

# Appraisal of lands of fields with consideration to ecological state of territory (direction after territory recultivation - construction)

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**Abstract.** The article dwells on the methodical, ecological and financial aspects of the appraisal of the field lands with the consideration to the ecological state of the territory. The main idea of this article is to perform the appraisal of the lands of the field development, based on their cadastral value, the subsoil value, but with the consideration to its decrease on the account of the previous ecological state of the territory. The ecological situation in the administrative districts of the Russian Federation differs significantly. The Chelyabinsk Region is at the last place in the Russian Federation ecological ranking. That is why for our region the condition of lands for the field development should be mandatorily taken into account. The essence of the idea suggested by this article is that the lands of field development should be appraised based on their cadastral value but with the consideration to its decrease on the account of the previous ecological state of the territory.

## 1. Introduction

The analysis of literary sources revealed that when performing appraisal of the field lands, etc., the ecological state of the territory for the moment of development, which is then added to the total environmental damage resulting from the development, is not taken into account. The authors have attempted to take this factor into consideration.

Berezhnyakovskoye gold ore field is located in Etkul District of the Chelyabinsk Region, 50 km south-westwards off Chelyabinsk and 80 km north-eastwards off the city of Plast. The mining of gold ore at Berezhnyakovskoye field is being performed by OJSC Etkulzoloto. The amount of the field's proved reserves is 1,475 thous. tonnes of ore and 15,047 kg of gold. When calculating the cost of the gold reserves in the subsoil the price of 1,000 grams of gold as per data of the Russian Federation Central Bank as of June 2018 was used: 2,569,920 roubles per 1 kg [1]. Thus, the cost of the reserves equals  $38.67 \times 10^9$  roubles. The gold mining has been in progress since 2002. The annual average mining amounts to approximately 0.8-1 tonnes of gold. In 2010 the construction of a new gold recovery plant was started at the field.

For the moment of the field development the natural vegetation was disturbed by the human economic activity. The lands suitable for agricultural use were ploughed up. The worksite's vegetation consists of separated birch forest stands with thin underbrush and bushes.



According to the performed analysis on land use, initially, the following types of lands were distinguished on the territory being withdrawn: wild herbs – 10-15%, woods – 40%, hunting lands – 10%, agricultural fields – 30% (plough lands, pastures).

As a result of work of the beneficiation plant, the ratio of various types of lands noticeably changed: wild herbs – less than 10%, woods – 15%, hunting lands – 0%, open pits and dumps – around 70%.

A significant part of the lands of the Chelyabinsk Region, where multi-metal ore deposits were discovered and were further mined, belong to the category of agricultural lands. According to the land legislation norms [2], prior to the development the category of such lands shall be changed to the industrial lands (the categories and types of the permitted use of the land plots is changed), i.e. their functional designation should change.

The state cadastral appraisal of the agricultural lands is performed as per a uniform method in order to ensure the comparability of the appraisal results across the territory of the Russian Federation.

## 2. Methods

The goal of the appraisal is to determine the cadastral value of the agricultural lands for substantiation of the land tax, lease payment, and other payments in case of transactions with the land plots. The land plot cadastral value is calculated by multiplying the specific indicator of the cadastral value of the land plot by its area.

$$SICVTL = SICVLnpd \times Cu \times Ce \quad (1)$$

*SICVTL* is the specific indicator of the cadastral value of *i* type of lands;

*SICVLnpd* is the specific indicator of the cadastral value of lands of nature-protection designation (7.07 roub./sq. m) [2];

*Cu* is the coefficient of uniqueness of biological diversity for that type of ecosystem which prevails on the lands of specially protected natural territories;

*Ce* is the coefficient of the ecosystem's importance for the prevailing type of the ecosystem of the lands of specially protected natural territories.

The object of appraisal are agricultural lands within the boundaries of the Russian Federation entities, administrative districts, land ownership (land use) of legal bodies and private individuals. In our case these are lands in Etkul District of the Chelyabinsk Region, where in the context of a disturbed ecology:

$$Cu = Ce = 1$$

Then

$$SICVTL = SICVLnpd \times Cu \times Ce = 7.07 \times 1,421,900 \text{sq.m} \approx 10,052,850 \text{roub.per.sq.m}$$

However, the ecological situation in administrative districts of the Russian Federation differs significantly. The Chelyabinsk Region is in the last place in the Russian Federation ecological ranking. That is why for our region the condition of lands for the moment of field development should be mandatorily taken into account.

The essence of the idea suggested by this article is that the lands of field development should be appraised based on their cadastral value but with consideration to its decrease on account of the previous ecological state of the territory\*.

The bottom-line cost of lands with consideration to withdrawal and land use, as the article authors see it, should be a combination of the following:

- cadastral value of lands with consideration to the previous ecological state of the environment ( $C_v - C_e$ )\*\*;
- subsoil value;
- damage from lost profit due to land withdrawal from agriculture ( $D_w$ );
- expenses on land reclamation after mining (reclamation-  $E_r$ );

- environmental damage over the period the land use (De-mining).expenses on health improvement for people and on additional territory improvement (for instance, investment into modern projects on reclamation-Ehi).

\*Provided the land is used by the lessee (or land buyer) for the first time.

\*\*Land may be bought out or rented, for a certain number of years. We consider the first case.

$$C_{\text{ок}} = (C_v - C_e) + D_w + D_e + E_r + E_{hi} + C_{ei} \quad (2)$$

$C_{ei}$  is the cost of the earth's interior. The cadastral value does not take into account seasonality, demand, and market condition. However, these factors do not influence mining of gold and other precious metals. The cadastral value is a less flexible indicator compared to market value, however, budget revenues depend namely on its amount, especially when it comes to mining.

Often, cadastral value can be overstated for not good reason due to faults in the calculation mechanism. That is why the decrease in the cadastral value on account of the ecological state of the territory prior to the field development is all the more so relevant for the territories with disturbed ecology.

To calculate the bottom-line cost of withdrawal and use the land withdrawn for the field development (in this case, the territory of Berezhnyakovskaya gold recovery plant), we opted for:

1) approach taking into consideration the ecological state of the territory for the moment of the field development;

2) technique of assessment of the economical damage from the impact of mining complexes on the biosphere; and

3) combinatorial method (approach and technique).

The methodical approach taking into consideration the ecological state of the territory for the moment of the field development was suggested by N S Rasskazova and elaborated on the grounds of [3,4].

The approach is based on the weighted coefficients taking into account natural and anthropogenic factors. To introduce correction coefficients, all indices of priority ecological problems were divided as per geographical location. And as per their causes – into natural and anthropogenic (Table 1). In case an ecological problem was caused by both natural and anthropogenic factor, the value of the weighted coefficient doubled.

On the territory of the Chelyabinsk Region 4 types of ecological-and-economical zones were distinguished [4].

The territory of Berezhnyakovskaya gold recovery plant belongs to type III: highly urbanized territories with complex environment disturbance approaching the edge of irreversible changes. It is characterized by the following priority indices:

$IUp$  – industrial and urban pollution of atmosphere and water bodies;

$Rr$ – reduction of river runoff;

$Ld$  – land disturbance resulting from mining works;

$Pd$  – pastures degradation;

$Ds$  – soil dehumification;

$Hmp$ - heavy metal pollution.

### 3. Results

1) Let us perform the required calculation of the change in the cadastral value with consideration to ecological factors, using approach 1. The index weight for the urbanized territory

$$I_{urb} = \frac{100\%}{10 + 6} = 6.25$$

Taking into account the index weight of anthropogenic and natural factors (%), the decrease in the value of the gold recovery plant lands will be:

$$6,25IUp + 6,25Hmp + 6,25Rr + 6,25Ld + 6,25Pd + 6,25Ds \approx 50\%$$

Taking into account the coefficient of tension in the ecological situation:

$$SICVTL = \frac{10,052,850 \times 50\%}{100\%} = 5,026,425 \text{ roub.}$$

Therefore, the cadastral value in this case decreased by half.

**Table 1.** Calculation of the weighted coefficients with consideration to natural and anthropogenic factors.

Urbanized territory		Non-Urbanized territory	
Anthropogenic Indices	Natural Indices	Anthropogenic Indices	Natural Indices
IUp	Ds	Ld	Ds
Ap	Ld(Se,Ds)	Pd	Ld(Se,Ds)
Ds	Ds	Ds	Ds
Hmp	Se	Df	Se
Rr	Rr	Rr	Rr
Pd	Eld	Rpd	Eld
Eld		Eld	
Rct			
Ld			
Rpd			
Number of indices -10	6	7	6
100%		100%	
62.5%	37.5%	53.8%	46.2%

*Rpd* - recreational potential of the depletion;

*Rct* - radioactive contamination of the territory;

*Eld* -ecological land deficit;

*Se* - soil erosion;

*Df* - degradation of forests.

2) According to the technique of assessment of the economical damage from the impact of mining complexes on the biosphere [5], the economical damage was calculated as per data for Berezhnyakovskaya gold recovery plant: the area of the withdrawn land plot taking into account the open pit area equals 142.19 ha; the period of the land plot withdrawal –  $T = 20$  years; the ecological zone of the gold recovery plant is categorized as a crisis one. The coefficient of decrease of the economical value of natural resources for this zone is  $\mu = 0.7$ . Other data for the calculation were taken from [5]. We have tested the technique earlier [6-16], and it showed good results. According, to the technique, the total damage from the land plot withdrawal and pollution equals:

$$Td = Tdw + Dep \quad (3)$$

*Td* is the total damage;

*Tdw* is the total damage from the land plot withdrawal;

*Dep* is the damage from the environment pollution

$$Tdw = Lp + Lunr + Lnp + Er \quad (4)$$

*Lp* is the lost profit;

*Lnp* is the damage from the loss of natural resources;

*Lunr* are the losses from underdrawal of natural resources;

*Er* are expenses on reclamation.

Using the formulas from guidance [5], we see that the damage from the land plot withdrawal equals:

$$Tdw = 235,000 + 8,285,700 + 483,500 = 9,004,200 \text{ rouble.}$$

Next, we will calculate the damage from the environment pollution.

According to technique [5], in the context of Berezhnyakovskaya gold recovery plant the value of the damage is explained by the environmental implications of the field development

$$Dep = De$$

The annual economical assessment of the land resources as per ecological zones depends on the reclamation period, and in the crisis zone equals 2% of the total economical assessment of the resources.

The damage from the environment pollution is calculated as  $Y = 776,800$  rouble. The total damage from the withdrawal and pollution will amount to:

$$Td = Tdw + Dep = 9,004,192 + 776,813 = 9,781,000 \text{ rouble.}$$

3) Now, let us combine the technique and the approach with consideration to the ecological state of the territory for the moment of the land withdrawal for the field development – Formula (2).

#### 4. Results

The combination of the technique and the approach is justified for the territories for which a detailed map of their pollutions was elaborated. Otherwise, only the second method is applicable. The combination of the two allows to calculate the most correct amount of the damage inflicted to the territory by the field development, and the total value of the lands withdrawn for the field development.

However, this technique does not take into account the value appraisal of hazard to the local population's health - Cok, what in the end increased the damage by approximately 35-40% [5].

$$\begin{aligned} Cok &= (Cv - Ce) + Dw + De + Er + Ehi + Cei = \\ &= (1,0052,850 - 5,026,425) + 9,004,200 + 776,800 + 3,912,400 + 38.67 \times 10^9 = \\ &= 18,719,825 + 36.67 \times 10^9 = 36.69 \times 10^9 \text{ rouble.} \end{aligned}$$

We believe that in the context of development of Berezhnyakovskaya gold recovery plant, located just 50 km off Chelyabinsk, its impact on the environment, no matter how insignificant, may noticeably change the already severely disturbed environment and bring its ecology to the so called point of no return. This circumstance will require attracting additional material means (35-40%, which were not taken into account during the calculations). We recommend to spend them on environment protection in order to reduce ecological load on the territory, and on improvement of the population's health.

#### 5. Conclusion

Thus, using the case study of the lands of the gold recovery plant in Etkul Municipality we demonstrated the methodical, ecological and financial aspects of the field lands appraisal with consideration to the ecological state of the territory. The developed approach is used on practice, and the proof of that is the Act on implementing the combinatorial method with consideration to the ecological state of the territory by Profit Lain LLC.

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