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ASSESSMENT CRITERIA AND ECONOMIC RATIONALE FOR THE RECLAMATION OF DRAINED PEATLANDS

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Abstract

From sequestering and storing carbon to purifying water and maintaining a treasure trove of biodiversity, peatlands benefit people, wildlife and the environment in a myriad of ways. And although they occupy only about 3% of the earth's surface, the ecosystem services that peatlands provide and the positive impact they have on our planet more than justify their support and our diligent care for them.

Covering more than 400 million hectares worldwide, peatlands can be found anywhere from high mountains to the sea, from high to low latitudes. They are a type of wetlands - ecosystems with peat soil. Peatlands provide important ecosystem services that contribute to the well-being of people and the natural environment.

The drained peatlands are extremely diverse and heterogeneous in their condition. This is due to the use of different methods of peat extraction, the timing of sites being decommissioned, the state of the drainage system, the type of deposit, the strength of the residual layer of peat and its properties, the properties of the mineral rocks underlying the peat deposit, etc.

When choosing the direction of use of VTR, all the above factors must be considered in a complex manner. Rewetting at least two-thirds of drained peatlands, or 30 million hectares, could help prevent the combined human land-use practices in these areas from becoming a source of net carbon emissions. • Re-wetting of peatlands can significantly contribute to the achievement of ecosystem goals.

Drained peatlands are extremely diverse and heterogeneous in their condition. This is due to the use of other methods of peat extraction, the conditions of the decommissioned site, the condition of the drainage system, the type of deposit, the strength of the residual layer of peat and its properties, the properties of the useful mineral rock underlying the peat deposit, etc.

On the basis of scientific research, materials are presented that confirm the possibility of using produced peat deposits taking into account their natural properties.

Introduction

The drained peatlands are extremely diverse and heterogeneous in their condition. This is due to the use of different methods of peat extraction, the timing of sites being decommissioned, the state of the drainage system, the type of deposit, the strength of the residual layer of peat and its properties, the properties of the mineral rocks underlying the peat deposit, etc.

When choosing the direction of use of VTR, all the above factors must be considered in a complex manner. Let's analyze the value of each of these parameters.

The most important technical requirement for peat extraction from the point of view of further use of the drained peatlands is obtaining a flat surface and a constant depth of the residual layer of peat.

In practice, it is not always possible to comply with these conditions. It depends mainly on the relief of the surface of the underlying mineral bed (geomorphological conditions). In order to leave a fixed depth of the deposit, it is necessary to copy the topography of the underlying layer before completing the peat extraction which leads to the same uneven surface of drained peatlands. The leveling of such peatlands indicates a significant difference in the relief and hydrological regime of individual areas. Development of such deposits is complicated.

When a flat surface is reached, the thickness of the residual layer of peat in individual areas and, as a result, the type, degree of decomposition, ash content, physical and agrochemical properties, and the presence of woody remains differ dramatically.

1. Natural properties of drained peatlands

Currently, peat extraction is carried out mainly by milling and up to 10% by excavator methods, therefore, according to the extraction method, extracted milling fields and extracted peat quarries are distinguished.

The quarries filled with peat, stumps of various shapes, thickets of shrubs and forest, with almost no drainage network, are unsuitable for agricultural use.

The most suitable for agricultural use are the fields after the extraction of peat by the milling method in the form of separate aligned maps with a width of 20-40 м, length of 500 м, separated by frequently operating drainage map and bulk channels. The depth of the map channels is 0,5-0,7 м; gross channels - 2-3 м, and the width along the surface - 5-8 м.

Hydrotechnical structures on bulk channels are stored in different ways. Crossings are suitable for the passage of agricultural machinery, locks and crossing locks require repair or reconstruction.

The strength of the residual layer of peat when used in agriculture should be at least 0,5 м, but this layer is not enough. Different crops require a larger layer: perennial grasses - 0,6-0,65 м; cereals - 0,65-0,7 м; in-row - 0,7-0,8 м, that is, the optimal thickness of the layer should be 0,75-1,0 м.

The residual layer on the extracted t/r is mainly represented by peats of the lowland type, since upland peat is rarely found in the bottom layer.

Lowland peat is characterized by an ash content of 6-18%; degree of decomposition 25-40%, acidity pH 4,5-6,0, high content of nitrogen (1,4-4,0 %) and calcium (1,5-6,5%) and low content of phosphorus, potassium and trace elements. The content of mobile forms of phosphorus and potassium rarely exceeds 10 mg/100 g of soil. Hydrolytic acidity varies between 10 and 60 mmol/100 g of water , the degree of saturation with bases - 50-90%. The majority of lowland type VTRs are characterized by a high content of mobile forms of iron oxides (0,3-1,3 %) and mobile aluminum (0,01-0.2%).

Degraded peatlands must be restored, regardless of the type of deposit and the method of peat extraction, no later than one year after the end of mining operations.

If the areas are not restored immediately, they will gradually become overgrown.

Wood species, shrubs, and grasses quickly appear on the lowland-type VTR. Overgrowth of the upland type begins only 3-4 years after the completion of peat extraction.

Prolonging the term of land restoration leads to a sharp increase in the cost of reclamation. First of all, it is necessary to recultivate the developed areas of the lowland type. Upland type peat deposits and quarries belong to the objects of the second priority due to the high costs of their cultivation.

For drained peat deposits, the normative depth of the peat deposit is established depending on the direction of its further use.

For the use of degraded milled fields for agricultural purposes, the residual layer must be at least 0,5 m; for afforestation, which involves plowing with wrapping of the residual layer under mineral soil, is 0,15-0,5 m(not less 0,3 m for afforestation); for a water reservoir or fish farms should be removed completely, including the bottom deposits (silt, sapropel), since the peat flooded in the reservoir is not only lost valuable organic material, but also a harmful component of the reservoir, since the flooded peat often floats to the surface of the reservoir, forming alloy and contributing to its overgrowth.

The depth of the residual layer is conditional, as it depends on the following factors: hydrological regime, geomorphological conditions, type of deposit, mechanical composition of the underlying mineral rocks, properties of the peat layer (dispersity, moisture absorption and moisture retention capacity).

The depth of the residual layer is largely determined by the availability of nutrients in the underlying layer. If the mineral rocks contain sufficient nutrients, the residual layer can be smaller and vice versa. At the same time, it is necessary to take into account the water permeability of the underlying soils. If the soil is dense, the layer of peat should be larger than on permeable soils.

2. Assessment criteria and ecological and economic rationale of peatlands.

At the stage of designing a peat extraction enterprise, it is necessary to substantiate the criteria by which the direction of use of the drained peatlands is chosen, without which the achieved results will not be effective enough, and the reclamation costs will be useless. The analysis of characteristic features of peat deposits allows to develop criteria and a classifier, by which it is possible to determine to which geomorphological group the peat deposit belongs, and to choose a rational direction of use of the area after production of industrial peat reserves. The classifier includes six criteria: the area of the peat deposit within the zero deposit, the configuration of the boundaries of the peat deposit in plan, the shape of the cross-section, and three criteria characterizing individual sections of the peat deposit: the stratigraphy of the deposit, the average ash content of the peat, the acidity of the peat in the bottom half-meter layer.

It is impossible to determine the geomorphological group of a peat deposit based on only one or two criteria. For example, peat deposits of moraine plains, sewage basins and floodplains can have the same area.

But at the same time, they will differ in configuration in the plan. Peat deposits of moraine plains of shallow interfluvial depressions and slopes of floodplain terraces do not differ in plan configuration, but have different deposit stratigraphy, etc.

The dependence of the sizes of the areas of the peat deposit on the geomorphological conditions of occurrence is unclear. If you classify by only one indicator, objects belonging to different geomorphological groups may be in the same group. There is no clear difference between neighboring geomorphological groups. But the groups that stand from each other in a row by four intervals or more differ significantly (Table 1).

Table 1

The area within the zero deposit t/r of different geomorphological groups

Geomorphological group	Area within zero deposit, ha	
	mnimum	maximum
Drainless between moraine basins of the final moraine landscape	100	800
Buried floodplains	100	1000
Floodplain peat deposits	100	2500
Drainless basins	500	6000
Sewage basins	800	8000
Plavno - priterasni	1000	12000
Slopes of floodplain terraces	1500	12000
Moraine plains	1500	16000
Shallow interriver depressions of the basin type	600	20000
Old year	500	28000
Polish plains	7000	45000

In the case when the area does not correspond to the geomorphological group to which it belongs, preference should be given to the remaining five criteria.

The contours of the peat deposit in plan and the shape of its section acquire characteristic features depending on the geomorphological conditions of occurrence.

On Fig. 1 shows the contours of some t/r drainless basins , the development of which took place in conditions of insufficient mineral nutrition.

The group of t/r drainless basins is characterized by a closed contour in plan with a sharply defined boundary. The cross-section of the t/r of this group is characterized by great depths filled with sapropels , a convex surface of the deposit in several places.

T/r of non-drainage basins formed in conditions of rich mineral nutrition , in contrast to T/r of non-drainage basins formed in conditions of poor mineral nutrition, did not enter the oligotrophic stage, therefore do not have a convex shape, they are characterized by the presence of non-peat remains of lakes (Fig. 1), the area of which in some cases exceeds the area of the deposit. Then the shore of the lake and the borders of the t/r (within the zero deposit) have a common closed circuit.

Drainage between moraine basins end -moraine landscape are distinguished by a smaller area, the presence of pine-downy peat and a much smaller layer of sapropels . The cross-section is characterized by the convexity of the deposit surface only in its central part (Fig.).

T/r sewage basins are characterized by a broken contour, the shores converge to the place of the break. Accordingly, slight slopes of the surface of the deposit and the bottom of the basin, directed towards the gap, are visible on the cross section (Fig. 1). The bottom of the basin has many dips and rises. Depressions are filled with sapropels . The place of narrowing is often a transition to a floodplain or floodplain -interterranean t/r.

T/r of shallow interriver depressions (Fig. 1) were formed in the conditions of weak relief. In the beginning, there were shallow depressions underlain by impermeable rocks. Since the initial cells were shallow, the peat-forming process quickly passed into the oligotrophic stage. These features affected the shape of the cross section. If in plan their configuration is little different from the configurations of most t/r lying on watersheds, then the cross-section is very different with a convex surface and a small depth of the basin.

Boundary configuration and cross-sectional shape of peat deposits of moraine plains (Fig. 1) in general terms, they look like t/r of drainless basins , which were formed in conditions of poor mineral nutrition: they have a closed contour, in the central part they are convex. They differ in the absence of thick lake sediments and are present only in the lowest parts of depressions. Sometimes, instead of sapropels, hypnotic peat is observed at the bottom of the depression .

The territory of the Polish plains (Fig. 1 *)* in plan is a large area, limited by a closed contour of an uncertain shape. A characteristic feature is the smooth surface of the deposit and the mineral bottom . almost no slopes and a shallow depression in the mineral soil.

Fig. 1. Scheme of the possible location of peat deposits (t/r) according to the relief: I- the first supraflood terrace; II - the second floodplain terrace; III - watershed, and - t/r floodplain; o - t/r of the first supraflood terrace; *c*, *d*, *d* - t/r of the second supraflood terraces: *e* - t/r flow-through: *g* - t/r of drainless basins ; from - t/r of sewage basins .

The peat industry uses significant areas of peat deposits, which are transferred to it for temporary use from forest and agricultural land funds. According to the existing regulations, after production, t/r must be returned to former land users in a condition suitable for their further use. The total area of produced peat in Ukraine is about 32,000 ha.

On the territory of Ukraine today there are about 32,000 hectares of cultivated peat areas, most of which are not used in the national economy).

The volumes of reclamation are extremely unstable: 2016 - 657 га; 2017 - 168 га; 2018 - 730 га; 2019 - 114 га; 2020 - 235 hectares.

The peat deposit is an important link of the ecological system. With its drainage, the ecological balance that has developed in the area of its location is disturbed. If the peat deposit is drained for the purpose of peat extraction, the changes in conditions in the ecological system occur for a short period (20-30 years), during which these changes do not acquire critical significance. The use of produced peat deposits lasts much longer, and the failure to implement scientifically based directions for their use can cause a large peak in forest areas, reservoirs (waterlogging of nearby lakes, shallowing and disappearance of rivers) and meadows located in adjacent territories, which is usually several times larger than the area of the deposit rational use could provide a significant amount of forest plantations, marketable fish, and hay for livestock. In general, the developed areas must be returned as soon as possible to their original state, in which they were in ancient times.

Until now, the following main directions of use of VTR have been formed: agricultural , forestry, water management and creation of hunting grounds. For many decades, the choice of the direction of use of VTR was not carried out on a scientific basis, but by voluntary decisions of the authorities, mainly for agriculture, in connection with which the practical use of VTR led to negative economic and environmental consequences. The transition to a scientifically based direction of the use of VTR led to a nature protection direction - rewetting, with justified use of individual sub-farms, afforestation and creation of reservoirs.

The phasing of determining the direction of use of disturbed land should be implemented in the following sequence: - at the stage of development of the construction project of the enterprise, the section "Reclamation of areas after peat extraction " is developed, in which the direction of use is determined based on the materials of exploration of its properties and the conditions of the deposition of the peat deposit VTP, the corresponding depth of the residual layer and, taking into account the ecological and socio-economic condition of the region, develop a project of reclamation of the VTP.

Unfortunately, this sequence is rarely followed leads to negative consequences of reclamation even with the investment of significant funds. For example, according to the data, out of 15,6 thousand hectares that were surveyed and transferred to agricultural enterprises, 6,3 thousand hectares were not harvested at all, and 5,1 thousand hectares were up to 15 c/ha of fodder units, and only on 4,2 thousand ha. hay yields ranged from 16 to 30 c/ha.

The main reasons for the low productivity of agricultural land are the neglect of the genetic features of the VTR. Thus, it is practically impossible to create a favorable water regime for agricultural crops on peat deposits of closed basins or the slope of watersheds: in the first case, the soil is overmoistened, in the second - overdried. Unfavorable for agricultural use of VTP with a residual layer of top peat, due to its high acidity, for neutralization of which it is necessary to apply up to 28 t/ha of limestone materials, which is unprofitable , and a layer of peat underlain by sapropel.

One of the most important criteria for choosing the direction of use of the produced areas is the geomorphological and geological features of the peat deposit, which depend on its water and mineral nutrition and, as a result, the properties and direction of use . For the correct assessment of the economic value and the optimal mode of their use. The most complete quantitative and physicochemical characteristics of peat, its underlying mineral soil and information on water and air properties are necessary.

It must be taken into account that the properties of the residual layer peat significantly differs from the surface layer of peat in its low fertility due to the low content of NPK nutrients necessary for plant development elements. Contact layer. which lies on the mineral bottom. on the contrary, accumulates such a high NPK content, that their concentration is toxic for plants. The bottom layer of peat has unsatisfactory water-physical properties, because there is a sharp difference in water-physical characteristics when passing from the peat layer to the mineral underlying rock, and at the border of these layers, after drying, the capillary bonds break, as a result of which the supply of water from the mineral to the the peat layer and the water regime do not depend on the level of groundwater, but are determined by meteorological conditions.

The thermal regime is not very favorable for the development of plants: peat soils are cold, they are characterized by sharp changes in heat and cold during the day and season.

The residual layer is characterized by weak aeration. The number of pores occupied by air is low (does not exceed 2-6 %) compared to unprocessed peat deposits (37-62%).

The excess layer has low biological activity, which is explained by the content of a significant amount of substances that are not hydrolyzed and therefore inaccessible to microorganisms. With the oxidation of the peat of the residual layer, its components are gradually hydrolyzed, the number of microorganisms increases and, as a result, the peat turns into soil. But this process is very slow.

Taking into account the above facts, it is necessary to preserve a significant part of natural ecosystems and use VTR mainly for rewetting, reservoirs and only exclusively for agriculturalland (pastures, hay meadows or cultivation of crops resist ant to the factors specified in this section).

3. Land reclamation and calculation of their economic efficiency at the design stage

Projects for the reclamation of disturbed lands are developed on the basis of the design task and technical conditions.

In the reclamation project, the technical and economic feasibility of reclamation is established, the type of further targeted use of reclaimed land is substantiated, the scope of work of the technical and biological stages of reclamation is determined, the most rational complexes of machines and equipment are selected, schemes for the formation of dumps and mining and planning works, removal, transportation, assembly are developed and applying a fertile layer of soil to the prepared surface of the dumps. A calendar plan of works is drawn up, summary technical and economic indicators and the estimated cost of reclamation works are developed. If necessary, the reclamation project substantiates changes in the technological process of operating enterprises and other, previously approved, design solutions (location of dumps, their shape, parameters, method of backfilling, technology of removal and storage of the fertile soil layer, etc.).

Design organizations of the Derzhkomzem system, the Ministry of Agrarian Policy, the Ministry of Ecology and Natural Resources, and the Ministry of Education and Science of Ukraine are involved in the design of biological reclamation on contractual terms.

The development of individual sections of the project (extinguishing, development, lowering and reshaping of mine tericons followed by their landscaping) or landscaping projects without performing the work of the technical stage of reclamation is allowed to be carried out by divisions of production facilities with the involvement of specialized organizations on contractual terms or using the recommendations developed by them. For example, the following recommendations for biological reclamation on spent mine sites in the Donbass were proposed by the Donetsk Botanical Garden of the Academy of Sciences of Ukraine, dumps on the territory of the Nikopol Manganese Ore Combine - Dnipropetrovsk State Agrarian University, and overburden dumps on the territory of the Precarpathian sulfur-bearing basin by the Lviv State Agrarian University.

Materials of the technical project are transferred to the customer by the project organization (general designer) in four copies, and to the subcontracting project organization in five copies, except for objective estimates, the number of copies of which must be one more. In cases of execution of certain types of work by subcontracting organizations or land users, the project organization shall provide the customer with one additional copy of objective estimates for each subcontracting organization (land user). Working drawings are issued to the customer in four copies. The technical and working project is issued to the customer in the same number of copies as the working drawings.

projects establish the economic efficiency of costs in the process of agricultural and fishery reclamation, which is determined by the time at which reclamation costs will pay off

$$E_3 = \frac{T \cdot B}{E_r} \text{ ,years} \quad (1)$$

where *T* is the amount of costs for the technical stage of reclamation, UAH/ha;

B - the same for the biological stage, UAH/ha;

E_r - annual income from the sale of agricultural (fish) products from the reclaimed (irrigated) area, hryvnias/ha.

The initial data for calculating the economic efficiency of reclamation is used from the following sources:

- costs for the technical and biological stages of reclamation - from the estimate to the project;
- a list of agricultural crops - from the structure of crop rotations in which the plot is expected to be used, or from the crop rotation, if they will be used outside the crop rotation; in the design of the reservoir, the species of fish that will be bred are established;
- costs for the production of a unit of production - from the materials of agricultural or fishing enterprises of the annual reports of farms located near mining enterprises;
- costs for processing and sales of products are estimated to be 7,2% of the total costs of products sold.

The comparative economic efficiency of biological remediation can be calculated as at minimal costs

$$C1 + EnKr = min \quad (2)$$

and for maximum profit:

$$Er - En\ Cr = \max \quad (3)$$

where C1 is current costs for each option, UAH;

Kr - capital costs for 1 raland reclamation, which includes production losses associated with land disturbance, hryvnias;

Er - the total amount of the average annual effect from 1 raland reclamation, hryvnias;

En - normative efficiency ratio of capital investments.

The technical conditions for the design of reclamation are a document that justifies the choice of use of reclaimed land, determines feasibility and production value, as well as establishes the approximate scope of work, cost and technical indicators necessary for the design of reclamation.

Technical conditions are drawn up at the expense of the founder by the general designer with the participation of project organizations of the system of the Ministry of Agrarian Policy, the Ministry of Forestry , the Ministry of Fisheries, Derkomzem of Ukraine, etc., which are involved as subcontractors in the design of reclamation, agree with the customer and other interested organizations and are approved by the head (deputy) executive committee of the regional Council of People's Deputies.

In the case of land reclamation of the state forest fund , the working project must be agreed with the relevant forestry authorities.

Technical conditions include:

- general conditions about the object of reclamation (location, characteristics and area of disturbed lands, characteristics of soil cover, direction of reclamation, etc.);
- conditions for performing the technical stage of reclamation (requirements for backfilling of sinkholes, planning of dumps, etc.), approximate scope of work, etc.;
- the conditions for the implementation of the dialogue stage of reclamation, the terms of biological reclamation, the type of subsequent use of reclaimed land, including arable land, hayfields, limed slopes, afforestation, greening of tericons, etc.;
- the procedure for carrying out reclamation works and their financing.

In general, recommendations developed by Derzhkomzem, branch ministries and departments can be used when drawing up technical conditions.

At existing mining and other enterprises, before drawing up the technical conditions, a survey of the land plots that are planned to be reclaimed is carried out. For this purpose, a commission is created, which includes representatives of the regional state administration, the Department of Agriculture, the Department of Land Resources, forestry authorities (for the lands of the state forest fund), agricultural enterprises to which the plots of land will be transferred, customers and general designers, on whose initiative the survey is conducted. If necessary, the commission includes representatives of subcontracting organizations, sanitation stations, basin and fish inspection, etc.

The commission establishes:

- the presence of disturbed lands, including those subject to reclamation;

- according to which decision (order), when, for what period, for what purposes and at the expense of which lands were the lands confiscated.

At the same time, the commission agrees on the directions and type of reclamation and enumerates measures that must be carried out at the technical and biological stages of reclamation to protect soils from erosion, waterlogging, chemical melioration of toxic rocks, etc.

The results of the survey are formalized in an act, and their materials are used during the drafting of technical conditions.

The reclamation design task is prepared by the customer (production association) with the participation of the design organization that undertakes the development of the project (general designer), with the involvement, if necessary, of specialized (agricultural and forestry) organizations.

The reclamation design task includes:

- basis for drawing up the reclamation project;

- characteristics of the design object;

- the list of options to be considered on the basis of a technical and economic comparison depending on the complexity and volume of violations, as well as: the value of the violated lands;

- approximate values of the main technical and economic indicators and other data.

Attached to the task is a certificate on the types and number of machines and mechanisms that can be used during reclamation, as well as those that have design and research materials.

During the development of reclamation projects, technical documentation on geological prospecting and other survey works is used, on the basis of which the construction (reconstruction) project of the mine was drawn up, as well as general plans, profiles and materials of additional surveys carried out during operation and after its completion.

In cases where the initial data necessary for the design of reclamation are not available or the initial materials cannot be used, the customer may instruct the project organization-general designer or, on his recommendation, a specialized design or search organization to prepare, under a separate contract, the necessary for the design of reclamation raw materials at the expense of funds of the main activity of the customer enterprise or funds allocated to it for such purposes by a higher authority.

The list of raw data for designers includes:

- brief data on the economy and prospects for the development of the district's industrial and agricultural (forestry) potential;

- requirements of local forestry and agricultural authorities and the sanitary-epidemiological service regarding improvement of land use, preservation or restoration of nature, improvement of sanitary-hygienic conditions, etc.;

- information on the acquired experience and proposals for reducing the negative impact of mining operations on the earth's surface;

- data on positive experience and existing proposals for technological schemes of mineral development, which ensure the most complete extraction of subsoil;

- information on methods of forming internal and external overburden dumps;

- land use plan and land management project of land plots that may be disturbed as a result of the activity of the mining enterprise, or have already been disturbed;

- data on soil grading and economic evaluation of lands to be disturbed by industrial enterprises.

The list of raw data of operating enterprises with disturbed lands includes:

- general information about the enterprise (name, subordination, location with indication of administrative district, region, country);

- the area of the mining concession according to the project of the enterprise (ha);

- land area (ha), including;

- lands of agricultural enterprises (total, including: arable land, perennial plantations, hayfields, pastures, fallows, forests and shrubs, swamps, other lands);

- lands of the state forestry fund (total, including: agricultural land, forests and shrubs, swamps);

- land of other categories (total, including agricultural land, others);

- the total area of disturbed land at the beginning of reclamation design, including outside the boundaries of the registered land acquisition;

- from the total area of disturbed lands (ha) are occupied by: filtration fields, settling ponds and other treatment facilities;

- drinking and technical water reservoirs, industrial sites;

- warehouses of coal and other products, electric substations, pumping stations and other buildings, structures and areas outside the main industrial site;

- rock dumps (total, of which: plate-shaped (flat), dumps of mining enterprises, external and internal dumps, cuttings, hydraulic dumps , ash accumulators, etc.);

- lands disturbed as a result of surface manipulation by underground mining works (total, of them: sinkholes, dry depressions, waterlogged or swampy sinkholes and depressions, areas of the surface unsuitable for use in agriculture (forestry) under the conditions of the formed microrelief (undulations, drops, etc.));

- lands disturbed by open mining (total, of which: quarry excavations, total, including: with internal dumps, residual access trenches, other violations);

- reclaimed land subject to reclamation (total, including the types listed above);

- the number of rock dumps of mining enterprises and their characteristics (total, incl .), which are still in operation, actual and design forms and parameters of the dumps, storage technologies, terms of operation, intensity of erosion processes, lithological composition, presence of places of burning and heated rocks, for mine areas, data on self-vegetation and greening, development of dumps and removal of rock with an indication of the achieved technical and economic indicators, parameters of the protective zone, the nature of the territories adjacent to the diversion, the possibility of using rocks for filling in dips and depressions, the presence and characteristics of access roads roads;

- a brief description of the special conditions of disturbed lands (waterlogging, flooding, loss of valuable agricultural and other lands, formation of complex cross-country terrain unsuitable for agricultural use, other features).

The raw data of active mining enterprises with disturbed lands include:

- brief mining-geological and mining technical characteristics of the enterprise (geological structure, reserves, characteristics of overburden and sediments, minimum and maximum depth of work, angle of incidence, number of developed layers and their thickness, development system and method of roof management, methods of forming dumps, roof coefficient, volume of mined overburden).

Data are provided regarding:

- general information about the enterprise (name, subordination, location with an indication of the administrative district, region);
- the area of the mining concession according to the project of the enterprise (ha);
- area of land acquisition (hectares), including : land of agricultural enterprises (total, including : arable land, perennial plantations, hayfields and pastures, fallows, forests and shrubs, swamps, other lands);
- lands of the state forestry fund (total, including agricultural land, forests and shrubs, swamps);
- land of other categories (total, including farmland , others);
- the expected maximum area of disturbed lands (by types of disturbances) based on forecasts of disturbance of the earth's surface;
- design characteristics of rock piles (shape, method of formation of piles, parameters, rock composition, number of piles, their location, period of operation, expected volume of rock storage by periods, the possibility of using rock for filling pits, depressions, quarry excavations, etc. .);

- predicted assessment of forms and parameters of surface disturbances during underground mineral development (falls, depressions, etc.) taking into account the work experience of this enterprise and others that are in similar mining and geological conditions, and using the methodological instructions of project institutes regarding the prediction of sizes and the nature of land disturbances, deformation of the earth's surface during underground mineral development to substantiate the scope of reclamation works;

- predictive assessment of other possible violations of land (flooding, waterlogging, drying, etc.);

- measures and proposals for making changes in the mineral extraction technology in order to reduce the areas disturbed in the process of mining operations (leaving rock on the territory of the deposit).

4. Economic justification of the reclamation of produced peat deposits by its afforestation

Reclamation of VTR through its afforestation is one of the world-recognized directions of their reclamation.

When afforesting the VTR, it is advisable to follow the following recommendations.

- Since VTPs are located on the lower parts of the terrain, their forestry use is possible only with high reliability of the drainage network.

- The conditions of forest growth depend on the fertility and strength of the residual layer of peat and the composition of the rocks of the mineral bed .

- Reclamation must be carried out in the first 2-3 years after the areas are decommissioned , before the creation of a powerful grass cover and the natural restoration of the shrubbery (mainly verbolisis - thickets of willows). Overgrown areas require additional labor costs and funds for reclamation during their afforestation.

- Areas on which tree species have recovered well in the amount of at least 20,000 trees per hectare, with their uniform distribution over the area, are included in the forest fund without additional cultivation of crops.

- Natural regeneration of the forest.

- Soil preparation for afforestation depends on the category of the field according to the level of groundwater.

The main condition for the effective use of water resources in both agriculture and forestry is the compliance of the drainage network with their requirements. A dense network of manufactured maps, destroyed map and shaft channels, the poor condition of bridges and crossings, and the presence of a narrow-gauge railway greatly hinder the timely and effective development of the VTR. The complex of measures to put the VTR in order, which are handed over to forestry, includes:

- cleaning of all channels, deepening of roll-overs, giving the bottom of the slopes at least 0.0002 to ensure spontaneous drainage, and slopes - a coefficient from 1.0 to 2.0.
- deepening of each - 6 map channel, which runs along the lowest part of the developed area, up to 1-1,2 м. The distance between the map channels is 150-250 м.
- surface profiling.

repair and construction of bridges, crossing pipes, regulator pipes, pumping stations and cleaning of fire protection reservoirs.

The surface of the VTR is uneven and has ups and downs. The nature of the alternation of relief elements is different: from clear to gradual.

The topography of the VTR surface determines the hydrological and thermal regime of the area, as well as the physical and agrochemical properties of the soil. The heterogeneity of the relief leads to the fact that in the post-flood period, some places are temporarily flooded, while others are not flooded at all. This leads to the fact that crops are planted at different times and often with great delay. The residual layer of peat, depending on the relief, is heterogeneous in terms of capacity, botanical composition, degree of decomposition, and ash content. All these factors have a different effect on the reforestation capacity, the growth of tree species and the development of grass vegetation.

The milling fields of the Russian Federation, which are best suited for afforestation, are divided into 4 categories according to the hydrological regime with a close technological complex of reforestation works:

Fields that *are flooded* , with RHV from +30 in the spring and until - 40 смautumn, as a rule, these are fields where water lowering was carried out with the help of pumping stations. They are often overgrown with cattails. If up to 35% of the area is subject to flooding, they are not suitable for afforestation and can be used for meadows or marshland for wild game. They occur infrequently.

Low fields - with RHV fluctuations from +10 to -60 см. Flooding is observed in early spring on areas less than 25 %. Such areas are common and suitable for afforestation and meadows. The nature of development, agrotechnics of processing and assortment of wood species depend on the duration of flooding of areas. Tractor units are difficult to operate on them, and only crawler tractors and tillage machines of swamp modifications can work. In low fields, it is mandatory to create elevations in the form of rolls, which are poured during plowing of the soil with ditching plows or two-furrow forest plows. Planting is carried out manually in the spring in the ridge of the shaft . Autumn planting is unacceptable, as the plants get wet and die from diseases .

To afforest these fields with well-decomposed peat, spruce, black alder, and to a lesser extent Scots pine are used.

Areas with medium and weakly decomposed peat are afforested with pine and spruce.

Weevils and birches often appear in low fields, which suppress the development of pine, therefore, after 4-5 years of planting, lighting must be carried out. Chemical lightening is carried out in May by spraying with herbicides (4 - 5 kg/ha).

Medium fields - with RHV fluctuations from -50 to -150 см, often developed to mineral soil. They are less common than low fields. Areas with a layer of peat are more 30 смappropriate to use for meadows, the rest - for afforestation. They are cultivated by continuous plowing. If there is turf, it is discusted in two tracks. Plants are planted with SLN-1, SNL-1L, LMD-1, etc. machines.

For afforestation of these fields, it is best to use pine and up to 30% spruce. On fertile soils, the proportion of spruce is increased to 50%. Birch is regenerated here naturally. It is advisable to introduce it in fire protection areas, protective strips.

High fields - with RHV fluctuations from -1,0 to -2,5 м. They occur infrequently. On them, sandy mounds alternate with peaty depressions after peat production. They are not filled with water. In the summer, the peat layer dries out a lot. High fields are planted only with pine or warty birch after continuous plowing or in the bottom of the furrow.

This classification is the basis for the appointment of silviculture measures, the compilation of technological maps and the planning of works on the VTR.

In all fields, it is better to plant in the spring. The approximate planting rate is 7,000 seedlings per hectare. The distance between seedlings in rows is 60 80 см, the distance between rows is 1,8-3 м.

Planned survival after the second year is 70%, seedlings are planted in the spring of the second year.

In order to prevent overgrowth of plantations with foreign plants in the spring, before the soil dries out, it must be treated with herbicides, which ensures the purity of plantations for 2-3 years.

All tree species grow better with a residual layer of peat no more than 20-30 см, which allows the roots to penetrate into the mineral soil and carry out processing that ensures the mixing of mineral soil with peat.

Mixing the residual layer of peat with the bedding layer of mineral pound is the most effective method of soil treatment for forestry development. From this point of view, the peat layer should have a thickness of 5-10 смless than the processing depth. If soil cutters are used for processing, which loosen the soil to a depth of, then the thickness of the remaining 20 смlayer of peat should be 1 0 - 1 5 см. The strength of the residual layer also affects the subsequent growth and development of tree crops. In areas where the peat layer is smaller, the root competition of the tree stand occurs earlier and leads to self-thinning . At the same time, waste occurs rather in dense stands of trees and in areas where the nutrient reserves of the mineral underlying rock are insignificant.

On sandy and loamy soils, it is necessary to leave a layer of peat with a thickness of 15-20 см. For the cultivation of species most demanding of mineral nutrition (poplars, spruces), the layer of peat can be increased to 30 см.

Therefore, it is impossible to name a single depth of the residual layer of peat under forest plantations for all types of plots.

The nature of the underlying soil largely determines the technology of primary, basic and additional soil treatment. Yes, heavy mineral soils do not allow water to pass through, and when they dry out, they harden a lot.

The stratigraphy of the VTR differs not only in individual massifs, but also in small areas of the peat deposit. Lowland deposits are formed mainly on sands, loams , rarely on loams, upland deposits are formed on clays, loams, moraine and calcareous deposits of various thicknesses.

The development of VTR leads to an increase in the degree of decomposition, which improves soil properties and increases nutrient reserves. The intensive decomposition of peat is especially facilitated by sowing perennial lupine (without lupine - by 2 %, *with* lupine - by 5-9%; ash content increases by 0.5% and 1.4-1.9%, respectively).

A sharp transition has a special effect on the development of woody plants:

- from loose peat to strongly compacted mineral soil,
- excessively high humidity to low,
- from light peat to heavy soil.

The roots of many plants cannot always overcome this transition line. This environment can be changed by agrotechnical measures, one of which is the mixing of layers of peat and soil. Significant changes in physical properties (looseness, humidity, etc.) in the upper layer, where the root system of plants is located, require the development of special agricultural techniques, the selection of machines and equipment.

The presence of stumps in peat creates great difficulties in the processing of VTP, increases the wear of the working parts of machines, complicates the movement of aggregates, reduces their productivity.

Depending on the number of stumps in the residual layer, the processing technology is largely determined. Stumps and hardwoods are fragile and easily destroyed during initial processing, so it is not necessary to remove them. Pine stumps are stored well, so they must be removed before forestry development. Only equipment with disk working bodies works normally with high pileness .

Agrochemicals include such properties as absorption capacity, hydrolytic acidity, content of potassium, phosphorus, mobile forms of nitrogen, ferrum Fe^{2+} . With cultivation, by growing a forest, 10 смslight acidification of the soil occurs in the upper layer due to the decomposition of peat with the formation of acids. In the upper 20 смlayer, the content of mobile forms of nitrogen increases, potassium reserves decrease. The presence of ferrum Fe $^{2+}$, toxic for plants, in peat and the underlying mineral layer significantly complicates the cultivation of forest crops . Its content reaches 25.5 mg in 100 гthe soil and prevents the penetration of roots into the depth, weakens the development of plants, and also negatively affects the processes of nitrification and accumulation of mobile phosphorus. Mobile aluminum is also harmful to the root system. Stocks of toxic compounds in the soils of the VTR significantly decrease when moving from overmoistened, low-lying areas to elevated areas, i.e., where aeration is better. At the same time $Fe^{2+} \rightarrow Fe(OH)_2 + Fe(OH)_3$. After mixing the residual layer of peat with mineral soil, it is necessary to apply fertilizers once, in contrast to agricultural development, which replenish the soil with nutrients, stimulate the decomposition of peat components that are not assimilated by plants, and create favorable conditions for microbiological and enzymatic activity of the soil. It is necessary to revive the dead organogenic rock as soon as possible and create conditions for the development of woody species in it.

Natural regeneration of the forest depends mainly on the regime of groundwater, properties of peat, the presence of a source of insemination, etc.

The first 2-3 years of the VTR are not overgrown with woody vegetation, only in some cases willow and birch seedlings appear . Initially, they inhabit low-lying, waterlogged areas that are periodically flooded, and the slopes of the drainage network. Then they spread throughout the massif. In areas that are flooded, the stairs gradually differ in growth. Trees develop best on natural microelevations , the lowered areas are overgrown with reeds, sedges, thistles, etc.

In the elevated areas, recovery is weaker due to the lack of moisture in the upper layers and the wind blowing the seeds to the lower areas . The species composition of self-regenerating crops is very limited: it is mainly downy birch, and aspen, pine, and spruce regenerate much worse. Aspen and spruce grow well in areas with RH from -0.2 to 0,6 м. Pine grows better in areas with a lower level of groundwater, that is, in elevated and medium areas.

A large number of shoots are squeezed out in areas with a deep layer of peat, because in the spring the peat swells up a lot, and with the onset of warm days it shrinks a lot.

In addition, areas with a significant layer of peat become overgrown with grass vegetation earlier and more intensively, which prevents the regeneration of tree species. Therefore, VTP can self-restore, but the assortment of tree species will be quite limited, therefore the main area of the VTP should be subject to cultural afforestation.

Processing soil has a decisive role in the productivity of forest plantations, as it determines the water-physical, air, agrochemical and microbiological properties of the soil. Types of processing include *continuous processing (plowing), creation of micro-elevations and making furrows* .

Continuous tillage changes the layer in which the horizontal roots are located, which make up 90% of the root system.

The creation of micro-elevations in the form of ramparts improves conditions on one part of the area due to deterioration (pits, furrows) on the other and enables crops to overcome the most unfavorable periods (flooding, waterlogging).

Conducting furrows worsens the agrochemical and water-physical properties in the areas and slightly improves them outside of them. It is used where the provision of moisture is crucial in the first years, as their bottom is moistened better than the slopes and ridges of the shafts.

The quality of any type of soil treatment depends on the type of treatment tool.

Soil processing in forestry production is carried out only when creating crops, then natural processes take place.

The following ways of creating cultures are possible:

- process of forest restoration as a result of self-sowing of seeds, but environmental conditions are not always favorable for the emergence of seedlings and their subsequent growth and development;
- sowing pine and spruce seeds 10-12 pcs. in the sowing place. The success of this method is low: in 9 81% there were no ladders;
- the main method of reforestation is planting saplings. It is carried out *manually* or forestry machines. In low places, where micro-rises are created , planting is carried out manually, since it is difficult to move equipment on the prepared soil and there is a high probabil-

ity of significant damage to the shafts.

The success of forest crops strongly depends on the period of planting. Survival and preservation of plants planted in spring is much higher than in autumn.

The main reason for the loss of plants in low places is wetting and washing of plants (37-64%) and crushing (13-40%). Spruce is best stored here.

Autumn planting of medium and high fields is more successful, but also unsatisfactory in general. Pine seedlings are especially poorly preserved (41-75% loss).

The success of forest crops is evaluated by their survival after planting seedlings and by their growth rates. Their survival depends on the breed, the age of the planting material, the soil category, weather changes, susceptibility to the development of weeds, etc.

On medium and tall one-year-old pine saplings, this indicator ranges from *87* to 100 *%, and* decreases to 53-94% in two-year-olds. High survival rate (90-100 *%)* two- and three-year-old Christmas *trees* and 1-2-year-old *birches* , somewhat lower in *aspen* (48-79%).

In low fields, the survival of one-year-old pine seedlings is: on unprepared soil 89-95%, after plowing - 71-93%, on ridges of shafts 80-87%. Survival of two-year-olds does not exceed 37 - 86%. In *spruce* and *birch, this* indicator is much higher (97-100%), in *black* alder it decreases to 74-98%.

Survival on deep peat is significantly lower than on a mixture of peat and sand.

On areas prone to intensive overgrowth with weeds, large saplings up to 0.4 cm high are used 0,6 м, which allows you to get rid of time-consuming and costly expenses.

In terms of growth indicators, warty and downy birches are the best in low fields.

Pine accelerates growth in height only from the second year, spruce from 4-5, and birch and alder, under favorable conditions, already from the year of planting.

Large pine and spruce saplings tend to get sick after 2-3 years and only then develop normally. Alder, spruce, aspen, poplar, oak suffer from freezing in depressions of middle fields.

Successful development of species that grow quickly and build up a significant mass of roots that bind the peat soil before the beginning of the autumn-winter season. These species include poplar or energy willow (Fig. 2).

Fig. 2. Growth of crops on different VTR: *1* - cultivated peat; *2* - produced edge; *3* - deeply peated areas, low fields; *4* - shallow bottom deposit

From Fig. 2 shows that only on cultivated (processed and fertilized) uncultivated outskirts, shallow areas with favorable aeration, these cultures form highly productive plantations.

The preservation and growth of crops strongly depends on the development of weeds and the application of mineral fertilizers.

Weeds and the dynamics of their growth on different VTPs differ significantly.

The most intensive development of weeds is on *fertile deposits of low fields.* These are Ivan-tea, cypress, thistle thistle , cypress , chernobylnik, etc., which reach a height of 60-80 см, the degree of coverage is 70-100%, and at the same time 8-18 t/ha of green mass is built up, then grasses take root, which after 4-5 years form a solid sod.

Medium and low decomposition the peat is covered with mother-and-stepmother, marsh horsetail, occasionally reed. They develop weakly, so they are not a threat to the development of crops.

There are mechanical and chemical methods of weed destruction.

Among the first, loosening of the inter-rows with cultivators, weeding with hoes, mowing of weeds and their trampling by various means are used. The efficiency of the mechanical method is low.

The best results are observed with the use of chemical agents, including triazine herbicides such as Radokor , Simazine, and Atrazine . When applying 20 кгthe active substance per hectare of soil, they thin out the grass by 80%. Their effectiveness depends on the terms of introduction. The most effective application is before the emergence of weeds.

Application of mineral fertilizers to accelerate forest growth is necessary in connection with the poverty of the peat substrate for phosphorus and potassium.

Application of only nitrogen, potassium and copper-containing fertilizers ($_{60}$ Cu_{12} and N_{60} K_{120}) does not cause noticeable growth of weeds. Superphosphate (N_{60} P_{90} and P_{90} Cu_{12}) and especially phosphorus -potassium fertilizers intensively provoke the growth of weeds, which reduces the squeezing of seedlings, protects them from frost and burns , that is, contributes to their preservation.

A significant acceleration of the growth of forest crops is observed with the introduction of phosphorus -potassium mixtures and various combinations of complete fertilizers, in which the potassium content exceeds the phosphorus content. Already in the first year, growth in height increases by 2-7 times. The best mixture is phosphorus -potassium fertilizers in the ratio of P_{90} K_{120} active substance Fertilizers must be applied to pine and spruce crops that are no older than 5 years and birch trees that are 2-3 years old.

There are various methods of introduction. It is most rational to spread it over the surface of the soil in the spring, before it thaws, since it is possible to use the wheels of tractors during this period . Agricultural spreaders are used (STN-2.8; RTT-4.2; RUM-2; 1-RMG-4, etc.).

5. Economic efficiency of afforestation of the VTR

The main way of developing *low fields* under afforestation there is manual planting of forest crops in ridges and dumps.

From methods of care chemical weeding showed the best results, but even a one-time treatment increases the cost of growing crops by 30%. The involvement of areas covered with shrubs doubles the cost of afforestation. The cultivated areas must be recultivated in the first two years after the completion of peat extraction, before the development of a strong grass cover and before the start of the natural restoration of vermilion.

Labor and money costs can be reduced by combining soil preparation with planting seedlings into one operation. Cultivation of low-lying fields for sown grasses (that is, for agriculture), even with the introduction of significant doses of mineral fertilizers, is relatively inexpensive for farms . And already in the first year, you can get 2-3 tons of hay per hectare, and the labor costs are 14 times lower than during afforestation.

In the conditions of *medium fields,* mechanization of all crop growing processes is possible. Mechanized planting without soil preparation is the most economical . Application of mineral fertilizers in medium doses ($P_{90}K_{120}$) increases costs by 35%.

The cost of developing these fields under agriculture is approximately the same. But the payback of different methods of afforestation and agricultural use differs significantly: - when growing pine, silvicultural measures are paid for in 8-21 years, spruce in low fields and in fertile areas of the middle strip - in 10-12 years, alder in flowing deposits in 11-18 years, birches in medium and high fields for 17-20 years.

Growing natural birch plantations, which are often formed in low fields, do not require any costs, but their value is always lower than timely planted pine and spruce crops with a payback period of no more than 10 years .

Cultivation of sown grasses in low fields with fertile peat pays for itself within the first year, and with a rotation of crops (3 years) can bring a significant profit. It is even more profitable to grow cereals, even such a low-yield crop as oats.

it is more profitable to use the produced TR with a fertile layer of peat in agricultural production. It is most appropriate to grow pine on fields unsuitable for meadow and field use, prepared for mineral soil and with little decomposed peat.

In areas prone to dense population of birches and willow trees, it is economically expedient to focus on the production of spruce, the cost of labor and money for its cultivation is always lower than for the formation of pine plantations, since silvicultural care and unprofitable lighting are reduced.

For growing poplar, it is better to use shallow areas of middle fields, where grain and row crops give a low yield.

6. Calculation of the ecological and economic assessment from the rehabilitation of the developed areas under the water

management direction

In the conditions of a market economy, Ukraine must have an effective policy for managing its national wealth. Land resources are one of such riches. The current state system of land management of Ukraine at the international, national, and regional levels needs improvement. Careless treatment of land resources, as an object of capital formation, a tool of work and a means of production, leads to a decrease in the future income of the state and the economic, social, and ecological benefits of the country's population.

The main issue of today remains the issue of restoration of exhausted lands by mining enterprises of the region, i.e. bringing them to a state suitable for further use.

Exploitable lands lose their original value at almost every technological stage of mineral development. The initial and final value of the land plot does not correspond to the real market value according to the main indicators of the condition, and depending on the complex of factors is overestimated, or vice versa - below the real value.

Reclamation of produced peatlands is an important reserve for increasing agricultural land. However, during their development, it should be taken into account that they differ significantly from undisturbed soils in terms of their physical and chemical-biological properties. For example, it was established that there are very few easily soluble phosphorus compounds in the residual natural layer of peat . Even less exchangeable potassium. Despite the significant reserves of total nitrogen, in the absence of mobile forms of this element, the peat layer of the production may turn out to be barren. Weak aeration, the presence of oxidizing compounds of aluminum and iron, underoxidation of organic residues leads to suppression of many microbiological processes.

In the process of reclamation of produced peatlands, the thickness of the natural layer of peat, the amount of organic matter in it, and, ultimately, its productivity, must first be determined. According to the existing recommendations, in the case of completion of peatland production, it is necessary to leave a layer of peat at least 50 см.

Practically all peatlands are overmoistened due to groundwater, therefore land reclamation is an important condition for increasing the fertility of the lands on them. Usually produced peatlands are drained in small areas (as they are produced), independently or connected to adjacent reclamation networks.

The development of produced peatlands should be undertaken immediately after the end of peat production and the completion of land reclamation. During primary processing, plowing, disking, milling and rolling are carried out.

Produced peatlands by milling and machine-forming methods of peat extraction should be returned to land users for use in hayfields, pastures, afforestation and irrigation. For this purpose, a drainage network is arranged, the surface is planned, and roads are built. Peatlands produced by the hydro-method are usually reclaimed for fishery use. On them, stumps are uprooted and removed, a drainage network is planned and laid. In Germany, there is a technology for the renaturalization of bogs and peatlands.

There is a distinction between mining and biological reclamation.

The preparatory stage includes: survey and typification of disturbed lands and lands subject to disturbance; study of the properties of overburden rocks and their classification regarding suitability for biological reclamation; determination of directions and methods of reclamation; preparation of feasibility studies and technical work projects for reclamation.

The mining engineering stage involves the implementation of works on the preparation of land vacated after the mining development of deposits for further targeted use in the national economy. During this period, enterprises or production facilities that carry out the development of deposits perform the following works:

- selective removal, storage and preservation of overburden suitable for biological reclamation, including the fertile soil layer;
- selective formation of overburden rock dumps;
- if necessary, planning and covering the planned surface with a layer of fertile soil or potentially fertile overburden;
- backfilling and planing of deformed surfaces;
- arrangement of access roads;
- remedial measures.

The biological stage of reclamation is performed after the mining stage and includes measures to restore the fertility of disturbed lands, aimed at the reproduction of flora and fauna.

Biological reclamation is carried out by land users, to whom lands are transferred after mining technical reclamation at the expense of enterprises and organizations of the relevant ministry, which carried out mining operations on the lands.

The directions of reclamation determine the final use of disturbed lands after carrying out the relevant mining, engineering and construction, hydrotechnical and other measures, they are chosen on the basis of a comprehensive accounting of the following factors:

- natural conditions of the field development area (climate, soil types, geological structure, vegetation, animal life, etc.);
- the state of the disturbed lands before the reclamation (character of man-made relief, degree of natural overgrowth, etc.);
- mineralogical composition, water-physical and physico-chemical properties of rocks;
- agrochemical properties (content of nutrients, acidity, presence of toxic substances, etc.) of rocks and their classification according to suitability for biological reclamation;
- engineering-geological and hydrological conditions;
- economic, socio-economic, ecological and sanitary-hygienic conditions;
- the service life of reclamation lands (possibility of repeated violations and their periodicity).

In the process of choosing the direction of land reclamation, it is necessary to keep in mind that the reclaimed lands and the territories surrounding them - after the completion of the works, represent an optimally formed and ecologically balanced landscape area.

The choice of the type and direction of reclamation is determined by natural and economic conditions and, in most cases, is dictated by which lands were disturbed in the process of mining and how they were previously used.

For example, it is not possible to approach the choice of the type of reclamation in the same way, if fertile chernozems and low-humus, structureless podzolic or sod-podzolic soils are disturbed by the development of deposits. So, the very basic characteristics suggest to a large extent what decisions need to be made. Indicators such as the degree and type of salinization, the level of soil and subsoil water, the method of field development, etc., can provide similar assistance when choosing the type and direction of reclamation.

The effectiveness of reclamation largely depends on the timing and quality of its implementation.

The effectiveness of reclamation largely depends on the timing and quality of its implementation. At the same time, it should be taken into account that the responsibility for timely mining reclamation and the transfer of lands in proper condition, which became vacant after the completion of raw material extraction operations, rests with the heads of mining enterprises, and for timely and rational use - with the land users to whom the rehabilitated lands are transferred.

Studies show that the reuse of reclaimed land can be rational and effective only in the case of the correct choice of the direction of restoration works on disturbed lands. This approach makes it possible to later recreate the disturbed landscape and partially or completely restore the flora and fauna lost in the process of mining development. At the same time, it is necessary to take into account that bringing disturbed lands into a state suitable for reuse may not always coincide with their previous purpose.

Thus, the correct choice of the direction of reclamation should provide for a single goal - the rational reuse of disturbed lands in the national economy.

After conducting a field survey of one of the fully developed and rehabilitated plots, we concluded that no more than 10% of the rehabilitated land is used for agricultural production by the population of the surrounding villages. Advantages in use are given to elevated areas along bulk channels, or on the outskirts with low peat capacity.

The measures envisaged by the reclamation projects aimed at maintaining the necessary water regime of the reclaimed lands do not have the expected effect. Drainage system without maintenance quickly fails, this is facilitated by large settlements of beavers, which build dams on canals. Lands are returning to their natural state - overgrown with swamp vegetation.

Therefore, after analyzing the inefficiency of the use of reclaimed land, I want to propose a water management direction of reclamation. It envisages the use of pits and other man-made depressions for various reservoirs, including fish ponds. Therefore, it will allow not only to restore the cultural landscape, but also to bring additional income to the enterprise.

Requirements for land reclamation in the water management direction should include:

- Creation of reservoirs for various purposes in pits, trenches, deformed areas of mine fields;
- Complex use of reservoirs mainly for water supply, fishing and recreational purposes, irrigation;
- Construction of appropriate hydrotechnical structures necessary for flooding pits and maintaining the estimated water level in them;
- Measures to prevent landslides and erosion of reservoir slopes;
- Shielding of toxic rocks, beds and sides of reservoirs and formations prone to spontaneous combustion in the zone of variable level and above the water level;
- Protection of the bottom and shores from possible filtration;
- Measures to prevent acidic or alkaline groundwater from entering reservoirs and maintaining a favorable water regime and composition in accordance with sanitary and hygienic standards;
- Measures for the improvement of the territory and greening of the slopes.

Table 2

Technical conditions for reclamation

The name of the object	Peat bog
1	2
Purposes of the reclaimed area.	Reclamation under the reservoir of technical water with the creation of a green zone around it for fishing activities.
The thickness of the removal of the fertile layer of the soil, the place of its storage or transportation for the improvement of unproductive lands.	Remove the vegetation layer on the uncultivated area of the quarry with a thickness of 30 cm, with further use to create a green zone around the reservoir.
The thickness of covering the reclaimed area with a fertile layer of soil.	According to the volume of the laid soil.
Construction of access roads to the reclaimed site.	Use existing driveways.
Term of completion of mining reclamation works.	The reclamation work should be completed within a year after the deposit has been worked out.

7. Economic evaluation of the expediency of land reclamation

Environmental conditions of disturbed lands largely determine the amount of restoration work and costs on their implementation, technology and directions of reclamation.

However, in the economic evaluation of the costs of reclamation aimed not only at the reproduction of natural resources, but also at meeting public needs as a natural environment, it is necessary to take into account both its results (economic and socio-ecological), as well as the factors that determine them.

The role of socio-ecological factors characteristic of disturbed and rehabilitated areas, as well as the area of their location, in the economic evaluation of reclamation is manifested in the form of their influence on the value of economic indicators (costs and results), the choice of optimal directions and technological schemes of reclamation in each of the areas objects

As one of the types of economic activity, land reclamation (unlike other production processes) does not bring profit to the enterprise , but is characterized by costs.

Costs for the technical stage are calculated based on the volume of work and specific costs, determined on the basis of uniform district unit prices for earthworks and other types of work or according to costing, which is summarized by cost elements.

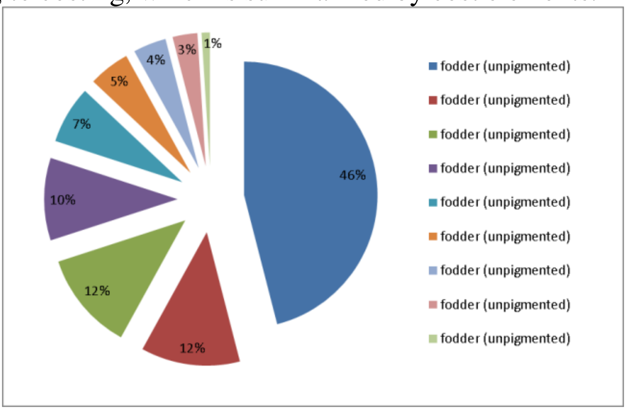

Fig. 3. Diagram of the distribution of costs for the water management method of reclamation

According to Vlasov VA, the production of fish products is characterized by high productivity compared to other products containing animal proteins. Capital investments for the production of 1 ton of meat are almost four times more than for the production of 1 ton of fish products.

From 1 hectare of reservoir area only due to natural fish productivity, 2-3 centners of fish products can be obtained annually, that is, approximately the same amount of meat that can be obtained by grazing cattle on high-quality natural pastures. When feeding, you can get 10 times more fish.

Costs for the mining and technical stage of reclamation per 1 ha in the water management direction are UAH 8,104.

Let's calculate the costs for the mining stage for the creation of artificial ponds according to formula (4):

$$V_{gr/z} = V_g * (S_{oz} + S_{forest}) \quad (4)$$

where $V_{gr/z}$ - costs for the mining stage for the creation of a recreation area

Vg – costs for 1 ha of mining reclamation

S_{oz}- the area of the lake

S_{forest}- the area of forest plantations

$$V_{gr/z} = 16{,}22 * 8104 = 13144688 UAH$$

To launch in the reservoir, it is assumed to buy fry of carp, crucian carp , white carp weighing 20-30 grams/piece, price 20 UAH/kg, delivery 3.5 UAH/km (30-40 kg is assumed for 1 ha of the reservoir. ufry).

Let's calclate the costs of stocking the lake with fish according to formula 5

$$T_{smal} = C_{kg} * S_{oz} * P_{mal} \quad (5)$$

where T_{smal} is the cost of the required amount of fry to launch into the lake

C_{kg} - the number of fry for launching per 1 ha of reservoir

S_{oz} - the area of the lake

P_{mal}- the cost of 1 kg of fry.

T_{smal}= 40*16*20 = 12,800 UAH

Costs for the delivery of fry per 1 km - UAH 3.80 for a distance of 100 km, in this way we will pay for delivery:

D = 100*3.80=380 UAH.

30 hryvnias are needed to populate 1 ha of the lake with plankton. for the settlement of 16 hectares of the lake - 480 hryvnias, costs for the purchase of fry are 12,800 hryvnias, costs for delivery - 380 hryvnias. therefore, we can calculate the costs for the biological stage of lake reclamation (6)

$$V_{boz} = V_{pl} + T_{smal} + D \quad (6)$$

where V_{boz} is the cost of the biological stage of lake creation

V_{pl} - spending on plankton

D - transportation of fry

T_{smal} - the cost of the necessary amount of fry to launch into the lake

$$V_{boz} = 480 + 12800 + 380 = 13660\ UAH$$

Thus, the costs of creating a recreation area will be

$$V_{r/z} = V^{g}_{r/z} + V^{b}_{r/z} \quad (7)$$

where Vr /z - costs for creating a recreation area

$V^{g}_{r/z}$ – total costs for the mining and technical stage of reclamation

$V^{b}_{r/z}$ - total costs for the biological stage of reclamation

$V_{r/z}$=34126.88+ 13660 = 47786.88 hryvnias.

The future profit from the recreation area 1 year after the opening of the area was calculated. Profit from the sale of fish - UAH 26. - 1 kg, there are 700 individuals in our lake, therefore:

Year = 26·700=18,200 hryvnias.

Thus, the profit in a year will be UAH 3,704,000. with expenses for the creation of a recreation area 5956412.88 hryvnias. Comparing costs and profits, we can say that more than half of the invested money will be returned already a year after the opening of the zone. Thus, in the third year of creation of the recreational zone, the costs will be fully paid off and the zone will bring profits.

Conclusions

On the basis of scientific research, materials are presented that confirm the possibility of using produced peat deposits taking into account their natural properties.

1. The main areas of use of VTR: agricultural, forestry, water management and creation of hunting grounds. For many decades, the

choice of the direction of use of VTR was not carried out on a scientific basis, but by voluntary decisions of the authorities, mainly for agriculture, in connection with which the practical use of VTR led to negative economic and environmental consequences. The transition to a scientifically based direction of the use of VTR will lead to a nature protection direction - re-wetting, use of separate areas for agriculture, afforestation, creation of reservoirs, cultivation of energy willow.

2. The phasing of determining the direction of use of disturbed land should be implemented in the following sequence: at the stage of development of the enterprise construction project, the section "Reclamation of areas after peat production" is developed, in which, based on the intelligence materials of its properties and the conditions of the peat deposit, the direction of use of VTP is determined, appropriate the depth of the residual layer and, taking into account the ecological and socio-economic condition of the region, develop a project for the reclamation of the VTP.

3. The main reasons for the low productivity of agricultural land are the neglect of the genetic features of the VTR. Thus, it is practically impossible to create a favorable water regime for agricultural crops on peat deposits of closed basins or on the slopes of watersheds: in the first case, the soil is overmoistened, in the second case, it is overdried. Unfavorable for agricultural use of VTP with a residual layer of top peat, due to its high acidity, for the neutralization of which it is necessary to apply up to 28 t/ha of limestone materials, which is not profitable , and a layer of peat underlain by sapropel.

4. A substantiated ecological and economic evaluation of the rehabilitation (reclamation) of the developed areas and corresponding calculations of the ecological and economic feasibility of implementing the rehabilitation of the VTR are given.

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