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SOCIAL AND ECONOMIC EVALUATION OF DRAINED BOTTOM RECLAMATION IN THE DEVELOPMENT OF THE KAZAKHSTANI PART OF THE ARAL SEA

Abstract

This article deals with the methods for evaluating an object of nature management which includes the ecological, social and economic component of natural resources. The specific conditions for the formation of the soil cover of the drained bottom of the Kazakhstani part of the Aral Sea, the climate and EDA physics of plant community growth contributed to the formation of three main types of elementary ecosystems on the territory of the drained bottom (ephemeral, wasteland and non-ecosystem). Based on this fact, in the drainage zone of the Aral Sea, it was revealed that the most perspective for phytomelioration works are the representatives of the native flora such as sarsazan (carp), Schober saltpeter, tamarix multifaceted, black saxaul and zhuzgun (calligonum).

Proceeding from this, in the Aral Sea drainage zone it was established that representatives of the native flora are the most promising for phyto-reclamation works; sarsazan, Schiter's nitrate, tamariks multi-branched, black saxaul and zhuzgun. At the same time, the placement of Schobert nitrate is most acceptable on loams (areas in the splash and saline wasteland); multibranched tamarix and black saxaul - in a strip of salt and xeromorphic wasteland, represented by loams; zhuzguna in a strip of xeromorphic wasteland.

Keywords*: phytomelioration, halophytes, drained bottom, ecosystem, agriculturallandscape, nature management.*

Introduction. The problem of creating a system of rational use of natural resources, the optimal interaction of nature and society can be successfully solved within the developed social and economic structures, since the solution of these problems is closely related to the problem of environmental and economic evaluation of the natural basis of society and its separate components which enable to combine the results of natural, technical and economic sciences in the development of scientifically based standards of using natural resources, including the appropriate qualitative, quantitative and cost indicators.

The methods for evaluation of the nature management object include the ecological, social and economic components of natural resources. Making these assessments significant and due to the specifics of the problems being solved, one must consider them as a whole in solving the problem «society – nature». Moreover, the ecological evaluation should be aimed at solving the problem of environmental protection, and the economic evaluation should be aimed at solving the social and economic aspects of the problem [1,2].

Ecological evaluation. The subject of ecological evaluation of the environment is a set of natural factors that determine the formation and development of flora and fauna within the considered region at a given level of development of productive forces, i.e. taking into account the positive or negative anthropogenic changes of natural components.

The main significance is given to the flora and fauna. At the same time, it goes without saying that a set of natural factors includes wildlife itself as a self-determining factor. In fact, biocenosis is a set of plants and animals that inhabit a part of the habitat with more or less homogeneous natural (climate, topography, soil, hydrology, hydrogeology, etc.) and anthropogenic (created by human activities) living conditions.

Social evaluation. The object of nature management is not only a natural basis for economic development, but also as a human living environment. The consumer value of an environmental

management object exists as a factor of the need for certain conditions of human life: biomedical, industrial, food, and others. Therefore, the subject of a social evaluation of a nature management object is the social consumer value of a set of natural factors that affect human living conditions. First of all, this evaluation should be aimed at ensuring optimal, ecological and social living conditions of people within a specific natural and economic region at a given level of development of productive forces.

Economic evaluation. In economic practice, the issue of assessing natural resources should be considered differentially on their separate types: land, water, landscapes, etc. Science and practice should certainly connect the objective of evaluation with the maximum effect in the national economy when using this natural resource.

The economic evaluation of the nature management object is aimed at creating the most rational (optimal) system of water consumption and land use taking into account the ecological and social factors at a certain rated level [3]. Thus, the subject of economic evaluation of the nature management object is the consideration of the social consumer value of the nature management object. Moreover, the target function is the maximum national economic effect from the use of natural resources that is achieved taking into account ecological and social restrictions in their development.

Research material and methodology. The given system of estimated indicators can serve as a measure of damage and is the basis for obtaining economic and social estimates. When calculating the costs, one should base on the standards of the conditions of natural systems and the activities of enterprises (maximum permissible emissions, maximum permissible concentrations, etc.) that are developed on the basis of social and economic approach. The economic evaluation is usually expressed in a value form, and its important advantage is considered to be its general integral character.

The scheme for obtaining a social and economic evaluation can be carried out in the following sequence:

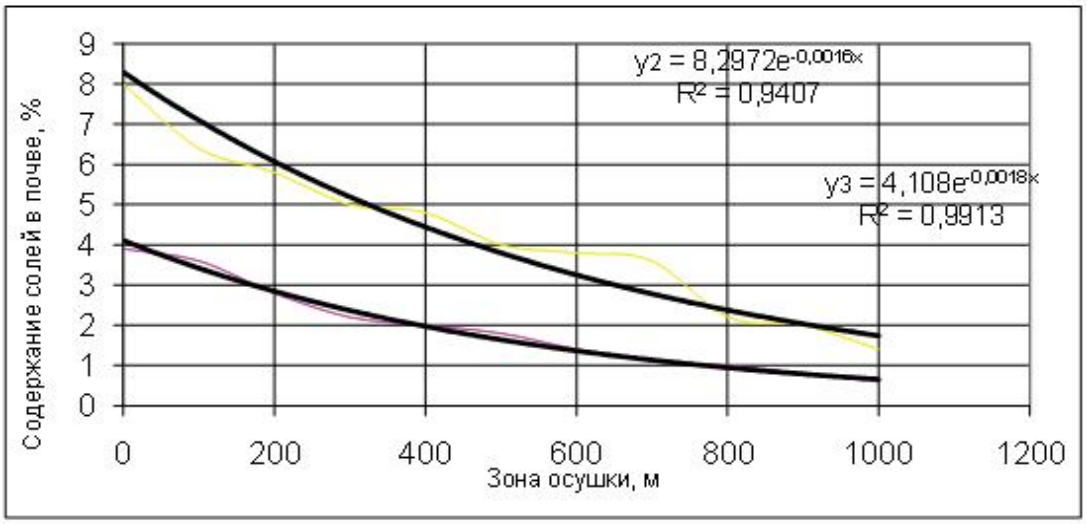
- analysis of the impact on nature, the assessment of the consequences which are significant for a given object in the structure of the natural and economic complex;
- selection of criteria of social and economic significance, quantitative assessment of these criteria;
- calculation of economic damage.

The implementation of this set of issues is of great importance, since their solution can serve as the basis for target research on the formation of optimal environmental conditions, which is associated with a systematic approach to the solution of the problems under consideration. Regarding the conditions of phytomelioration arrangement, another group of factors of environmentally sustainable nature management can be implemented:

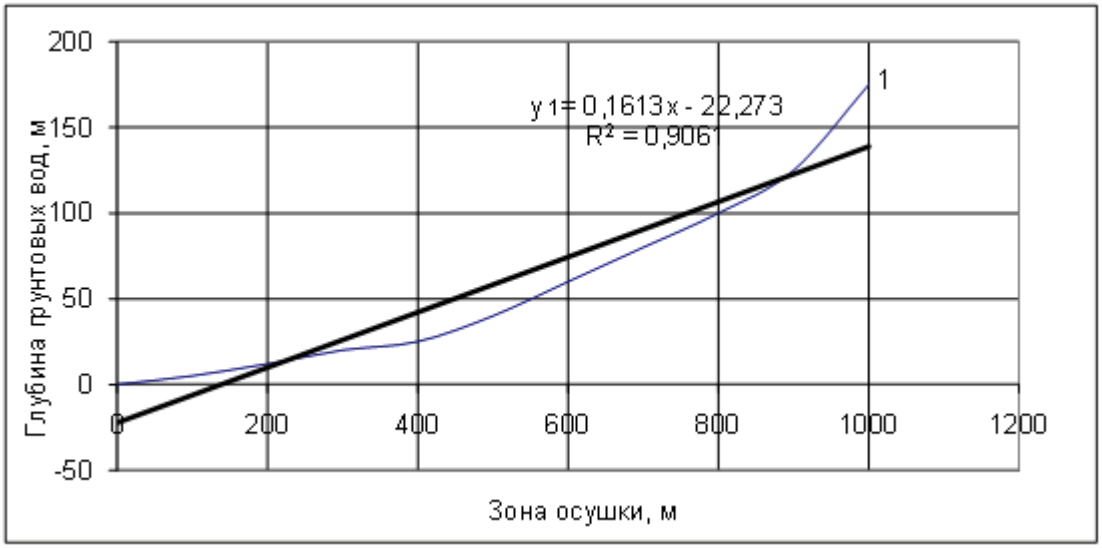
- dynamics of the balance of water resources in the river basin for the estimated period;
- characteristics of the agricultural landscape condition and its ecological and reclamation indicators.

Research result. In conditions of restoration of degraded territories by means of engineering arrangement and phytomelioration measures, an integral natural and anthropogenic sphere is formed with a certain level of ecological reliability and its assessment in specific conditions allows defining the required characteristics of its constituent structures that determine operational stability. Obviously, this kind of problem should be solved taking into account the availability of certain resources. Only this approach allows having an environmentally reliable object [4-6].

While studying the intensity of salt migration in the soil profile under the industrial conditions, depending on the degree of drainage of the territory, it is difficult to calculate the amount of water filtered through a given point in time due to the curvature of the filtration line and side flow. In this regard, the specified desalinization of soil in the areas is achieved by increasing the filtration rate with a significant subsidence of the groundwater level (Figure 1).



Salt content in soil % dry zone depth of ground waters



1- change in the level of groundwater occurrence in the drainage zone; 2- dynamics of soil salinization degree in the aeration zone; 3- dynamics of soil salinization degree in the root layer

Figure 1 - Change of soil mineralization degree in the drainage zone depending on the degree of drainage

These processes taking place in the soil are completely confirmed by the experience of M.K. Ragimov [7], who found out that the efficiency of desalination of soil decreased with the reduction in the rate of infiltration water discharge.

We propose an approach to the determination of salt migration in soil, based on the use of a simplified mathematical model of soil surrender processes, which is based on the hydrodynamics of the area drainage. Suppose that the change in the concentration of salts over time in the elementary volume *ds* of the soil with sufficient drainage is equal to the intake of salts as a result of the difference in the concentration of the soil solution, the transfer of salts by moving water and due to the dissolution of the solid phase of the salts and their entry into the solution.

In the first approximation, the decrease of salts in the elementary volume of soil with coordinates *(X, H)* under the influence of the filtering stream can be described by the differential equation:

$$\left(\frac{dC}{dt}\right)_x = D \cdot \left(\frac{d^2C}{dl^2}\right)_x - V_{фx}\left(\frac{dC}{dl}\right)_x , \quad (1)$$

where C is the concentration of salt in the soil solution; X - the coordinate measured from the surface along streamlines passing through the volume *(ds = XH)*; V - filtration rate on the corresponding axis X (in the direction of the streamline).

When $V_{фx}$ developing a specific nature management project in the absence of a certain part of the data that establish the effect of a measure on the general environmental situation, the method of expert assessments can be used. When assessing the environmental reliability of an object, the concept of complete and incomplete consideration of environmental requirements is introduced:

$$\overline{\Pi} = \sum_{i=1}^{n} N_p \qquad \overline{H} = \sum_{i=1}^{m} N_p \quad (2)$$

where n, m – respectively the number of all and only considered ecological requirements, with $m \le n$.

For a number of objective reasons, in the conditions of the problem under consideration, the ecological requirements of position 6 of the estimated table have not been taken into account. Taking into consideration the above requirements and table data, we have:

$$\overline{I} = \sum_{i=1}^{9} N_p = 7.0 \qquad \overline{H} = \sum_{i=1}^{7} N_p = 5.9 \quad (3)$$

Using the probability integral, we can assess the environmental reliability of the phytomelioration system [7].

$$R = \frac{1}{\sqrt{2\Pi}} \int_{z_0}^{\infty} e^{-0.5z^2} dz \qquad \text{where} \qquad z_0 = -\frac{\overline{\Pi} - \overline{\Pi}}{\sqrt{\sigma^2{}_n + \sigma^2{}_н}} \quad (4)$$

where z_0 is the lower limit of integration, and $\sigma^2{}_n = D_n$, $\sigma^2{}_н = D_n$, - the sum of the variance, which is determined, respectively, with complete and incomplete consideration of the requirements of Table 1.

Table 1 - Assessment of ecological reliability level and quality of environmental management in the Aral Sea

№	Ecological requirements (criteria)	Implementation of ecological requirements	Reliability assessment	
			N_i	σ_{Ni}
1	Soil-protective actions	Preservation of fertile soil layer and its aggregate state	0,8	0,1
2	Erosion-preventive actions	On the adjacent territory and directly on the phytomelioration site	0,9	0,1
3	Forest shelter actions	Along roads and engineering structures of water regulation in the river floodplain	0,6	0,1
4	Preservation of flora	Natural conservation of different plant communities	0,75	0,2
5	Preservationoffauna	Conservation of different populations of the animal world	0,85	0,1
6	Fire-fighting activities in the area oftugai thickets of river floodwaters	Fire furrow flash, etc.	0,5	0,2

In conclusion, it should be noted that the formation of soil cover in the river delta and the drained sea area is accompanied by intensive salinization of soils and the formation in the area of the active beach of marching and seaside salts of chloride, sulfate-chloride and chloride-sulfate type, their degradation, desertification and loss of economic potential.

The specific conditions of soil cover formation, climate and edaphysis of plant communities have contributed to the formation of three main types of elementary ecosystems on the territory of the drained bottom (ephemeral, empty and non-ecosystem) that are developing in dynamics, which has determined the main directions of restoration of their stability - recultivation by phytomeliorative measures, reconstruction of delta lake systems and watering of floodplains.

The existing provisions are insufficient for the specific conditions of the Sydarya River Delta: problems with the use of wild halophytes (rapid loss of germination, difficulties with introduction, low productivity); Insufficient justification for both inter-State and intra-republican water production and water resources management; Inadequate techniques for the rehabilitation of degraded delta agrolandscapes have necessitated further research, taking into account the natural conditions of the region under consideration.

Proceeding from this, in the Aral Sea drainage zone it was established that representatives of the native flora are the most promising for phyto-reclamation works; sarsazan, Schiter's nitrate, tamariks multi-branched, black saxaul and zhuzgun. At the same time, the placement of Schobert nitrate is most acceptable on loams (areas in the splash and saline wasteland); multibranched tamarix and black saxaul - in a strip of salt and xeromorphic wasteland, represented by loams; zhuzguna in a strip of xeromorphic wasteland.On this basis, it has been established in the drying zone of the Aral Sea that members of Aboriginal flora are the most promising for phytomeliorative work; Sarsazan, Shoberaselitrana, tamarix multi-Soviet, saxaul black and buzzgun. At the same time, the placement of Schauber 'sselitrane is most acceptable on loam (areas in the adhesive strip and salt void); Tamarix of multi-vowel and saxaul of black - in a band of salt and xeromorphic void represented by loam; A buzzgun in the xeromorphic void band.

It is recommended to perform planting works by special mechanisms by trench method with simultaneous mulching of soil for moisture retention. During planting works, even under conditions of compliance with all recommendations and technological techniques, it is necessary to focus on low percentage of survival of seedlings and seedlings 10-30% in unfavourable years and 30-60% in favorable years.

At the same time standard species of topole rocks are different, sharp-leaf maple and karagach, grown in forest pits for creation of forest field in the arid zone, in specific conditions of drained bottom of the Aral Sea for recultivation with the help of phytomeliorative planting are not suitable.

Conclusion. The sharp decrease in the water content of floodplains hinders the intensive development of recultivation through phytomeliorative measures, and therefore, in order to increase the water availability of agrolandscapes, the development of grazing and forest areas, engineering of delta systems of the lower reaches of the Sydarya River should be carried out.

The environmental-economic assessment of the proposed activities for the management of degraded agrolandscapes showed that, with full consideration of the requirements, the efficiency of their reconstruction has a sufficiently high potential. At the same time ecological reliability of recultivation sites will be R = 0.9, which is at the level of optimal value.

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ТҮЙІН

Бұл мақалада табиғи ресурстардың экологиялық, әлеуметтік және экономикалық құрамдас бөліктерін қамтитын табиғат пайдалану объектісін бағалау әдістері қарастырылады. Арал теңізінің қазақстандық бөлігінің дренаждалған түбінің топырақ жамылғысының қалыптасуының ерекше жағдайлары, климат және Эда өсімдік қоғамдастықтарының өсу физикасы дренаждалған түбі аумағында қарапайым экожүйелердің (эфемерлік, бос және экожүйелік емес) үш негізгі түрінің қалыптасуына ықпал етті. Осы фактіні негізге ала отырып, Арал теңізінің дренаждық аймағында фитомелиоративтік жұмыстар үшін сарсазан (тұқы), Щоберская селитра, сан қырлы тамарикс, қара сексеуіл және жүзғұн (каллигон) сияқты абориген флорасының өкілдері ең перспективалы болып табылатыны анықталды.

Осыған орай, Арал теңізінің дренаждау аймағында фитомелиоративтік жұмыстар үшін аса перспективалы абориген флорасының өкілдері: сарсазан, Штитер нитраты, көп қабатты тамарикс, қара сексеуіл және жүзғұн болып табылатыны анықталды. Сонымен қатар, Шоберт нитратын саздақтарға орналастыру барынша қолайлы (иықтағы учаскелер мен сортаң бос жерлер); көп тармақталған тамарикс және қара сексеуіл - саздақтармен ұсынылған сортаң және ксероморфты бос жерлер жолағында; жүзгун-ксероморфты бос жерлер жолағында.

РЕЗЮМЕ

В данной статье рассматриваются методы оценки объекта природопользования, включающего экологическую, социальную и экономическую составляющие природных ресурсов. Специфические условия формирования почвенного покрова дренированного дна казахстанской части Аральского моря, климат и Эда физика роста растительных сообществ способствовали формированию на территории дренированного дна трех основных типов элементарных экосистем (эфемерных, пустошных и неэкосистемных). Исходя из этого факта, в дренажной зоне Аральского моря было выявлено, что наиболее перспективными для фитомелиоративных работ являются представители аборигенной флоры, такие как сарсазан (карп), Щоберская селитра, тамарикс многогранный, черный саксаул и жузгун (каллигон).

Исходя из этого, в зоне дренирования Аральского моря установлено, что наиболее перспективными для фитомелиоративных работ являются представители аборигенной флоры: сарсазан, нитрат Щитера, тамарикс многозабойный, черный саксаул и жузгун. В то же время размещение нитрата Шоберта наиболее приемлемо на суглинках (участки в плеще и солончаковой пустоши); многоразветвленных тамарикса и черного саксаула - в полосе солонцовых и ксероморфных пустошей, представленных суглинками; жузгуна в полосе ксероморфных пустошей.