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Factors influencing the effective use of land and resource potential in Ukrainian agricultural businesses

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Abstract. Ukrainian agrarian enterprises have significant land and resource potential, but effective use of this potential depends on many factors, the study of which is of current relevance. The purpose of the research is to develop an integrated approach to changing the process of effective use of land and resource potential and to find the main determinant of its reproduction in the post-war period of economic development of the country's agricultural sector. To achieve this purpose, mathematical tools and the income capitalisation method were applied. As a result of the study, it was established that increasing the area of land plots for growing crops that have been leased until 2025 would lead to an increase in their total size by 0.245 thousand ha in the structure of elements of reproduction and effective use of land and resource potential. Increasing



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the area of land of agricultural enterprises from the purchase (sale) of additional land plots will increase their value by 0.006 thousand ha, and enlarging the area of exchange land will increase by 0.377 thousand, which is a priority determinant in the structure of land and resource potential, and changes in emphyteusis will increase the total area of land plots by 0.347 thousand ha in the potential of enterprises. Thus, 97% of the variability of the area of agricultural land in the domestic market circulation will occur due to changes in the above-mentioned elements of the land determinant, which will provide for the effective use of the land and resource potential of agricultural enterprises until 2025 and augment the volume of production. The study of factors influencing the effective use of the land potential of Ukrainian agrarian enterprises has significant practical importance, as it allows identifying key factors that affect the success of agrarian enterprises, which can help them improve their strategy and find ways to improve productivity

Keywords: agricultural land; reproduction; economic development; monopolistic establishments; transactional circulation

INTRODUCTION

The beginning of transformational changes in the Ukrainian economy in the post-war period is associated with various models of a competitive economic system development, which puts forward one of the key conditions for the stable development of agricultural production – ensuring the highest and most efficient level of resource use. At this stage, the institutionalisation of agricultural production should be based on the rights of autonomous use of the land and resource potential of agricultural enterprises, which before the war period was ensured by regulators of land relations related to clear processes of land use, ownership and disposal of land resources. Due to the moratorium on buying and selling, the agricultural land market in Ukraine does not perform important functions – determining the real value of land plots and harmonising interests between the state and agricultural enterprises when changing the land infrastructure, stimulating alternatives for the effective use of resources in a competitive economic environment.

Underestimation of radical changes in land relations regarding the development of the agricultural land market can have unpredictable adverse socio-economic and environmental consequences for the country and its regions. This problem is actualised by the scale of reproduction of the land resource potential in those temporarily occupied regions, where the integral mechanism of the agrarian economy of Ukraine is broken, where the principles of effective development of agricultural enterprises are not ensured by a system of protection of the rights and legitimate interests of the owners of agricultural land plots, where business processes are distorted, land raiding and fraud are performed.

According to an integral approach, the land resource potential is a complex of natural and social development, which is characterised by the features of spatial and integral use of resources that are objects of economic activity, means of production, placement of productive forces in a specific territory, with certain environmental conditions that level loss of functioning of agricultural enterprises (Kaminetska, 2017). The land

and resource potential of agricultural enterprises during the production process transforms input elements (factors of production) into outputs (products), which, under the influence of the forces of nature, require time for their implementation. Accordingly, the static elements involved in the process of reproduction of the material component of the potential, as the final result of the activity of agricultural enterprises, are provided with additional value (price) of their production stocks to increase the level of efficiency in using land and resource potential (Kovalchuk & Khintsinska, 2012).

Methodologically, the connection between the input and output elements of the land and resource potential is described by the production function, which is an economic-mathematical model of analysis and forecasting of the level of its effective use. The production function, when changing the technology of agricultural production, leads to the transformation of the total value of the land and resource potential. This change is more elastic in the long-term than in the short-term and a specific combination of input elements of the land and resource potential ensures an increase in the volume of production if only two main input elements are used in the land resource potential: labour and capital. The determinant of the production function of the effective use of the land and resource potential in agricultural production is agricultural land, as a direct factor in the production of plant products and as a spatial resource that requires natural and artificial reproduction of soil fertility through the introduction of innovative technologies (Buiak & Pryshliak, 2018).

Since agricultural land depends on the quality of the soil, plant productivity, and technical and technological properties of agriculture, therefore, a specific determinant of the effective use of land and resource potential in agricultural production is the entrepreneurial ability of human capital (Kutsmus, 2017). The systematic approach allows determining the effectiveness of using the land and resource potential of agricultural enterprises due to the influence of ecological elements and to expand its production function (Schulte *et al.*, 2014).

The priority of the research is the development of an integrated approach to changing the process of effective use of the land and resource potential of agricultural enterprises in the conditions of dangerous impulses of loss of the balanced structure of its developing elements and determining the priority determinant of its reproduction through the circulation of agricultural land in the post-war period of economic development of the country's agriculture.

MATERIALS AND METHODS

To calculate the normative monetary valuation of agricultural land, the amount of absolute rental income, equivalent to 2 centners of grain from 1 ha ($A_{ri}=2h$) is used. The assessment of agricultural land is determined by the following formulas (Primdahl et al., 2013; Koshel, 2015):

$$A_{al} = (D_{ri} + A_{ri}) \times T_{cap}^{D_{ri}}, \quad (1)$$

$$M_{ca} = (D_{ri} + A_{ri}) \times P_r \times T_{cap}^{D_{ri}}, \quad (2)$$

$$M_{vlag} = \sum(M_{ca} \times A_{lg}^{ag}) \div \sum A_{lg}^{ag}, \quad (3)$$

where, A_{al} – assessment of agricultural land, centner; D_{ri} – absolute rental income, centner; $T_{cap}^{D_{ri}}$ – term of capitalisation (differential rental income), years; M_{ca} – conditional

assessment of 1 ha of agricultural land of a certain group, USD; M_{vlag} – monetary value of the land plot, USD; A_{lg}^{ag} – the area of agricultural lands of a certain group.

Accordingly, requirements are set for a certain group of agricultural lands regarding the terms of their purchase and sale, with a ban on changing the intended purpose and alienating them for public needs or public necessity. Therewith, the establishment of a minimum lease term for land plots and an increase in the amount of land rent should not be a biased measure regarding using agricultural land according to the time of its operation, during which it can be cultivated to support the economically active part of agricultural enterprises and the effective use of land and resource potential (Kozlovskiy et al., 2019). In the context of increasing the size of the land and resource potential of agricultural enterprises and its effective use, the circulation of agricultural land is introduced, which occurs based on a functional market formed by solvent buyers in the general land infrastructure, which regulates the socio-economic motives of the population (potential sellers of their land plots), according to the differential parameters of equally weighted land plot pricing (Fig. 1). The price determinants that influence the development of the value of agricultural land are listed in Table 1.

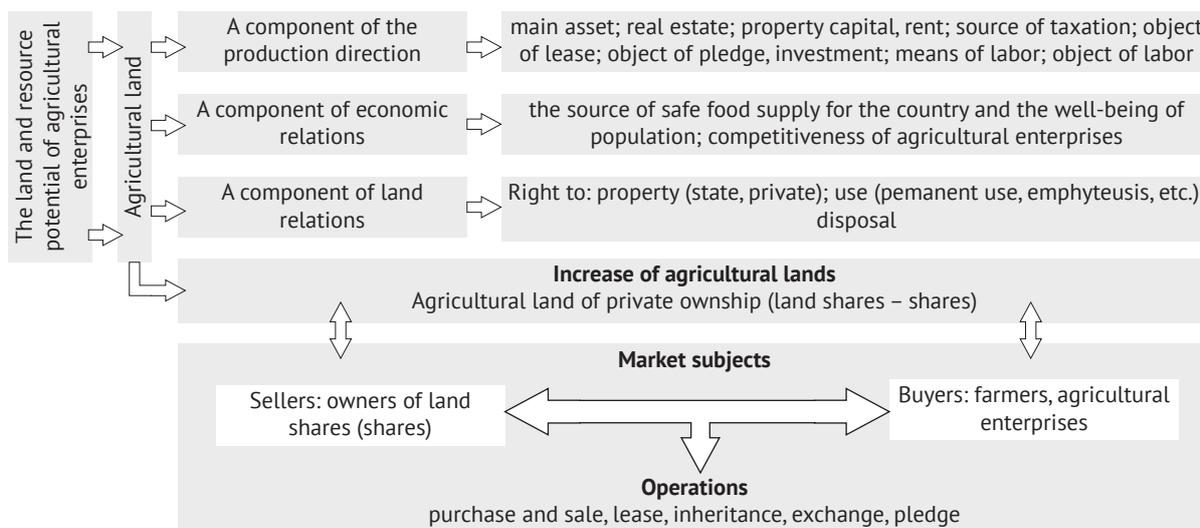


Figure 1. Targeting the effective use of the land and resource potential of agricultural enterprises

Table 1. Price determinants of influence on the development of the value of agricultural land plots

| Factors | Description |
|--|---|
| Bank rate of interest | The higher the bank interest rate, the lower the price of agricultural land, and vice versa. A bank loan for the purchase of land becomes profitable at low interest rates. |
| Future crop yields | The higher the quality of agricultural land, the higher the yield. The price of agricultural land at the time of its purchase and sale increases, provided that the yield growth of strategic agricultural crops is forecast. |
| Projected prices for products that will be grown in the future | Both internal (possible price support for strategic agricultural crops by the government and legislation of the country) and external (the possibility of free purchase and sale of agricultural land by foreign legal entities, the possibility of introducing free pricing of agricultural products in the country, considering the state of world markets) factors are considered. |

market determinant (Trusova *et al.*, 2021). However, the conditions of martial law in Ukraine weakened the resource and market opportunities of agricultural enterprises and reduced the scale of reproduction of their land and resource potential. Such a situation requires quick action to protect regulatory instruments in agricultural land relations and restore them to the post-war period. Regulating tools are subordinated to the sole purpose of agricultural enterprises – to reproduce, based on lease rights, the effective use of agricultural land as a powerful resource and production complex and, in the future, to be full participants in the process of pricing in the circulation of agricultural land for its intended purpose of their exploitation in the general infrastructure of the country's land fund.

The rapid damage assessment methodology from the World Bank and the Food and Agriculture Organisation of

the United Nations (FAO) allowed assessing the scale of losses of the land and resource potential of agricultural enterprises of Ukraine, which were directly affected by the active hostilities of the aggressor country. The damaged infrastructure of the land and resource potential is divided into two territories: the first, which was under occupation but was liberated (Kyiv, Sumy, Chernihiv, and Mykolaiv regions); the second – the territory that suffered from active hostilities and (or) occupied by the aggressor country (Kharkiv, Donetsk, Luhansk, Kherson and Zaporizhzhia regions). Thus, during the 9 months of 2022 of the full-scale military invasion of the aggressor country on the territory of Ukraine, the largest losses in the structure of the land and resource potential of agricultural enterprises occurred due to the destruction or partial damage of agricultural lands and failure to harvest – 2.135 million USD, (Table 2, Fig. 2).

Table 2. The scale of losses of the land and resource potential of agricultural enterprises of Ukraine due to the military invasion of the aggressor country in 2022

| Category | Total losses, million USD |
|--|---------------------------|
| Agricultural lands and the unharvested harvest of grain crops | 2.135 |
| Agricultural machinery and equipment | 926.1 |
| Warehouses | 272.4 |
| Animal husbandry | 136.4 |
| Perennial plantations | 89.1 |
| Production stocks (fuel, fertilizer, plant and animal protection products) | 119.6 |
| Agricultural products in storage | 613 |
| In total | 4292.3 |

Source: compiled by the authors

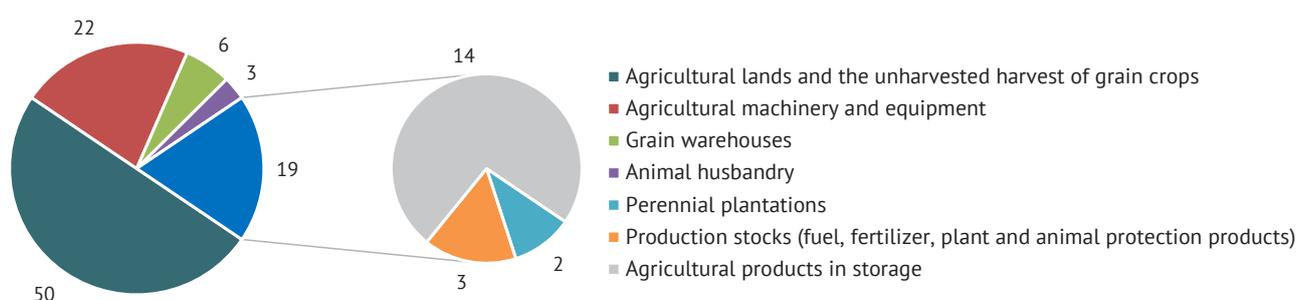


Figure 2. Losses in the structure of elements of the land and resource potential of agricultural enterprises of Ukraine due to the military invasion of the aggressor country in 2022, %

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine's agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022)

Agricultural land has suffered two significant types of damage – mine contamination and direct physical damage. Territories affected by active hostilities are contaminated with unexploded ordnance and unsuitable for agriculture. This poses a mortal threat to Ukrainian farmers and a high risk of field work. The cost of surveying these land plots in Ukraine is estimated at 436 million USD. As a result of physical damage to

the fertile soil layer (funnels from artillery shelling and missile strikes, soil damage by tank tracks or other military equipment), agricultural lands require technological restoration (reclamation and levelling of the surface) and is estimated at 39.6 million USD. The estimated cost of replacing and repairing the damaged irrigation infrastructure is 225 million USD. In addition to the direct damage to agricultural lands (occupation,

military operations, and mine damage), small and medium-sized agribusiness entities do not have full access to fields with the possibility of harvesting – approximately 2.4 million hectares of winter crops have been lost, in total worth 1.435 billion USD. Accordingly, in 2022, agricultural enterprises sowed only 75% areas of agricultural land from the total amount of agricultural land in 2021 (Agriculture during the..., 2022).

The material and technical component of the land and resource potential of agricultural enterprises (agricultural machinery and equipment) was also damaged as a result of shelling, airstrikes and hostilities. Tractors and trucks have a higher risk of damage than other types of farm equipment such as combines, planters and sprayers. In the occupied and temporarily uncontrolled territory of Ukraine, agricultural machinery of the highest price category is at risk of theft. The estimated cost of restoring damaged machinery is 926.1 million USD. The aggressor country purposefully destroys elevator capacities to weaken the Ukrainian agricultural sector. Thus, if storage facilities (barns) are relatively inexpensive to repair (average cost is 50-130 USD per ton of storage), then reconstruction of damaged modern concrete and metal silos requires restoration costs up to 250 USD per ton. The estimated volume of warehouses that were partially or completely damaged is 3.9 million tons. The total amount of losses due to damage or destruction of grain storages amounted to 272 million USD (Overview of war damage..., 2022).

The estimated value of the dead animals is more than 136 million USD. The approximate number of animals that died due to the lack of feed and veterinary services in the affected regions of Ukraine is 42

thousand sheep and goats, 92 thousand cattle, 258 thousand pigs and over 5.7 thousand poultry heads. More than 7.8 thousand hectares of perennial plantations located in the affected territories of Ukraine were partially or completely destroyed. The cost of damaged plantations is estimated at 89.1 million USD. In the occupied territories of Ukraine, the total amount of losses from damage and theft of material stocks of agricultural enterprises (physically damaged and lost fertilizers and means of protection of plants and animals; fuel lost due to looting), which ensured the production structure of their land and resource potential, is equal to 120 million USD (The impact of the war..., 2022).

In 2022, the Food and Agricultural Organisation of the United Nations provided financial assistance to restore the land and resource potential of medium and small agricultural enterprises of Ukraine in the amount of 2.4 million USD. The funds were used to restore material stocks (seeds of vegetables, potatoes and grain crops) for the 2023 harvest, and the purchase of special equipment for storage and protection of the crop; 3.605 million USD was spent on the modernisation of phytosanitary and veterinary laboratories. In general, in Ukraine in 2022, almost a quarter of the agricultural sector was lost – direct losses amount to 6.6 billion USD, indirect losses – 34.5 billion USD. It is considered in more detail the size and structural elements of the land and resource potential of agricultural enterprises of Ukraine in the pre-war and post-war periods. Thus, in 2021-2022, the number of active agricultural enterprises in Ukraine decreased from 47.34 thousand units up to 38.01 thousand units, which is only 80.3% from the level of 2021; in general, for 2017-2022, their number decreased by 11.6% (Fig. 3).

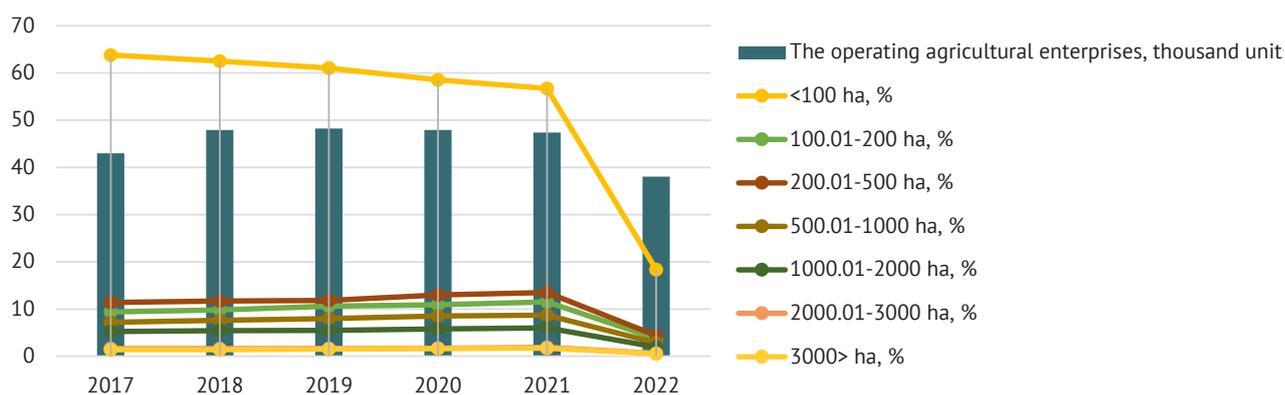


Figure 3. Structure of operating agricultural enterprises in Ukraine in 2017-2022

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine's agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskaya (2022)

Until the post-war period (2017-2021), the area of agricultural land in Ukraine, including the area of leased land plots that were cultivated by agricultural enterprises and developed the foundation of their land and resource potential, increased by 2.6%. However, due to the occupation of the Southern regions

of Ukraine by the aggressor country, in 2022 their share decreased in relation to the level of 2021 by 29% (Fig. 4). The yield of grain crops and sunflower is the main raw material component of the land and resource potential of agricultural enterprises of Ukraine (Fig. 5).

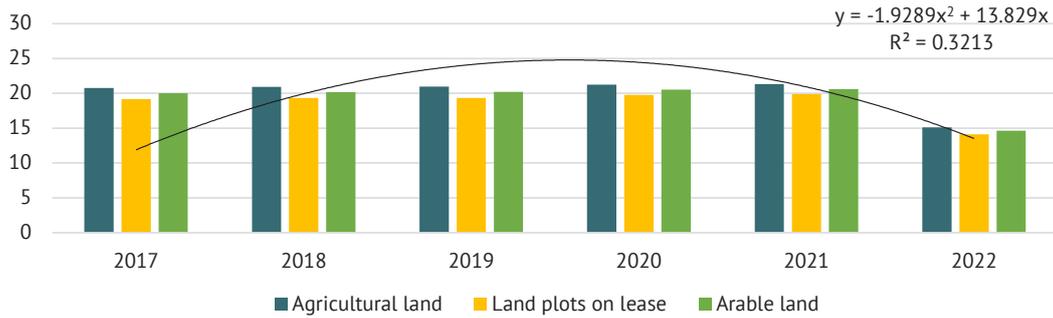


Figure 4. Area of agricultural land cultivated by agricultural enterprises of Ukraine for 2017-2022, million ha
Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine’s agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskva (2022)

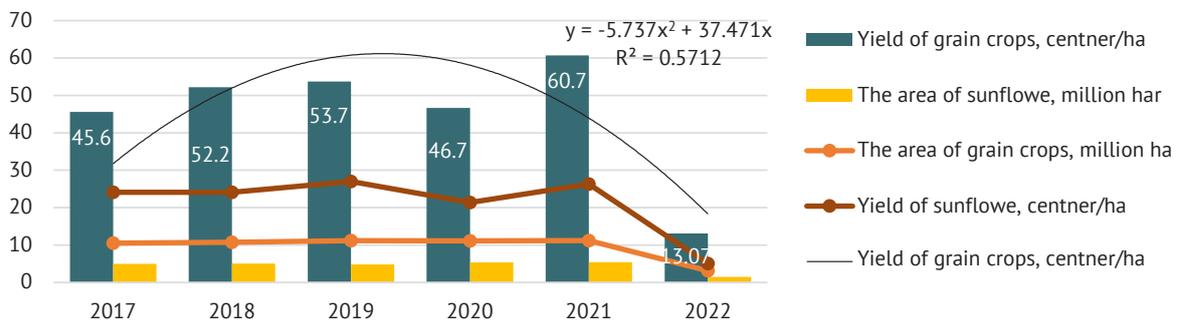


Figure 5. Correlation between harvested area and yield of priority crops of agricultural production in agricultural enterprises of Ukraine for 2017-2022

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine’s agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskva (2022)

In 2017-2021, the yield of grain crops increased by 33.1%, sunflower – by 9.2%, the same time, in 2022, almost 12 million hectares of arable land were lost due to military actions and the occupation of the Southern regions of Ukraine. For these reasons, agricultural enterprises did not receive 78.5% of the

harvest of grain crops and 80.8% of the harvest of sunflowers. An important component of the land and resource potential in agricultural production of agricultural enterprises is fixed assets, the level of renewal of which increased from 13.3% to 15.2% in 2017-2021 (Fig. 6).

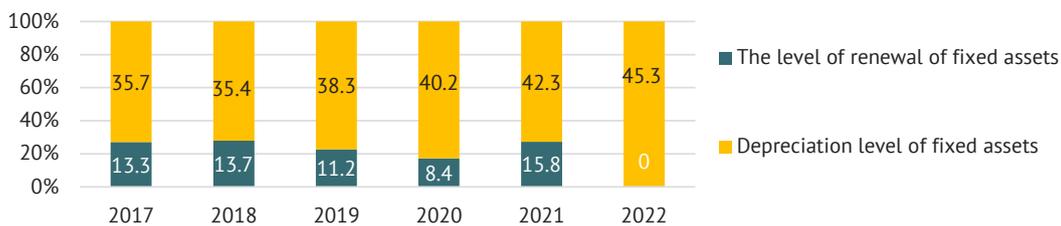


Figure 6. The level of renewal and depreciation of fixed assets in the field of agricultural production in agricultural enterprises of Ukraine for 2017-2022, %

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine’s agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskva (2022)

During 2017-2022, significant fluctuations in the poultry population of all species were observed in agricultural enterprises of Ukraine, which number decreased by 5.2% due to hostilities in the territory of the

Southern regions (Fig. 7). During the research period, a dynamic reduction in the number of cattle (including cows), sheep, and goats was observed at agricultural enterprises in Ukraine (Fig. 8).

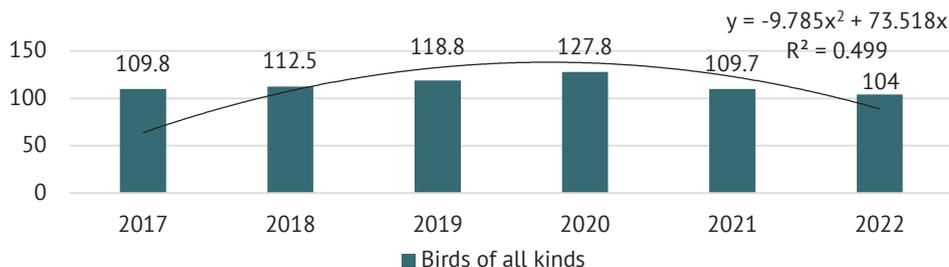


Figure 7. Poultry population of all types in agricultural enterprises of Ukraine for 2015-2021 and the third quarter of 2022, million heads

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine’s agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskva (2022)

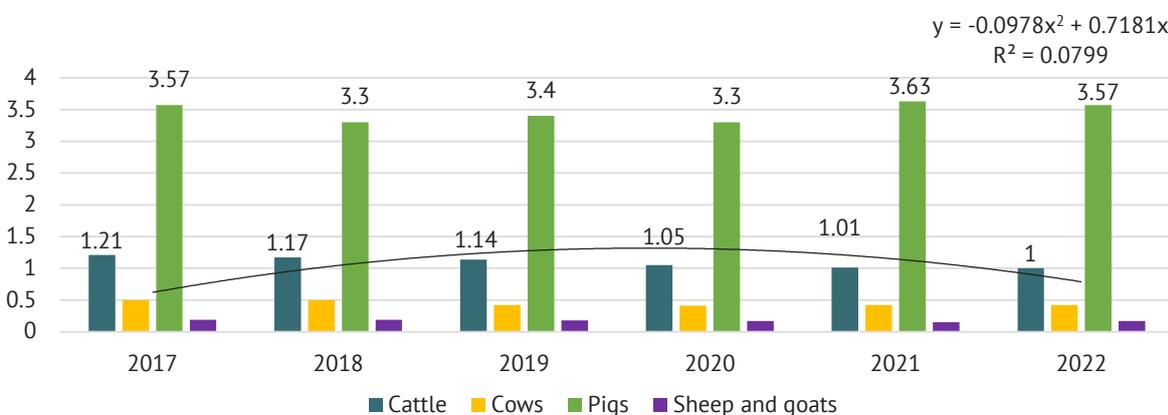


Figure 8. Livestock of all species in agricultural enterprises of Ukraine for 2017-2022, million heads

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine’s agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskva (2022)

The quality of the balanced fodder ration of animals and the proper conditions of their keeping has a significant impact on livestock productivity. The volume

of feed costs per conventional head in agricultural enterprises of Ukraine for 2017-2021 increased by 9%, (Fig. 9).

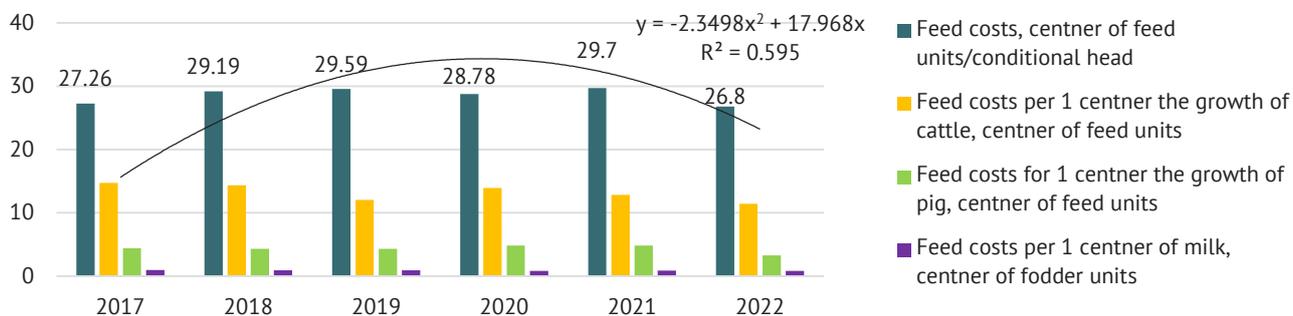


Figure 9. Feed costs for keeping animals and output of livestock products in agricultural enterprises of Ukraine for 2017-2022

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine’s agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskva (2022)

Thus, during the research period, on average, from 14.74 centner to 12.84 centner of fodder units were spent on 1 centner of cattle growth in agricultural enterprises; for 1 centner of gain of pigs – from 4.41 centner to 3.29 centner of fodder units; for 1 centner of milk – from 0.97 to 0.84 centner of fodder units. The consumption of fodder for feeding animals for 2017-2021 is due, first of all, to a decrease in their number by 200 thousand heads. Meanwhile, in 2022, the volume of feed costs per 1 centner of cattle growth decreased by 11.1%, compared to the level of 2021, as a result of the death of animals

(10 thousand heads), as a result of hostilities in the territory of Ukraine, and due to the reduction of the area of agricultural land for the production of fodder base (physical damage to the fertile soil layer of land plots by the aggressor country). The adverse consequences of Russia's military aggression affected the slowdown in the increase in the productive capacity of animals in agricultural enterprises of Ukraine (Fig. 10).

The dynamics of the volume of production of certain types of animal husbandry products in agricultural enterprises of Ukraine is presented in Figure 11.



Figure 10. Productive capacity of animals in agricultural enterprises of Ukraine for 2017-2022, kg

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine's agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskaya (2022)

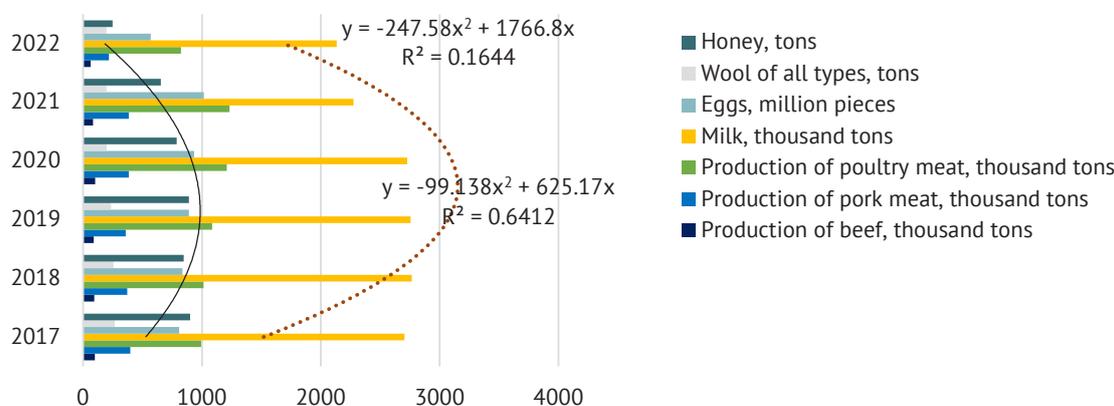


Figure 11. Production of livestock products in agricultural enterprises of Ukraine for 2015-2021 and the third quarter of 2022

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine's agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskaya (2022)

Thus, the volume of beef production in 2017-2022 decreased by 36.7%, pork – by 45.2%, poultry – by 17.1%, eggs – by 29.4%, milk – by 26%, honey – by 72.6%. Only during the year of the full-scale war in Ukraine, the production determinant of the land and resource potential of agricultural enterprises in the field of animal husbandry, in relation to the level of 2021, suffered large losses.

Products were not received in the following proportion: beef meat – for 25.9%, pork – for 43.5%, poultry – for 33.2%, eggs – for 44.1%, milk – for 6.3%, honey – for 62.3%. In the structure of the land and resource potential of agricultural enterprises of Ukraine, the determining lever of labor productivity of economically active human resources had a catastrophically weakened influence (Fig. 12).

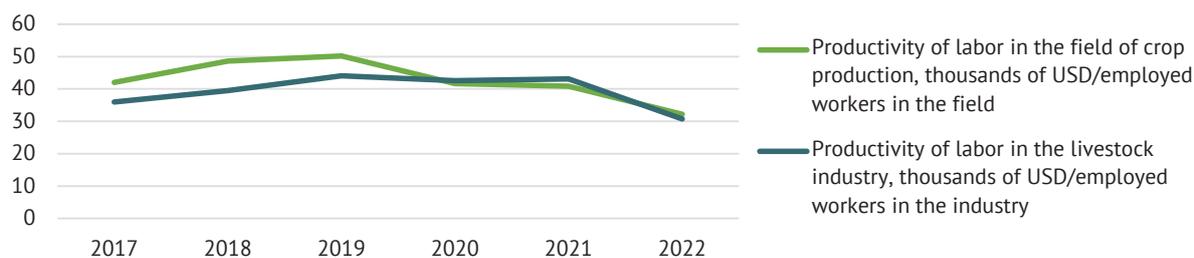


Figure 12. Labor productivity in agricultural sectors of Ukraine for 2017-2022

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine's agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskya (2022)

Due to the military conflict, which weakened the state of economic development of the regions of the country, the number of full-time workers in agriculture, with the dynamics of their annual reduction in agricultural production, for the period 2017-2021, led to a decrease in labour productivity in the field of crop production by 23.4%, in the field of animal husbandry – to 14.5% в 2022 p. in 2022. However, with an intensive decrease in the efficiency of using economically active human resources in agriculture, in 2021 the average nominal salary of a full-time employee at Ukrainian

enterprises amounted to 634.6 USD, which is 2.7 times higher than the minimum wage (236.4 USD). Among the regions of Ukraine in 2021, full-time employees of agricultural enterprises in Mykolaiv region got – 669.6 USD and Kyiv region – 633.1 USD (the highest salary level); the least salary was valued in the Kirovohrad region – 484.8 USD. The size of the average nominal wage in the agricultural sector was 583.34 USD. In 2022, it increased from the level of 2021 by 22.2%, and compared to 2020 – by 23.1%. In general, wages in agricultural sectors for 2020-2021 increased by 48% (Fig. 13).

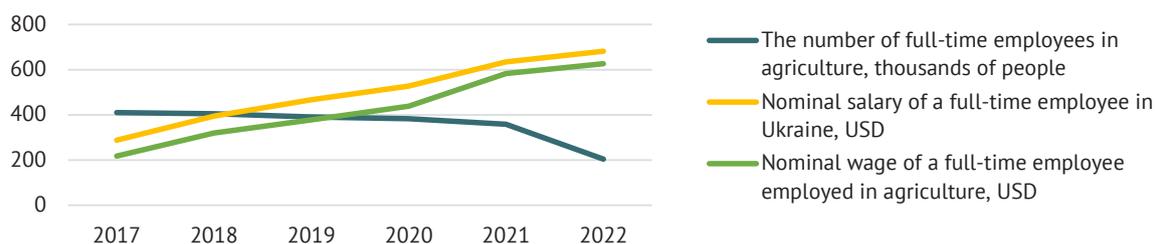


Figure 13. Dynamics of the number of full-time workers and the level of average nominal wages in the agriculture of Ukraine for 2017-2022

Source: Agriculture during the war: Changing priorities (2022), Overview of war damage in Ukraine's agriculture (2022), The impact of the war on agriculture: The UN presented an assessment of the urgent needs of the agricultural sector and the rural population (2022), O.A. Vyshnevskya (2022)

Since the beginning of 2022, the average amount of payment in relation to the level of 2021 has increased by 7.4% and amounted to 681.6 USD. The recession of the economy during 2022, caused by the military aggression of the terrorist country, led to stagnation and suspension of wage growth in all spheres of agricultural activity.

Based on the downward dynamics of the development of the structural elements of the land and resource potential in the agricultural production of agricultural enterprises of Ukraine, the discrete Dirac delta function $\delta(x)$, was used, which made it possible to determine the impulse of the danger of fluctuations of its indicators, causing the probability of losing the effective use of land and resource determinants. According to the power averages, the impulse fluctuation of

the indicators, with an adverse decrease in their level, is determined as the sum of a large number of separate numerical values subject to the law of distribution of the discretionary value $M(x)$ and dispersion σ , subject to the individual random values of the following elements, as: areas of agricultural land, yields of crops, the productive capacity of animals, level of renewal and wear of fixed assets, level of feed costs per 1 centner of increase in animals and milk, and index of increase in average nominal wages of economically active human resources in agriculture. The probability of loss of efficiency in using land and resource potential in agricultural production in the presence of pulse fluctuations of its indicators and an adverse decline in their level is calculated using the following integral function (Phillips & Joao, 2017; Randolph, 2003).

$$\delta(x) = 0 \text{ for } x \neq 0$$

$$LRP_{loss}^{ef} = \int_{-\infty}^{\infty} \delta(x) \omega_i HRO_i = \sqrt{\sum_{i=1}^n (\omega_i \times HRO_i + \varepsilon_i)^2} / n_i \rightarrow \min, \tag{9}$$

where, LRP_{loss}^{ef} – the probability of the level of loss of efficiency in the use of land and resource potential of agricultural enterprises in the presence of a negative impulse of fluctuation of the n -th number of indicators during the study period; ω_i – the level of fluctuation of the i -th indicator of the effectiveness of using land and resource potential during the study period; HRO_i – change in the value of the i -th indicator, which has an impulse of dangerous fluctuations of the land and resource potential during the study period; ε_i – danger pulse error; n_i – the number of indicators in the research period.

For indicators with a variation of the impulse fluctuation from 0.1 to 0.33, the weighting factor is set at the level of 2.64 (the probability of loss of efficiency in using land and resource potential is low), from 0.34 to 0.57-3.64 (the probability of loss of efficiency in using land and resource potential is medium-acceptable), from 0.58 to 0.8-5.52 (the probability of loss of efficiency in the use of land and resource potential critical-permissible), above 0.8-8 (the probability of losing the efficiency in using land and resource potential is critical). The calculation results are presented in Figures 14 and 15.

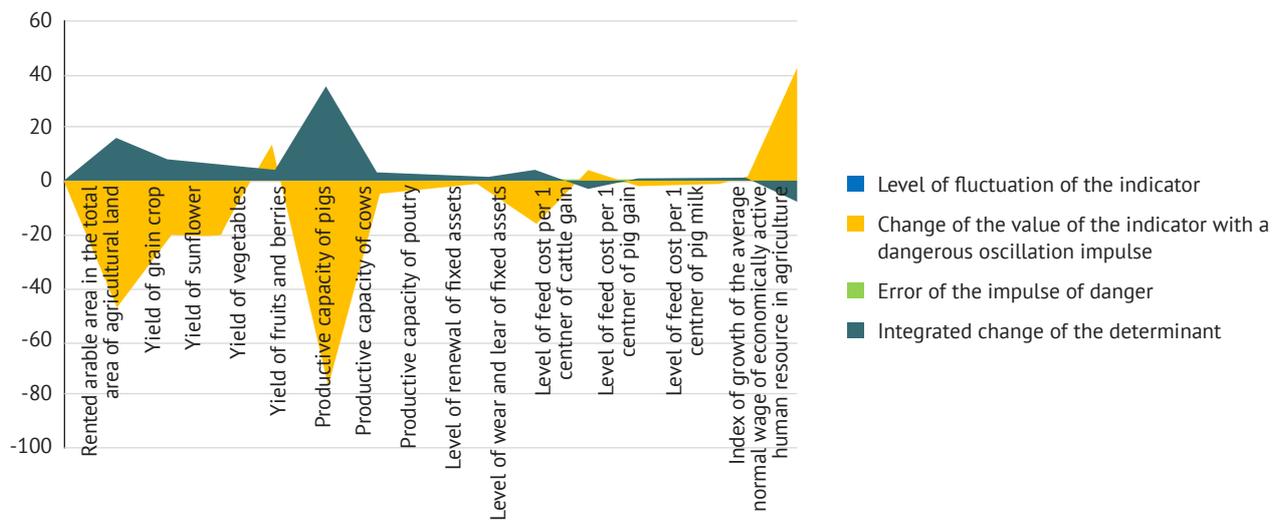


Figure 14. Impulse of adverse fluctuation of indicators causing the threat of loss of land and resource potential of agricultural enterprises of Ukraine in the period of martial law (2022)

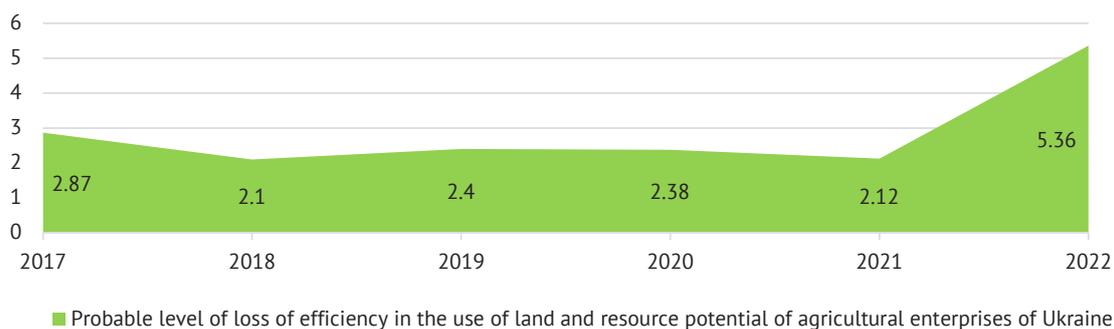


Figure 15. Probable level of loss of efficiency in the use of land and resource potential of agricultural enterprises of Ukraine for 2022

The established pulses of the danger of fluctuations in indicators of agricultural production of agricultural enterprises in the field of crop production in 2022 confirm that due to the occupation and hostilities in a significant territory of Ukraine, there was a reduction in agriculture. Leased arable land in the structure of agricultural land, in just one year of Russia's military aggression, suffered physical damage and decreased by

5.77 million hectares. It led to a decrease in the yield of grain crops by 47.7 centner/ha, sunflower – by 21.25 centner/ha, vegetables – by 18.52 centner/ha, fruits and berries – by 12.96 centner/ha. Accordingly, there is a real danger of losing the production capacity of agricultural enterprises for the effective use of land and resource potential in the field of crop production. It is evidenced by adverse changes in the integrated determinant in

the calculation indicators, a positive increase of which demonstrates the momentum of negative fluctuations of the indicator, an adverse value – the momentum of positive fluctuations. In the livestock industry of Ukraine in 2022, an even worse trend is observed than in crop production, since this industry is directly dependent on agricultural land and the technological capacities of agricultural enterprises, which suffered losses due to the occupation and hostilities in the territories of Kyiv, Sumy, Chernihiv, Mykolaiv, Kharkiv, Donetsk, Luhansk, Kherson and Zaporizhzhia regions of the country. Evidence of the adverse dynamics of the production of livestock products is the high momentum of the loss of resource and production capacities of agricultural enterprises. The integral change in the determinant of the productive capacity of cattle, cows, pigs, and poultry shows an increase in the value of indicators with a dangerous oscillation impulse, namely, by 73 kg, by 5 kg and 2 kg of average live weight and by 0.4 kg of milk yield (Fig. 14).

Due to the terrorist actions of the aggressor country, the area of agricultural land in the affected regions of Ukraine decreased by 6.19 million hectares. Accordingly, only in 2022, the level of feed consumption per 1 centner of increase in cattle decreased by 1.42 centner of feed units, pigs – by 1.55 centner of feed units, milk – by 0.05 centner of feed units. Therewith, the level of serviceability of fixed assets in agricultural enterprises of Ukraine has decreased by 3% due to the inability to update them during wartime (lack of budget funds under the programmes to support small and medium-sized agricultural businesses in the country planned for the beginning of 2022). Thus, in 2022, the probable level of loss of efficiency in using the land and resource potential of agricultural enterprises of Ukraine amounted to 5.36 and characterises the critical and acceptable limits for its recovery (Fig. 15).

In relation to 2021, the integral indicator has increased 2.5 times, which confirms the growing crisis in agricultural production of agricultural enterprises of Ukraine. Effective measures of an economic nature

are needed to level the threatening trends in the country's agriculture, which are capable of harmonizing the mechanism of land relations for targeted and timely restoration of the land and resource potential of economic entities. One of these mechanisms is the forecasting of scenarios for the development of the agricultural land market, to ensure the rational use, protection of land as a component of the natural environment, preservation, multiplication and reproduction of its productive power as a natural resource.

An optimistic scenario of the development of the agricultural land market provides consistent, qualified and free implementation of the right of ownership by landowners, attracting investments in the field of agriculture, increasing the level of effective use of the land and resource potential of agricultural enterprises. Implementation of such a scenario allow determining institutional restrictions, forms of interaction, and methods of harmonizing the interests of economic entities in the land market: lease conditions, restrictions on the area of purchase of agricultural land, transfer of land from one category to another and determination of cadastral value. The pessimistic scenario envisages the introduction of the free circulation of land without restrictions when active participants in transactions for the purchase of agricultural land plots are large agricultural enterprises that have more opportunities for effective use of land and resource potential. However, this can result in the development of monopoly ownership of agricultural land in the absence of legal protection of ownership rights to land plots of small and medium-sized agricultural enterprises. To determine the priority level of effective use of the land and resource potential of agricultural enterprises of Ukraine and the significance of its main determinant – agricultural land shortly, an analysis of the circulation of their structural elements (rent, purchase and sale, inheritance, exchange, emphyteusis and mortgage) was performed, according to transactional operations that were conducted before the war period (Fig. 16).



Figure 16. The structure of the transaction of elements of agricultural land in Ukraine for 2017-2021, %

Considering the extended period of martial law in Ukraine in 2023 and based on the method of exponential smoothing, the forecast values of the transaction turnover of agricultural land in Ukraine for 2024 were calculated, in particular, the area of land plots for the

production of crops, which were included in the calculation of the indicator of probable loss of the land and resource potential of agricultural enterprises due to the temporary occupation of the country's territories in 2023 (Fig. 17).

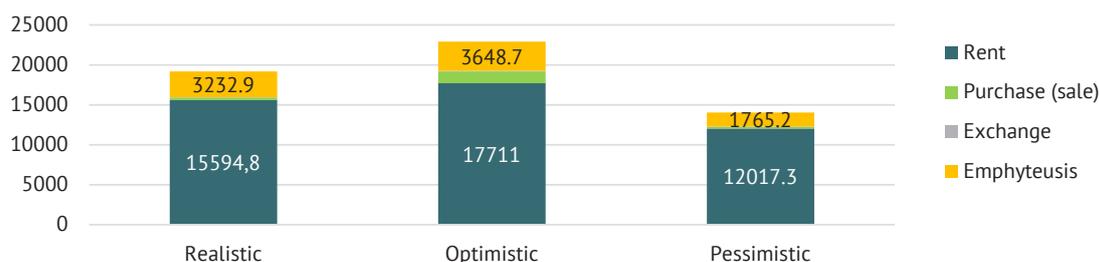


Figure 17. Forecast scenarios of the transactional circulation of agricultural land for reproduction and stabilisation of the land and resource potential of agricultural production entities of Ukraine for 2024, thousand hectares

Thus, according to the realistic scenario, a moderate increase in the number of transactions regarding the lease of land plots for the production of crops in the amount of 15594.8 thousand hectares is predicted, since the subjects of agricultural production in the domestic market will gradually exit the period of deoccupation of territories and recreate the priority determinant of the land and resource potential, with the annual growth of demand for Ukrainian products on foreign markets to the level of 2021. Such a scenario of events will gradually speed up operations to restore forward contracts for future harvests. In general, according to the scenario of realistic development, the area of land plots with which transactions will occur will increase to 19084.5 thousand hectares in 2024 (Meyers *et al.*, 2018).

According to the forecast of the optimistic scenario, in addition to the increase in transactions for the lease of land plots for the production of crops – up to 17711 thousand ha, there will be an increase in the turnover of agricultural land for emphyteusis – up to 3648.7 thousand ha and purchase (sale) agreements – up to 1466.3 thousand ha. It will be connected, first of all, with the stabilisation of the economic determinant of the land and resource potential of agricultural enterprises, secondly, with the ability to capitalise the land and material determinant for the reproduction of the livestock industry, due to the attraction of investments, thirdly, with the increase in the number of economically active human resources to revive the productivity of agricultural industries, reduce unemployment and population migration within rural areas (Levkina *et al.*, 2019).

According to the pessimistic scenario, the demand and price for agricultural land will decrease due to the inability to de-occupy the territory of Ukraine from the terrorist aggressor country, which will result in the loss of part of the elements of the circulation of land plots for purchase (sale) – up to 190.3 thousand hectares, a decrease emphyteusis transactions – up to 1765.2 thousand hectares and lease transactions – up to 12017.3 thousand hectares. In general, according to a pessimistic forecast, the total value of the priority determinant for transactional operations of building up the land and resource potential of agricultural enterprises will amount to only 14034 thousand hectares. To establish a model of reproduction of the land and

resource potential of agricultural enterprises up to the level of 2014, by introducing the determinants of the development of the internal market of agricultural land, a multiple regression model is proposed. Adequacy of the model is substantiated on the basis of Fisher's test scores. In its classic form, the multiple regression model, is depicted in the following formula (Kozmenko & Kuzmenko, 2014):

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m + \varepsilon, \quad (10)$$

where, Y – dependent (resultant) variable; $X = (X_1, X_2, \dots, X_m)$ – vector of independent explanatory (factor) variables; R – parameters of the multiple regression equation to be determined; ε – random error (deviation); β_0 – free coefficient that determines the value of (Y), if all explanatory variables X_i are equal to 0.

To establish a multiple regression model, a variable value was introduced, the dependent variable, the area of land plots for the production of agricultural crops in the circulation transaction is denoted by Y ; independent variables: X_1 – area of land plots leased; X_2 – area of sold land plots; X_3 – the area of land plots for which the emphyteusis right was registered. The value of the multiple correlation coefficient (index) $R=0.99$ indicates a close relationship between the model factors and the dependent variable (Y), in particular, the coefficient of determination – $R^2=0.98$. The significance of the multiple regression model, is assessed using Fisher's F-test. Since the actual value of the criterion is greater than the critical value, $F > F_{critical}$, the multiple regression equation is recognised as statistically significant (Kozmenko & Kuzmenko, 2014). Based on the results of the calculations, the multiple regression equation was obtained:

$$Y = 0.262 + 0.245X_1 + 0.006X_2 + 0.377X_3 + 0.347X_4. \quad (11)$$

Based on the regression model, the predictive value of the circulation of the area of land plots for the production of crops in the domestic market of Ukraine was calculated, as a priority determinant of the reproduction and effective use of the land and production potential of agricultural enterprises of Ukraine until 2025 (Fig. 18).

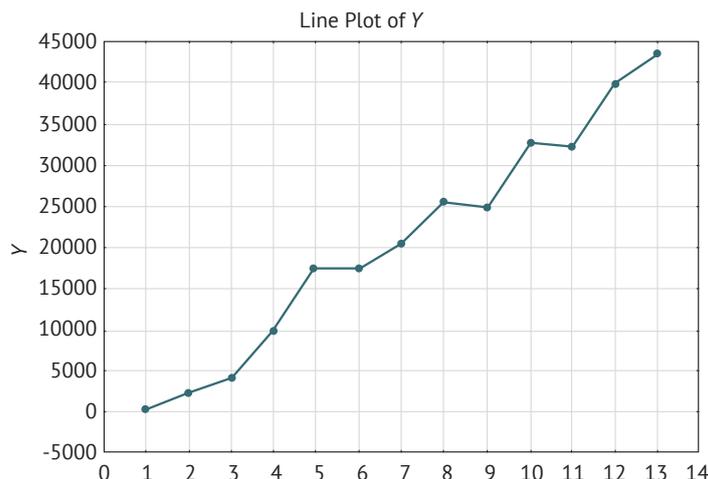


Figure 18. Estimated size of land plots for the production of agricultural crops for effective use of land resource potential of agricultural enterprises of Ukraine

Thus, the increase in the area of land plots for the production of crops, leased to agricultural enterprises until 2025 (based on 1 thousand hectares), will lead to an increase in their total size in the structure of the elements of reproduction and effective use of the land and resource potential by 0.245 thousand hectares; the increase in the land area of agricultural enterprises from the purchase (sale) of additional land plots will allow for increasing their value by 0.006 thousand ha; increasing the area of land for exchange with defined soil fertility criteria will increase by 0.377 thousand priority determinant in the structure of land resource potential; for emphyteusis changes, the total area of land plots in the potential of enterprises will increase by 0.347 thousand ha. Thus, 97% of the variability of the area of agricultural land in the circulation of the domestic market will occur due to the change of the above-mentioned elements of the land determinant, which will allow reproducing and effective using the land and resource potential of agricultural enterprises until 2025, and to increase the volume of produced products, which is demanded on the foreign market.

DISCUSSION

Land and resource potential is a complex of natural, technical, economic, and social factors that determine the opportunities for the effective use of land and other natural resources in a considering territory. Land and resource potential is the object of both commodity-money and land relations and is characterised by spatial limitations (Mander *et al.*, 2010). According to W.H. Meyers *et al.* (2018) various approaches and methods can be used to ensure the rational use of the land and resource potential of agricultural enterprises. For example, it is important to ensure the efficient use of land resources by applying rational methods of soil cultivation and modern land-use technologies, which can provide optimal land use, as confirmed by the research conducted (Meyers *et al.*, 2018).

In his research, J. Randolph notes that economic activity in rural areas is one of the key components of effective use of the land and resource potential in agricultural enterprises. An integrated approach to rural agriculture development is effective as it considers all aspects of economic, social, and ecological sustainability of agricultural production. Therefore, it is important to use modern technologies and innovations, improve employee qualifications, attract investments, and develop partnership relations with other enterprises, as reflected in the research conducted (Randolph *et al.*, 2003).

Thus, according to the results of J. Primdahl *et al.* (2013) research, the most effective strategy for rural agriculture development in rural areas is a comprehensive approach that involves using all possible resources of the territory and interaction between different industries and enterprises in rural areas. For this purpose, it is important to establish favourable conditions for the development of small and medium-sized enterprises and use various financing tools (Primdahl *et al.*, 2013).

The obtained data of the conducted research correlates with the results of R.P.O. Schulte, who believes that the development of the agricultural land market can have several scenarios designed to ensure rational use, conservation of land as a component of the environment, preservation, multiplication, and reproduction of its productive capacity as a natural resource. Several possible scenarios for the development of the agricultural land market include:

1. State-controlled land market: in this scenario, the state has full control over the land market and manages the land resources in accordance with the strategy for agricultural development and environmental purposes. The land market operates under state rules and mechanisms, ensuring efficient use of land resources and their protection:

2. Liberalised land market: in this option, the land market is completely liberalised, meaning that land plots can be bought and sold without any restrictions. In this case, the land market should develop based on efficient competition and private ownership of land.

3. Restricted land market: this option involves a land market regulated by special rules and mechanisms. For example, restrictions on selling land to foreigners or corporations, or limitations on using land for certain types of agricultural crops (Schulte *et al.*, 2014).

Ukraine is a country with a high land resource potential, which enables efficient use of agricultural land and development of other industries. However, the existing real danger associated with military aggression and a terrorist-minded state can affect the country's economy, including agriculture. Nevertheless, despite these conditions, Ukraine has significant potential in the production of agricultural products, allowing it to maintain strong positions in the international market. In particular, Ukraine is one of the largest exporters of grain crops, sunflowers, and other oilseeds.

First and foremost, the agricultural sector is an important component of the Ukrainian economy, and the government is doing everything possible to support this sector. Various support measures and programmes for agriculture have been introduced, such as subsidies, lending, and other forms of support. However, the conditions of existing danger may affect Ukraine's export opportunities, and therefore agricultural enterprises should focus on preserving and developing the domestic market, which will be more resilient to external changes (Kozmenko *et al.*, 2014).

A.O. Koshel (2015) believes that there are several factors that can affect the effective use of land and resource potential in Ukrainian agricultural enterprises. Some of these factors include:

1. Preservation of natural resources: rational use of land and other natural resources must be implemented to ensure their preservation for the future.

2. Crop rotation and organic production: adhering to rational crop rotation and using organic production methods allows for the preservation of soil fertility and ensures a sustainable production process.

3. Modernisation of equipment and technologies: using modern techniques and technologies allows for increased productivity and ensures efficient use of resources.

4. Development of human resources: it is necessary to provide training and opportunities for professional development to increase the qualifications of employees.

5. Expansion of market outlets: developing market outlets allows for increased profitability of agricultural enterprises and ensures sustainable industry growth.

6. Access to financing: lack of access to financing can limit the ability of agricultural businesses to invest in modern equipment, technologies, and infrastructure needed for effective use of land and resources.

7. Government policy: policies related to land ownership, land use, and resource management can have a significant impact on the ability of agricultural businesses to effectively use their land and resources.

8. Infrastructure: inadequate infrastructure, including roads, irrigation systems, and storage facilities, can

limit the ability of agricultural enterprises to efficiently transport and store their harvest.

9. Environmental conditions: natural disasters such as floods and droughts can have a significant impact on the ability of agricultural enterprises to effectively use their land and resources (Koshel, 2015).

R.V. Levkina *et al.* (2019) states that the functioning of the land market in Ukraine must be based on the principles of social justice and the protection of state, societal, and private interests. It means that the land market should be regulated by the state to ensure the accessibility of land for various categories of citizens, including small agricultural enterprises and individual farmers (Levkina *et al.*, 2019). Moreover, the functioning of the land market must be ensured by legality, efficiency, transparency, and openness. It means that the government should provide transparency in the processes related to the land market, including land rights registration, land assessment, and other important aspects. In addition, it is necessary to ensure the effective functioning of the land market, allowing various citizens, including foreign investors, to perform land operations without excessive obstacles (Lebedenko, 2011).

Furthermore, ensuring balanced development of both large-scale agricultural business and small-scale agricultural entrepreneurship in all areas of activity is an important aspect of the functioning of the land market. To achieve this, it is necessary to ensure equal conditions of competition, including accessibility to credit for small and medium-sized agricultural enterprises. Therefore, the effective use of land and resource potential in Ukrainian agricultural enterprises requires a combination of access to funding, government policy support, adequate infrastructure, stable market conditions, learning opportunities, and a favourable natural environment.

CONCLUSIONS

Thus, the land and resource potential has always been and will remain a special object of both commodity-money relations and land relations, which is characterised by spatial limitation, irreplaceable territory for using agricultural land in agricultural production. Even in the conditions of the existing real danger associated with military aggression and a terrorist-minded country, agricultural enterprises of Ukraine can defend the interests of farmers in the foreign market, controlling the vector of their development to the effective and rational use of land in the interests of meeting the needs of food security of the state and reproduction of land relations in rural areas. These conditions are satisfied by the national policy on land management, with clear guidelines for the reform of land ownership, established technologies for the organisation of land and real estate accounting, land cadastral assessment, land management; improvement of land resources management; preservation of land and resource potential for future generations.

Land is an exhaustible natural resource that should be used sparingly. It especially applies to agricultural land. The functioning of the land market in Ukraine should be performed based on social justice, ensuring state, public and private interests, legality, efficiency, transparency, openness, ensuring the balanced development of both large agrarian businesses and small agrarian entrepreneurship in all territories where agricultural enterprises are located. Preservation and rational use of the land and resource potential of agricultural enterprises allows optimising the necessary conditions for ecological and economic support of agricultural production under the condition

of a favourable territorial environment in rural areas to increase the productive capacity of agricultural industries. Therewith, the main generator of effective use of the potential, its economic "engine" should be economic activity in the countryside, rational use of agricultural land and multi-system functioning of the rural economy.

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CONFLICT OF INTEREST

None.

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Анотація. Аграрні підприємства України мають значний земельно-ресурсний потенціал, але ефективне використання цього потенціалу залежить від багатьох факторів, дослідження яких є актуальним. Метою дослідження є розробка комплексного підходу до зміни процесу ефективного використання земельно-ресурсного потенціалу та пошук основної детермінанти його відтворення у післявоєнний період економічного розвитку аграрного сектору країни. Для досягнення поставленої мети було застосовано математичний інструментарій та метод капіталізації доходу. У результаті дослідження встановлено, що збільшення площі земельних ділянок для вирощування сільськогосподарських культур, переданих в оренду до 2025 р., призведе до збільшення їх загального розміру на 0,245 тис. га у структурі елементів відтворення та ефективного використання земельно-ресурсного потенціалу. Збільшення площі земель сільськогосподарських підприємств від купівлі (продажу) додаткових земельних ділянок збільшить їх вартість на 0,006 тис. га, а розширення площі обмінних земель – на 0,377 тис., що є пріоритетною детермінантою в структурі земельно-ресурсного потенціалу, а зміни в емфітевзисі збільшать загальну площу земельних ділянок на 0,347 тис. га в потенціалі підприємств. Таким чином, 97 % варіативності площі сільськогосподарських угідь у внутрішньому ринковому обігу відбуватиметься за рахунок зміни вищезазначених елементів земельної детермінанти, що забезпечить ефективне використання земельно-ресурсного потенціалу сільськогосподарських підприємств до 2025 р. та нарощування обсягів виробництва продукції. Дослідження факторів, що впливають на ефективне використання земельного потенціалу аграрних підприємств України, має важливе практичне значення, оскільки дозволяє виявити ключові фактори, які впливають на успішність аграрних підприємств, що може допомогти їм удосконалити свою стратегію та знайти шляхи підвищення продуктивності

Ключові слова: землі сільськогосподарського призначення; відтворення; економічний розвиток; монополістичні утворення; транзакційний обіг