devoted to the comparison of traditional and organic farming, which clearly identifies both the motivational aspects for farmers (Naspetti et al., 2016), and offers different methods and models. In particular, for crop production in the Polissya region of Ukraine, the authors propose a crop rotation model, which is characterized by positive forecast balance of humus and acceptable balance of basic nutrients (NPK) (Khalep and Moskalenko, 2020). Nevertheless, in order to achieve a competitive profitability level, organic production must be priced higher than traditional agricultural products. Having compared the traditional and organic agriculture systems, it has been established that when growing particular types of crops, organic system yield is 2.5 times higher. To summarise, organic farming is productive, economically viable, and it saves resources. It can substantially contribute to sustainable agricultural production depending on regional conditions and crops grown (Adamtey et al., 2016).

CONCLUSIONS

Non-traditional eco-innovative agricultural production in the form of cultivation of marginal and niche crops not only contributes to an increased profitability of land use, but also increases its price (capitalization) by applying ecological modernization. It can be achieved due to a direct correlation between the figure of the generated added value per a unit of area and the value of agricultural land. Another important socio-economic effect is that such production is promising both for agricultural enterprises and for small farms, particularly private farms and farming enterprises.

Moreover, the eco-innovative agricultural production will secure an increased supply of niche crops with a high level of profitability and thus, it will raise income from the land tax by means of the lease of agricultural land, used for their growing.

The cultivation of marginal and niche crops plays a significant role today, during the COVID-19 pandemic, but it will play an even more important role in the post-COVID period of agricultural development, because it suggests not only satisfaction of the social demand for healthy environment through the introduction of environmental eco-modernization technologies, but also specific agricultural crops, including some medicinal ones. Thus, it is an important task to support small agricultural producers and farmers who specialise in the cultivation of marginal and niche crops in the conditions of lockdown and post-lockdown period, when the opportunities of selling their produce is restricted .

Prospects for additional research and its most promising directions include possible study of qualitative indicators of land and soils status due to the cultivation of niche crops; establishing the relationship between the size of agricultural enterprises and their competitiveness, in particular, in export; valuation and prospects for monetization of ecosystem services in agricultural landscapes, where niche crops are grown and where organic production is practiced.

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UPRAWA ROŚLIN NISZOWYCH I PERSPEKTYWY INNOWACYJNEJ EKOLOGICZNEJ PRODUKCJI ROLNEJ W UKRAINIE

ABSTRAKT

Cel pracy

Artykuł poświęcony jest zbadaniu perspektyw innowacyjnej ekologicznej produkcji rolnej w Ukrainie, polegającej na uprawie roślin niszowych w celu ochrony i przywrócenia żyzności gleb, a także rozwoju potencjału eksportowego szeregu niszowych upraw.

Materiał i metody

Na empirycznym i teoretycznym poziomie badań, na potrzeby niniejszego artykułu, wykorzystano zestaw ogólnych i specjalistycznych narzędzi naukowych, w szczególności: analizę systemową (strukturalną i funkcjonalną), abstrakcję, syntezę, dedukcję i indukcję, porównanie, formalizację, wizualizację graficzną (*mapping*) oraz idealizację. Metody te posłużyły do: opisania warunków produkcji rolnej w Ukrainie (warunki naturalne, gleby, udział rolnictwa, leśnictwa i rybołówstwa w regionalnym PKB, eksport niektórych upraw niszowych do krajów UE); przeanalizowania struktury Funduszu Ziemi i użytkowania gruntów w Ukrainie, w krajach UE i ogólnie w krajach europejskich; zbadania powierzchni upraw rolnych według kategorii przedsiębiorstw i gospodarstw rolnych w Ukrainie; porównania wybranych parametrów upraw rolnych, upraw sadowniczych i upraw roślin jagodowych w Ukrainie i w Europie Wschodniej oraz eksportu niektórych niszowych produktów rolnych w kontekście ukraińskim i ogólnoświatowym.

Wyniki i wnioski
Zidentyfikowano istotne różnice w strukturze Funduszu Ziemi i użytkowania gruntów w Ukrainie, w krajach UE i ogólnie w krajach europejskich. Ukraina ma niedoskonałą strukturę gruntów, duży udział gruntów rolnych i wysoki udział gruntów ornych. Tendencji tej towarzyszą pogłębiające się procesy degradacji gruntów. Zidentyfikowano trendy w uprawie określonych roślin użytkowych w Ukrainie w zależności od kategorii i typów gospodarstw rolnych. Ocena aktualnego stanu eksportu niektórych upraw niszowych w Ukrainie i na świecie wskazuje na jej wysoki potencjał eksportowy. Zważywszy na to, że wartość dodana w przeliczeniu na jednostkę powierzchni bezpośrednio wpływa na cenę gruntów rolnych, a także na potencjał ochrony i przywracania żyzności gleby, proponuje się wykorzystanie gruntów rolnych pod uprawę upraw niszowych, a także rekomenduje się wdrażanie innowacji ekologicznych w rolnictwie, wraz ze zmodernizowanymi technologiami, które nie są szkodliwe dla ludzkiego zdrowia. Rekomendowane działania służyć będą ponadto ochronie bioróżnorodności, eliminacji lub minimalizacji zanieczyszczenia środowiska, ułatwieniu racjonalnego (zrównoważonego) użytkowania gruntów i innych systemów zasobów, właściwemu wykorzystaniu nawozów, mikroelementów i dodatków do celów technologicznych – w ustalonych maksymalnych dopuszczalnych ilościach, a także ich przechowywaniu w odpowiednio przygotowanych lokalizacjach. Rolnicze innowacje ekologiczne oraz produkcja upraw niszowych rekomendowane są również jako praktyczna realizacja zintegrowanego systemu celów zrównoważonego rozwoju bezpośrednio związanych z rolnictwem.

Słowa kluczowe: użytkowanie gruntów, grunty rolne, innowacje ekologiczne, eksport płodów rolnych, przedsiębiorstwa rolne, cele zrównoważonego rozwoju