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AN INTEGRATED APPROACH TO PLANNING, ASSESSING AND IMPLEMENTING THE REMOVAL OF TOPSOIL: FROM REGULATIONS TO EVIDENCE-BASED LAND MANAGEMENT PRACTICES

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Abstract. *Scientific and methodological approaches to the development of land protection measures in modern land management documentation are proposed.*

The article examines the current requirements for the development of working land management projects for the removal and transfer of fertile soil in accordance with the regulatory framework of Ukraine. The main tasks of such projects are outlined, including ensuring the rational use and preservation of soil fertility, minimising the negative effects of economic activity, and restoring disturbed lands. The article analyses the key indicators that determine the feasibility of removing and storing soil layers: humus content, acidity, proportion of exchangeable sodium, and particle size distribution. It is shown that compliance with these parameters is an important factor in environmental safety and sustainable development of agricultural production.

The content of working land management projects includes design tasks, an explanatory note, description of natural conditions, results of soil and geodetic surveys, design solutions to determine a set of land protection measures, plans of agricultural soil groups, and calculations of the estimated cost of work. This structure ensures the scientific validity of decisions and the practical efficiency of their implementation.

The article summarises current knowledge and practices in the field of land management, offering a comprehensive approach to the development of working land management projects. The proposed rules and recommendations can serve as a basis for professionals involved in land management, agronomy and ecology.

Keywords: *land protection, land management, land improvement, land management, land management documentation, removal of fertile soil layer, working draft of land management.*

Actuality

Soil health is a key constraint on agricultural productivity and climate resilience. According to the IPCC, arable soils have lost 20-60% of their organic carbon stocks since the beginning of development, and degradation processes (including erosion) directly reduce fertility and increase greenhouse gas emissions [1]. The UNCCD estimates that up to 40% of the world's land is already degraded, which requires systematic measures to restore and manage soils based on the principles of land degradation neutrality (LDN) [2].

Ukraine is one of the countries with the most fertile black soil, but suffers from significant erosion losses. According to FAO estimates, more than 20% of arable land (≈6.5 million hectares) in Ukraine is degraded or unproductive, with 300-600 million tonnes of soil lost annually and crop losses of up to 50% depending on the level of degradation [4]. National assessments under the LDN initiative document the spread of water and wind erosion over approximately 57% of the country's territory [5]. Separately, significant annual losses of humus due to mineralisation and erosion are recorded [9].

The European Soil Strategy 2030 defines the goal of "healthy soil ecosystems" and requires linking land use, soil protection, and climate policy to reliable indicators of soil ecological status [3]. In Ukraine, since 2022, the Rules for the Development of Working Land Management Projects have been in force, which directly regulate the removal and transfer of fertile soil, storage and use of excavated soil, and reclamation of disturbed land [6]. However, international generalisations show that the effect of topsoil removal depth on yield and degradation risks is quantitatively sensitive and ambiguous, and therefore requires substantiation by specific data. A meta-analysis of topsoil removal experiments shows that yield reduction becomes statistically significant with decreasing thickness of the A-horizon and increases with increasing depth of removal [7]; modern field studies also document an increase in erosion flows, changes in infiltration and moisture after topsoil removal [8].

Thus, the scientifically sound design of topsoil removal and transfer works in Ukraine is critically important for three reasons: 1) the scale of degradation and loss of fertility at the national level [4], [5], [9]; 2) the requirements of European policy on soil restoration and monitoring [3]; 3) the quantitative sensitivity of yields and erosion processes to topsoil removal parameters, which requires local experimental data and standardised methods for assessing effects [1], [7], [8]. It is this framework that creates the basis for the transition from normative description to obtaining reproducible scientific results necessary for adjusting land management practices [2], [6].

Analysis of the latest scientific research and publications

International reviews have documented the causal link between soil degradation, loss of organic carbon and

declining agricultural productivity. The IPCC report (SRCCL) summarises the data on SOC losses due to arable land development and shows that degradation reduces yields and increases GHG emissions, which directly addresses the need to minimise topsoil disturbance [1]. The UNCCD in GLO2 assesses the extent of land degradation and formulates the LDN framework for restoration planning, where topsoil removal, relocation and return operations are considered high-risk without proper reclamation and monitoring [2]. The European Soil Strategy 2030 requires quantitative indicators of soil health and alignment of land management practices with ecosystem restoration goals [3].

The Ukrainian regulatory context is structured by the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Rules for the Development of Working Land Management Projects" No. 86 of 02.02.2022, which regulates the content of working land management projects for the removal and transfer of the fertile layer, including quality parameters, technologies, storage and reclamation [6]. DSTU 4362:2004 "Soil quality. Indicators of soil fertility" defines fertility indicators (humus content, density, granulometry, pH, etc.) that should be the basis for design decisions and monitoring the effects of work [7]. The Law of Ukraine "On Land Protection" sets out the legal framework for preserving soil fertility and reproduction, including through technological requirements for land use [8]. FAO's generalisations about Ukraine confirm the widespread degradation of arable land and the need for restorative practices and monitoring [4], [9].

The quantitative assessment of the effects of topsoil removal is summarised in the 2021 meta-analysis: the effect of erosion "cutting" or experimental removal of the surface layer statistically reduces yields; critical thresholds are associated with the residual thickness of the A horizon (> 25 cm) and the depth of removal (< 5 cm), beyond which the yield drop increases sharply [7]. Field surveys in 2023 recorded an increase in erosion flows, changes in infiltration and moisture, and a restructuring of plant communities after the surface layer was removed, which confirms the need for spatial risk modelling and phased implementation of the work [8].

A separate segment of the literature relates to temporary stockpiling and surface layer transfer. It has been proven that with the increase in storage time and height of the dumps, the viability of the seed bank decreases and the biological integrity of the soil deteriorates; direct prompt return of the removed layer to the reclamation sites provides better results for vegetation restoration than long-term storage [10-13]. Altered geochemical profiles and a decrease in nutrients in the thickness of the dumps, sometimes with accumulation of metals, have also been recorded, requiring control of the composition and stratification of dumps [14]. In different biomes, the results are consistent: the need to minimise the time between removal and placement, limit the height/angle of slopes, and apply protection against drying out and weed germination have been pointed out [10-15].

Ukrainian research emphasises the need for integrated monitoring of agricultural land and the link between degradation and economic losses, which is consistent with international findings on the criticality of topsoil conservation [9]. Taken together, the body of work forms a methodological basis for science-based design: quantitative justification of the depth of removal, storage, storage, mon-

itoring of fertility and erosion risks, as well as alignment with EU requirements for soil health [1-4], [6-15].

The aim of the study is to provide scientific justification for methodological approaches to the development of working land management projects for the removal and transfer of fertile soil layers, taking into account regulatory and legal requirements, soil and environmental parameters, and the practical results of a specific case study – a 11.8-hectare land plot located in the Kyiv region.

Materials and methods of scientific research

The study uses a set of generally accepted scientific methods aimed at analysing the regulatory, agrochemical, and spatial-soil aspects of developing working land management projects for the removal and transfer of fertile soil layers. The basic materials were the provisions of the current regulatory acts of Ukraine (Land Code, Law "On Land Management", Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Rules for the Development of Working Land Management Projects" No. 86 of 02.02.2022), the results of soil and geodetic surveys of a land plot with an area of 11.7981 hectares, as well as agrochemical indicators determined in accordance with DSTU 4362:2004. The following methods were used analysis and synthesis – to systematise legislative requirements; comparative method – to compare national and international approaches to soil protection; systematic method – to assess the interrelationships between standards, soil removal technology and environmental consequences; geoinformation analysis was used to spatially visualise agricultural soil groups and land development plans; generalisation was used to formulate practical recommendations and conclusions on improving the structure of working land management projects.

Research results and their discussion

In accordance with paragraph 28 of Resolution No. 86 of the Cabinet of Ministers of Ukraine dated 2 February 2022 "On Approval of the Rules for the Development of Working Land Management Projects," such working projects are developed to implement measures for the reclamation of disturbed lands, the removal and transfer of fertile soil layers, conservation of land, improvement of the quality of agricultural and forest lands, as well as for their protection against erosion, flooding, waterlogging, salinisation, drying out, landslides, compaction, acidification and contamination with waste, radioactive and chemical substances.

Working projects are developed by business entities that have the right to perform land management work in accordance with the Law of Ukraine "On Land Management", on the basis of a contract with the customer.

The working land management project includes: tasks for its preparation, an explanatory note, a description of the natural and agroclimatic conditions of the territory, materials from soil and geodetic surveys, technical and economic indicators, design solutions for land protection, cost estimates, plans of agricultural production groups of soils and slopes (if necessary), plans of measures and materials for transferring the project to the ground.

The main purpose of developing working projects for the removal and

transfer of fertile soil layers is to determine the scope of work involved in removing, transporting and storing soil, and in the case of soil covering, also the scope of its rational use. Such working projects involve developing the technology for performing the work, determining the sequence of operations and calculating costs.

Practical experience in developing working land management projects indicates the advisability of a two-stage approach to their creation.

The first stage involves conducting a soil survey of the land plot to determine the mass fraction of humus at the lower boundary of the fertile layer, which is the basis for establishing the depth of its removal and transfer. The survey should include not only agrochemical analysis, but also a detailed study of the genetic profile of the soil.

The second stage is the direct development of a working land management project in accordance with Article 54 of the Law of Ukraine "On Land Management".

According to the Resolution, a working land management project for the removal and transfer of fertile soil must contain justified decisions on the layer-by-layer removal and separate storage of the most fertile layer.

The object of the study of methods for developing land management documentation was a land plot with an area of 11.7981 hectares. The land plot is located in an agricultural land mass and borders on privately owned land plots.

According to soil survey data, the soil cover of the land plot is represented by an agricultural production group of soils with code 42d (dark grey podzolised, slightly leached, medium loamy soils).

According to the agrochemical characteristics of the soil, the humus content in this agricultural soil group in the 0-100 cm layer varies from 1.80 to 2.10%, which is assessed as slightly hu-

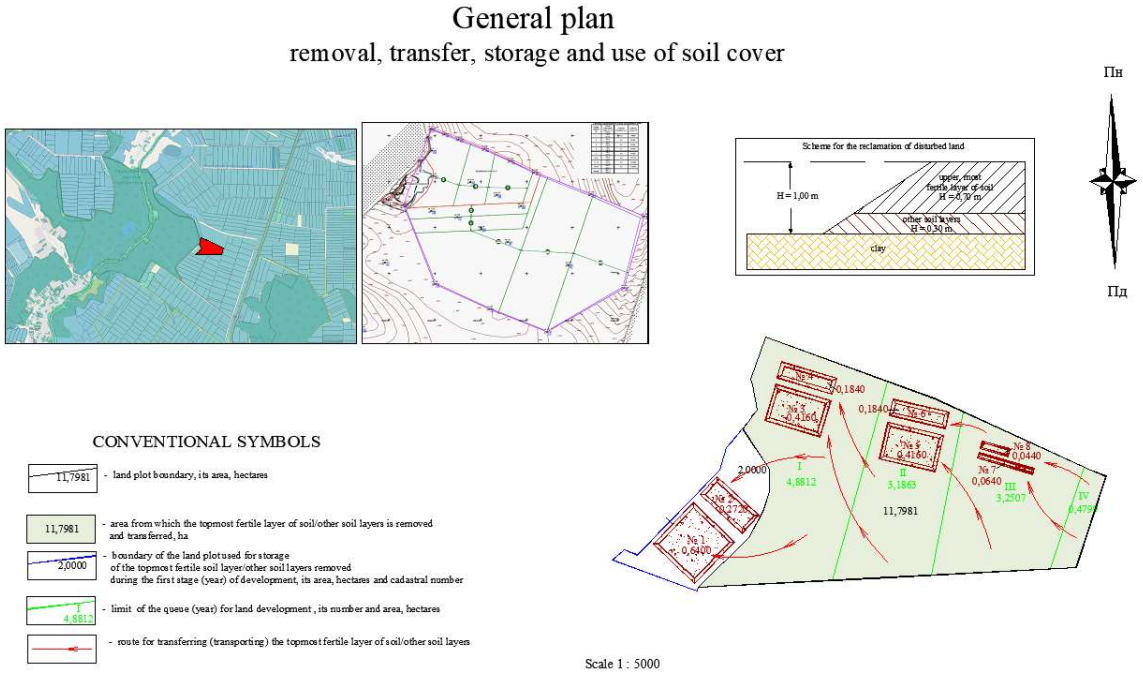

Fig. 1. General plan for removal, transfer, storage and use of topsoil

mus soil (according to DSTU 4362:2004 Soil quality. Soil fertility indicators).

The project solution provides for the layer-by-layer removal of the upper most fertile soil layer to a depth of 0.70 m and other soil layers to a depth of 0.30 m from an area of 11.7981 ha and their separate storage. The soil density is 1.30 t/m^3 (Fig. 1).

General standards for removing soil cover from land plots and standards for removing soil cover in terms of stages (years) of development are given in Tables 1 and 2.

The removal and transfer of topsoil will be carried out in the fourth stage of development. The technological scheme for removing topsoil includes:

- removal of the upper most fertile soil layer to a depth of 0.70 m;
- removal of other soil layers to a depth of 0.30 m.

The topsoil from the first stage of development is to be transferred and stored in temporary dumps No. 1 and No. 2. Subsequently, during the development of the quarry, as the areas of the development stages are freed up,

Table 1. General standards for removing soil cover from land plots

No.	Code agro-choi soil group	Area from which the topmost fertile soil layer/other soil layers are removed, m2	Depth of removal of the topmost fertile soil layer/other soil layers, m	Volume of the upper most fertile soil layer/other soil layers, m3	Density of the upper most fertile soil layer/other soil layers, t/m^3	Removal of the topmost fertile soil layer/other soil layers, tonnes
1	42d	117981	0,70	82587	1,30	107363
2		117981	0,30	35394		46013
Total:		-	-	117981		153375

Table 2. Standards for soil cover removal in terms of stages (years) of development

Queue number (year) of development	Area from which the topmost fertile soil layer/ other soil layers are removed, m^2	Depth of removal of the topmost fertile soil layer/other soil layers, m	Volume of the upper most fertile soil layer/other soil layers, m^3	Density of the upper most fertile soil layer/other soil layers, t/m^3	Removal of the topmost fertile soil layer/other soil layers, tonnes
I	48812	0,70	34168	1,30	44419
		0,30	14644		19037
Всього:			48812		63456
II	31863	0,70	22304	1,30	28995
		0,30	9559		12427
Всього:			31863		41422
III	32507	0,70	22755	1,30	29581
		0,30	9752		12678
Всього:			32507		42259
IV	4799	0,70	3359	1,30	4367
		0,30	1440		1872
Всього:			4799		6239
Разом:	117981		117981		153375

the soil cover of the next stage will be transferred (stored) to temporary dumps Nos. 3-8 in the space developed during the previous stage.

In accordance with paragraph 26 of the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Rules for the Development of Working Land Management Projects" dated 2 February 2022 No. 86, land plots of any intended use may be used for temporary storage of fertile soil with the consent of the owner or user of the land plot.

When the soil cover is removed, it is loosened, resulting in a 5-7% increase in volume, and the volume of temporary dumps for storage also increases by 5-7%. Before laying temporary soil cover dumps, the area is cleared of debris and its surface is levelled with a bulldozer (loader). A complex of works on the arrangement of a temporary dump includes levelling the soil cover, forming the "body" of the dump, approaches and exits from the dump, levelling the slopes and crest of the dumps. Work to protect temporary dumps from denudation processes (washing away, blowing away, weathering, etc.) is carried out by sowing perennial grass seeds on its surface.

The proposed stages (years) of development are generally advisory in nature and determine the general directions for removing and transferring soil cover and the general sequence of actions. They may change (be adjusted) depending on the economic situation and the increase in the number of units of equipment.

In accordance with Article 168 of the Land Code of Ukraine and Article 52 of the Law of Ukraine "On Land Protection", the fertile soil layer/other soil layers will be used for land reclamation. The reclamation scheme is shown in Figure 1.

Conclusions and perspectives

The results of the study confirmed that the effectiveness of developing working land management projects for removing and transferring fertile soil layers directly depends on the scientific validity of the parameters of the work, taking into account agrochemical indicators and spatial characteristics of land plots. The analysis of the regulatory framework, combined with a case study based on a land plot with an area of 11.7981 hectares, proved that the current standards need to be adapted to regional fertility conditions and different soil types, since the actual values of humus, acidity and granulometric composition may differ significantly from the established limits.

It has been determined that a two-stage structure for preparing working projects (preliminary soil survey and development of technical and economic solutions) provides an optimal combination of regulatory requirements and practical implementation of work, but its effectiveness is enhanced by the use of digital mapping methods, automated models for predicting erosion losses, and multifactorial analysis of soil quality indicators. The proposed approach to assessing the suitability of land for topsoil removal based on agrochemical indicators (humus content, pH, exchangeable sodium, granulometry) creates the basis for the formation of national standardised criteria for the environmental safety of these works.

The results confirm that the integration of geoinformation technologies, digital monitoring and regionally adapted standards can significantly reduce the risks of soil degradation and increase the effectiveness of recultivation of disturbed lands. This approach

forms a practical basis for the transition from formal implementation of project procedures to systematic soil fertility management, which is consistent with European standards of "soil health" and the goals of land degradation neutrality.

References

1. IPCC. (2019). Climate Change and Land: an IPCC Special Report. Available at: https://www.ipcc.ch/srccl/
2. UNCCD. (2022). Global Land Outlook (2nd ed.). Bonn: UNCCD. Available at: https://www.unccd.int/resources/global-land-outlook/glo2
3. European Commission. (2021). EU Soil Strategy for 2030: COM(2021) 699 final. Brussels. Available at: https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:52021DC0699
4. FAO. (2018–2024). FAO Soils Portal: Ukraine country profile. Available at: https://www.fao.org/soils-portal/soilex/country-profiles/details/en/?iso3=UKR
5. UNCCD. (2015). Land Degradation Neutrality Target Setting Programme: Ukraine Country Report. Available at: https://www.unccd.int/sites/default/files/ldn_targets/2019-06/Ukraine%20LDN%20TSP%20Country%20Report.pdf
6. On Approval of the Rules for Developing Land Management Projects (2022). Cabinet of Ministers of Ukraine: Resolution No. 86. Available at: https://zakon.rada.gov.ua/laws/show/86-2022-п#Text
7. DSTU 4362:2004. (2006). Soil Quality. Indicators of Soil Fertility. Available at: https://zakon.isu.net.ua/sites/default/files/normdocs/dstu_4362_2004.pdf
8. On Land Protection (2003). Law of Ukraine Verkhovna Rada of Ukraine. No. 962-IV. Official Bulletin of the Verkhovna Rada of Ukraine, No. 39, Article 349. Available at: https://zakon.rada.gov.ua/laws/show/962-15#Text
9. Perovich, L., & Hulko, O. (2019). Monitoring the actual ecological and economic situation of agricultural land use in Ukraine. Geodesy and Cartography, 68(2), 349–359. DOI: 10.24425/gac.2019.128464. Available at: https://journals.pan.pl/Content/112067/PDF/08_GC_2_2019.pdf
10. Zhang, L., Huang, Y., Rong, L., Duan, X., & Pan, F. (2021). Effect of soil erosion depth on crop yield based on topsoil removal method: A meta-analysis. Agronomy for Sustainable Development, 41, Article 63. DOI: 10.1007/s13593-021-00718-8. Available at: https://link.springer.com/article/10.1007/s13593-021-00718-8
11. DeVilleneuve, S., López-Ballesteros, A., Bennett, S., et al. (2023). Impacts of vegetation and topsoil removal on soil erosion, soil moisture and infiltration. Agrosystems, Geosciences & Environment, 6(4), Article e20402. DOI: 10.1002/agg2.20402. Available at: https://acsess.onlinelibrary.wiley.com/doi/10.1002/agg2.20402
12. Valliere, J. M., et al. (2022). Stockpiling disrupts the biological integrity of topsoil for restoration. Plant and Soil, 470, 63–79. DOI: 10.1007/s11104-021-05217-z. Available at: https://link.springer.com/article/10.1007/s11104-021-05217-z
13. Golos, P. J., & Dixon, K. W. (2014). Waterproofing topsoil stockpiles minimizes viability decline in the soil seed bank. Restoration Ecology, 22(4), 495–501. DOI: 10.1111/rec.12090. Available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/rec.12090
14. Fischer, A. M., et al. (2022). Impacts from topsoil stockpile height on soil geochemical properties. GeoHazards, 2(2), 251–268. DOI: 10.3390/geohazards2020017. Available at: https://www.mdpi.com/2673-6489/2/2/17
15. Mackenzie, D. D., et al. (2019). Native seed, soil and atmosphere respond to boreal forest restoration following mining. Restoration Ecology, 27(6), 1284–1295. DOI: 10.1111/rec.13076. Available at: https://pmc.ncbi.nlm.nih.gov/articles/PMC6746386/

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КОМПЛЕКСНИЙ ПІДХІД ДО ПЛАНУВАННЯ, ОЦІНКИ ТА РЕАЛІЗАЦІЇ РОБІТ ІЗ ЗНЯТТЯ РОДЮЧОГО ШАРУ ҐРУНТУ: ВІД НОРМАТИВІВ ДО ДОКАЗОВИХ ПРАКТИК ЗЕМЛЕУСТРОЮ

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Анотація. *Запропоновано науково-методичні підходи щодо розроблення заходів з охорони земель в сучасній документації із землеустрою.*

У статті розглянуто сучасні вимоги до розроблення робочих проєктів землеустрою щодо зняття та перенесення родючого шару ґрунту відповідно до нормативно-правової бази України. Окреслено основні завдання таких проєктів, серед яких – забезпечення раціонального використання та збереження родючості ґрунтів, мінімізація негативних наслідків господарської діяльності та відновлення порушених земель. Проведено аналіз ключових показників, що визначають доцільність зняття й складування ґрунтових шарів: вміст гумусу, кислотність, частка обмінного натрію та гранулометричний склад. Показано, що дотримання цих параметрів є важливим чинником екологічної безпеки та сталого розвитку аграрного виробництва.

Зміст робочих проєктів землеустрою включає завдання на проєктування, пояснювальну записку, характеристику природних умов, результати ґрунтових і геодезичних обстежень, проєктні рішення із визначення комплексу заходів з охорони земель, плани агровиробничих груп ґрунтів та розрахунки кошторисної вартості виконання робіт. Така структура забезпечує наукову обґрунтованість рішень і практичну ефективність їх реалізації.

Стаття узагальнює актуальні знання та практики у сфері землеустрою, пропонуючи комплексний підхід до розроблення робочих проєктів землеустрою. Пропоновані правила та рекомендації можуть служити основою для фахівців, зайнятих у сфері управління земельними ресурсами, агрономії та екології.

Ключові слова: *охорона земель, землеустрій, поліпшення стану земель, управління земельними ресурсами, документація із землеустрою, зняття родючого шару ґрунту, робочий проєкт землеустрою.*