TERRITORIAL DISTRIBUTION OF LAND RESOURCE POTENTIAL OF AGRICULTURAL USE IN WORLD COUNTRIES

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Abstract

The article considers the territorial distribution of agricultural land and resource potential. From the standpoint of implementing the integrated value of the ecological and economic component of land resources, a methodological approach to the monetary valuation of agricultural land as one of the regulatory tools of territorial distribution of land in the world. The systematic approach to the formation of market turnover of agricultural lands and the formation of land resource potential of agricultural enterprises is substantiated. Indicators for assessing the land resource potential of agricultural use from the standpoint of the development of land relations in agriculture are presented. The method of normative monetary valuation of a separate agricultural land plot has been modified by changing its estimated value by an integrated indicator. The indicators for assessing the efficiency of land use are systematized. The territorial distribution of the main categories of lands in the world is analyzed. The share of arable land suitable for growing crop products in the world is determined. The dynamics of agricultural land areas by regions of the world and their reserve volume suitable for the development in the world are given. The ecological and agrochemical condition of the wholesale coverage of agricultural lands in Ukraine and in the natural and climatic zones of Polissya, Forest-Steppe and Steppe has been determined. The value of agricultural land in Europe and Ukraine is estimated.

Keywords: agricultural lands, agricultural production, monetary valuation of land plots, crop products, ecology.

JEL classification: Q12, Q13, Q16, Q17

1. Introduction

The transformation of economic mechanisms that have developed in a centralized economy, objectively led to not only the growth of instability of the external environment of agricultural enterprises, but also to the destruction of state-regulated, well-established and effective system of land formation and use of agricultural resources.

Centralized distribution of resources, in accordance with the plan of economic and financial activities, specialization, concentration and diversification of production, the formed sectoral and territorial division of labor, required economic entities to solve tactical tasks of distribution of allocated resources. The decision of strategic questions of the development of agricultural enterprises, including problems of formation, protection and reproduction of their land resource potential was considered as a prerogative of state management bodies. Left face to face with the elements of the market, in the context of shock therapy and accelerated reform of the economic mechanism, most agricultural formations have not been able to adapt to changes in the external environment. The state's refusal to participate in the process of forming the land resource potential of agricultural enterprises has led to not only a sharp decline in their resource security, but also to a rapid increase in resource imbalances. They deepen the difficult financial and economic situation of agricultural enterprises, especially small and medium, instability of their ecological development, disparities in land supply, capitalization, and specialization of production.

The use of land resources is a key factor in ensuring the effectiveness of socio-political and economic activities in the country, a determinant of human culture and social order in the state, production and rational development of its resource potential. Currently, this process requires in-depth study, clarification of its components, as the issue of economic valuation of land and, consequently, the functioning of market turnover of land is a cornerstone of agricultural growth, rural welfare, rural development and national economy. The process of forming the methodology of land valuation and market turnover of land, in particular agricultural, is, polar. However, on the other hand, according to the requirements of the time, monetary valuation of land is considered as the basis for land transfer, inheritance, pledge, lease, obtaining a bank loan, determining land tax rates, pricing, a condition for the development of rural areas.

The study of regulatory tools for efficient and rational use of agricultural land was carried out by A. Berle and G. Means (1932), J. Campbell (2004), G.C. Van Kooten (1993), V. Dankevych (2014, 117-123), H. Demsetz (1983, 385-387), F. Dovring (1988, 490-491), S. Kay, J., Peuch, J. Franco (Kay et al., 2015) and the land management system was studied by P. Ciaian, d'A. Kancs, J. Swinnen, H. Van, L. Vranken (2012, 1-19), R. Ely, P. Whelpton, L. Dublin, H. Bodfish, R. Newcomb (1931, 125-133), M. Shchuryk (2016, 68-74), J Swinnen and L. Vranken (2009), I. Yasinetska (2016, 127-131), O. Yatsenko (2013, 31-38).

The priority of our study is to substantiate a comprehensive methodological approach to monetary valuation of land as one of the regulatory tools for territorial distribution of resource and land potential of agricultural land in the world, based on the optimization model of integrated indicator of land production and related ecological and economic component.

2. Methods and Materials

The objective need to assess the land resource potential of agricultural use arises from the moment of considering land as a means of production. The development of scientific heritage on land use allows assessing agricultural land from a statistical and economic point of view. In the methodological and methodical context, the assessing of the land resource potential of agricultural use have a valuable scientific heritage of results on the construction of scales for multidimensional analysis of agricultural land to obtain estimates; use of methods of valuation of lands with perennial plantations and lands with reclamation network (irrigated and drained) and natural forage lands, etc. (Dankevych 2014, 117-123; Tolidis and Dimopoulou 2012, 51-67). We should note that the monetary valuation of agricultural land is divided into expert and regulatory. Expert monetary valuation of land and rights to land is carried out in order to determine the value of the object of evaluation (Table 1), normative – to determine the amount of land tax, state duty on exchange, inheritance (Berle and Means, 1932).

Table 1. Methodical approaches to expert monetary valuation of agricultural land

Methodical approach	Features	Calculation algorithm	Legend
Direct capitalization	Based on the assumption of consistency of cash flow from land use	V*dk*= D*o*/ C*k*	Vdk – the value of the land plot, determined by direct capitalization, USD; D*o* – net or rental income, USD; C*k* – capitalization rate.
Indirect capitalization	It is based on the assumption of limited and substitutable cash flow from land use over a period of time.	V*idk* = Σ D*oi*/(1+Ck)^{i} + P	V*idk* – the value of the land, determined as a result of indirect capitalization, USD; D*oi* – expected net operating or rental income for the *i*-th year, USD; P – current cost of reversion; C*k* – capitalization rate.
Comparison of sales prices of similar land plots	The value of land is determined at the level of prices prevailing in the market by amending the selling prices of such land, taking into account differences in the terms of transactions.	V*lp* = P*a* +Σ Δ*Paj*	V*lp* – adjusted sale price of such land, USD; P*a* – the actual sale price of such land, USD; m – the number of comparison factors; P*aj* – the difference in the sale price of such land in relation to the plot.
Taking into account the cost of land improvements	It is used to assess improved land plots or those that are expected to be improved, provided that they are used most effectively.	Vli= P*o* – C*oc*	Vli – the value of the land plot, determined by taking into account the cost of land improvements, USD; P*o* – expected income from the sale of improved land or capitalized net operating or rental income from its use, USD; C*oc* – costs of land improvements, USD.

Source: formed based on (Lobunko 2015, 17-21; Mesel-Veseliak and Fedorov 2016, 18-22).

The modern method of normative assessment of agricultural land involves the use of a classifier of land use by the factor that describes the functionality of lands (Kf = 0.3) (Harazha 2015, 21-24). In this case, the normative monetary value of one square meter of lands of settlements is determined by formula (1) (Dankevych 2017, 135-141):

$$R_a = \frac{C \times E_r}{R_c} \times K_f \times K_l, \quad (1)$$

where: – normative monetary valuation of a square meter of the land, USD; – costs for the development and arrangement of the territory per square meter, USD; – rate of return (6%); – capitalization rate (3%); – coefficient that characterizes the functional use of the land (for housing and public buildings, for industry, transport, etc.); – coefficient that characterizes the location of the land.

The coefficient that characterizes the location of the land ( ) is calculated by formula (2) (Andriichuk and Sas 2017, 22-33):

$$K_l = K_{l_1} + K_{l_2 + K_{l_3}}, \quad (2)$$

where: K_{l_1} – coefficient that characterizes the regional factors of the location of the land, in particular: a) population and administrative status of the settlement, its place in the settlement system; b) placement within the settlements located in suburban areas of large cities; c) placement within settlements that have the status of resorts; K_{l_2} – coefficient that characterizes the zonal factors of the location of the land within the settlements, in particular: a) distance to the city center of the settlement, concentrated places of work, mass recreation of the population; b) location in the core of the center of large and largest cities and other settlements of special historical importance, in the coastal strip of settlements; K_{l_3} – coefficient that characterizes the local factors of the location of the land by territorial-

planning, engineering-geological, historical-cultural, natural-landscape, sanitary-hygienic conditions and the level of the arrangement of the territory.

The average (base) cost of one square meter of the land of the settlement depending on regional factors of location (R_{al}) is determined by formula (3) (Andriichuk and Sas 2017, 22-33):

$$R_{al} = \frac{C \times R_r}{R_n}, \quad (3)$$

The value of the coefficient K_{l_1} is the product of coefficients that take into account: population, geographical location, administrative status of settlements, their economic functions; locations of settlements in the suburban area of large cities; assignment of settlements to resorts; locations of settlements in the territory that was exposed to radioactive contamination as a result of the Chornobyl disaster. The normative monetary valuation of a separate agricultural land is determined by formula (4) (Hutsuliak 2013, 46-48):

$$M_{vd} = (\sum(P_{ag} \times Mn_{ag}) + P_{non-ag} \times Mn_{ag}), \quad (4)$$

where: M_{vd} – normative monetary valuation of agricultural land, USD; P_{ag} – area of agricultural production group of soils of agricultural land, hectares; Mn_{ag} – normative monetary assessment of the agricultural production group of soils of the respective agricultural land of the natural-agricultural district, hryvnias per hectare; P_{non-ag} – the area of non-agricultural lands (lands under economic roads and runs, field protective forest strips and other protective plantings, except for those referred to forestry lands, lands under farm buildings and yards, lands under the infrastructure of wholesale markets of agricultural products, temporary conservation lands, etc.), hectares; Mn_{ag} – standard of capitalized rental income of non-agricultural lands on agricultural lands, hryvnias per hectare.

At the same time, a retrospective analysis of the methodology for assessing the land resource potential of agricultural land proves the need to take into account the factor of lifting the moratorium on the sale of agricultural land, according to the experience of EU countries, namely (Dobriak et al. 2013, 12-15):

- from the standpoint of the national level, the process of buying and selling land should be carried out, taking into account the preservation of the optimal institutional structure of agricultural production;
- establishing a transitional period during which there are temporary restrictions or rules of operation of agricultural land, in order to agree on lease terms, pricing policy for sale and lease, determining the min / max size of land that may be available to one owner, the tax scale etc.;
- preservation of the ecological component of the activity of various business entities;
- formation of requirements to the potential buyer, namely, the presence of agricultural education, experience of business entities, able to physically, intellectually, materially conduct activities on a certain land plot;
- formation of legislative norms on the conditions of sale of land plots to the citizens of another country.

In European countries, the value of land is determined by calculating the productivity index or by establishing its real market value according to the purchase or sale prices of land. Land is revalued regularly, as its market value may change. The average net income per year provided by the land is determined for the last 15 years. Two years are not taken into account, which are characterized by the smallest and largest yield.

$$"Index\ \ Cmopt" = A \times B \times C \times X, \quad (5)$$

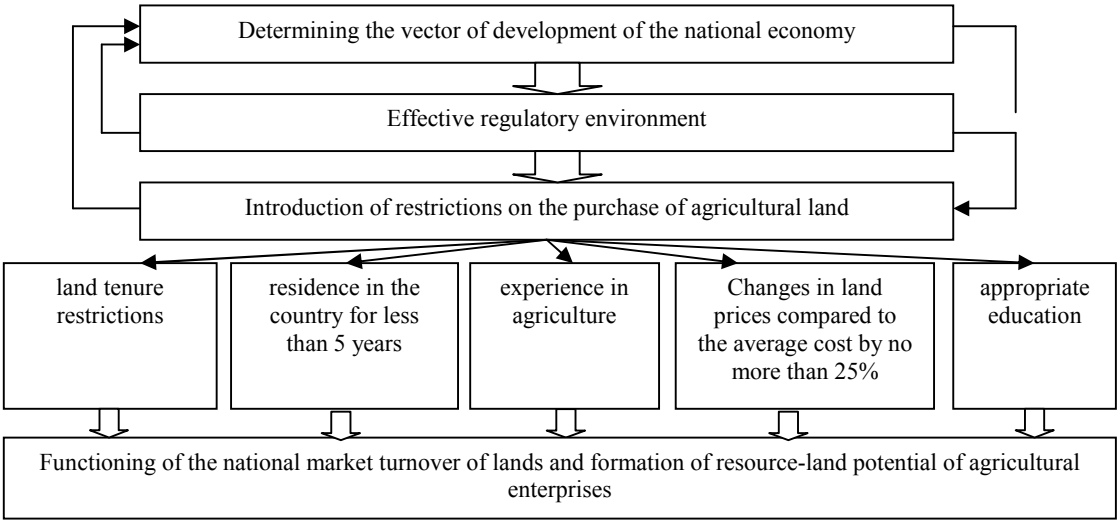
where: A – different characteristics of the soil profile; B – mechanical composition of the soil; Mn_{ag} – normative monetary valuation of the agricultural production group of soils of the respective agricultural land of the natural-agricultural area, USD per hectare; C – the slope of the surface; X – other characteristics (drainage, erosion, fertility level, micro relief).

It should be noted that in the United States when assessing the agricultural land potential, the following indicators are taken into account: the degree of intensity of agricultural activity, structure and type of soil. At the same time, the most suitable is the method of land valuation by Storey, namely: the state budget, which ensures the development of agricultural production, growth of the agricultural economy as a whole while preserving national interests. Arable land in the United States is divided into five grades: Grade 1 – the Storey index for this grade of land is 80–100%; 2nd grade – 60–79%; 3rd grade – 40–59%; 4th grade – 20–39%; 5th grade – less than 20%. According to this estimate, the value of US agricultural land can range from 300 to 1200 USD per a year (Barnard et al. 1997, 1642-1650).

In Spain, the assessment of land resource potential is determined by the level of profitability of crops, taking into account their degree of intensity. Yield (profitability) is capitalized at 3%, it allows to determine the value of land. The evaluation is carried out in several stages. The first stage – data are submitted to the territorial councils on real estate about those crops that are grown in a particular area, with information on the assessment of soil characteristics, the level of mineral fertilizers and technical support of farms. The second stage – each municipality is assigned a qualification number. At the third stage, the cadastral value of all rural land holdings is determined, taking into account the agronomic characteristics of the area, profitability and other factors that allow: to consistently place the level of profitability according to the degree of importance; to classify land plots depending on profitability; to assess the profitability of crops (Guyomard et al. 2004, 125-148).

Based on the above, the authors formed a systematic approach to national market turnover of land, which is based on the requirements of resource and land potential of agricultural use and land use by economic entities, taking into account the dynamics of socio-economic development of the agricultural economy (Image 1).

Image 1: System approach to the formation of market turnover of agricultural land and the formation of land resource potential of agricultural enterprises



Source: developed by the authors

Methodological innovations in the study of agricultural land potential are as follows:

1) application of indicators of land resource potential assessment, in the context of land relations development: registration of land ownership rights, transactions on change of ownership and use rights (sale, lease, inheritance, exchange, etc.), land taxation, change of ownership forms and resolving disputes over land plots;
2) use of SWOT and PESTEL-analysis, in order to determine the formation of organizational, legal and socio-economic priorities for the development of land relations and the use of land and resource potential of agricultural use;
3) application of the method of expert evaluation – a method of predicting future results based on the conclusions of experts (heads of agricultural enterprises, farmers, landowners, heads of district and regional departments of agro-industrial development, specialists of research institutes), to determine certain variables required to assess the research issue;

4) use of computer programs and forecasting models based on geographic information systems and substantiation of scenarios and directions of spatial transformation of the regional land use system.

The authors propose indicators for assessing the land resource potential of agricultural use in the context of the development of land relations at the subnational level, which will allow local authorities to adopt effective practices of cities and districts with similar conditions of agricultural land use (Table 2).

Table 2. Indicators for assessing the land resource potential of agricultural use from the standpoint of the development of land relations in agriculture

Indicator	Characteristic
Soil quality	comparative assessment of soil quality by their main natural properties, which have a sustainable nature and significantly affect the yield of crops grown in specific climatic conditions
Physical and chemical condition of the soil	characteristics that determine the selection of tillage technologies, allow to estimate energy costs for them, to choose the optimal timing of field work with their minimum deformation and the highest productivity of agricultural labor
Registration of land ownership rights	the share of land plots registered in the cadastre, calculated to the total number of lands of the relevant form of ownership, according to statistical reporting
Transactions for change of ownership and use	change of owner (purchase-sale, inheritance, change-donation) and user (rent); is calculated for 1 thousand landowners and land users on the basis of data on the number of transactions with land registered in the register of real estate rights
Land taxation	the number of taxpayers for land per 1 thousand owners of private land in terms of citizens and legal entities; allows to monitor the state of agricultural land use; stimulates the transition of plots to more efficient land users
Conflict resolution in the field of land relations	the number of lawsuits against land relations received by local courts per 10 thousand landowners in terms of civil and administrative proceedings
Change of ownership of agricultural land	number of citizens who exercised the right to free land privatization for agricultural land use

Source: developed by the authors

From the point of view of land relations, the proposed indicators are an innovative tool for assessing the agricultural land potential at the local level, which can be used by local authorities, investors and the public to identify problematic aspects of agricultural land use, ownership and disposal. The indicators cover almost all key areas of land relations. Indicators can serve as an indicator of investment attractiveness, and therefore will be of interest to investors. An important condition for the land resource potential of agricultural use in the economic turnover of enterprises is the long-term forecasting of efficient use of agricultural land.

To analyze the conditions of use of agricultural land, it is important to identify factors influencing the indicators of economic efficiency of agricultural activities of enterprises. The latter criterion depends on many factors, and in particular, environmental, which characterizes the environment and conditions for agricultural production and food. Therefore, monitoring of resource-land potential of agricultural use should be considered in the process of interaction of agricultural production entities and the environment, as well as between social, environmental and economic indicators that characterize their performance results (Ciaian and Swinnen 2006, 799-815).

In order to analyze the impact of environmental factors on the efficiency of land resource potential of agricultural use and agricultural economy in general, it is proposed to establish the relationship between economic and environmental indicators and modify the method of normative monetary valuation of individual land (formula (4)) by changing its estimated value on the integral indicator (formula (6)) (Hutsuliak 2013, 46-48):

$$M_{vd} = (\sum^{\Sigma}(P_{ag} \times Mn_{ag}) + P_{non-ag} \times Mn_{ag}) \times I_{int}, \quad (6)$$

where: I_{int} – is an integral indicator of the correction of the ecological assessment of agricultural lands.

Accordingly, the integrated indicator of ecological assessment of agricultural lands is determined by the integrated functionalities of the relationship between its components: of socio-ecological, innovative, investment and informational nature. Thus, the model of the

production function will have the form of the following dependence (formula (7)) (Hutsuliak 2013, 46-48; Marta-Costa et al. 2012, 111-124):

$$Iec_{inov\ invinf_{int}}, \qquad (7)$$

where: I_{int} – is an integral indicator of the correction of the ecological assessment of agricultural lands.

Since the efficiency of land use in agriculture is influenced by positive and environmentally destabilizing factors to improve the methodology of its study, it is urgent to calculate economic indicators (Table 3). Leading positions among these indicators are: the share of privately owned agricultural land, the ratio of organic production to its total volume, the rental rate, yield, specific land productivity, value added per 1 ha of land, the share of perennial crops in the structure of agricultural land, the cost of additional products obtained through the transformation of sown areas (Ciaian and Kancs, 2009; Karjoo and Sameti 2015, 47-54). Thus, ecological and economic assessment of land is the basis for ensuring the rational use of resource and land potential in the conditions of transformation of property relations, economic regulation of entrepreneurial activity, improvement of social welfare of the rural population and environmental protection.

Table 3. Indicators for assessing the efficiency of land use

Indicators	Method of calculation
The share of privately owned agricultural land	the share of agricultural land cultivated in farms and private farms
The share of perennial plantations in the structure of agricultural land	opportunity for the costliest type of agricultural activity, which involves a larger list of lands in terms of qualitative and quantitative characteristics
The ratio of organic production to its total volume	the level of natural harmonization of production in agriculture
Rental rate	the share of regulatory valuation of land paid as rent to the landlord
Crop capacity	natural return of land resources
Specific productivity of land	comparative assessment of land use of different forms of management
Added value per 1 ha of agricultural land	the amount of value added per unit of land resources
The cost of additional products obtained through the placement of crops on environmentally friendly lands	absolute increase in production according to expert estimates of crop rotation optimality
Land return (taking into account the value of land)	rate of income according to the normative assessment (market value) of land
Land return (excluding the value of land)	specific profitability of the entire agricultural sector of the economy
The mass of profit per 1000 USD of value (regulatory assessment) of land	mass of profit per value unit (regulatory assessment) of land
Gross output growth rate	growth of gross output over a period of time
Growth rate of sown areas	increase in sown areas over a period of time
The growth rate of profit from sales of agricultural products and services	dynamics of accumulation of own capital and own enrichment of founders
The level of profitability of agricultural activity	the mass of profit accounted for the mass of costs
Yield growth rate	increase in yield over a period of time

Source: summarized by the authors based on (Dewbre et al. 2001, 1204-1214; Duvivier et al., 2005; Blancard et al. 2006, 351-364; Swinnen and Vranken, 2009; Breustedt and Habermann 2011, 225-243).

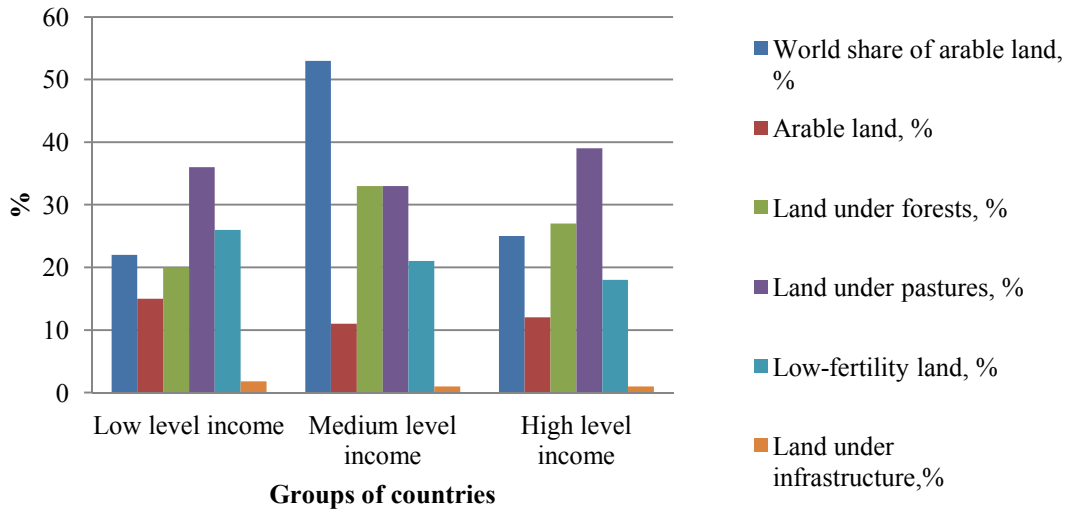
3. Results and Discussion

Land resource potential and methods of its use play an important role in solving the problems of food security in the world. The impact of global changes on soil resources and agricultural production, with the existing demographic problems, climate change and increasing competition for land resources in the absence of sufficient food cause an increase in insecurity of the population (Robison et al. 2002, 44-58; Dovgal et al. 2017, 231-242; Martinho 2018, 135-152). In order to improve the food security situation and succeed in the fight against malnutrition, it is necessary that the growth of agricultural production outpaces the growth of the population. This can be solved by intensifying land use, which minimizes existing food and social problems.

According to FAO forecasts, up to 3.2-3.5 billion hectares (20%) can be used in world agriculture, of which only 0.45 billion hectares after development can become highly productive agricultural lands. According to Doing Business, in the last 50 years the area of arable land in the world has increased by 12% due to the reduction of forest, wetlands and meadows (The State of the world's land…, 2016). At the same time, the area of irrigated areas has doubled the distribution of land resources and the state of their use is different, given the level of the development of countries.

According to the criteria of the state of economic development of the world, they are divided into groups according to the level of income (low, medium and high income). The World Bank's classification covers 209 countries: the first group ("low-income countries") includes countries in which per capita GDP is 725 USD or less; the second group ("middle-income countries") includes countries with average GDP per capita income in the range from 726 to 8995 USD; the third group ("high-income countries") includes countries in which GDP per capita is 8995 USD and above (Food and Agriculture Organization…, 2020; Trusova et al. 2021, 169-182). Each of the groups of countries has its own natural and climatic features, different areas of land suitable for agricultural production (Image 2).

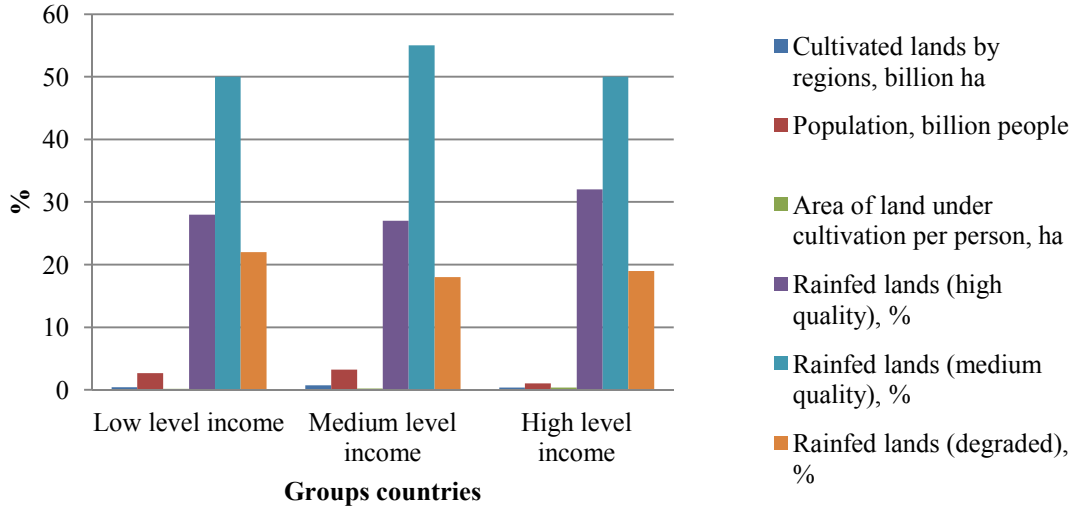
Image 2: Territorial distribution of major land categories in the world, 2020



Source: calculated by the authors according to data (Food and Agriculture Organization…, 2020).

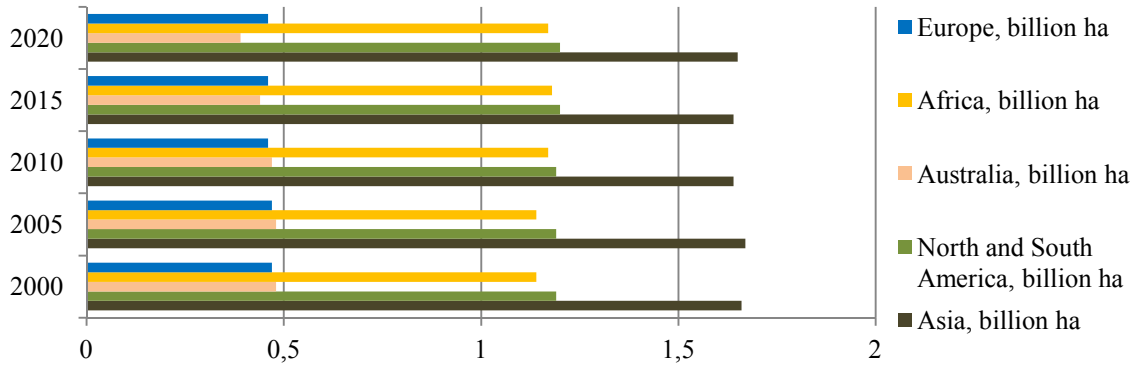
The territorial distribution of countries shows that favorable conditions for the expansion of arable land are in Africa and North America; potentially fertile lands of Asia are developed by 90%, Europe – by 97%. From the standpoint of the distribution of the main categories of land by groups of countries, there is a situation that shows that the highest regional share of arable land is concentrated in Central America and the Caribbean – 42%, Western and Central Europe – 38%, North America – 37% (The State of the world's land…, 2016; Balomenou and Maliari 2013, 127-143). On average, for high-income countries, the share of fertile land is 32% (Image 3). Soils in low-income countries are often less fertile and only 28% of all arable land is of high quality. It should be noted that the agricultural land potential is divided into five main regions of the world: Asia, Europe, North and South America, Africa and Australia (Image 4). Each of the studied regions has its own resource, economic, socio-political, environmental and climatic features. Thus, the prospects for the development of agriculture in Asia are inextricably linked with the development of new arable land, the introduction of irrigated agriculture. At the same time, mountains and deserts occupy most of the region, so there are limited land resources suitable for agriculture.

Image 3: The share of arable land suitable for growing crops in the world, 2020



Source: calculated by the authors according to data (The State of the world's land…, 2016).

Image 4: Dynamics of agricultural land areas by regions of the world, million hectares, 2000-2020



Source: calculated by the authors according to data (The State of the world's land…, 2016)

The regions of North and South America are sufficiently provided with land resources. The total land fund of the region is 3.889 billion hectares, agricultural lands occupy 1.194 billion hectares, of which arable land – 30%. A characteristic trend in 2005-2020 is the greening of land use; more than 9.2 million hectares of agricultural land are used for organic farming. The largest areas of them are in the USA (million hectares) and Brazil (1.8 million hectares), they are constantly expanding.

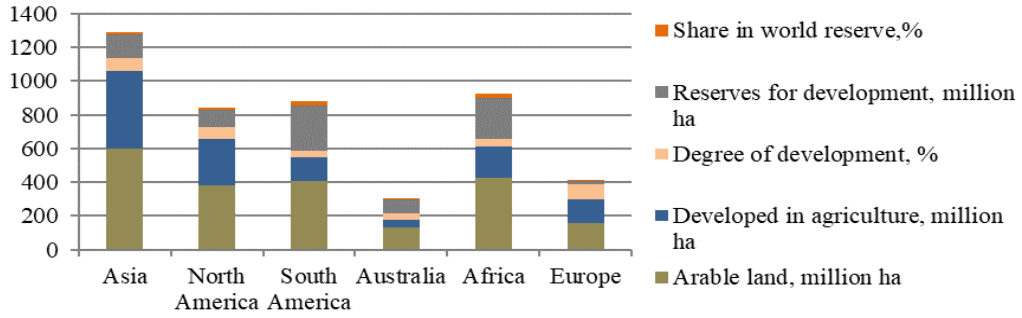
A favorable natural environment and an effective policy for the use of agricultural land resources allow to fully meet food needs in the United States and increase world exports of agricultural products. More than 190 million hectares of arable land and 220 million hectares of pastures and 20 million hectares of land are under irrigation for agricultural needs (The State of the world's land…, 2016; The world bank group, 2020; Tibério and Francisco 2012, 57-86). The main advantage of US agriculture is its high productivity. The United States competes only with Canada, Australia, and New Zealand in terms of the value of output per worker.

An important player in the agricultural market of the world is Australia, which has significant agricultural land potential. The country is the leader of the Kern Group of agricultural producers, which carries out 20% of world exports (The State of the world's land…, 2016). The effectiveness of Australian land use is due to the government's close cooperation with national associations of agricultural producers. The state initiates research, advisory and educational services, organizes international marketing services, regulates price levels, provides financial support to farmers during droughts and floods, and stimulates the development of environmentally friendly farming systems. The land resource potential of the African continent is low due to the primitive conduct of agricultural production with rapid

population growth, the introduction of monocultures, plowing of new unproductive lands, overloading the structure of agricultural land with pastures. Extensive farming methods accelerate soil degradation and depletion.

The general trend for all studied regions (Asia, Europe, North and South America, Africa and Australia) is the process of degradation of agricultural land. Thus, due to erosion, 6-7 million ha are removed from circulation annually, and due to water logging and salinization – 1.5 million ha. A serious threat to the land fund in Africa and Asia is the emergence of a desert on previously cultivated lands, which covered an area of 9 million km^2 (The State of the world's land…, 2016; Rastvortseva 2017, 45-54). Degradation of agricultural land is caused by their transformation into anthropogenic landscapes. These processes significantly reduce the area of reserve for land development in the world (Image 5).

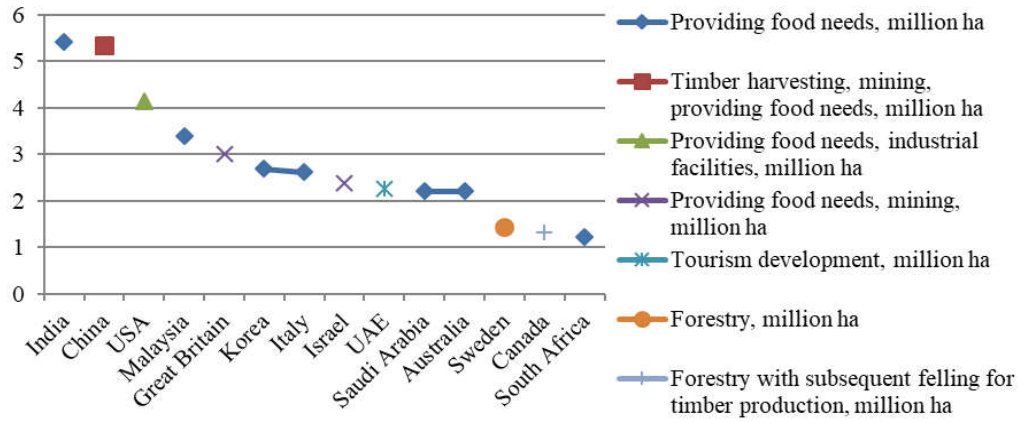
Image 5: Reserve areas of agricultural land suitable for development in the world countries



Source: calculated by the authors according to data (The State of the world's land…, 2016; The world bank group, 2020)

In the context of globalization of the economy, especially in the agricultural sector, the risks are manifested in all regions of the world with renewed vigor, because they are unpredictable and require significant costs to minimize their negative impact. In addition, external factors, such as climate change, competition with other sectors and socio-economic changes, are added to the restrictions on access to agricultural land resources in some countries. This requires a more rational use of agricultural land and increase in their fertility. This is especially true for countries dependent on imports of agricultural products. The largest importer of cereals is Japan – 126.8 million tons; Egypt – 74.4; Mexico – 73.6; South Korea – 62.6; Spain – 59.7 million tons. TOP-10 world importers of grain are the countries of Asia and Latin America, oilseeds – China – 241.4 million tons; Germany – 34.3; The Netherlands – 31.0; Japan – 30.4 and Mexico – 28.4 million tons (Shchuryk 2016, 68-74; Napolskikh and Yalyalieva 2019, 73-81; Fafurida et al. 2019, 49-57). At the same time, a significant number of countries solve their own food problems through the purchase of agricultural land (Image 6).

Image 6: Global trends in land purchase and sale in world countries, 2020

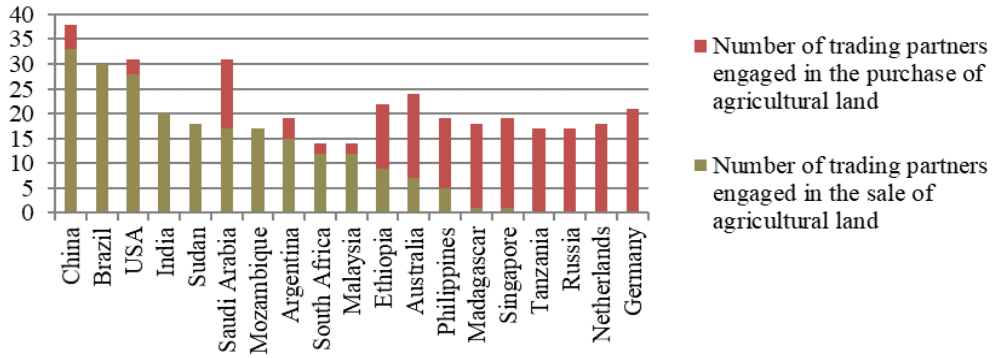


Source: calculated by the authors according to data (The State of the world's land…, 2016)

Demand for land resources is also determined by the investment factor. Analysis of global trends in the purchase and sale of agricultural land proves that the main purpose of buying land in 2005-2016 was to meet the food needs of the population – 11.6 million hectares, timber harvesting – 7.3 million hectares, mining – 6.1 million hectares, forestry – 5.7 million hectares and placement of industrial facilities – 3.2 million hectares.

Among the world leaders in concluding foreign economic contracts for the purchase and sale of agricultural land are: Great Britain, the United States, Germany, India and Saudi Arabia (Image 7). The areas of land that are sold and bought are constantly increasing: from 0.75 to 1.75% of the world's agricultural lands have changed the right of ownership or disposal as a result of international agreements. This trend may intensify as the population grows. The area of agricultural land controlled by multinational corporations is constantly expanding and the leaders in this indicator are the Democratic Republic of the Congo, Papua New Guinea and the Russian Federation.

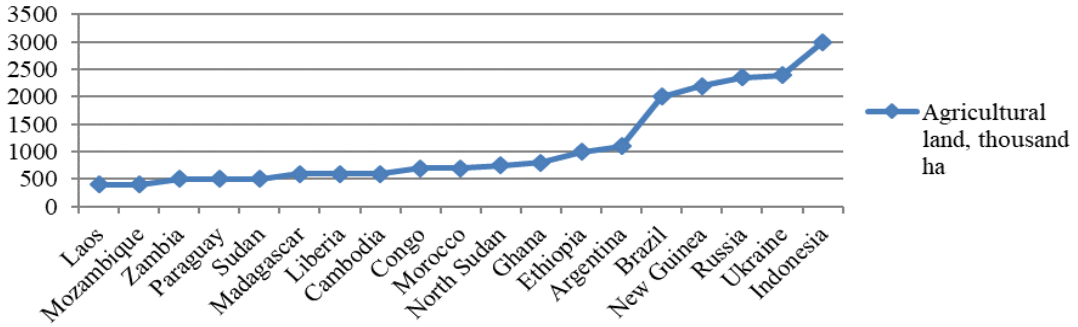
Image 7: Companies engaged in the purchase **and sale of agricultural land in the world, 2020**



Source: calculated by the authors according to data (The State of the world's land…, 2016)

The countries for investing in agricultural land are Indonesia, Ukraine, Russia, Papua New Guinea and Brazil (this is 46% of the total area of purchased agricultural land), (Image 8). Seven companies with foreign capital have a land bank in Ukraine of over 2 million hectares. Thus, NCH Capital Corporation controls Ukrainian land with a total area of over 400 thousand hectares. In general, since 2000, 26.7 million hectares of agricultural land around the world have come under the control of foreign investors; their share is approximately 2% arable land in the world. In the coming years, this process will become increasingly threatening for the local population, as it is typical for investors to introduce a shift method of economic activity (The State of the world's land…, 2016; Lukin 2019, 65-72; Islam et al. 2012, 159-182).

Image 8: Area of agricultural land controlled by foreign countries in the world, 2020

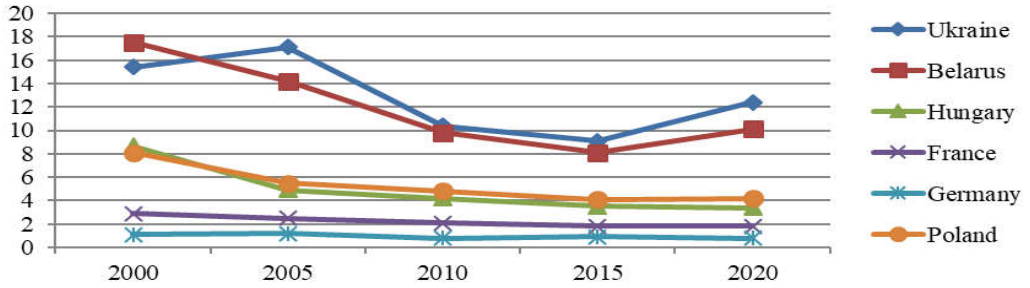


Source: calculated by the authors according to data (The State of the world's land…, 2016)

In order to assess the available land resource potential and the possibility of intensification of production, the authors investigated the effectiveness of land use potential in countries where agriculture is one of the priority sectors, and which have close natural and climatic conditions to Ukrainian. Five countries were selected (Belarus, Poland, France, Germany and

Hungary) according to the following criteria: the share of the agricultural sector in the country's GDP, natural and climatic features, the historical specifics of land reforms and economic activity (Image 9). Ukraine is less urbanized compared to the studied countries, but the share of agriculture in the country's GDP structure is the highest – 12.4%.

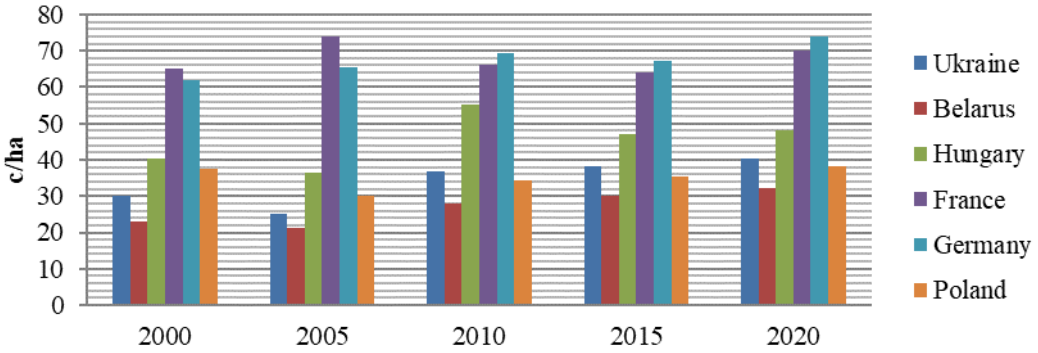
Image 9: The share of agricultural products in GDP of the world countries for 2000-2020, %



Source: calculated by the authors according to data (The State of the world's land…, 2016; The world bank group, 2020)

The dynamics of crop yields in 2000-2020 tends to increase and for 20 years has increased by 62%. In Ukraine, compared to Poland and Belarus, these performance indicators are much higher. This trend is explained by the concentration of land in integrated corporate formations of the country and the development of small enterprises in Belarus and Poland. At the same time, domestic enterprises have not yet reached the yield of 1 hectare in countries such as Hungary, France and Germany (Image 10). The analysis of socio-economic effectiveness of land use of agricultural enterprises in Ukraine was carried out based on the following indicators: rent for land shares, average monthly wages, average number of employees, etc.

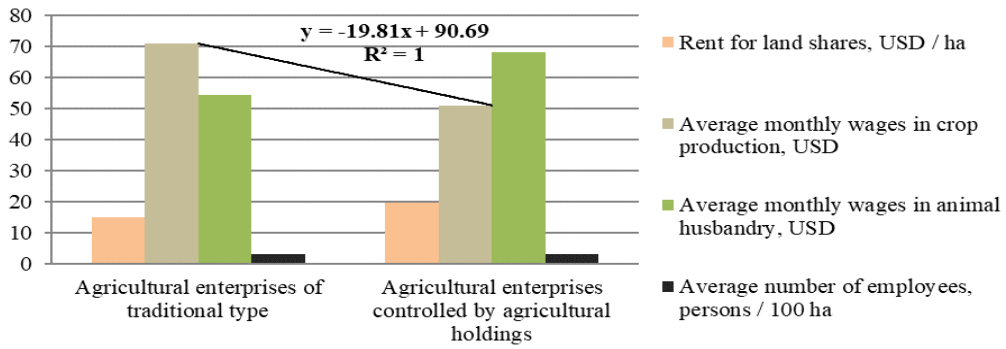
Image 10: Dynamics of grain yields in the world countries for 2000-2020, %



Source: calculated by the authors according to data (The State of the world's land…, 2016; The world bank group, 2020)

Despite the positive dynamics of growth of social benefits, their level remains low both in agricultural enterprises and in agricultural holdings (Image 11).

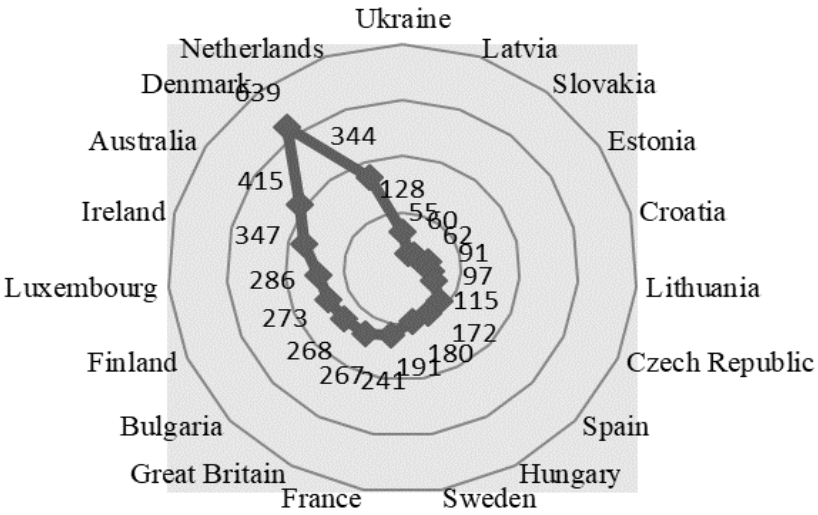
Image 11: Socio-economic results of land use of agricultural enterprises in Ukraine, on average for 2019-2020



Source: calculated by the authors according to data (The world bank group, 2020)

Payment for the lease of agricultural land in Ukraine depends on the lease term. In the country, the amount of rent is determined as a percentage of the regulatory monetary value of arable land, which for the period 2000-2020 has increased almost by 6 times. At the same time, an increase in the number of leased lands by 1% increases the rent by 3.5%. Image 12 presents a comparison of the average amount of rent for agricultural land paid by producers in Ukraine and European countries.

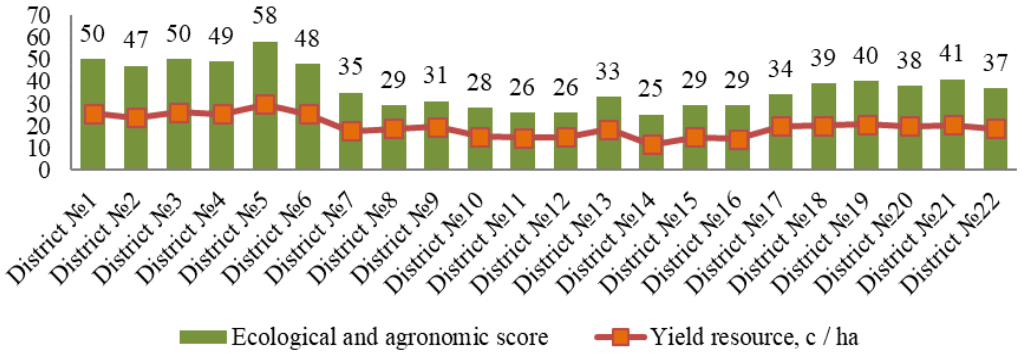
Image 12: The average amount of payment for the lease of agricultural land in some EU countries and Ukraine in 2020, USD/ha



Source: calculated by the authors according to data (The world bank group, 2020)

In order to assess in detail the ecological and agrochemical condition of the soil cover of agricultural lands, the qualitative condition of lands for one region in Polissya, Forest-Steppe and Steppe natural-climatic zones of Ukraine was studied. Thus, the ecological and agrochemical condition of the soil cover of agricultural lands in one region of the Steppe zone is 38 points, arable land – 39 points, in the Forest-Steppe zone – 51 points, Polissya zone – 30 points (Image 13). The analysis of economic activity of agricultural enterprises of Ukraine, grouped by natural and climatic zones proves that crops grown on lands with different scores react differently to material costs, so the same costs on different fertility soils give different results.

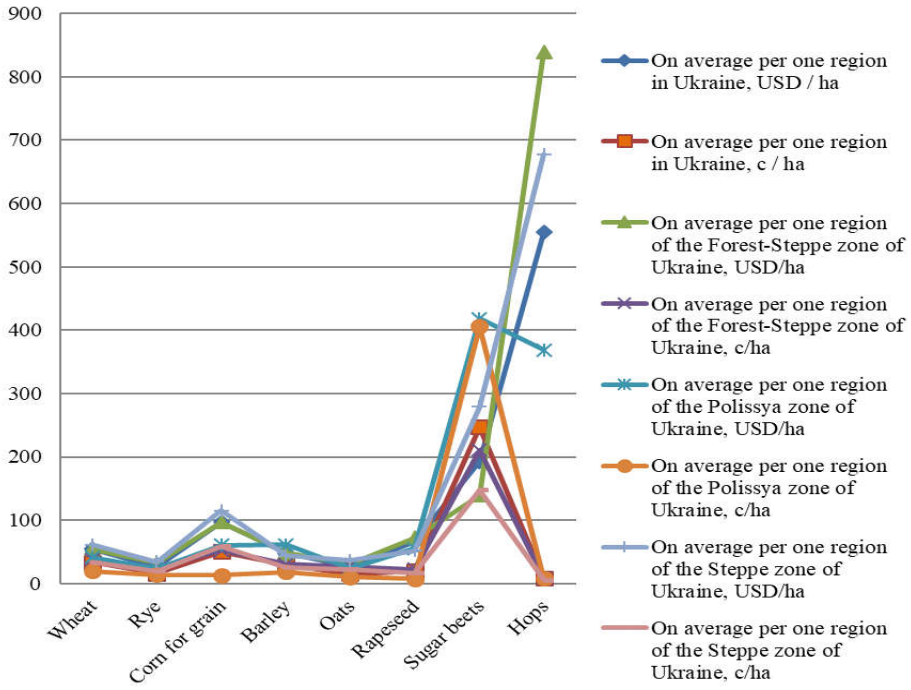
Image 13: Assessment of ecological and agrochemical condition of the soil cover of agricultural lands by districts per region of the Steppe natural and climatic zone of Ukraine, 2020



Source: calculated by the authors according to data (The State of the world's land…, 2016)

In particular, the production of corn for grain per 1 USD of material costs in Polissya, with an average land quality 30 points by 2.5 times lower than in the Forest-Steppe (land quality 51 points) and by 1.9 times lower than in the Steppe zone (land quality 39 points), rapeseed – by 2.4 times, wheat – by 1.5 tames (in comparison with the Forest-Steppe zone), oats – by 1.4 and by 1.6 tames (in comparison with Forest-Steppe and Steppe zones, respectively) (Image 14).

Image 14: Material costs and yields of crops by natural and climatic zones of Ukraine in 2020



Source: calculated by the authors according to data (State Statistics Service…, 2020)

The effect of the scale of vertically integrated use of agricultural land resource potential of agricultural holdings is presented in Table 4. The analysis of economic activity of agroholdings showed that their specifics of land use, along with advantages, have certain shortcomings in ecological and social spheres. First, when researching agricultural holdings and enterprises of the traditional type, one should take into account such a feature as the place of registration and payment of taxes. A significant number of agricultural holdings are not registered at the place of business, and in many cases, they are registered even outside Ukraine.

Table 4. Efficiency of use of land resource potential of agricultural use by agricultural holdings in Ukraine, 2020

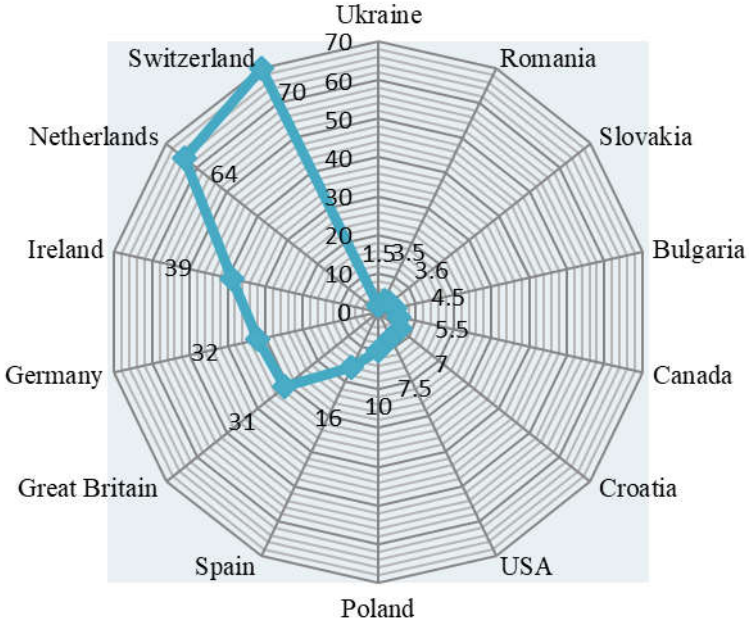
Companies	Sales revenue, million USD	Income per 100 hectares of agricultural land, thousand USD	Profit per 100 hectares of agricultural land, thousand USD
PAEAgrofirm “Svitanok”	12.63	43.56	31.58
LLC “A.T.K.”	8.35	42.81	25.68
LLC Bakhmut Agrarian Union	2.89	147.52	23.0
LLC Myronivsky Khliboprodukt	62.58	94.61	20.85
Kernel Group of Companies	38.58	143.11	17.78
Group of Companies “Mriya”	42.3	36.30	17.62
LLC Astarta-Kyiv	30.58	37.08	13.30
PJSC “TAKO”	4.49	24.06	12.83
Ukrlandfarming plc	60.90	42.89	12.73
Group of Companies “Ovostar Junior”	2.62	46.97	11.42
LLC JC “Nibulon”	7.25	610.88	10.36
LLC Agro Oven	1.56	126.70	9.16
Agricultural firm “Gardens of Ukraine”	1.73	18.76	4.32
LLC “Green Valley”	1.25	242.98	4.15
LLC “Agro-Trade company”	1.68	121.77	3.73
LLC “UkrAgroCom”	1.56	13.38	2.47
LLC “Agro-Union”	0.27	55.56	2.26

Companies	Sales revenue, million USD	Income per 100 hectares of agricultural land, thousand USD	Profit per 100 hectares of agricultural land, thousand USD
PJSC "Ukrzernoprom"	2.16	10.38	2.25
JC "Nafkom-Agro"	2.45	2.49	1.23
LLC "Loture"	0.77	5.65	0.76
LLC "Avias-2000"	0.13	4.78	0.16

Source: calculated by the authors according to data (The largest agricultural holdings…, 2020)

For example, PJSC "UkrlandFarming" is registered in Cyprus, NCH Capital (Nev Century Holding) – in the USA, PJSC "Myronivsky Hliboproduct" – Luxembourg (Yasinetska 2016, 127-131; Pleshanova and Yalyalieva 2019, 29-39). Secondly, the negative consequences of agricultural holdings in the social context are low employment of the rural population, the shift method of economic activity, the payment of taxes at the place of registration, rather than the in region of economic activity. It has been established that the land holding in agricultural holdings is 4.2 times lower than the average in Ukraine, due to specialization in crop production. Image 15 shows the value of agricultural land in European countries. However, if the moratorium is lifted, the price of land in Ukraine may change significantly.

Image 15: The cost of agricultural land in Europe and Ukraine in 2020, thousand USD/ha



Source: calculated by the authors according to data (The State of the world's land…, 2016)

The results of the study show that there are two approaches to regulating the land market in the EU: one can be described as rigid, for example in Denmark, and the other as softer, for example in Germany. However, in all states, the priority in land matters belongs to farmers and the provision of national interests. The land policy of the EU countries is based on the European model of multifunctional agriculture, which is primarily characterized by the presence of small and medium-sized family farms, as well as cooperatives (Plantinga et al. 2002, 561-581). Analyzing the market turnover of land, it is necessary to note the developed market infrastructure of foreign countries, namely: banks, exchanges, auction firms, tender and tender commissions, brokerage offices and real estate organizations of authorized land management bodies, supervisory boards, consulting firms, marketing organizations, notarial institutions, insurance companies, information centers, mass media and advertising agencies, special educational institutions that train specialists to work in the land market system. The purpose of such structures is to protect the constitutional rights of landowners, increase the investment attractiveness of the agricultural sector, and prevent speculation on agricultural lands.

In the countries of the world, in particular in Europe, enough attentionis paid to land protection. Thus, more 5% agricultural lands are under the ecological protection of the state. In Belgium, Spain, Germany and France, specially authorized organizations regulate the

implementation of land protection measures at the legislative level. Reclamation works are carried out at the expense of the state and with financial assistance within the framework of the Common Agrarian Policy. Such countries as Bulgaria, Estonia, Latvia, Lithuania, Poland, Romania and Hungary have similar characteristics to Ukraine in the development of the land market. The evolution of private ownership of land took place through a consistent change in the forms of ownership of former cooperatives and state farms into market-type enterprises.

The variety of factors influencing the land resource potential of agricultural use in Ukraine indicates the complexity of causal links in the process of determining the negative impact of factors on agriculture, namely: imbalance between agricultural ecosystems (arable land, pastures and hayfields), forestry and fresh water; development of water and wind erosion of lands (according to experts, losses of agricultural products in agriculture from erosion reach 8-13 million tons of conventional grain units), which leads to economic and environmental losses in the amount of 11-13 billion USD (Mesel-Veseliak and Fedorov 2016, 18-22); excessive application of mineral fertilizers and reduction of organic fertilizers, which leads to losses of humus due to mineralization in the amount of 30-31 million tons, and this figure is equivalent to 310-320 million tons of organic fertilizers. Moreover, economic and environmental losses due to erosion reach 347.98 million USD (Ciaian and Swinnen 2006, 799-815); yields on re-saline soils (due to the use of poor-quality fresh water for irrigation and violation of scientifically sound irrigation regimes and agricultural techniques) tends to decrease, in particular grain crops – by 1.54-2.04 times; row crops – by 3.1-4.2 times, in open ground vegetable crops – by 5.2 tames (Lobunko 2015, 17-21; Gyulgyulyan and Bobojonov 2019, 121-134).

In order to analyze the impact of environmental factors on the efficiency of land resource use of agricultural potential in the natural and climatic zones of Ukraine, we propose to establish a relationship between economic and environmental indicators. According to the production function of the integrated indicator of ecological assessment of agricultural lands (formula 5-6), econometric modeling of the use of internal and external resources in the process of land price formation is carried out (Table 5). According to the linear regression data, the Pearson correlation coefficient (0.68) shows the average relationship, as well as the direct relationship between the studied indicators. In turn, the coefficient of determination (0.50) indicates that 50% cases of all changes in the indicators of the normative monetary valuation of a particular land plot are due to changes in the volume of organic fertilizers.

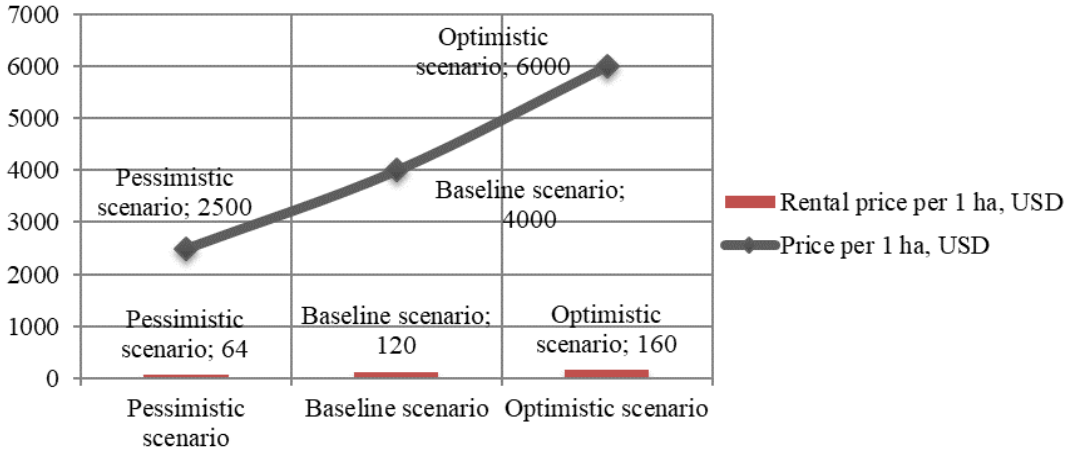
Table 5. Coefficients of ecological and economic component of normative monetary valuation of a separate land plot of agricultural use

Indicator	The values of the coefficients of the model		Correlation coefficient	Coefficient of determination
	a	b		
Ecological coefficient, units	1036.3	280.41	0.68	0.46
Destructive component, %	-7.0	7.56	-0.70	0.49
Application of organic fertilizers, t / ha	278.56	565.32	0.71	0.50
Application of min. fertilizers, kg / ha	3.094	391.88	0.69	0.48

Source: calculated by the authors

Linear regression shows (with probability 50%), that with the increase of organic fertilizers, the price of land will increase, as this improves the quality properties and fertility of the soil. In a more detailed analysis of the influence of these factors (except for less influential) on the change in the normative monetary valuation of an individual land plot, a linear multiple regression model is built. With the help of a modified method of determining the normative monetary valuation of land, a change value in the price of land in the state in the case of lifting the moratorium on the purchase and sale of agricultural land is predicted. The forecast scenario of the value of agricultural land in Ukraine under the condition of opening the land market is presented in Image 16.

Image 16: The forecast scenario of the value of agricultural land in Ukraine for 2021-2022



Source: calculated by the authors

4. Conclusions

Thus, according to the forecast in 2021-2022, the price of 1 hectare may be 6000 USD. However, when choosing a model for the formation of market turnover of agricultural land in Ukraine, it is necessary to take into account the indicators of supply and demand in the market of agricultural land, to protect the interests of producers and the country as a whole. Timely determination of the impact of environmental factors on the economic efficiency of agricultural production will allow in the control system of agricultural nature management to solve pressing environmental problems, as in modern conditions the state of the environment largely depends on providing agricultural producers with friendly environment (compliance with environmental and legal requirements at all stages of agricultural production). Thus, using the equation of dependence of environmental and economic indicators, it is possible to purposefully control the environmental status of agricultural production. In addition, for agricultural holdings it is proposed to establish the business purpose of each individual land plot in accordance with the results of ecological and economic assessment of agricultural land. This will identify factors that limit the development of crop production and develop a system of technological and management measures for the use of agricultural land, taking into account the available land resource potential of enterprises, the ecological condition of fertile land and the requirements of the agricultural market.

Thus, the studies of trends in the development of land and resource potential of agricultural use in the world in a multifunctional world economy have revealed significant reserves for improving the efficiency of land use. Significant reserves are in the use of untapped land resources. Increasing the resource segment in the agricultural sector of the economy will certainly contribute to the growth of commodity, financial segments, followed by a positive social effect. Overcoming the crisis and solving existing problems in the development of the global agricultural sector and the national economy is possible through innovation. The introduction of innovative developments will effectively transform agricultural production, stimulate small and medium-sized enterprises and, at the same time, ensure market entry, which is extremely important given the available land resources. These actions will help increase productivity, save various resources, reduce losses and food costs, increase volumes and efficiency of agricultural production.

The results of the introduction of land use innovations are reflected in the growth of capital and labor productivity, increasing the profitability of labor and other production and financial indicators of agricultural enterprises, as well as socio-economic development of rural areas. At the same time, the innovation process is significantly affected by: a wide range of agricultural products and products of its processing, differences in production technologies, a large time gap between the creation of new developments and their mass adaptation, which provides additional testing and reproduction, dependence on natural area and climate, seasonality of agricultural production. In addition, further development of land policy should

be planned in accordance with the strategy of innovative development, which includes: increasing the contribution of science and technology to the development of land use economy; ensuring progressive transformations in the field of material production; increasing the competitiveness of agricultural products on the world market; strengthening land use security.

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