Якість, стандартизація, безпека, екологічність та ергономічність машин і технологій
Quality, standardization, safety, environmental and ergonomic properties of machines and techniques

УДК 332.74:631.153.3 **https://doi.org/10.5281/zenodo.6824123**

Criteria for economic assessment of land quality

N.A. Lyubymova [1], V.K. Pusik [2], L.M. Pusik [3], A.P. Gorbanyov [4], A.V. Lioubimova [5]

[1-4] State Biotechnological University, (Kharkiv, Ukraine)
[5] Victoria University of Wellington (Wellington, New Zealand)
email: [1] nina.lioubimova@gmail.com, [2] kysmish@gmail.com,
[3] Ludmilap@gmail.com; [5] alexandra.lioubimova@vuw.ac.nz
ORCID: [1] 0000-0001-8964-7326; [2] 0000-0001-5028-9461;
[3] 0000-0002-5465-2771, [5] 0000-0002-8920-9657

This article is devoted to the study of criteria for assessing the quality of land to solve the problem of integrated management of its quality in order to comply with environmental standards. This approach allows you to predict and optimally plan the activities of both individual farms and the entire state. It promotes high yields, strategic process management to reduce soil dehumidification, land cadastre organization, and land ordering in an agricultural setting.

The strategic direction of the use of land resources in the future determines its further nature of use, the choice of crop rotation, the timing of sowing and harvesting, etc. The state of the soil should be displayed in the Land Registry, the nature of degradation and trends should be controlled and subject to environmental monitoring and control. Information support of soil quality will allow to manage and reduce the negative phenomena that affect due to anthropogenic excessive load.

The proposed criteria for assessing the quality of land will allow us to evaluate and ensure profit in the economy of the regions and the country as a whole. This will create the basis for the formation of new economic market mechanisms. The sources of differential land rent are considered as additional net profit. The economic criteria for the cost of gross output, the payback of costs for land resources, the size of differential profit and differential rent, the coefficient of conditional cultivating land, and others are considered.

Economic criteria for land quality allow guaranteeing property rights and their reliable protection, supporting the taxation system, guaranteeing mortgage loans, conducting state control over the use and protection of land, legal support for land, development of territories, strategic planning of agricultural activities. Rational use of land based on economic criteria, together with the assessment of environmental indicators, will allow a systematic approach to the issue of environmental conservation, increase the profitability of production, reduce costs and payback period of invested funds

The obtained results of the study can be used to formalize the assessment of the state of the soil in order to streamline land management and cadastre, solve community diagnostic problems of strategic and current correction and improvement of land quality in order to obtain effective and optimal solutions to improve productivity, subject to the implementation of environmental legislation.

Keywords: *ecology, model, control, forecasting, multicomponent, pollution*

Relevance of the research. Over the recent years, the Cabinet of Ministers of Ukraine has adopted a range of regulations aimed at the development of methodology and procedures for controlling the energy, water and land use as well as their practical application and improvement. Tackling the challenges associated with control, accounting and efficient use of economic and natural resources at the national level has become a state priority.

Due to the lack of an integrated management system for the use of natural resources in Ukraine, the recent years have seen significant losses. Consequently, the Verkhovna Rada of Ukraine proposed a set of measures aimed at improving the monitoring system to assess the impact of anthropogenic factors on the environment, to ensure environmental control and compliance with environmental and economic standards of emissions and discharge of pollutants into atmosphere, hydrosphere, lithosphere and biosphere.

The concept of ecological reserve is used to assess stability of ecosystems (lithosphere). It is represented as the difference between the maximum permissible deviation and the actual condition of the ecosystem. It shows the buffer area where non-destructive changes can take place [1-3]. Every 10

years, humanity loses about 7% of the upper layer of soil due to erosion caused by natural or anthropogenic factors. Degradation in soil formation is quite easily diagnosed in the environmental aspect [4]. Unfortunately, these trends have become more pronounced in the recent years.

Dehumidification is one of the most characteristic implications of irrational soil use in agricultural production. In Ukraine, operational control of natural objects (atmosphere, hydrosphere and lithosphere) requires considerable costs. Currently, complex mathematical models for control, assessment and further strategic decisions to preserve and restore fertility of agricultural soils are not developed to a sufficient extent [4, 5].

Therefore, it is crucial to develop new, more advanced methods and tools to resolve the contradiction between the IT support for soil control systems and the costs required for their provision without any deterioration of quality control. The information support for controlling the soil quality must be recorded in the State Land Cadastre (SLC), and the soil quality shall be continuously monitored by the state.

The SLC is a systematized collection of information on real estate registered in accordance with the law, as well as information on the state border, the borders between the economic entities of Ukraine, the borders of municipalities, settlements, territorial areas and areas with special conditions of land use, as well as other information provided by the law.

Creation of the State Land Cadastre system of Ukraine and further operation of all its components will allow for developing a reliable database on the status and use of the country's land in all the areas of economic activity which is continuously updated. This will permit to form a system of land rights for all the entities of land relations and create an effective land market.

The information support of any control system is closely connected with the object to be controlled in terms of the types and number of informative parameters reflecting basic properties of the object. Environmental pollution control involves a large number of physically heterogeneous parameters reaching hundreds and even thousands of units [3, 4, 5].

This is reflected in certain specific features and difficulties associated with the vector of input signals for information and measurement systems for environmental control (IMS EC), especially for multicomponent pollution processes where the controlled parameters correlate [9].

A systematic approach to assessing the quality of land will attract additional investment in the economy of regions and countries, ensure the inflow of additional funds for central and local budgets due to land payments, create a basis for new market mechanisms, etc.

1. Research objectives

The economic assessment of land reflects its comparative value as a specific means of production in agriculture based on the objective conditions in the respective natural and economic regions. The economic evaluation proceeds from the differences in the quality of soil caused by both natural and economic factors of production.

The economic assessment of land determines the degree to which the soil quality influences such important economic indicators as gross output, gross and net income, profit, etc.

The economic assessment of land directly affects investments in this sector of the economy. The welfare of the region depends on them. Figure 1 shows the growth of capital investments and net income over 9 years.

According to the results of the 3rd quarter of 2019, Kyiv region is still taking the first place in the ranking in Ukraine in terms of attracting investments. It is followed by Dnipro and Mykolayiv regions (analytics of the Euro-Rating agency). The score of Kyiv region increased by 13 (up to 236 points), Dnipro region has 234 points, Mykolaiv region closes category A (maximum investment efficiency) with 207 points.

In comparison with the previous period, the number of regions with a medium investment activity or higher has increased significantly. This was partly due to the rise in certain regions (Cherkasy, Chernihiv). It was also partly caused by a fall in other regions (Lviv, Poltava, Kharkiv), which showed the maximum investment efficiency a quarter ago.

Fig. 1 Growth in capital investment and net income

These investments cannot be made without a systematic economic evaluation of the land.

Operational monitoring data, presented on the Organic Map of Ukraine 2019, was selected by the Ministry of Economic Development, Trade and Agriculture of Ukraine as foreign certification bodies

that certified production of organic products in Ukraine in 2019.

This map (Figure 2) was developed with the support of Swiss certification body (Organic Standard), a public organization (OrganicInfo.ua), Organic Ukraine as part of the Swiss-Ukrainian program implemented by the Research Institute for Organic Agriculture (FiBL, Switzerland) in partnership with SAFOSO AG (Switzerland).

Figure 3 shows a map of the land suitability for organic farming in Ukraine.

Fig. 2 Organic map of Ukraine

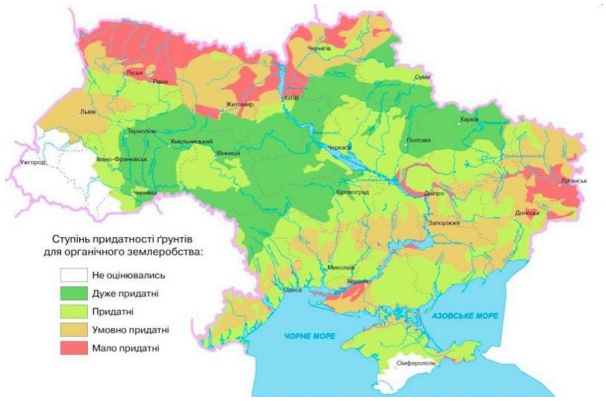

Fig. 3 Degree of soil suitability
for organic farming in Ukraine

The results of these studies should also be taken into account when developing optimal economic criteria for land quality. They should form the basis for the formation of the cost of land. Thus, the quality, and, consequently, the cost of future products directly depends on the quality of the soil on which crops are grown.

The potential level of profit, the return on economic investments and many other economic factors that characterize potential investors should be transparently and adequately reflected in the criteria for the economic assessment of land quality.

These maps show that soils in Kharkiv, Cherkasy, Ivano-Frankivsk, Ternopil regions are the most suitable for organic farming.

Scientists classified the lands near Chernobyl and in mining areas, mainly in Luhansk region, as well as most of Rivne region, as unsuitable for organic farming. Such studies are necessary for a realistic economic evaluation of land, especially at the present stage.

The economic assessment of land is carried out in two aspects: a general economic evaluation of land as a means of production and a specific evaluation of the efficiency with which individual crops are cultivated.

Methodology for the economic assessment of land is based on the mass data on the actual yield of agricultural crops and costs of their production for at least five years. The estimated indicators are calculated for agricultural production groups of soils and are separate for irrigated, drained and non-reclaimed lands with a relatively even structure of production.

Land rent as an economic category represents the income received by land owners as payment for the land use. The various forms of rent represent an economic form of implementing the right to land ownership [2].

Differential land rent is characterized by an additional profit as a difference in labour productivity in case of equal costs on the land plots of middle and high fertility and location. The conditions for determining the differential land rent include the existence of differences in the level of soil fertility, location of land plots in relation to sales markets, as well as the return of additional capital investments in land resources.

An additional net income generated from lands which are better and more conveniently located or from an increasing productivity of additional investments into land constitutes a source differential land rent. In the practice of land assessment, differential rent is also called differential income.

Depending on the way additional profit is generated, there are two types of differential rent: differential rent -1 and differential rent -2.

Differential rent-1 is a stable additional profit received due to different productivity of the same labour costs on equal land plots of different fertility and location. It can be divided in two categories: differential rent 1 determined depending on the fertility of plots and differential rent 1 determined depending on the location of the plot.

Differential rent-2 is a stable additional profit received as a result of different productivity of successive additional investments of capital for the same plot. It is connected with intensification of agriculture aimed at an increase in the output per unit of land at given capital expenditures.

Differential rent-1 preceded differential rent-2 and is growing with the development of extensive agriculture. It increases due to involvement of new land plots.

The amount of differential rent-1 can increase at a given level of technology both in the case of a transition from lands of a lower quality to those with a better quality, and in the case of a reverse transition.

In the first case, the rent growth is determined by the level of the regulating price when land plots of better quality are exploited.

In the second case, the rent will grow in connection with an increase in additional profit due to the large area of middle-sized land used.

Under conditions of private ownership, there are two types of land monopolies in agriculture: the monopoly of land use and the monopoly of land ownership.

In the first case, the land is monopolized by lessees as a business entity, and each land plot is managed by an individual lessee. It does not allow other lessees to invest their capital in the same land plot.

In the second case, the land is monopolized as property of the landowner and each land plot is owned by a specific individual. The latter decides whether or not to give the lessee the opportunity to invest capital in the land.

2. Aim the research. Study of the criteria for economic and environmental land efficiency during its assessment for inclusion in the State Land Cadastre.

Development of criteria for land assessment will provide legally relevant information and help solve a number of top-priority tasks for sustainable development of the modern state and society:

- guarantee of property rights and sufficient protection;
- support for taxation of land and other real estate;
- mortgage guarantee;
- development and control of land sale and purchase;
- state control over protection and use of land;
- consideration of land disputes;
- land reform, including land privatization;
- development of territories, planning and efficient use of the land resources;
- rational use of the environment.

3. Suggested criteria for economic assessment of land.

Economic efficiency of land use in agriculture is characterized by a system of natural and cost indicators. The main ones include the following:

- yield of agricultural crops, c/ha;
- price of gross output, gross and net income per 1 hectare;
- return of costs for land resources, val per 100 val. costs;
- differential income, val/ha;
- profitability of production, in%.

The gross output value is determined as the ratio of output to crop yields (main products and by-products) and the cadastral price of a particular type of product (K_p).

$$K_p = C_p + P_s,$$

where C_p is the cost of production of a particular type of product, val./c.; P_s is the amount of surplus product, val./c.

The amount of the surplus product is usually determined as a percentage of the value. So if the cost of producing 1 centner of grain is 400 val., and the surplus product is 40 % of the cost of production, the cadastral price of grain will amount to 560 val. (440 val. + (400 * 0.4)) per centner.

The value of gross output, gross and net income per 1 ha of soil are taken as the criteria of economic land assessment [5].

The best lands in terms of quality and long-term average economic indicators are estimated at 100 points. The indicators of deep black soils are taken as the standard of 100 points. The scale for assessing other types of soils is set as the ratio of the gross output value, gross and net income of each agricultural group compared to the indicators of the standard.

Return of the costs (R_c) for the land resources is determined according to the following formula:

$$R_c = \frac{V_c}{M_c},$$

where V_c is the value of gross output at cadastral prices, val./c.; M_c - costs per 1 ha of land. The differential income is based on the value of gross output and return.

The differential income (D_i) is calculated as follows

$$D_i = M_c \cdot (R_c - 1{,}4),$$

where, 1,4 – coefficient of the surplus product.

The estimated value of agricultural land can be determined as a derivative of the differential rent for the period of land capitalization.

In turn, the differential rent (D_r) is calculated as follows

$$D_r = \frac{(P_w - I_p)}{Y_n},$$

where P_w — weighted average selling price of the main crop, val/c.; I_p — individual price of production, val/c ; Y_n — normal yield, c/ha.

The individual price of production is represented by the costs of standard wages, material resources, transport costs associated with production multiplied by the regulatory profitability, which ensures expanded reproduction and costs for transporting the crop to the market.

Additional indicators of determining the land use efficiency include the following:

- share of agricultural land in the total land area, in %;
- share of arable land within the agricultural land, in %;
- share of agricultural crops within the arable land, in%.

An increase in agricultural production can be successfully achieved only on condition of a significant increase in the efficiency of land use. This is becoming especially relevant in Ukraine now.

Intensive agricultural production involves additional investments of material and financial resources for the introduction of new machines and technologies, developed use of chemicals and land reclamation, introduction of promising varieties and hybrids of agricultural crops, and highly productive animal breeds.

This will ultimately contribute to a more efficient use of land resources.

The unified state land fund includes the following categories of land: agricultural land, land of industrial, transport, mining and other organizations and enterprises, as well as resorts and nature reserves, lands of cities, towns and other settlements.

Lands of the State Reserve. The largest areas of land belong to agricultural enterprises and organizations [6].

Such concepts as total land area and area of agricultural land are normally singled out. The total land area includes the entire territory belonging to an agricultural enterprise.

Agricultural land is the land used for agricultural production. They are usually called the structure of the land area, while the percentage of individual types of land within the total area of agricultural land represents the structure of agricultural land. The structure of agricultural land depends on the zonal features of land use and is different depending on the economic region.

The indicator of relative arable land is used to compare agricultural land of different structure.

1 ha of sown grass is taken as a unit of relative arable land. The coefficient of conversion of natural hayfields and pastures into relative arable land is calculated as follows

$$C = \frac{Y_{hp}}{Y_a},$$

where, Y_{hp} — yield of hay or green mass on hayfields and pastures, c/ha; Y_a — yield of hay or green mass on arable land, c/ha.

The indicator of relative arable land balances differences in the structure of agricultural land. However, this does not take into account the quality and fertility of soils. Rational use of land and a constant increase in its fertility require a comprehensive assessment of land in terms of quality and quantity on the basis of a single cadastre.

4. Conclusions

Thus, the State Land Cadastre (SLC) constitutes a system of necessary data and documents on the legal status of land, its distribution among land owners as well as in terms of land categories and land quality and value.

Establishment of the State Land Monitoring Program will make it possible to make a reliable assessment of the undesirable processes taking place, timely diagnose and evaluate these processes, develop measures to prevent and mitigate the consequences of such phenomena, and exercise control over the status of land, its use and protection at a higher level.

The State Property Cadastre (SPC) shall serve multiple purposes and the transition from the SLC will involve information support for all functions of the state land management: land planning, redistribution, control over their use and protection, land management, resolution of land disputes, taxation, protection of land rights, etc.

A systematic approach to the SPC establishment, on the one hand, serve the purpose of legal protection of rights to real estate in the interests of citizens and legal entities, and on the other hand, the purpose of taxation in the interests of the state. These goals must be pursued by the entire SPC system, including its individual subsystems.

Thus, the subsystems of registration and assessment of land cover the economic parameters of property (area, type of use, quality, price, etc.). If they are not sufficiently defined, it becomes impossible to make agreements and register them. Therefore, securing the rights to real estate for the purpose of their legal protection is a top priority in the creation of a real estate cadastre system in modern market relations.

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Анотація

Критерії економічної оцінки якості землі

Н.О. Любимова, В.К. Пузік, Л.М. Пузік, А.П. Горбаньов, О. Любимова

Дана стаття присвячена дослідженню критеріїв оцінки якості землі для вирішення задачі інтегрованого її керування з метою виконання норм природокористування. Даний підхід дозволяє прогнозовано та оптимально планувати діяльність, як окремим господарствам, так і всієї державі. Він сприяє отриманню максимального урожаю, стратегічному керуванню технологічними процесами для зменшення дегуміфікації грунту, організації земельного кадастру та упорядкуванню землі в умовах сільськогосподарського господарювання.

Стратегічний напрямок використання земельних ресурсів у перспективі визначає його подальший характер використання, вибір сівозмін, застосування оптимальних технологічних процесів, строків висіву та збору урожаю, тощо...

Стан грунтів повинен відображатись у Земельному Кадастрі, характер деградаційних процесів та тенденцій бути контрольованим та підлягати екологічному моніторингу і контролю. Інформаційне забезпечення за якістю грунтів дозволить керувати та зменшити негативні явища, які впливають через антропогенне надмірне навантаження. Запропоновані критерії для оцінки якості землі дозволять забезпечити надходження в економіку регіонів і країни в цілому. Це створить основу для формування нових економічних ринкових механізмів. Розглядаються джерела диференційної земельної ренти як додаткові чисті прибутки. Досліджуються економічні критерії вартості валової продукції, окупність витрат на земельні ресурси, розмір диференційного прибутку, та диференційної ренти, коефіцієнт умовного пасовища та інші…

Економічні критерії якості землі дозволяють надати гарантії прав власності та їх надійний захист, підтримку системи оподаткування, гарантії іпотечних кредитів, проведення державного контролю за використанням та охороною землі, юридичний супровід землі, розвиток територій, стратегічне планування сільськогосподарської діяльності. Раціональне використання землі на основі економічних критеріїв разом із оцінкою екологічних показників дозволить системно підійти до збереження навколишнього середовища, підвищити рентабельність виробництва продукції, зменшити витрати та скоротити строк окупності вкладених коштів. Отримані результати дослідження можливо використати для формалізації оцінки стану грунтів з метою впорядкування землеустрою і кадастру, вирішення загальних діагностичних задач стратегічного та поточного корегування і поліпшення якості землі для отримання ефективних і оптимальних рішень покращення урожайності за умови виконання екологічного законодавства.

Ключові слова*: земля, оцінка, критерії, кадастр, прибуток, стратегія землекористування*

Аннотация

Критерии экономической оценки качества земли

Н.О. Любимова, В.К. Пузик, Л.М. Пузик, А.П. Горбаньов, А. Любимова

Данная статья посвящена исследованию критериев оценки качества земли для решения задачи интегрированного управления ее качеством с целью исполнения норм природопользования. Данный подход позволяет прогнозировать и оптимально планировать деятельность, как отдельным хозяйствам, так и всему государству. Он способствует получению высоких урожаев, стратегическому управлению технологическими процессами для уменьшения дегумификации грунта, организации земельного

кадастра и упорядочиванию земли в условиях сельского хозяйства. Стратегическое направление использования земельных ресурсов в перспективе определяет его дальнейший характер использования, выбор севооборота, сроков посева и сбор урожая, и т.д.

Состояние грунта должно отображаться в Земельном Кадастре, характер деградаций и тенденций должны быть контролируемы и подвержены экологическому мониторингу и контролю. Информационное обеспечение качества грунта позволит управлять и уменьшить негативные явления, которые влияют вследствие антропогенной чрезмерной нагрузки. Предложенные критерии для оценки качества земли позволят оценить и обеспечить прибыль в экономике регионов и страны в целом. Это создаст основу для формирования новых экономических рыночных механизмов. Рассматриваются источники дифференциальной земельной ренты как дополнительная чистая прибыль.

Рассмотрены экономические критерии стоимости валовой продукции, окупаемость затрат на земельне ресурсы, раз мер дифференциальной прибыли и дифференциальной ренты, коэффициент услоуловноготбища и другие.

Экономические критерии качества земли позволяют гарантировать права собственности и их надежную защиту, піддержку системы налогообложения, гаранти ипотечных кредитов, проведение государственного контроля за использованием и охраной земли, юридическое сопровождение земли, развитие территорий, стратегическое планирование сыльскохозяйственной деятельности. Рациональное использование земли на основе экономических критериев вместе с оценкой экологических показателей позволит системно подойти к вопросу сохранения окружающей среды, повысить рентабельность производства продукции, уменшить затраты и срок окупаемости вложеных средств. Полученные результаты исследования можно использовать для формализации оценки состояния грунта с целью упорядочивания землеустройства и кадастра, решения общих диагностических задач стратегического улучшения качества земли для получения ефективных и оптимальних решений повышения урожайности при условии выполнения норм экологического законодательства.

Ключевые слова: *земля, оценка, критерии, кадастр, прибыль, стратегия землепользования*

Бібліографічне посилання/ Bibliography citation: Harvard
Kravtcov, A. G. (2022). Study of the delay time in stress relaxation by the structure of a lubricating film on a friction surface with fullerene compositions. *Engineering of nature management*, (1(23), pp. 126 - 132.

Подано до редакції / *Received: 15.02.2022*