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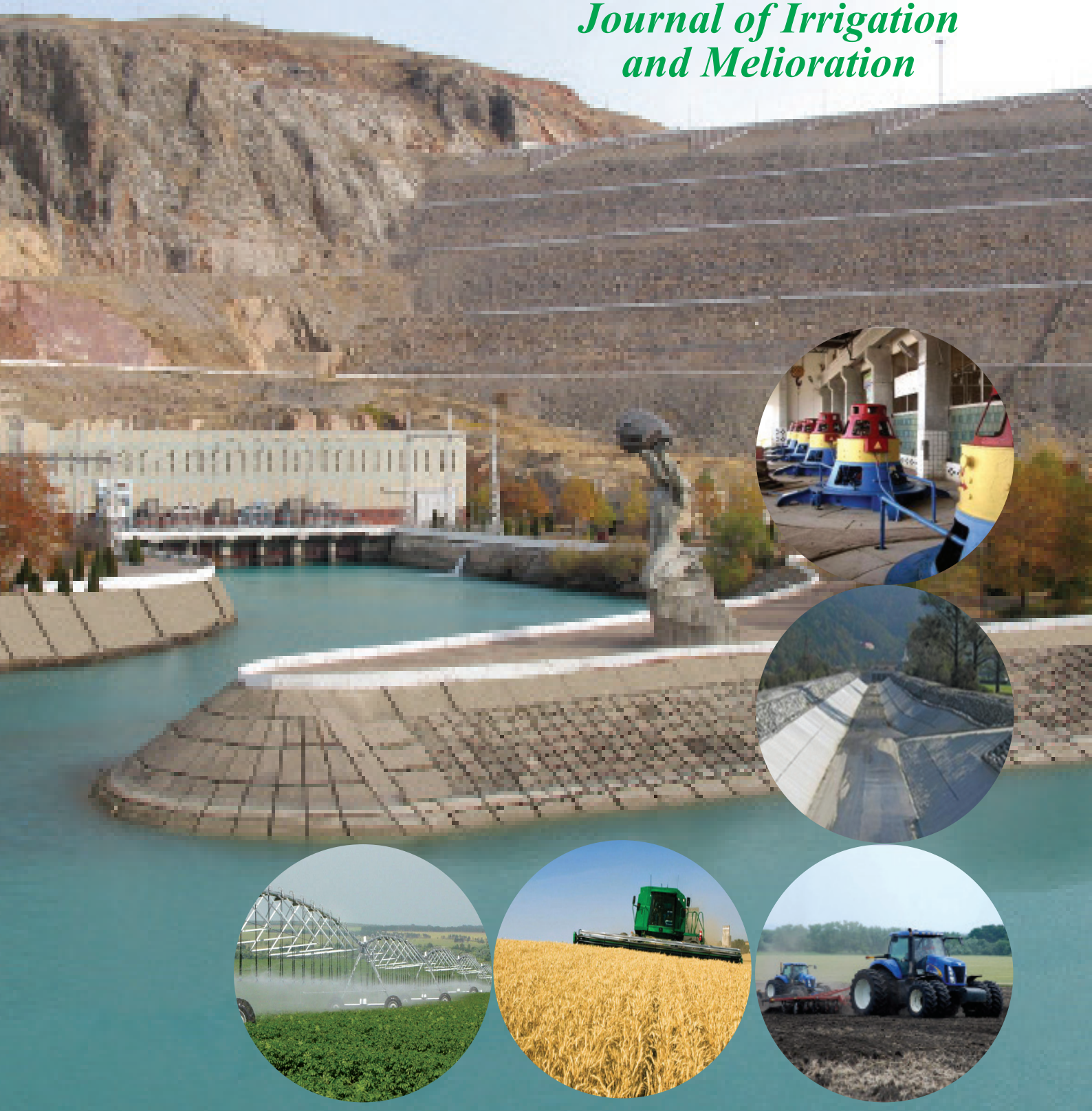

IRRIGATION AND MELIORATION

HYDRAULIC ENGINEERING STRUCTURES AND PUMPING STATIONS

ELECTRIFICATION AND AUTOMATION OF AGRICULTURE AND WATER RESOURCES MANAGEMENT

ECONOMICS OF WATER MANAGEMENT AND USE OF LAND RESOURCES

LAND USE SYSTEM MODERNIZATION: ENVIRONMENTAL ASPECT OF MANAGEMENT

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Abstract

The main causes of degradation of irrigated and dry lands, pasture lands are considered in the paper. Significant economic damage to agricultural production due to degraded land use is stated. The transition to a new environmental policy in land use in conditions of innovative economy requires the modernization of structural and functional relations in the land use system on the basis of scientific, technological and technical innovations. In this regard, it is necessary to modernize the land use management system, that is, to modernize the whole complex of management aspects.

Among them, an important place in the modernization of land use management is given to the modernization of environmental aspect of management, since the land degradation has become a limitation of the rise in socio-ecological efficiency of its use. The modernization content of environmental aspect of land management system and its role in ensuring a synergistic effect in the management of sustainable land use have4 been established.

Key words: land use, degradation, ecology, management aspects, modernization, innovation, sustainable development, reproduction of soil fertility.

Introduction. The world community transition from a model of economic growth to a model of sustainable development presupposes the harmonization aspects of nature and society development, rational use of natural resources, which ensures meeting the needs of the present generation within reasonable limits and retains the same opportunities for future generations.

This condition fully applies to the use of land resources. In Uzbekistan, in agricultural land use, an insufficiently favorable ecological situation has developed, which requires the transition to a new environmental policy in the context of innovative economy and sustainable land use development [1,2,3]. New environmental policy consists in ecologization of land use and requires the development of a mechanism for priority consideration of environmental factor at all stages of reproductive cycle of land use through radical modernization of land use as one of the most important sectors of economy [4, 5, 6].

The land use modernization in structural and functional relations involves modernization of environmental aspect in the overall land use management system.

Situational analysis. Low efficiency of agricultural land use in the country is largely due to its outdated technical equipment, imperfect technologies for the use of land resources, inefficient structure and management system. These shortcomings are true for all sectors of agricultural land use: irrigated and dry farming, grazing lands and forestry.

Irrigated lands are depleted by 45% (average soil growth class in the republic is 55 [7]) due to the lack of fertility reproduction; salinity is about 46% [8]; about two million hectares of arable land is subject to water and wind erosion, and the forest shelter belts are absent. Dry farming arable land is also subject to wind and water erosion, and the changes in climatic conditions have a negative impact on agricultural production. Out of 752 thousand ha of dry arable land, annually, up to 400-500 thousand ha are not sown [7].

Pasture lands are subject to significant degradation, especially in the desert and semi-desert zones [9], the economic loss from pasture degradation is significant [10, 11]. These shortcomings (and a number of others) in agricultural land use reduce the quality of agricultural land, the income of land users and landowners, and the standards of rural population well-being. The ecologization and implementation of innovative methods in agricultural land use requires a radical modernization of the land use system, including the aspects of system management [12]. The content of the modernization of environmental aspect in land management has been studied considering the significant negative impact of land degradation on agricultural land use effectiveness.

Methodology. Ecologization in land use development provides for the integration of environmental and economic politics and ensures high priority of rational use of land resources, the transition in environmental policy from protecting individual nature objects to protecting their entire system, restoring and protecting ecosystems, moving from combating the effects of land degradation and desertification to controlling the causes of their occurrence. Ecologization is aimed at land degradation prevention, implementation of modern technologies for their use, ensuring the improvement of their quality and environment protection.

In conditions of sustainable development of the country's economy and the transition to a "green" economy model, an important role is given to ensuring environmental safety, quality of the population living conditions, and rational and efficient environmental management [13, 14]. The new environmental policy in land use is reflected in the Rio de Janeiro United Nations Convention to Combat Desertification [15], resolutions of the UN General Assembly [16], Resolution of the Cabinet of Ministers of the Republic of Uzbekistan "On measures to implement national goals and targets for sustainable development for the period until 2030" [17], in other international documents regulating relations in the sphere of environmental protection and sustainable development.

Analysis of results and examples. The aim of land

use ecologization is an expanded reproduction of land resource potential, ensuring investment and economic interest of land users and landowners in its rational and efficient use and protection. An economic mechanism for land use management is to restore soil fertility at the end of each agricultural year. As a result of tillage and care of agricultural plants (crops) technologies, negative changes in squality occur, causing a decrease in its productive forces.

The soil is depleted as a result of nutrients consumption by plants for the formation of crop, its water-air balance, mechanical, chemical and biological compositions are changed, the surface layer is washed off and blown out. Soil quality reduction during agricultural production is an objective process associated with agricultural crop cultivation technologies, and requires annual land reclamation to restore its fertility.

The reproduction cycle of land use by the beginning of the next agricultural year should be closed (simple or expanded reproduction). If it is not closed for several years, the soil quality is significantly reduced, its degradation sets in. Therefore, the requirement of closeness of land use reproductive cycle based on the necessary types of agricultural land reclamation measures is an objective condition to maintain the environmental sustainability and efficient use.

In practice, land reclamation is carried out either in a limited form or not at all, with the exception of water conservation. If the reproduction cycle of land use is not closed year after year, the process of degradation of irrigated and dry lands, pastures, and forestry lands is developing. In recent years, there has been virtually no land reclamation on biological reproduction of soil fertility, since legumes (alfalfa) have been removed from field crop rotations; anti-erosion land reclamation is not carried out; only in the last 2 years, work has begun on agroforestry (protective shelter belts in zones of irrigated agriculture) [18, 19].

At the same time, significant means from the Fund for Ameliorative Improvement of Irrigated Lands are allocated for irrigation and drainage - to combat salinization of land and its washing. The washing of saline lands gives a temporary effect (for 4-5 years), then the salinization resumes due to the failure to maintain the irrigation regime. Insoluble salts in mineral fertilizers remain in soil, pollute and degrade it. When washing saline lands with significant leaching rates, nutrients (humus) are washed out of soil and aerobic bacteria and other living organisms die; this contributes to the decomposition of organic substances residues in soil.

As a result, the soil, like a living organism, after repeated washing irrigations turns into a lifeless soil in structure, there are no living organisms in it, the process of soil formation ceases, and the land degradation occurs due to soil quality decrease. From an environmental point of view, it is necessary to control not the salinization, but the causes of soil salinization.

Dry farming arable lands are degrading due to the negative effect of climatic factor and an ineffective system of dry farming. Due to global climate change, maximum temperatures are higher and more frequently occur, the amount of atmospheric precipitation becomes less and/or redistributes over the seasons, the droughts become more frequent. In dry farming, modern technologies for cultivating fields (contour plowing, "zero" plowing, etc.) and soil-protective and water-saving crop rotations are practically not used; drought-resistant varieties of crops are poorly introduced, forest shelter belts are absent, agricultural product diversification and agricultural land transformation are poorly practiced. As a result, almost all areas of dry arable land are subject to varying degrees of wind and water erosion of soils, that is, they are degraded; for these reasons, annually, about 50-60% of dry arable land is not included in economic turnover.

The main factors of pasture degradation are global warming and increased anthropogenic pressure on land. Increased maximum temperatures and droughts, reduction in amount and/or seasonal redistribution of precipitation negatively affect the state of pastures.

Despite the fact that only about 15% of total pasture degradation is due to climatic factor, and the rest - to anthropogenic factors [2], the process of global climate warming will strengthen the role of climatic factor in pasture degradation; this requires the compulsory consideration of environmental aspect of pasture land management in the process of modernization. A significant anthropogenic cause of pasture degradation is an unsystematic grazing.

Agricultural lands in forestry are also subject to degradation. The State Forest Fund (SFF) of the country covers 2.98 million ha of pastures, located mainly in the desert and semi-desert zones and in a lesser areas - in the foothill and mountain zones. The most degraded are the pastures of the desert and semi-desert zones, where the year-round grazing is realized and the negative impact of climatic factor is felt to a greater extent.

The main causes of pasture degradation are the poor consideration of the climatic factor effect, the lack of land productivity restoration, that is, the non-closed reproductive cycle of pasture use, SFF includes dry arable land and the land use for many years. A qualitative assessment of these agricultural lands and pastures is not carried out, as a result, there is no comparative assessment of the degree of their degradation, and the land reclamation measures are not carried out to restore the land productivity.

The absence of land reclamation after each agricultural year increases the degree of degradation and economic damage from its use. This process has a detrimental effect to grazing lands and dry agricultural lands, which are at risk of desertification. The combat against land degradation requires the modernization of structural and functional relations in the land management system based on scientific and technological innovations.

Among the recommended targets and ways to develop sustainable land use of the country until 2030, a number of tasks related to the environmental aspect of land use management system are given [12, 20]. In relation to the environmental aspect of management, the innovations should apply to all three stages of reproductive cycle of land use. Land quality improvement should be carried out through the planning and implementation of modern technologies for land cultivation and caring for plants, and carrying out the necessary land improvement to restore soil fertility.

The first stage includes technologies planned for soil cultivation and caring for crops and pasture vegetation, types of land improvement to restore land productivity

and optimal water-air regime of soil. Particular attention should be paid to the implementation of highly scientific technological innovations and to guaranteed investments for their implementation, indicating the sources.

On irrigated lands, a special attention should be paid to the introduction of modern technologies in mechanized tillage which do not violate mechanical composition of soil and do not excessively compact soil by integrated simultaneous performance of several operations (in one pass of the unit), and to the use of "zero" and minimal tillage technologies in grain cultures production. Particular attention should be paid to the land productivity reproduction by biological methods exclusively and, first of all, by crop rotation introduction, including legumes, the compulsory introduction of the recommended rates of organic fertilizers in soil at specified dates and strict adherence to reasonable rates of mineral fertilizers, avoiding their excess.

A special attention should be paid to irrigation methods that do not violate the water regime of the lands used; it is necessary to strictly observe reasonable irrigation rates in accordance with the needs of plants. On the areas of perennial plantations, melons and vegetables, it is advisable to apply a resource-saving method of irrigation - drip irrigation, including the cotton crops complex. At present, many fruit farmers are successfully using the drip irrigation. In order to create a microclimate and improve the water regime of irrigated lands, it is necessary to plan and create the shelter belts.

When planning the irrigated lands use, it is advisable to remove perennial plantations from the valley part of lands into the foothill zone with the introduction of drip irrigation. Firstly, it will allow increasing the area of irrigated lands due to previously unused lands; secondly, perennial plantations in the foothill zone perform soil protection and water regulation functions as well, and, thirdly, climatic conditions are better used in fruit production. This innovative solution will contribute to the conservation of irrigated land and their more rational use for sowing crops, and ultimately will ensure a significant economic effect in agriculture.

When planning the use of dry lands, it is important to take into account the climate data prediction for winter and spring periods of the year. Based on them, it is advisable to distinguish between the lands with a guaranteed and insufficient, risky amount of precipitation. In the second case, crops of drought-resistant grain and oil-bearing plants are planned to sow, and if necessary, transformation of dry arable land into perennial plantations (fruit shrubs planting) is provided. At medium and severe winds, it is advisable to plan a coulisse method of crops planting.

It is advisable to remove heavily degraded areas from economic turnover and preserve them for the land reclamation purpose. If necessary, it is possible to transform them into areas with perennial plantations (fruit bushes) and/or grazing land, reducing the anthropogenic load on soil [21]. Crops location requires effective mechanized tillage of fields. Plowing should be carried out considering the topography of fields (contouring plowing), it is advisable to use the method of "zero" plowing to prevent wind and water erosion of soil. In this agricultural zone, soil-protective and water-saving crop rotation should be introduced, and forest shelter belts should be created on the massifs.

Pasture use planning is based on geobotanical surveys of land productivity, considering climatic conditions of the year. To increase the results reliability, geobotanical surveys should be carried out using modern technologies, remote sensing methods based on modern aerial and satellite images. Particular attention is paid to the climatic forecast materials of Uzhydromet on weather conditions in winter and spring periods of year to assess possible real feed reserves and to take them into account when planning cattle grazing.

Ameliorative measures are recommended in areas with 10-25% of degradation; they should be removed from the economic turnover to realize phyto-melioration measures. At 30-40% of degradation the plots should be temporarily conserved, and at 50% or more, they should be turned to protected areas. Great attention should be paid to the creation of forest shelter belts on pasture lands. To optimize the cattle grazing, allowable livestock population must be calculated in accordance with the feed consumption of pasture plots, considering the rates of eaten plants (allowable percentage of feed intake).

An important element of planning and management is the preparation of an annual plan for the implementation of economic and ameliorative measures and cost estimates, farm budgets. Pasture rotation is recommended for rotational grazing. Restoration of pasture productivity is a prerequisite for their effective use, implementation of environmental policies in pasture land use.

At the second stage of the reproduction cycle, the necessary technological operations for the use of agricultural land are carried out: mechanized tillage, plant care, including field irrigation, harvesting, and use of fodder vegetation. Modern high-tech and resource-saving technologies should be applied in order to prevent as much as possible the deterioration of mechanical composition and properties of soils; to reduce its productive forces and productivity, that is, to preserve ecological condition of land.

At the third stage of reproductive cycle, the restoration of land productivity is carried out - simple or expanded one. All types of planned land reclamation measures are being implemented taking into account their technological features and climatic conditions. Effective restoration of land productivity, rise in crop yields, and improvement of land ecological condition depends on the completeness and quality of their implementation.

It should be noted that some types of reclamation measures must be carried out during the third stage of reproductive cycle, others can be performed during the second and third stages. Soil fertility reproduction based on crop rotation with perennial legumes should be carried out year-round, during all three stages of the reproductive cycle. Other types of land reclamation are carried out mainly at the third stage of reproductive cycle. This aspect of management is responsible for the ecological condition of soil.

Thus, the introduction of scientific and resource-saving technologies for tillage and crop care, as well as the implementation of all necessary types of agricultural land reclamation is a scientific-technological innovation to modernize the environmental aspect of the land

use management system, at all stages of reproductive cycle of land use.

Compulsory implementation of all requirements of the environmental aspect of management should be stated in land legislation; to control their implementation, it is necessary to introduce the monitoring of ecological condition of land and the quality of environment. It should be noted that the environmental aspect of land management is closely interlinked with other aspects of management, especially with the technological aspect.

Conclusions. The studies allow us to conclude the following:

- modernization of the environmental aspect of land management system is based on innovations in agricultural process and includes: planning and implementation of advanced high-tech technologies for tillage and crop care in agricultural process, implementation of all types of necessary agricultural land reclamation and guaranteed investments for the reproduction of land productivity;

- the effectiveness of modernization of the environmental aspect of management depends on the effectiveness of introducing modern science-intensive and resource-saving technologies of an innovative nature into the agricultural process of production and the effectiveness of restoring land productivity;

- the features of land use ecologization in irrigated and dry agriculture, pasture and forest lands use determine certain features of modernization of the environmental aspect of management;

- the modernization of environmental and technological aspects of land use management are closely interconnected to achieve the goal – to improve the environmental efficiency of land use;

- modernization of the environmental aspect of management, together with modernization of other aspects, provides an integrated management of the land use system and a synergistic effect in land use, conservation of landscape ecosystems, and quality improvement of the environment.

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