# Development of projects for recultivation of lands using GIS technologies



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**Abstract.** The necessity of reclamation of disturbed lands as a result of mining is substantiated. Disturbed lands lose all economic importance. In addition, they are a source of pollution of soil and air in the adjacent territories, worsen the living conditions of the population and the appearance of the landscape. The technique of drawing up the working projects for the recultivation of disturbed lands as a result of mining by using the GIS software "Panorama" is considered. The use of this software reduces the time needed to complete a project, reduces the costs and improves the accuracy of project calculations. The use of the technique is shown by the example of the recultivation of disturbed lands in the "Kushbulak" plot of the Karakhtay field. Agricultural reclamation with restoration of pastureland use is recommended. It is planned to create a beach zone with a 30 cm layer of sand in the far northwestern section. It is planned to fill the bottom of the quarry with soil to the design level and create a terrace, as well as work on the land area with a fertile soil layer of 20 cm and planning the surface. The efficiency of reclamation in parallel with the use of a mineral deposit is substantiated.

## 1. Introduction

Nowadays 2,700 different types of mineral deposits have been identified in Uzbekistan. More than 400 mining enterprises operate on the basis of divorced mineral reserves. During the extraction and processing of minerals, more than 60-70 million tons of dumps are formed annually, for the placement of which 10,000 hectares of land are required per year, which come to the mining territories. Such powerful technogenic process leads to the dynamic development and expansion of the area of mining and technogenic landscapes, and the areas of natural landscapes, respectively, are reduced, both in mountainous and lowland territories. Therefore, a comprehensive study of the formation of mining and technogenic landscapes, sustainable dynamic development and their morphological structure, as well as the development of the physical and geographical foundations of their restoration have priority scientific and applied value in the arid climatic conditions of Uzbekistan [7].

The formation of land uses for various non-agricultural purposes, on which the industrial and other construction is being carried out, mining of the minerals, disturbed lands appear, must be restored. This requires the removal and use of the fertile soil layer. Disturbed lands lose all economic importance. Owing to this, the lands lose their value. In addition, they are a source of pollution of soils, water, air in the adjacent territories, worsen the living conditions of the population and the

appearance of the landscape. To return these lands to use and eliminate their environmental impact, it is necessary to reclaim them.

Scientists A. N. Nigmatov, H. Vakhabov, Z. A. Jabbarov and other scientists conducted scientific research on restoration of disturbed lands. Projects of reclamation, agrotechnical and other measures aimed at restoring the biological productivity and economic value of disturbed land were developed [1–3]. Currently, the use of GIS technology and remote sensing data can help to monitor and detect changes in disturbed lands and reclaimed areas. The experience of China and Germany in this field has a special place in the world [13].

Recultivation is carried out for the use of land in equal branches of the on-farm economy. The type of land use after restoration and its technology depend on natural conditions, social need and economic feasibility. Land reclamation is carried out in two stages: technical, including the preparation of land, the design of its surface for subsequent intended use; biological, including the measures to restore land fertility [6, 7].

## 2. Materials and Methods

When developing a working project for land reclamation of the "Kushbulak" plot for agricultural use, the following materials were used:

- Topographic plan of the territory of the economy "Ohangaron" of the Ohangaron region in 1: 10000 scale;
- Working project of the "Kushbulak" plot of the Karakhtay field;
- Documents of engineering are construction surveys.

The "Kushbulak" plot is located on the north side of the field and is a natural extension of it. The relief of the territory of the deposit is flat-plained, rugged by meridional, deep sai. The absolute elevation of the plot is from 694 to 817 m. The climate of the territory is sharply continental, daily temperature changes reach 23°C. The maximum temperature in July is +41°C, the minimum in January is –18.8 °C. The average annual rainfall is 478 mm. Given there is a geological structure of the "Garbiy" and "Kushbulak" plots, their location on the downstream and on the left bank of the Tavaksay River, the length of the warm period and the short duration of winter, features of land use and other factors, agricultural reclamation with restoration of pasture land use is recommended.

The creation of a beach zone is planned in the extreme northwestern section. The beach area is planned to be covered with 30 cm of sand. Recultivation is carried out on the territory of 86.05 ha of the quarry plot. To develop a working recultivation project, good planning material is required [7, 9]. To develop a recultivation project using GIS, a topographic plan on a scale of 1:10000 was used. For automation, the development of the project used the "Panorama" geographic information technology. The "Panorama" complex includes 4 GIS: a professional GIS map; land information system VMS; GisToolKit graphical editor and user tools. All these technologies are open to users, any exchange formats are supported, regulation of classifiers of electronic cards is provided, and a system of projection of cards is supported [4–6].

## 3. Results and Discussion

Geoinformation technology "Panorama" was developed to automate the development of land management projects, including the land recultivation projects. Therefore, we recommend the use of this technology in the development of land restoration work projects. Project development begins with a field survey of the territory. With these, the necessary shooting and measuring work is necessary to compile a 3D terrain model. The graphic and attribute databases are created to store the collected data.

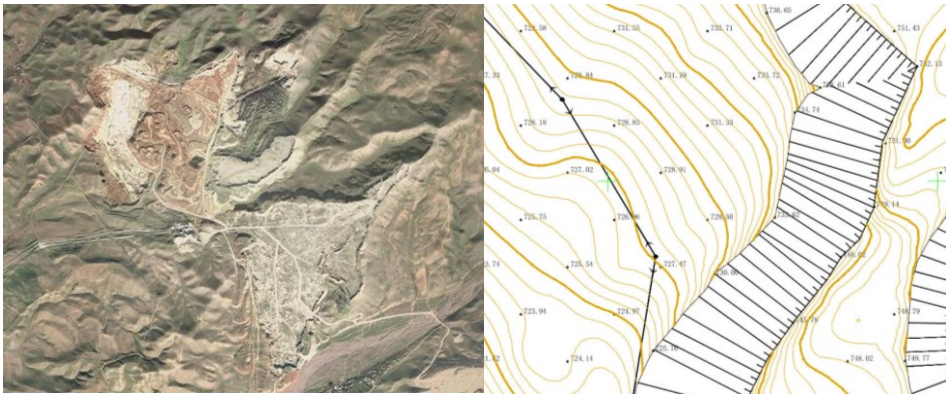

**Figure. 1.** Recultivation of disturbed lands on the land plot "Kushbulak" of the Karakhtays.

A topographic plan of the recultivation area is entered into the computer. The technology allows editing of the entered image and obtaining a good raster, digitizing of the raster with the introduction of semantics by layers, obtaining integrated or transformed layers, and editing digitized objects. Using materials of field measuring works we create 3D terrain models. The volumetric image makes the map more visual [4, 10].

Detailed three-dimensional terrain models facilitate the preparation of work projects for the restoration of disturbed lands. The technology allows performing operations with surfaces, calculating in planes and in space, analyzing the geological factors at the recultivation plot and estimating the labor costs, automated calculation of the volume of land works, assessing the composition of soils, and the relief of the recultivated territory.

Using the "Panorama" technology, a working project of land recultivation on an area of 86.5 hectares has been developed. The project provides for the beginning of the technical part of reclamation in the liberated lands from mining. Work begins with filling the bottom of the quarry with soil to the design level and terraces are created. Further, work is carried out on land fertilization with a fertile layer and surface planning.

**Table 1.** The volume of work for recultivation.

| No. | Name of work | Unit of measurement | Quantity |
|---|---|---|---|
| 1 | Area | ha | 86.05 |
| 2 | Landwork volume | $m^3$ | 23295448 |
| 3 | The volume of soil transportation (distance of 600m) for filling the quarry, including to the bottom of the quarry to build a terrace | $m^3$<br>$m^3$ | 2416920<br>2074620 |
| 4 | Terraces construction incl. cut-off volume filling volume | $m^3$<br>$m^3$ | 342300<br>259472 |
| 5 | The volume of transportation of the fertile soil layer to create the 20 cm layer | $m^3$ | 172100 |
| 6 | Carriage of sand to create a 30 cm layer on the beach | $m^3$ | 4077 |
| 7 | The volume of transportation of sand and gravel mixture to create a 25 cm layer | $m^3$ | 191 |

The bottom of the quarry is filled on an area of 75.7 hectares. In the development of minerals in an open way, dumps are formed. Rocks from dumps are used to backfill the bottom of a quarry. The

volume of rocks is 2329548 $m^3$, and the transportation distance is 600m. After filling the bottom of the quarry on an area of 10.35 ha, terraces are created. The width of the terrace is 8 m, consists of 3 steps. After planning the surface, the bottom is carried out by land. The territory is covered with a fertile soil layer of 20 cm [8, 9, 11].

For areas covered with hummocks, a special improvement technology is being developed, including operations such as seedbed milling or disking. Depending on the size of the irregularities, milling is carried out in 1–2 passes to a depth of 8 to 22 cm. For this, FBN-2.0 milling machines, FBN-1.5 swamp cutters or disc harrows are used. After removing stones, trees and shrubs, the resulting pits and ditches are leveled using graders or bulldozers.

With a radical improvement, in contrast to a superficial one, additional work is planned, such as primary plowing, cutting of sod layers and soil compaction.

On clayey and heavy loamy soils, in order to improve the water-air regime of fodder lands, when land drainage is impractical or impossible to carry out, mole and chiselling are provided in the working draft. Mole-covering is carried out in the direction of the greatest slope of the territory after plowing or simultaneously with-it using MD-1 mole-drainage machines or RK-1,2 mole-drainage machines. The distance between mole drives is 2-3 m, their cutting depth is 30-45 cm, mole frequency is 1 time in 3-4 years. Slotting is recommended to be carried out once every 2-3 years with a slotting machine ShchN-2-140 to a depth of 20-25 cm with a distance between slots of 0.7 m.

Works on the cultivation of fodder lands include the application of mineral and organic fertilizers, herbage. Doses of application of mineral fertilizers depend on the agrochemical properties of the soil and the planned yield; – usually 45–60 kg w.d. is applied per 1 hectare. phosphorus, 60–90 – potash, 30–40 – nitrogen fertilizers. Organic fertilizers contribute at least 20–30 kg of lime. from 3 to 8 tons per 1 ha.

Illumination (sowing of perennial grasses) is carried out with a radical improvement of fodder lands, reseeding of grasses - with a superficial one. In the working draft, they define grass mixture methods, select grass mixtures, set seeding rates and seeding methods. In practice, several tinning methods are used, differing in the territorial basis (solid or strip tinning) and the pace of work (accelerated and gradual). Strip grass sowing is planned in the zones of water and wind erosion; at the same time strips of natural vegetation and newly created lands alternate. In the steppe and dry steppe zones of Russia, with a lack of moisture and sparse turf, accelerated grass seeding is used when grasses are sown directly on plowed turf.

Upon completion of the specified part of the working draft, technological maps or technological schemes for the performance of work on the radical or superficial improvement of fodder lands are drawn up.

Recultivation is carried out in parallel with the use of the “Kushbulak” plot. This greatly reduces costs. Table 1 above shows the volume of restoration works.

**Table 2.** Technical and economic indicators of the working project of recultivation.

| No. | Indicators | Unit of measurement | Quantity |
|---|---|---|---|
| 1 | Remediation Estimated Cost | Thousand sum. | 26109100,58 |
| 2 | Reclamation period | month | 18 |
| 3 | Area of the technical reclamation | ha | 86.05 |
| 4 | Area of the biological reclamation | ha | 80.05 |

As you can see, the total cost of recultivation is 26109100,58 thousand sums and is covered by “Akhangarantsement” OJSC, which exploits the mineral deposits.

## 4. Conclusion

Disturbed lands lose their economic value or dramatically reduce their value. They are a source of pollution of soils, water, air in the adjacent territories, worsen the living conditions of the population. In order to return these lands for use in various sectors of the national economy and to eliminate their environmental impact, it is necessary to carry out the land reclamation work through the development of reclamation work projects as a part of the land allotment to mining enterprises.

Evaluation of the effectiveness of reclamation is carried out according to various indicators. Their choice depends on the level and scale of the measures being developed, the intended use of reclaimed land and other factors. The most commonly used are: total (absolute) efficiency of capital investments; total economic and environmental effect; comparative economic efficiency of capital investments.

In working projects, the indicator of the overall efficiency of capital expenditures for reclamation is defined as the ratio of the amount of net product growth and socio-ecological effect to the amount of costs for the technical and biological stages of land reclamation, as well as subsequent agricultural development and use.

The method of reclamation of disturbed lands developed by us using Panorama technology reduces the project development time by 30% and reduces the cost of their development by 25%. It improves the accuracy of design calculations.

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