

# Features of Agrochemical Certification of Agricultural Land Use in Ukraine

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**Abstract:** Under current European integration processes, the issue of the formation of agricultural land use to comply with the strategy of sustainable development of Ukraine is gaining considerable interest for research. Given the imperfection of the regulatory framework and the instability of the political situation in the country, the problem of maintaining the rational use and protection of agricultural land use is especially relevant. In our opinion, one of the factors in ensuring the formation of sustainable agricultural land use is the maintenance of agrochemical certificate of the field, land plot, i.e., implementing agrochemical certification. The purpose of this research is to analyze the regulation of relations in the field of agrochemical certification in the formation of sustainable agricultural land use. The study used general and special methods, such as monographic, analysis and synthesis, analogies and comparisons, graphics, generalization, statistics, and more. The methodological basis of the research is a comprehensive approach, system and structural analysis, and dialectical method of scientific cognition.

The paper substantiates that agrochemical certification of land is an important tool in the formation of sustainable development of agricultural land use through the interaction between the legal, technological, environmental, and economic environment. The algorithm of agrochemical certification has been improved, which gives a systematic representation of the certification process. The proposed algorithm includes the structuring of the nine stages of its implementation. Based on the study of the current state of agrochemical certification, its principles have been generalized, and the functional possibilities of its implementation have been identified, which can be taken into account in drafting the Law of Ukraine "On the State Agrochemical Certification of Agricultural Land". In terms of reforming land relations to obtain reliable information about the state of soils and the dynamics of changes in soil indicators, it is necessary to improve the methodology of soil sampling and agrochemical certification towards detailing and adapting to the conditions of agricultural sector reform; to introduce GPS software that allows integrating the results of field surveys with the GIS database in the research of agricultural lands; to create databases on the spatial characteristics of the state land fund.

**Keywords:** Agrochemical certification, agricultural land use, soil fertility, sustainable development, soil protection measures.

## INTRODUCTION

The result of land and agricultural reform in Ukraine was a system of private, private lease, and individual land use with different legal statuses. The redistribution of agricultural

land is in process, which led to the emergence of numerous landowners, farmers, and tenants. All this has complicated the implementation of measures to protect, preserve, and restore soil fertility, as well as intensified the degradation of agricultural land. A necessary condition for the efficient use of land resources is the availability of information on their ecological and agrochemical status. There is an increased need for information on the quality of agricultural land, decentralization of the agricultural sector, the emergence of a

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new layer of land users (landowners), which necessitates improving the methodological framework for agrochemical survey of agricultural land, developing a new approach to providing services to land users.

The analysis of research and publications shows that a significant contribution to the development of modern scientific approaches to the problems of agrochemical certification, in particular agricultural land use in Ukraine, made such scientists as S. A. Baliuk, O. B. Hafurova, M. V. Lisovy, T. K. Overkovska., V. V. Medvediev, B. S. Nosko, O. G. Tararico, and others. At the same time, the issues of agrochemical certification of agricultural lands are still understudied and require further scientific substantiation.

According to the order of the Ministry of Agrarian Policy and Food dated 11.10.2011 № 536: “Agrochemical passport of the field, the land is a document containing data on agrochemical characteristics of soils and the state of their contamination with toxic substances and radionuclides”.

Land plot or field (agricultural) is not only the territory but also the soil cover, which provides the formation of a certain level of the yield of agricultural plants. Yield is determined by the condition of the soil cover, i.e., the content of humus, nutrients, trace elements, water physical properties, and the content of toxic components (pesticide residues, heavy metals, radionuclides, etc.). Such a set of indicators can be established only following laboratory studies of the soil, which is the basis of the agrochemical certificate of the field.

Thus, the land certificate is a high-tech product that allows a clear assessment of productivity (level of possible yield), as well as environmental safety. Besides, it provides for the entry of data every 5-10 years, depending on the type of land use. Essentially, it is the “patient’s medical record”, which your soil is, according to which you can unambiguously judge the state of his health, if necessary, to diagnose, and prescribe treatment. Also, it is worth keeping in mind that this is a state standard document with civil law properties. Thus, it can be used in the lawsuit practice.

The objects of agrochemical certification of agricultural lands are bogharic tillable land, including irrigated, drained; hayfields and pastures; perennial plantings. Certification of arable land should be carried out every 5 years; hayfields, pastures, and perennials – every 5-10 years. It should be mandatory for all landowners and land users.

It is also important to note that agrochemical certification of land should be carried out by state structures that are directly involved in the field of land relations regulation. State regulation should promote the rational use and protection of land, as well as ensure the fulfillment of the conditions of sustainable development. It is the awareness of the need to carry out agrochemical certification of land that predicts the improvement of the state of the natural environment.

## MATERIAL AND METHODS OF THE RESEARCH

The research materials were literature sources, statistical data on Ukraine and the Kharkiv region, as well as some developments of modern Ukrainian and foreign scientists on the processes of agrochemical certification of agricultural land use. Logical, analytical, comparative, and descriptive meth-

ods were used, which allowed highlighting the relevance and issues of sustainable land use. The article is based on theoretical and methodological principles of complex research of ecological consequences of modern agricultural land use based on modern methods of studying phenomena and processes, namely, monographic – in considering and generalizing theoretical principles of agrochemical certification and its impact on agricultural land use; systematic and comparative analysis – during the ecological and economic assessment of agricultural lands; analytical method – to study trends in the dynamics of environmental phenomena; graphic – studying the structure of the impact of certification on state regulation of the formation of sustainable agricultural land use.

## RESULTS AND THEIR ANALYSIS

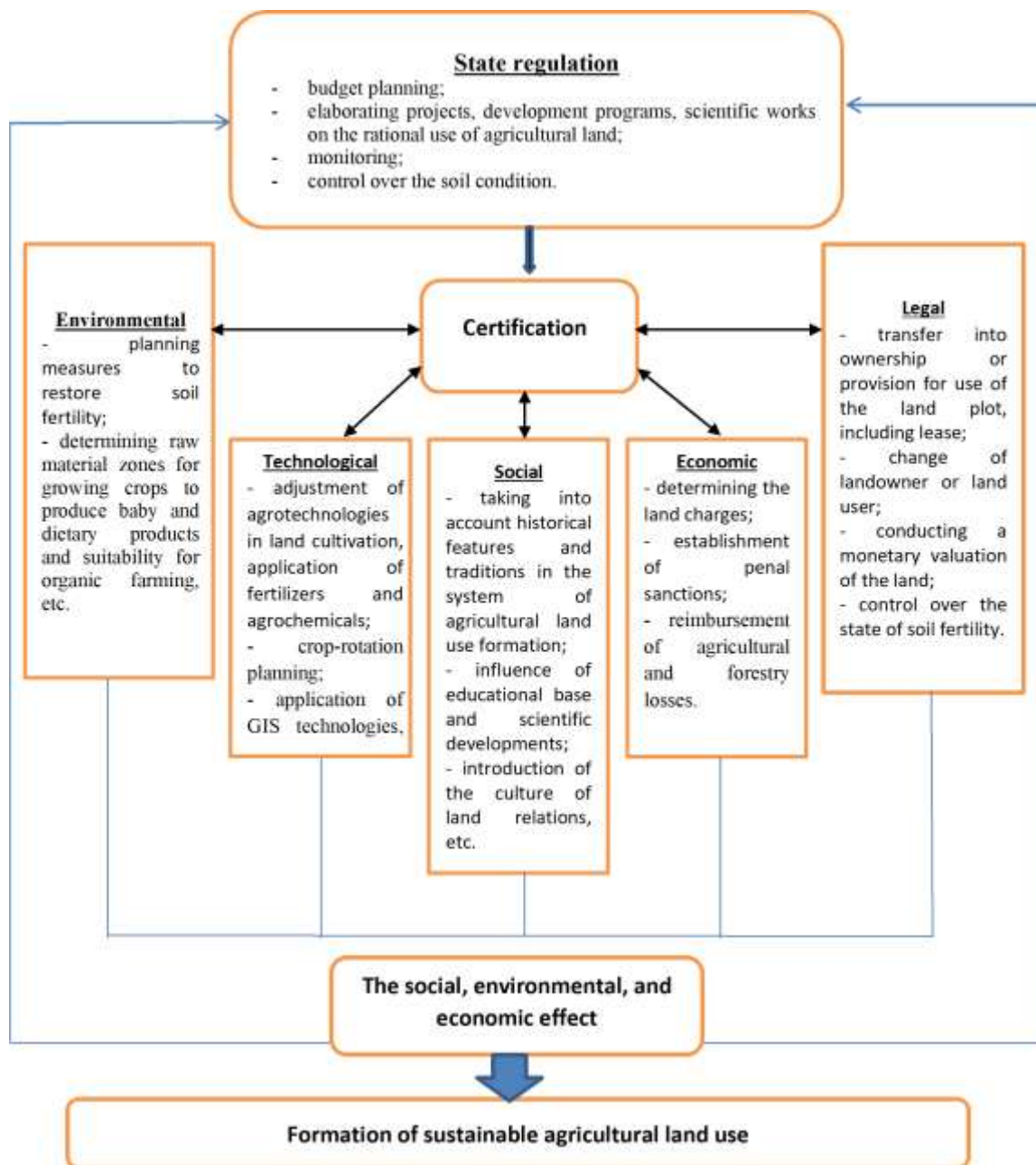
Agrochemical certificate of the field, land plot is the result of agrochemical certification of all agricultural lands, which is carried out for the state control over changes in fertility, soil contamination with toxic substances and radionuclides, and rational use of agricultural lands.

In general, agrochemical certification of any land plot is an important tool for the state regulation of sustainable agricultural land use through the interaction between the legal, technological, ecological, and administrative environment (Fig. 1).

The interaction of the above-described factors forms a “working” system. The system results in a social, ecological, and economic effect that is expressed in improving the quality of life, which is the basis for the formation of sustainable agricultural land use. For example, the functions of state regulation (planning, organization, and control) are implemented within a legal framework (improved legal framework). When a database on the quantitative, qualitative, and legal status of each land plot in the structure of agricultural land use is formed, it simplifies the planning of technological measures (adjustment of agrotechnologies in land cultivation, application of fertilizers and agrochemicals; crop rotation planning; application of GIS technologies, and others), as well as the development of ecological network (reproduction of soil fertility, provision of ecologically safe food products).

Having studied the functional capabilities of agrochemical certification, we have formed the basic principles, which, in turn, would contribute to the formation of sustainable agricultural land use. Namely, they are:

- control over land protection and its rational use;
- establishment of the appropriate type of liability (administrative, disciplinary, material, financial, and criminal) depending on the offense;
- state accounting and monitoring of soil fertility indicators of agricultural lands;
- the priority of soil protection technologies in the use of agricultural land over the economic interests of their owners and users, including tenants;
- providing state funding for soil protection measures based on land certification data;



**Fig. (1).** The structure of the impact of agrochemical certification on the formation of sustainable agricultural land use. Source: generated by the author.

- providing access to information on the use of state and local budgets to stimulate measures to protect agricultural lands and increase their fertility.

Agrochemical certification is the diagnostics of soil condition on 25 indicators of fertility, quality, pollution, micronutrient supply, and overall balance of elements that affect the absorption of nutrients in plant tissues. Thus, all this is the efficiency of fertilizers and high yield gains. Moreover, for the sale of products, some traders require an agrochemical passport.

Agrochemical certification contributes to the effective implementation of agrotechnical measures, which allows making a profit by adjusting the application of fertilizers (Table 1).

Today, fertilizers are becoming the source of soil pollution. Therefore, it is necessary to check the actual removal of nutrients from the crop, i.e., the availability of NPK trace elements in the harvested crop. The results of agrochemical certification will allow calculating the loss of fertility and future dosages of fertilizers more accurately.

Together with the agrochemical passport the land user receives:

- agrochemical cartograms of fields;
- results of agrochemical certification in the form of tables (for ease of use);
- indicators P and K for elementary plots (in the certificate – the average for the field). Phosphorus and potassium levels

**Table 1. Influence of Agrochemical Certification Indicators on Crop Yield Capacities.**

Indicators	Efficiency, Impact on the Yield Capacity, +/-
pH of soil solution	Below 6 or above 8 reduces the yield capacity and efficiency of fertilizers by 30-50%
Total of absorbed bases, mg-eq./100 g of soil	Potential yield capacity mg-eq./100 g of soil      25   35   40 c / ha                              60   100   120
Absorbed sodium, % to the total of absorbed bases Type and degree of salinity	Based on the degree of salinity and salinity loss of yield capacity and efficiency of fertilizers 30-50%. The use of chemical or agrobiological reclamation reduces losses by 80 - 100%.
The humus content in the arable layer, %	2-2,5 - 100%; 2,6-3,0 +15% ; 3,1-4,0 +25%; 4,1-5,0 +40%; 5,1-6,0 +50%.
Nitrate, phosphorus, and potassium nitrogen content in the arable layer, mg/kg	Based on the availability in the soil, an additional yield of 10 to 15 centners per hectare per cent. fertilizer per 1 ha
Trace elements' content	Increases the efficiency of fertilizers, as well as drought and winter hardiness
Content of mobile forms of heavy metals, radioactive contamination, and pesticide residues	A higher MPC contaminates products, leads to crop losses, diseases of plants, animals, humans, and problems with sales
Ecological and agrochemical assessment in points	Generalized indicator of cadastral soil assessment

can fluctuate significantly within the field, so it is important to monitor these fluctuations and, if possible, implement a precision farming system;

- optimal values of indicators determined during agrochemical certification;

- methodical recommendations on the use of the results of agrochemical certification.

In general, certification of agricultural land provides the following:

1. Performs soil monitoring, which enables the heads of farms, districts, regions, and the state to make decisions on soil protection.
2. Reduces the cost of fuels and lubricants, pesticides, fertilizers, as well as increases crop yields by an average of 3-4 quintals of grain units per hectare.
3. Detects uncontaminated land for growing environmentally friendly products.
4. Detects contaminated lands that require special management measures.
5. Allows creating / refining soil maps of the economy, implementing precision farming.

In addition, the availability of an agrochemical certificate of the field, agricultural land use is mandatory for the transfer of land ownership, use, and permission to remove and transfer the fertile soil layer of land, conservation, and reclamation of land, etc.

It is worth noting that the procedure for maintaining the agrochemical certificate of the field, land plot involves providing data on the levels of nutrient supply and contamination with toxic substances and radionuclides of soils every 5 years. We believe that the period needs to be reduced. Since the reduction of this period will contribute to the timeliness of measures aimed at improving the quality of land and pro-

tecting them from pollution. The importance of regulating the certification procedure determines the adoption of the relevant law "On certification of agricultural land", which would lay the foundations for the certification of agricultural land and ensure the protection and rational use of land. Moreover, several normative legal acts provided for the development of the draft Law of Ukraine "On State Agrochemical Passporting of Agricultural Lands". Such a bill was developed, but the relevant law has never been adopted.

Taking into account the above proposals, we have formed the main tasks of certification of agricultural land, which can be considered in the regulatory framework, namely:

- monitoring of soils and control over the quality of agricultural lands, as a priority in the composition of agricultural lands;
- providing landowners (land users) with state-standard passports, which include data on agrochemical characteristics of soils and the state of their contamination with toxic substances and radionuclides;
- determination, through research, indicators of soil quality and resource fertility, which are used in the certification of agricultural lands (soils), settlement of land relations, soil quality assessment;
- determination of conditions for rational use of organic, mineral and bacterial fertilizers, chemical ameliorants, and other agrochemicals that improve the quality of soils and prevent environmental pollution;
- finalizing the conclusions on changes in soil fertility and ecological status of lands for the implementation of economic incentives for measures to protect and use land and increase their fertility. Another feature of the certification process is that its subjects are landowners (land users) of large farms, as well as landowners of private plots.

Thus, in the first place, certificates allow the owners and land users who have the opportunity to form a sustainable agricultural land use to calculate the optimal number of fertilizers or ameliorants to obtain high and environmentally friendly yields of vegetables, berries, and fruits. In the certificate, the agrochemical score of the soil is indicated based on a 100-point scale. On this plot, they managed, applied organic and mineral fertilizers, limed, and probably improved the quality of the soil, that is, invested money, labor, and material resources in it. Therefore, a business entity has the legitimate right to request a significant increase in the value of the land, which is regulated by Article 205 of the Land Code of Ukraine.

Owners of private farms and farmers who own private or family land plots are also interested in conducting agrochemical surveys and periodic updates in the certificate because only in this way, the state and changes in soil resulting from agricultural activities can be analyzed.

The largest category is landowners who provide their plots for use. After performing the survey and obtaining an agrochemical certificate of the land plot, the owners have a document of the state standard, which provides real indicators of soil condition. Having handed it over to the tenant, the owners can discuss the condition that after the termination of the land lease agreement, the ground cover should not be in the worst condition. Namely, the agrochemical certificate is the only way to assess the quality of soil cover before signing the lease agreement and after its expiration.

For good owners, a certificate is a guarantee of moral and physical stability to landowners (landlords). By regulating the balance between the removal and entry of nutrients into the soil, using modern soil protection technologies, spending the appropriate funds, the tenant, taking into account the certificate indicators, plans their rational and efficient distribution, and as a result, gains profit and under current law control, gets proof of appropriate use of land resources. Besides, for the tenants who use the land for their benefit due to soil depletion, the mechanism of regulatory relations, which is designed in the certificate, will allow receiving appropriate compensation.

It is also worth considering the argument that applies to all categories of participants in land relations. For example, in case of emergencies, man-made disasters (involving chemical, biological, and radioactive contamination) or inappropriate treatment of neighbors and strangers, incompetent use of chemical plant protection products that led to pollution or deterioration of soil cover, the agrochemical certificate of a land plot (field) will bring the violator to justice or avoid it (in case of force majeure) within the current legal framework. And with the introduction of the market of agricultural land, the certificate will be the official basis for concluding documents (obtaining loans, insurance, refund, mortgage agreements, etc.).

In the works of leading scientists emphasis is placed on the need for certain changes in the method of agrochemical certification, which would provide information on the fertility of soils of the plot, field, share, taking into account the heterogeneity of soil cover. To do this, it is proposed to substitute the methods of route or selective by typical areas of the sur-

vey with a continuous method of the selection of nesting samples for a more detailed grid of points.

An integral part of the new methodological approaches to certification is also the use of space technologies (GIS, remote sensing, etc.), which ensure the efficiency of information on land use, soils, and the development of degradation processes. Given that certification materials are the basis for the implementation of state policy on protection and sustainable use of agricultural land, its priorities include research on the introduction of effective soil monitoring systems and the latest technologies for agrochemical certification of agricultural land, adapted to land reform. Changes are also needed to improve the scientific and information support of landowners, tenants, and landlords on the state of soil fertility and their agrochemical indicators. The introduction and operation of the system of certification of agricultural land at the current stage involve the use of topographic maps with a coordinate grid, a system of heights; use of land desoldering schemes; creation of an electronic version of soil maps within the lands of the relevant council on a modern topographic basis.

Under the order № 536 “On the statement of the Order of maintaining the agrochemical certificate of the field, the land plot”, results of the state agrochemical certification of the lands of agricultural purpose are used in:

- transferring of ownership or providing land for use, including lease;
- changing of landowner or land user;
- conducting a monetary valuation of the land;
- determining the land fees.

However, we believe that the results obtained should also be taken into account when:

- conducting economic incentives for measures to increase soil fertility;
- conducting state accounting of fertility indicators of agricultural lands;
- forming national, regional, and local information data banks on the condition of soils on agricultural lands;
- developing proposals for the withdrawal of marginal and degraded lands from active cultivation;
- monitoring the dynamics of changes in the quality of agricultural land due to their economic use;
- preparing expert opinions on violations of the legislation on pesticides and agrochemicals in the field of crop production, protection, and reproduction of soil fertility.

Equally important is the accuracy of field research, which is performed using modern cartographic material, mobile technical means of registration of coordinates of land boundaries, fields, and the place of determination of sampling and nesting soil samples. The use of a single coordinate system of land use will provide a quick determination of their exact geographical location, which is especially important in new land relations.

Such a system is a key component in the introduction of information technology. The first stage of such technology is

the preparation of a detailed map of land fertility. From here the volume of agrochemical, analytical works considerably grows.

To analyze and control changes in agrochemical data by fields and soil types, it is necessary to bring all information to the optimal survey scheme for elementary land plots, consolidate it and use it for field survey. Thus, regardless of the changed land use structure, the information on the main agrochemical soil indicators received on the elementary areas of the fixed scheme of the survey of the territory, will be summarized and analyzed in the fields of the landowner as a taxpayer and controlled under the Law of Ukraine “On Soil Protection”.

Under current conditions, methods of processing and summarizing the information of agrochemical certification of agricultural land and variable land use structure should be based on modern information technology with specially organized multilayered cartographic information, thematic databases, and a block of mathematical models. In general, the geoinformation system for assessing the agrochemical condition of soils is formed from an integrated cartographic database and a block of mathematical modeling. The generalizing factor of the system is a complex of geographic information systems, database management system, presentation of cartographic materials in electronic form. Such new information technologies will create conditions for operative agrochemical service of land users at a better level. However, this is only a partial solution to the problem. In general, at the state level, there is a need to create a land information system, which should consist of databases on the spatial characteristics of all the aspects of the state land and be based on a single coordinate reference system.

## CONCLUSIONS

The conducted analysis of the regulation of land relations and the formation of sustainable agricultural land use proved the need to introduce agrochemical land certification, which will allow to significantly improve the quality of agricultural lands in the future and ensure their rational use and protection. All this will significantly affect the state of the natural environment and contribute to the fulfillment of the conditions of sustainable development.

Under the conditions of reforming land relations to obtain reliable information about the condition of soils and the dynamics of changes in soil indicators, it is necessary:

- to adopt the law “On state agrochemical certification of agricultural land” and ensure state funding for agrochemical certification of agricultural land;
- to improve the methodology of soil sampling and agrochemical certification in the direction of detailing and its adaptation to the conditions of reforming the agricultural sector;
- to introduce GPS software that allows integrating the results of field surveys with the GIS database in the study of agricultural lands;
- to create databases on the spatial characteristics of the state land fund (including the State Land Cadastre), which would be based on a single coordinate system.

Thus, certification is an effective agrotechnical measure that allows earning extra income through the efficient use of fertilizers.

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