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FAIR VALUE OF LAND CAPITAL: METHODICAL APPROACHES AND SCENARIO MODELING

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Abstract. The article examines the principles of forming the fair value of land capital under the conditions of profound transformations in Ukraine's agricultural sector. It demonstrates that traditional approaches to land valuation no longer meet current challenges, as they fail to account for environmental threats, institutional changes, and risks associated with military actions. The author substantiates the feasibility of applying the fair value concept as a more flexible and adaptive approach suited to present-day realities. A modified model for determining the value of land capital based on net present value is proposed, which integrates the following factors: the share of land plots withdrawn from cultivation, annual net operating or rental income, losses due to demining and soil contamination (expenses or lost income), state compensations, discount rate, and risk premium. Scenario modeling was used to present several possible development trajectories—optimistic, pessimistic, pragmatic, and one excluding the effects of war. The results indicate that the speed of land resource recovery, the scope of state support, and the efficiency of managerial decisions are the key determinants for maintaining the economic potential of land capital. The developed methodological framework can be applied both for decision-making at the level of agricultural enterprises and territorial communities, as well as for improving state land policy in the context of post-war recovery.

Keywords: land capital, fair value, market value, net present value, risk premium, discount rate, rental income, state compensations, humanitarian demining, soil

contamination, post-war recovery, agricultural sector, land valuation, scenario modeling, investment attractiveness of land, land management.

Problem statement. Transformations in Ukraine's agricultural sector, driven by internal reforms and external challenges, particularly the ongoing war, necessitate the search for new approaches to land capital management. Land capital constitutes a key element of economic stability and agricultural development, and the efficiency of its utilization largely depends on the capacity to incorporate contemporary risks, innovative solutions, and conceptual frameworks for improving management mechanisms in the agrarian sphere. As a finite natural resource, land exists independently of human will, is subject to legal protection, and performs essential functions across multiple dimensions of human life. In light of global challenges - such as rising social inequality, natural resource degradation, and climate change - the concept of an integrated approach to rural development, food security, and land policy, grounded in human rights, becomes particularly relevant.

In the context of new challenges brought about by the war in Ukraine, it is essential to develop a model for valuing land capital on a renewed conceptual basis. Unlike traditional goods and services, the value of land is not determined by production costs but by economic rent, i.e., the income derived from ownership and use of land due to its scarcity and productivity. Therefore, the formation of land capital in the agrarian sphere should also be examined through the lens of the fair value concept, grounded in land rent.

Analysis of recent research and publications. The issue of land parcel capitalization in economic science has been explored by the following Ukrainian scholars: Olha Dorosh, Tetiana Zinchenko, Shamil Ibatullin, Nataliia Tretiak, Mykhailo Khvesyk, Stepan Lyzun, among others. Approaches to defining the concept of "land capital" have been highlighted in the works of such researchers as Yosyp Dorosh, Shamil Ibatullin, Oleksii Shkuratov, Roman Kharytonenko, Roman Kuryltsev, Olena Lazareva, Olena Lemishko, Serhii Ostapchuk, Nataliia Prokopenko, Liudmyla Bohinska, Anton Tretiak, and Nataliia Tretiak.

The purpose of the study is to substantiate a new model for calculating the value of land capital, constructed on a renewed conceptual basis and taking into account the contemporary challenges caused by the war in Ukraine.

Materials and methods of the study. The theoretical and methodological framework of the research is grounded in the fundamental principles of modern economic theory, environmental economics, as well as a set of general and specialized methods, including: the systems approach - examining land capital as an integrated set of elements within a network of interrelations and linkages; analysis and synthesis, deduction and induction - for substantiating the paradigm of land capital formation and its valuation; and scenario modeling - for developing forecast scenarios of land capital value dynamics.

Research results and discussion. According to the Resolution of the Cabinet of Ministers of Ukraine "On Expert Monetary Valuation of Land Plots" [1], value is defined as a socially recognized equivalent of the worth of an assessed object expressed in monetary form. In accordance with the Law of Ukraine "On Prices and Pricing" [2], "price is the monetary equivalent of a unit of goods, while pricing is the process of forming and setting prices. Valuation of property and property rights is the process of determining their value as of the valuation date in accordance with procedures established by regulatory acts, and represents the outcome of the practical activity of a certified valuation entity" [3].

The concept of value has multiple interpretations, as there are many types, including: land plot value, market value, liquidation value, reproduction value, special value, investment value, value-in-use, appraised value, insurable value, and fair value of an asset [4, 5].

Market value [6] reflects the current worth of investments determined by actual market transactions. It may fluctuate significantly over time and is strongly influenced by the business cycle. Market value decreases during bear markets, which accompany recessions, and increases during bull markets, which occur during economic upturns. According to the Cambridge Dictionary [7], a bear market is a period when stock prices

fall and many investors sell their shares, while a bull market is a period when the prices of most stocks rise.

It is important to note that the monetary amount paid for a given property almost never coincides with the value indicated in a certified appraiser's report. This discrepancy is usually caused by factors such as specific buyer or seller motivation, negotiation skills, the structure of the financial transaction, or other contextual circumstances [8].

At present, the value of land in Ukraine is calculated according to the state "Methodology for Expert Monetary Valuation of Land Plots" [1], and this indicator is actively applied in most land transactions. However, the actual price of land remains an unresolved issue [9, 10]. Therefore, there is a pressing need either to refine the existing methodology of land valuation or to develop a fundamentally new model for assessing land capital. Such a model would enable decision-makers at various levels to increase the efficiency of land ownership and use decisions, promptly identify unscrupulous land users who cause losses to the state through non-payment of land fees, and better anticipate risks associated with improper land use.

In constructing such a model, one of the main stages is the identification of economic and ecological factors influencing the value of land capital. In developed countries, the concept of fair value is widely applied. According to [8], fair value is defined as the monetary amount at which a seller is willing to transfer ownership of property to a buyer through a deliberate transaction, provided that both parties are well informed about the relevant facts and the transfer occurs under normal market conditions. In accordance with the Order of the Ministry of Finance of Ukraine "On Approval of National Accounting Regulation (Standard) 19" [11], fair value is the amount for which an asset could be sold, or a liability settled, under ordinary conditions at a specific date.

We propose using the fair value of land capital rather than market value, primarily because the latter differs in the following aspects:

- market value is subject to greater fluctuations than fair value;

•it may be based on the most recent prices or asset quotations. For example, if over the past three months the value of a land plot averaged 40,000 UAH/ha but declined to 30,000 UAH/ha at the latest assessment, its market value would be set at 30,000 UAH/ha;

•market value depends on supply and demand conditions in the market where the asset is bought and sold. For instance, the price of a land plot offered for sale will be determined by the prevailing market conditions in that specific locality.

According to the Corporate Finance Institute (CFI) [12], fair value is defined as the actual selling price of an asset that the buyer agrees to pay and the seller agrees to accept, with both parties benefiting from the transaction. The calculation of fair value incorporates an analysis of profitability, expected growth rates, and risk factors.

The three primary profitability indicators are gross profitability (total revenue minus the cost of goods sold), operating profitability (revenue minus the cost of goods sold and operating expenses), and net profitability (revenue minus all expenses, including interest and taxes) [12].

In assessing future growth rates of capital, the Net Present Value (NPV) indicator remains highly relevant. NPV is a fundamental financial metric used for evaluating investment projects and capital allocation decisions. It serves as a criterion for assessing long-term financial viability beyond conventional boundaries, helping to summarize economic outcomes and growth trajectories [13]. NPV is derived from calculations that determine the present value of future cash flows using an appropriate discount rate. This measure provides a stable and widely recognized evaluation, particularly under conditions of uncertainty, making it one of the most effective tools in financial analysis.

The discount rate applied in calculating the value of land capital is of critical importance for agricultural producers, as it reflects the profit they expect in the future. A higher discount rate implies higher expected returns but also greater risk, whereas a lower rate indicates reduced risk [14].

The discount rate is generally determined on the basis of the market interest rate (before tax) applied in financial transactions with similar assets or liabilities. In the absence of a market rate, its value is estimated using the interest rates of potential loans available to the enterprise or by applying the weighted average cost of capital method [15].

The discount rate is generally composed of three key elements [15]:

• the base interest rate for the use of borrowed funds, which reflects the return a lender would expect for providing capital over a certain period;

• the risk premium, which compensates for the possibility that a borrower may default on repayment obligations;

• the projected inflation rate, which is included to preserve the real value of money over time.

The discount rate may be determined on the basis of the market interest rate applied in financial transactions with similar assets. If an enterprise systematically attracts loans from banks or other financial institutions, it is advisable to use the actual interest rates at which financing is obtained. Current market indicators can be found in statistical reports published on the official website of the National Bank of Ukraine [15].

According to the Law of Ukraine "On the National Bank of Ukraine", "the discount rate of the National Bank of Ukraine is one of the monetary instruments by which the National Bank sets a benchmark for banks and other participants of the money and credit market regarding the cost of borrowed and allocated funds" [16]. Furthermore, "the discount rate is the primary instrument through which the National Bank of Ukraine controls inflation. The rate is constantly adjusted in line with price dynamics in the economy" [17].

It is important to clarify that, due to military aggression, agricultural producers who have suffered greater losses and whose territories are located closer to combat zones face a higher risk of repeated landmines and soil contamination. Consequently, they are characterized by higher risk premiums and higher discount rates. The authors [18] estimate such a rate at 40.16%. Nathaniel Higgins and John Horowitz [19], in their

study, determine this rate based on farmer surveys depending on the time horizon of expected benefits, with an average discount rate of at least 28% for all farmers. In contrast, Yuliia Sivytska [14] establishes a discount rate of 21.87% for agricultural business valuation.

According to the Order of the Ministry of Economy of Ukraine "On Approval of the Methodology for Analyzing the Effectiveness of Public-Private Partnerships" [20], "a risk premium is an additional required rate of return that must be paid to investors—both equity shareholders and debt holders—as compensation for risk."

The risk premium in capital (also known as the equity risk premium, market risk premium, or capital risk premium) is one of the most important yet widely debated and imprecise parameters in finance. The confusion partly arises from the fact that the term "equity risk premium" is used to denote four different concepts [14]:

1.   Historical equity premium — the historical differential return on the stock market compared to government securities;

2.   Expected equity premium — the anticipated differential return over government securities;

3.   Required equity premium — the additional return on a diversified portfolio (market premium) over the risk-free rate expected by an investor, used to calculate the required return on equity;

4.   Implied equity premium — the necessary equity risk premium inferred from the assumption that the market price is correct [21].

According to the World Bank guidelines [22], "agricultural production often represents a high short-term credit risk due to the combination of weather variability, crop diseases, high fixed costs of transportation, storage, and processing, fertilizers, unstable yields, as well as changes in global commodity prices and exchange rate fluctuations. Governments frequently intervene in various aspects of providing agricultural insurance. Developing countries depend on a sound farming economy both as a source of income through agricultural exports and as a means of introducing modern technologies. Moreover, many social issues are exacerbated by migration from rural to urban areas."

Institutional risks are associated with unpredictable policy shifts and regulatory changes affecting agriculture [23]. Risks may also include a technogenic dimension, particularly the consequences of military actions on agricultural lands. The risk premium in the U.S. market for the period 1928–2013 was estimated at 4.62% [24]. According to KPMG [25], as of June 30, 2025, the market risk premium for Germany stands at 6.00%. For Switzerland, the current market risk premium remains at 6.0%, reflecting relatively low interest rates compared to other countries [26].

World Atlas analytics [27] report that in 2015 the highest credit risk premiums were observed in the following countries: Madagascar – 51.0%; Brazil – 29.8%; Sierra Leone – 16.7%; Rwanda – 13.3%; Guyana – 11.0%; Kyrgyzstan – 10.8%; Jamaica – 10.4%; Belize – 10.2%; Solomon Islands – 10.0%; and Angola – 9.7%. For instance, in Rwanda the elevated premium is partly related to the impact of war. Angola, devastated by a civil war lasting from 1975 to 2002, has experienced only gradual economic recovery.

The Methodology for Expert Monetary Valuation of Land Plots [1] also employs the NPV indicator. "The methodological approach based on the capitalization of net operating or rental income (actual or expected) provides for determining the value of a land plot from its highest and best use, taking into account established encumbrances and restrictions. Direct capitalization is grounded in the assumption of constancy and stability of cash flows from land use. In this case, the value of the land plot is defined as the ratio of net operating or rental income to the capitalization rate. The capitalization rate is a coefficient used to convert rental or net operating income into the present value of the property being assessed" [1].

Similarly, the Methodology for Normative Monetary Valuation of Land Plots [28] applies the indicator of "normative capitalized rental income" in its calculation formula. The current methodology sets the basic normative capitalized rental income (Nrd) for agricultural land as the nationwide average normative value of one hectare of arable land, amounting to 27,500 UAH/ha [29]. This fixed figure, as defined in the annex to the methodology, does not reflect actual conditions. With the country's

transition to a market economy, EU accession, and the impacts of military actions, both risks and positive drivers of economic growth must be taken into account.

At the same time, when the national economy is unstable, the land market infrastructure underdeveloped, the number of market transactions limited, financial markets malfunctioning, and the banking system lacking sufficient resources, the potential for income generation is significantly reduced. This renders traditional land valuation methods inadequate. Consequently, market value (which is almost identical to normative monetary valuation), as presented in the open data of the State Service of Ukraine for Geodesy, Cartography and Cadastre [30], does not adequately represent the actual (fair) value of land as capital.

Land is not a classical commodity in the sense of economic theory, as it is not a product of human labor that possesses use value and is exchanged for other goods [31]. It is a unique asset; therefore, its fair value should be determined, one that is based on land rent and calculated using the NPV indicator.

In the context of new challenges caused by the war in Ukraine, there arises the necessity to calculate a model of land capital value on a renewed conceptual foundation. Within this model, we propose to account for the impact of compensations for the demining of arable land (up to 100% of costs) and the loss of land productivity due to contamination, pollution, and physical damage caused by hostilities. The model incorporates state compensations, the share of land plots withdrawn from cultivation, risks of repeated mining (risk premium), and pollution associated with the proximity of combat operations.

An improved NPV calculation formula is proposed by M. Zavodiana (Formula 1):

$$NPV_m = S \times \sum_{t=0}^{n} \frac{(1-d) \times (R - L + C)}{(1 + i + r)^t} \quad , \qquad (1)$$

where NPVm is the modified value of land capital; S – land use area; n – year number; t – number of years; d – share of withdrawn land plots; R – annual net operating or rental income; L – losses due to demining and soil contamination (expenses or lost income); C – state compensations; i – discount rate; r – risk premium.

According to Annex 2 of the methodology [28], the normative capitalized rental income for agricultural land amounts to 27,520 UAH per hectare.

According to paragraph 3 of the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Use of Funds for Compensation of Humanitarian Demining Costs of Agricultural Land" [32], agricultural producers are entitled to non-repayable compensation for demining works on such lands performed by certified operators. Starting from April 15, 2024, 100% of the cost of these services is reimbursed from the state budget. The Ministry of Economy reports that the average cost of humanitarian demining services amounts to 63,600 UAH per hectare [33].

Following humanitarian demining, continued state support for small agricultural producers is crucial. According to the Order of the State Statistics Committee of Ukraine dated April 11, 2011, No. 88 [34], small enterprises engaged in crop production include business entities classified as small under current legislation, as well as those owning or using agricultural land of less than 100 hectares.

Under the budget program KPKVK 2801500 "Support for Farms and Other Agricultural Producers", 4,796.0 million UAH (109.8 million EUR) are allocated from the state budget's special fund [35]. Agricultural producers receive subsidies of 4,000 UAH per hectare (up to 120 ha) [36].

The discount rate can be determined as the key policy rate of the National Bank of Ukraine. Over the past decade (2015–2025), the discount rate has ranged from a minimum of 6% (2020) to a maximum of 30% (2015). As of June 6, 2025, it is set at 15.5% [37].

Taking into account the current market situation, the updated range of the market risk premium for developing countries is estimated between 5.0% and 6.0%, depending on the risk-free rate of municipal bonds [26]. According to research by Aswath Damodaran [38], the equity risk premium for Ukraine as of January 9, 2025, is 16.02%.

Using scenario modeling, four alternative scenarios of changes in the modified value of land capital are examined: optimistic, pessimistic, pragmatic, and a scenario excluding the impact of war. All variables defined within these scenarios are presented in Table 1.

Table 1. The impact of indicators of the proposed land capital valuation model under scenario-based modeling*

Indicator description	Optimistic	Pessimistic	Pragmatic	Without the impact of war
Rental income	constant	constant	constant	constant
Losses from demining, soil contamination, etc.	gradually decrease	constant	gradually decrease	absent
State support	constant	absent	present during the first seven years, absent afterwards	present during the first five years, absent afterwards
Share of land plots withdrawn from cultivation	gradually decreases	gradually decreases, but not all restored	gradually decreases	absent
Base discount rate	gradually decreases	constant	gradually decreases	gradually
Risk premium (repeated mining, contamination, etc.)	gradually decreases	constant, high	gradually decreases	constant, low
Number of years	10	10	10	10

*Note: author's own elaboration

The calculated values of NPVm (Table 2) for land capital are presented for the examined forecast scenarios and for each year from 1 to 10, taking into account costs related to demining, contamination, littering, and physical soil damage caused by hostilities, as well as state support and the withdrawal of land plots from cultivation.

Table 2. NPVm values for each scenario over a 10-year horizon*

Year	Optimistic	Pessimistic	Pragmatic	Without the impact of war
1	942336,67	-1235447,20	942336,67	2604958,68
2	814176,77	-930688,89	429791,36	2170761,52
3	720562,97	-695313,64	114344,40	1824074,07
4	659308,46	-515858,40	-70291,30	1545662,21
5	628451,28	-380454,61	-166858,92	1320843,62
6	718363,85	-279160,35	-217637,44	993890,01

7	686364,28	-203924,83	-245684,28	863921,69
8	698799,19	-148383,87	336123,16	757435,22
9	761332,12	-107596,45	303027,80	669847,09
10	1061298,46	-77779,78	283929,93	597570,54
Σ	**7690994,05**	**-4574608,01**	**1709081,38**	**13348964,65**

*Note: author's calculations.

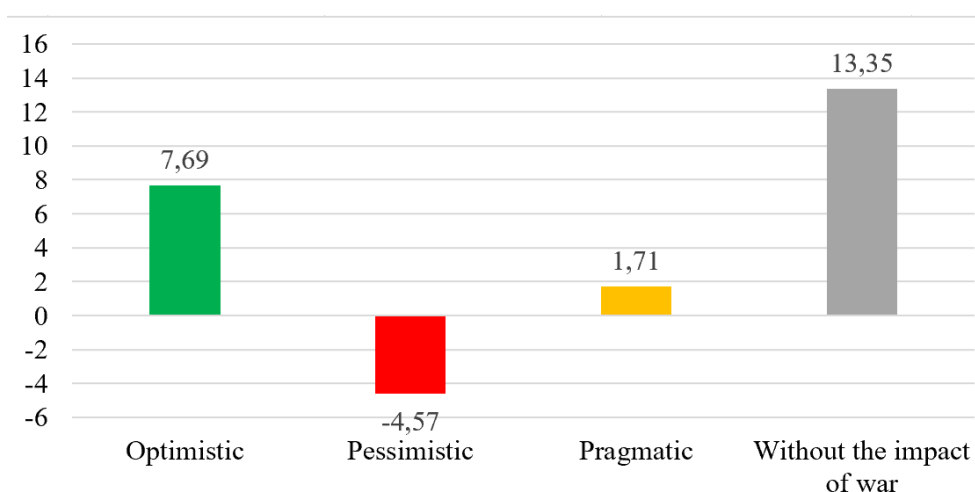Figure 1 illustrates the dynamics of land capital value over a 10-year period across different development scenarios.

Figure 1. NPVm of land capital under different development scenarios over a 10-year period (million UAH)*

* Note: author's own elaboration

The optimistic scenario shows a high land capital value after 10 years, amounting to 7,690,994.05 UAH (green column), reflecting favorable conditions, complete demining, and state support. A clear upward trend in land capital value indicates that the demining process outpaces the discount rate. This implies that land restoration proceeds faster than the loss of value caused by the time factor and risks associated with prolonged agricultural inactivity. The key factor is the speed at which land is returned to productive use—the faster demining and restoration are carried out, the higher the land's market value will be. Rapid recovery enables land to regain productivity earlier than expected, significantly increasing its net present value. This is particularly important for the agricultural sector and investment projects, where efficient land use without the risk of re-mining ensures sustainable development.

The pessimistic scenario demonstrates the lowest land capital value after 10 years, amounting to –4,574,608.01 UAH (red column), reflecting economic losses caused by the absence of state compensation and the risks of repeated mining, which result in the loss of rental income from the very first year of exploitation.

The pragmatic scenario (yellow column) yields 1,709,081.38 UAH, corresponding to intermediate conditions with partial support and certain risks.

Finally, the no-war scenario (gray column) shows the highest NPVm of 13,348,964.65 UAH, reflecting economic growth in a stable environment free from the influence of military factors. The chart clearly illustrates the direct dependence of land's economic potential on both the level of security and the extent of state support.

Conclusions. The proposed model of land capital valuation can be applied not only at the level of individual agricultural enterprises but also across territorial communities. It enables the assessment of economic dynamics not only within a single enterprise but also at the regional or national scale. This enhances the understanding of the sensitivity of factors influencing land capital and the broader economy.

For determining the value of land capital in post-war recovery, reliable data are required on actual demining costs, the impacts of contamination, physical damage, and land degradation, as well as on support programs for agricultural producers. The share of land withdrawn from cultivation can be estimated using operational reports or historical land-use data.

The risk premium should reflect, in particular, the market's perception of the risks of repeated mining, physical damage, and soil contamination, and may be derived from risk assessments or expert evaluations. Investors should integrate risk mitigation strategies into their planning, potentially through insurance mechanisms or specialized monitoring systems, to safeguard the long-term development of agriculture. If the risk of re-mining or secondary contamination remains high, the long-term viability of agricultural enterprises may be jeopardized.

The discount rate reflects both the time value of money and overall investment risk. Over time, parameters influencing land recovery—such as soil quality, pollution levels, and financial capacity—may be adjusted in the course of gradual rehabilitation

and return of land to cultivation. However, the long-term sustainability of these efforts depends on several key economic and political factors.

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СПРАВЕДЛИВА ВАРТІСТЬ ЗЕМЕЛЬНОГО КАПІТАЛУ: МЕТОДИЧНІ ПІДХОДИ ТА СЦЕНАРНЕ МОДЕЛЮВАННЯ

Анотація. *У статті розглянуто засади формування справедливої вартості земельного капіталу в умовах глибоких трансформацій аграрного сектору України. Показано, що традиційні підходи до грошової оцінки земель вже не відповідають викликам сьогодення, оскільки не враховують екологічних загроз, інституційних змін та ризиків, пов'язаних із воєнними діями. Автором обґрунтовано доцільність застосування концепції справедливої вартості як більш гнучкої та адаптивної до реалій сьогодення. Запропоновано модифіковану модель визначення вартості земельного капіталу на основі чистої теперішньої вартості, у якій інтегровано наступні фактори: частка площі вилучених земельних ділянок з обробітку, чистий операційний або рентний дохід за рік, втрати через розмінування та забруднення ґрунту (витрати або втрачений дохід), державні компенсації, ставка дисконтування, премія за ризик. На основі сценарного моделювання представлено кілька варіантів розвитку ситуації - оптимістичний, песимістичний, прагматичний та сценарій без впливу війни. Результати свідчать, що швидкість відновлення земельних ресурсів, обсяги державної підтримки та ефективність управлінських рішень є ключовими детермінантами збереження економічного потенціалу земельного капіталу. Розроблена методична база може бути використана як для прийняття управлінських рішень на рівні сільськогосподарських підприємств і територіальних громад, так і для вдосконалення державної земельної політики в умовах повоєнного відновлення.*

Ключові слова: земельний капітал, справедлива вартість, ринкова вартість, чиста теперішня вартість, премія за ризик, ставка дисконтування, рентний дохід, державні компенсації, гуманітарне розмінування, забруднення ґрунтів, повоєнне відновлення, аграрний сектор, оцінка земель, сценарне моделювання, інвестиційна привабливість земель, управління земельними ресурсами.