Environmental aspects of substantiation of the production decision efficiency

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Abstract. The current scale of industrial production is characterized by the intensive use of natural resources and the growth of waste pollution of the environment. A long-term program is needed to implement targeted measures to coordinate the prospects for the development of national economy and nature protection. Its implementation requires significant capital investment. To increase the efficiency of their use, a scientifically sound methodology for the economic evaluation of the most important types of natural resources and measures to protect the environment is necessary. In recent years, much attention has been paid to the development of such a methodology. Its most important task is to articulate and agree on a single theoretical basis the calculations of the economic efficiency of production decisions with the requirements for the protection of the natural environment. This chapter is devoted to the coverage of these issues.

1 Methods for economic evaluation of natural resources

Industrial construction and industrial production is carried out in close contact with the natural environment. It draws from the environment the necessary resources and throws in her own waste. The linkage of industrial activity with the natural environment mutual: production processes, depending on the natural environment, have on-the adverse effects and the results last later a person feels. [1]

Environmental impact of industrial activities become a major factor in its economic efficiency. The pursuit of the best performance without taking into account the environmental factor often causes the deterioration of the natural environment. The production, of course, cannot be isolated from this environment, but the allowable anthropogenic impacts should be strictly correlated to production effect of technological ways. Thus, the consideration of environmental impacts becomes an important part of determining the overall economic efficiency of the production and investment decisions. [2-4]

For separate consideration it is expedient to distinguish two effects of industrial construction and industrial production on the environment. The first type is directly linked to the consumption of natural resources input production process (extracted from minerals, built-up land, etc.); the second — pollution of water and air oceans of emissions at the outlet of the production processes.

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For economic assessment of natural resource, it is logical to take the effect which is obtained in the economy from its use. The size of this effect can be measured by the difference between what it gets and that takes the economy with the exploitation of the resource, i.e. the difference between the "value" and cost of its receipt. [5]

For a long time it was thought that this difference should be reflected in the form $P - C$, where P is the wholesale list price of the natural resource, and C — cost (or adjusted cost) of its receipt. In essence, therefore, the basis of economic valuation of natural resources taken profit. In our opinion, the possibility of applying current prices to economic valuation of natural resources although not excluded, in General, is less acceptable when you consider the real conditions of modern pricing. This is motivated by the following considerations.

First. Many types of natural resources price is not established (air, earth). And assuming that the price is the value of the goods expressed in money, the natural resources it can not be installed because, not being the result of human labor, these resources do not have a value in exchange. On the modern development of society natural resources such as air, earth, water, and do not enter into the sphere of commodity-money relations, and their prices do not exist. It is hard to imagine and ways of calculation of these prices on the basis of existing principles of pricing: the price of the goods is determined based on the level of production costs of goods and natural resources are not objects of production. If the monetary expression of the value of natural resources it is clear that the indicator should not be price, as a special economic category. [2, 6-7]

Second. Even for natural resources, later becoming the object of human labor (minerals, forest products) that are installed prices do not always accurately reflect the true economic value.

When to the currently accepted pricing methodologies, they are mainly determined on the basis of the average level of the cost of obtaining such resources (e.g., industry average cost of production of mineral raw materials). The planned average costs and added regulatory effect sizes needed to ensure a self-sustaining conditions for the functioning of the industry as a whole; the result of this calculation and stated in the form of prices.

However, for most natural resources characteristic of the vast differentiation of the costs associated with their involvement in the economy.

Third. Set the list price regulate current, rather than promising production conditions (otherwise they would perform the role of regulator of self-supporting relations). As for the indicators of economic evaluation of natural resources, their role objectively broader — to ensure long-term use of the resource from an informed position not only today, but also the prospects.

Fourth. Degree specific limitations of a particular type of natural resources is not always reflected in the price adequately. This applies particularly to estimates of scarce exhaustible and non-renewable mineral resources.

Due to the, price for natural resources and profit can't become reliable tools for their economic assessment. Here you will need a separate, additional tools that more accurately reflects the essence of the economic effect brought by the use of natural resources. [8]

The use of any estimated units of natural resource saves national economy from the need for engagement (in this period) no resources. The unit of resource flows in the economy, with some individual costs C_{ind} . In the case of the other net effect E of end of the field it would do with the limit (closing) costs C_{limit} .

The difference between these costs characterizes the net effect E , which brings people in relation to the economy estimated unit resource. He can be adopted as its economic evaluation.

$$E = C_{limit} - C_{ind} \quad (1)$$

In connection with the above concept will focus on how using it can ensure that different levels of assessments for the already mastered and have not yet begun the exploitation of natural resources. For example, there are two deposits of coal of the same quality and occurring under similar geological conditions. But one operation is conducted, and other industrial development has not yet begun so the capital investment made. The same value have stocks of both deposits? Obviously not. But how to reflect that in their evaluation?

Stated earlier, the "cost" concept was based on an assessment of the largest deposits have already been implemented at a cost: first, they are more on the above and economic evaluation of the first field.

On the concept of potential rental income the answer will be different: the last attachment does not play a role, most importantly — in the magnitude of the costs of the development and exploitation of the resource. In the developed field in the future will require not only significant operational costs. For undeveloped, apart from them, the cost of a detailed field exploration, completion and construction of mines, so the total costs of the above. With the same level of limit cost C_{limit} for both deposits individual costs on the second of them is higher; the smaller a difference $C_{\text{limit}} - C_{\text{ind}}$, i.e. economic valuation of undeveloped deposits.

It is easy to see that the same resource may be different depending on the overall needs of the national economy, but rather of the balance of needs with available opportunities cover them. Valuation of scarce and non-reproducible resources should be higher than the excess or easily reproducible. The concepts of the degree of limitation of certain types of natural resources are volatile over time, and practice assessments should be flexible enough. [9, 10]

Economic valuation of natural resources provide an important contribution of n in all calculations related to determination of economic effectiveness of a variety of production solutions. Specific techniques of using the given estimates in such calculations are reduced to the inclusion of optimized economic criteria (along with direct costs) the entire amount of indirect monetary damages arising in the national economy as a result of partial loss of natural resources due to the adoption of this decision [11]. The magnitude of these damages is calculated directly according to available economic estimates of this type of natural resources by multiplying a value of each of such assessment on the number of losing units of this natural resource. [12-15]

2 Calculation of socio-economic damages caused by industrial pollution of the environment

Modern industry emits air and water oceans hundreds of different substances in the mixing process which are unacceptable to the natural environment pollutants. Part of the waste due to the assimilative capacity of the natural environment on its quality is not affected. Completely eliminate the discharge of industrial wastes is impossible and a fraction of the pollution emitted into the environment, we should recognize the objective due to the current stage of development of the production technology. This percentage is regulated by the established standards of environmental quality: maximum permissible concentrations (MPC), maximum permissible ecological loads (MPEL), maximum permissible emissions (MPE). Usually, the environmental pollution understand the high concentrations of various pollutants in excess of the MPC. In this case we speak about the origin of the damages from pollution.

It seems to us that, since pollution damage is associated with the distribution of concentrations of contaminants in space and time, it is necessary to allocate direct losses and additional costs. The total economic damage from pollution consists of a number of components that consistently arise with increasing concentrations of compounds in time and their effects on different objects.

The first of these components — the cost of preventing impacts of polluted environment on different objects U_1 . This cost element allows to avoid negative influence of harmful substances contained in water and air, to other objects. This includes the additional cost of cleaning polluted water before its use for drinking and technological purposes, the cost of air conditioning in operating room, etc.

The second component includes direct (unresolved) loss of production, expressed in monetary form U_2 . Here is a direct effect of polluted environment on the object. It is the loss of crop yield, productivity, reduction of output, deterioration of fish stocks, plant crops, etc., calculated on the basis of the marginal (closing) cost of production *pririodookhrannaya* industries.

The third component may include costs of liquidation of consequences of pollution on the given object U_3 . This includes, for example, the cost of carrying out works on clearing of a forest, who died as a result of pollutants, the cost of cleaning the reservoir, affected by pollution, the costs of breeding in this fish, the cost of special handling of contaminated agricultural land.

Finally, the fourth component of the economic damages include the cost U_4 for compensation for the damage caused through other external sources to compensate for lost benefits (the development of new agricultural land to replace retired, missing production volumes from external sources, the additional costs for rearing in other areas).

The first component of the economic damage prevents the influence of polluted environment on the object, the next three to occur by direct exposure to contaminated environment. Direct losses of U_2 is evaluated by the magnitude of lost rents (or profits in the absence of calculated values of closing costs), the calculation of the other components is conducted on the basis of discounted costs.

The definition of harm by the magnitude of U_2 can be interpreted as an assessment that lets you know what it would cost society the failure of the conservation measures, and to calculate the amount of natural losses. When assessing the damage values U_3 , U_4 the opportunity to decide that it is cheaper to society to prevent the effects of contamination at their source or to raise funds for their compensation and liquidation. Sometimes the damage is characterized by the amount of costs required to achieve a predetermined end result that makes sense and simplifies the time consuming procedure of obtaining numerical values of economic damage. The calculation of the minimum value of the economic damage caused to the national economy of pollution requires the implementation of variational calculations for each component. The total damage is the smallest of the components, each of which in this case gives a full assessment of the damage and the minimum of their linear combinations.

The distribution of contaminants in the space leads to the necessity of site-specific and regional estimates economic damage from pollution and its components. Objects exposure are population and many sectors of the economy. The classification of certain types of economic damage by the elements and objects is proposed in Table. 1.

In the domestic literature, much attention is paid to the transition from taking into account the concentration of pollutants in the biosphere to the magnitude of natural damages and their subsequent valuation. In foreign literature, a similar connection was called "dose-effect", "dose-response". The main methods for estimating natural losses are the method of comparing the characteristics of the control and contaminated areas; method of empirical dependencies, based on the application of regression analysis; an optimization method for determining individual elements of economic damage. In the United States, approaches are being developed to assess economic damage by filling in the population with special questionnaires, in which two types of assessments are provided: the first is the maximum willingness of a person to pay for a clean environment, and the second is a minimum compensation for the deterioration of the environment. The justified greatness of the damage lies between these two assessments.

Table 1. The classification of the components of economic damage of environmental pollution on objects.

Objects	The cost of preventing the exposure	Direct loss	The costs to eliminate the consequences of pollution at the object	Compensation by connecting external objects
Population	Expenses for the purchase of air purifiers	Accelerated wearout of clothes, shoes, personal equipment (for example, accelerated wear of car tires, increased costs for cleaning, washing)		Migration of the population from contaminated areas to cleaner (relocation costs)
Health care, physical culture and social security	Preventive measures for preventing diseases from contamination, increasing expenditure on physical culture and sports	Increase in the consumption of media. Increase the number of beds. Charges for the payment of ballots		Equipment of new recreation areas
Industry	Additional costs of water treatment of previously contaminated water. Costs associated with the installation of air conditioners in work premises	Decrease in the output volume as a result of pre-temporary wear and unplanned downtime equipment. Decrease in the output of pro- duction and labor productivity as a result of retirement of the worker from the sphere of production because of the disease from pollution of the environment. As a result, the reduction of the national income produced.	Additional expenditure on current and capital repairs. Entering new enterprises for equipment to replace the outgoing one	Obtaining the missing volumes of products at other enterprises. Costs of enterprises for training employees in exchange for those who left
Agriculture	Preliminary clearing of water before irrigating lands	Losses in the production of plant-growing, livestock breeding, total land withdrawal from circulation	Expenses for cleaning this agricultural site, land reclamation. Increased costs for land reclamation, irrigation, fertilizers in the contamination zone	The development of new agricultural land in exchange for retired

Forestry	Planting of sanitary (protective) zones	Reducing the growth of trees, stocks of on-site use. Reduction of the anti-erosion, field-protective, water-protective, water-regulating, recreational, sanitary-hygienic functions of the forest	Costs for sanitary felling, clearing up due to pollution of the forest	Additional costs for growing young animals in other areas, the importation of wood from other areas
Fisheries		Loss of fish products (loss of fish, larvae, eggs, food organisms), deterioration of the quality of fish (appearance of soups, tastes, etc.), developmental anomalies	Additional costs for cleaning this water reservoir and developing fish. Expenses for the maintenance of additional workers	Reproduction of fish products due to additional costs in water bodies of other farms. Compensation due to imports and other sources
Housing, communal services and consumer services	Costs for planting sanitary zones, greenery. Additional costs for water treatment before using water for drinking purposes		Expenses for repairs of buildings and structures. Additional costs for clearing contaminated territories	Costs for the transfer of bills. The use of cleaner sources

3 Determination of the economic efficiency of production activities taking into account the environmental factor

Intensive use of all types of natural resources, reproduction of the required quality of the environment inevitably lead to an increase in the capital investment of the environmental value and the need for their economic justification. At the present time, certain progress has been achieved in developing methods for assessing environmental protection measures. At the same time, these are rather difficult in the methodological sense and difficult for the practical implementation of the task.

The difficulty lies in the fact that the nature protection effect has a number of characteristics. Firstly, the result of environmental protection measures consists of three equally important and interrelated components - economic, social and environmental. Each of them represents an independent side of the concept of efficiency, which is especially noticeable when assessing environmental protection measures.

The second feature of the environmental protection effect is its regional character. A concrete solution of various problems of effective environmental protection can be achieved only from the standpoint of a regional approach. It is often impossible to solve these tasks satisfactorily by enterprise or industry. The peculiar regional nature of environmental measures manifests itself in a specific form of distribution of the effect obtained from them.

It basically goes to society as a whole and only partially to the enterprises that cause pollution. So, stopping the discharge of contaminated sewage helps reduce costs for water users. The polluter enterprise, as a rule, does not feel this effect and is not sufficiently interested in the implementation of environmental measures; moreover, the commissioning of treatment facilities increases the cost of its products. In these conditions, it is particularly advisable to develop economic stimuli that induce the enterprise to reduce pollution, and to strengthen planned management methods.

Thus, in calculating the effectiveness of reconstruction projects, new technology, etc., the economic value of the economic effects that they bring should also include the pecuniary valuation E_{ecol} of the ecological effects: $E_{total} = E_{econ} + E_{ecol}$. Terms payback, the costs and other criteria for the overall effectiveness of the projects under review reconstruction, new technology in this case are calculated with the appropriate inclusion of the ΣE_{ecol} effect in them.

According to the form, the criterion reflects the overall (absolute) or comparative effectiveness of capital investments of ecological purpose. At the present time, there is still no consensus on specific interactions between the criteria of general and comparative effectiveness with respect to costs in environmental protection measures.

The basic principle on which any calculations of comparative effectiveness are based is the comparability of the compared options and the choice of the correct basis for comparison. Sredoohrannaya activities can be carried out in the following directions. The first is to prevent damage (this includes, for example, installing devices that trap sulfur from waste gases from thermal power plants). The second is the elimination of the damage caused at the place of their occurrence (such measures include, for example, reclamation of lands violated by mining operations). In those cases when the admitted damage is not eliminated within the immediate area (object) to which it was inflicted, there remains a third possibility - compensation for the natural resources that have left the normal use by additional input of new analogous resources in the nature in some other place. Such cases include, for example, the introduction of new land in the agricultural turnover in exchange for those disturbed by mountain work.

With this in mind, the task of assessing the economic effectiveness of any of these three types of environmental protection measures can be set in two ways. Namely: the result obtained during the environmental protection measure can be compared:

- a) the situation that arises, if at all, no environmental measures are taken (in this case there will be an uncontrolled violation of the natural resource in question);
- b) with the situation when the affected person in the given section of the resource will be replaced by a specially introduced new one located in another place.

The comparison with position "b" should be considered more reasonable. After accepting for the comparison base "a" ("do not do anything"), we would obviously have violated the universally binding rules of the methodology for assessing the effectiveness of any technical measures. Firstly, situations that are sharply different in their non-economic, social consequences, and therefore not subject to narrow economic evaluation, would be compared; secondly, we would disregard the rule "to designate as the base the best of all alternative options." For these reasons, a more reasonable alternative is, as a rule, the situation "b" - compensation for the loss of resources in this area by entering a substitute resource on the other. Such a replacement always requires an appropriate cost, and the task of assessing the environmental protection option is to compare it with the situation in which the damage caused is compensated outwardly. Both compared options (estimated and basic) equally meet the needs of the national economy in this natural resource and from this point of view are fully comparable.

To implement the estimated option, it is necessary to pay for environmental measures C_{em} and C_{ind} for the actual operation of the resource, and for the basic version - the cost of C_{comp}

to compensate for the retiring resource. The cost difference $(C_{em} + C_{ind}) - C_{comp}$ characterizes the effectiveness of the environmental protection option.

If

$$(C_{em} + C_{ind}) - C_{comp} < 0 \quad (2)$$

or

$$C_{em} + C_{ind} < C_{comp} \quad (3)$$

then environmental protection measures are beneficial.

It is not difficult to see that this formulation of the problem to some extent coincides with the one when, in place of compensation for the basic variant, the magnitude of the non-compensated damage D caused by the indicator of the economic evaluation of as (1), is taken into account. Thus, in the basic variant of "uncompensated waiver of environmental protection measures," there is damage to the predecessor $C_{limit} - C_{ind}$. The "implementation of these measures" does not have any damage, but there are additional costs C_{em} . Comparing the costs C_{em} with the value of the damage they are eliminating, we obtain the difference $C_{em} - (C_{limit} - C_{ind}) = C_{em} + C_{ind} - C_{limit}$. It also characterizes the effect obtained from environmental protection measures.

When

$$C_{em} - D < 0 \quad (4)$$

or

$$C_{em} + C_{ind} - C_{limit} < 0 \quad (5)$$

the implementation of environmental protection measures is economically viable.

The result coincides with the one to which we came earlier, with the only difference that C_{limit} is instead of C_{em} . If we assume that the compensation of the disturbed resource is due to the input of the closing sections (which is not always the case), i.e. that $C_{em} = C_{limit}$, then the results of the evaluation by both methods completely coincide.

So, two methods of estimating the economic effectiveness of environmental protection measures are possible. With the first method, the total costs for the environmental protection option are compared with the compensation costs. In the second method, additional costs for the environmental protection option (the cost of the environmental protection measures themselves) are compared with the amount of unacceptable damage calculated by the indicator of the economic valuation of the resource being consumed. The first method is universal; the second - is only acceptable for cases when compensation is possible only in the closing areas.

If there is a set of production options and it is assumed that each of the variants provides an equal level of environmental quality, i.e. equality of the final result of the eco-investment is achieved, the choice of the option is carried out according to the formula of the minimum of the costs. However, it is impossible to cover the whole range of solved economic problems with this requirement. Therefore, when comparing the reported costs for options that provide varying degrees of disturbance of natural resources or capture of pollutants, the magnitude of the damage is introduced into the criterion of comparative efficiency.

Here we take into account the fact that the evaluation of the activities of enterprises should be carried out according to final economic results, which include not only the production of good quality finished products, but also the preservation of the required level of the state of the environment. If environmental investments are not fully implemented at the given enterprise and it is necessary to resort to liquidation of adverse consequences, then the final national economic result is determined only after the negative ecological effect is repaid.

Often, these calculations need to take into account the time factor. This occurs in each of three cases: 1) when the implementation of environmental protection measures requires a long (several years) deadlines; 2) when possible damage (in case of not taking measures) would arise not immediately, but after a long time; 3) when the loss of a natural resource (when taking measures) would be temporary. In all these cases, traditional methods of time management, as described above, should be resorted to. In their simplest form, they are reduced to bringing all the temporary costs and damages to one year by multiplying by the coefficients B_t .

For the most complex multivariant problems, a dynamic setting is preferred, in which the integration costs and losses accumulated over the 15-25-year evaluation period are minimized.

Formula (6) takes the form

$$\sum_{t=1}^T (C_{em}^t + C_{ind}^t - C_{comp}^t) B_t < 0 \quad (6)$$

If environmental protection measures eliminate not one, but several types of environmental damage, the calculations take into account the entire amount of liquidated damages of the most diverse content and place of manifestation.

The implementation of environmental measures is ultimately designed to create an environmentally friendly type of production, which should be understood as such an organization of production, which provides for the integrated use of natural resources, the use of low-waste technologies with a closed cycle, the utilization of emerging waste and the compliance of harmful substances with the established social standards.

The characteristic of this type of production is a comprehensive assessment of the environmental friendliness (purity) of production, including at least three components: a resource-saving effect (E_2), an environmental effect (E'_2), and an additional effect of waste utilization (E''_2).

Achieving the resource-saving effect meets the requirement of saving labor, material and natural resources. In the basis of the formation of a resource-saving effect, it is advisable to put economic estimates of natural resources.

$$E_1 = E \cdot \Delta V, \quad (7)$$

where E is the economic estimate of a unit of natural resource; ΔV - the amount of the saved resource as a result of conducting technical and organizational measures. The environmental protection effect (E_2) is obtained both through the implementation of direct costs for cleaning (E_2), and through the addition of non-waste technologies (E_2).

The definition of E_2 does not cause fundamental difficulties and is based on a comparison of the amount of prevented damage with the costs of liquidating it:

$$E'_2 = \sum_i \Delta U_i \Delta V_i - (\sum C_{pur} + E_n \sum K_{pur}) \quad (8)$$

where ΔU_i is the prevented damage per unit of the captured quantity of the i -th pollutant;

ΔV_i - volume of caught i -th harmful substance;

$\sum C_{pur}$ - total current costs for cleaning harmful substances;

$\sum K_{pur}$ - total capital investments for the purification of polluting substances;

E_n - the normative coefficient of efficiency.

Evaluation of the environmental impact of the introduction of non-waste technologies E_2 is often a great difficulty. The result of the transition from conventional technology to low-waste technology can be represented as a reduction in the potential formation of the i -th harmful substance (ΔU_i) with the same volume of products. This value is calculated as the difference between the volume of the i -th waste with the conventional technology (ΔS_{iw}) and the low-waste (ΔS_{il-w}). Then the environmental protection effect from the introduction of wasteless processes will be expressed by the formula:

$$E_2'' = \sum_i \Delta S_i \Delta U_i - (\sum C_{l-w} + E_n \sum K_{l-w}) \quad (9)$$

where $\sum C_{l-w}$, $\sum K_{l-w}$ - additional total current and capital costs at the transition from conventional technology to low-waste.

The additional national economic effect is also brought about by the utilization of waste. Modern production is characterized by the presence of various wastes, which do not always find market opportunities; as a result, they are stored in various accumulators, buried or burned, which in turn leads to irrational use of land under storage tanks, pollution of the atmosphere and groundwater.

Calculation of the additional effect of waste management is based on a comparison of the costs of obtaining a useful product from the waste and the costs of their disposal, as well as the effect of reducing the additional costs of their storage:

$$E_3 = \sum_j C_{limit\ j} Q_j - (C_{disp} + E_n K_{disp}) + (C_{st} + E_n K_{st}) + E_3 \Delta V_3 \quad (10)$$

where C_{limit} - the closing costs for obtaining the j-th product (or its wholesale price);

Q_j is the volume of output of the j-th product from the captured product;

C_{disp} - current costs for waste disposal, including transport costs in the event of their transportation, or additional costs for the use of waste in technological processes;

K_{disp} - capital investments for waste disposal, including additional expenses for waste utilization in technological processes;

C_{st} - operating costs for storage of waste;

K_{st} - capital investments in storage of waste (construction of sedimentation tanks, slag storage, etc.);

E_3 - economic valuation of alienated land under storage for waste storage;

ΔV_3 - the area of alienated land.

The most effective, apparently, should be considered the creation of non-waste territorial and industrial complexes that combine the rational form of production organization with technical measures for environmental protection.

Auxiliary indicators of the effectiveness of environmental measures, characterizing the activities of self-supporting enterprises to reduce polluting emissions, the operation of treatment facilities, and the degree of equipment provided by enterprises with treatment facilities are a number of natural indicators (the amount of pollutants captured by types of ingredients and types purification, the volume of utilized valuable substances, reduction of harmful emissions per unit of output) and cost indicators (the value of the prevented damage, the cost of cleaning a unit of harmful substance, the capital costs for catching a unit of pollutants, the return on assets of treatment facilities, the profit from the sale of waste on the side). All of them not only characterize the purification activity, but either they are themselves particular types of assessment of the effectiveness of environmental measures, or they form the initial information base for the main evaluation of effectiveness.

4 Conclusions

The solution of ecological problems should lead to a change in the structure of capital investments and current costs for both individual sectors and the national economy as a whole (possibly, to a change in the structure of needs). The simultaneous solution of all tasks to protect the environment in conditions of maintaining high rates of economic growth and maximum satisfaction of life's needs is difficult. Therefore, among the main problems, in our opinion, it is necessary to consider the scientific justification for the share of the national income reaching for environmental purposes. The consideration of possible future negative consequences, irreversible social and ecological processes is an indispensable condition for making any decision. It seems to us necessary and possible to establish the limits in which

this quantity should be located. Its lower boundary could be taken into account on the basis of quantitative assessment of socio-economic damage, determined by taking into account the time factor, the upper limit - from the amount of costs to achieve the normative level of environmental quality.

The approaches and methods considered above to a certain extent make it possible to calculate the economic efficiency of individual environmental protection measures. It should be noted, however, that this, of course, is still not enough to solve the problem of rational nature management. A complex of action measures is needed, which will make enterprises more fully aware of the economic damage inflicted on their activities by the natural environment. The following measures in these directions are possible in principle and are expedient. The first is to impose monetary sanctions on companies, fines in the amount of environmental damage caused. The second is the introduction of a fee for the use of any limited natural resource (the basis for the numerical assignment of the sizes of such fines and fees is given by economic estimates of each type of natural resources). The third is to oblige an enterprise that caused damage or loss of a natural resource, and at its own expense to eliminate or compensate it (measures such as mandatory reclamation of agricultural lands that are violated by mining enterprises). The fourth is a direct legal prohibition of actions harmful from an ecological point of view and application of legal sanctions personally to violators. And finally, the fifth - a broad explanatory and agitation work among the population. The socialist state outlined the implementation of active environmental protection activity in the foregoing years practically in all these areas.

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