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Basin Concept In The Rational Use Of Land And Water Resources Of The Irrigated Areas Of The Current Delta Of The Amu Darya

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Abstract: The main stages of using the basin concept using the method of relief plasticity in the rational use of water and land resources of irrigated lands of the modern Amu Darya Delta are considered in this article. It is shown that reservoir basins are the most widespread geosystems of a high degree of functional integrity within the irrigated lands, with clear boundaries-riverbed shafts, having a powerful integrating factor-a system-forming water flow. The ideas about the reservoir basin as a geosystem, about the internal structures of the basin in the form of unidirectional relief elements: increases and decreases are substantiated. The modern delta of the Amu Darya is differentiated for the first time into reservoir basins that have the qualities of geometric and physical similarity. The role of the structure of the idealized reservoir basin in the reclamation assessment of irrigated lands is revealed; it is established that it consists of small deltas of different ages and they are the basis for nature management. It is proved that the integrating properties of the system-forming water flow allow us to consider the reservoir basin as an integral system formation from the standpoint of not only meliorative geography, but also geochemistry, as well as in complex physical geography – as functionally integral natural complexes, thereby creating a natural basis for nature management. At the same time, the reservoir basins of irrigated lands of delta geosystems are natural and economic systems. It is proposed to apply large-scale basin mapping - the method of relief plasticity in the study of natural and economic systems of territories in relation to the features of the structure of reservoir basins.

Key words: Reservoir basin, method of relief plasticity, water and land resources, increases and decreases, system-forming flows, natural and economic system, large-scale basin mapping.

Introduction. The development of modern science is determined by the tendency to solve many scientific and practical problems together - within the framework of physical (natural) and social (human) sciences. It is especially felt in the sphere of rational use of water and land resources of

irrigated territories of delta geosystems, where the problems of geoecology, desertification, protection of human health and geographical environment are most closely interrelated with each other.

However, a significant obstacle stands in the way of joint solution of ameliorative, geoecological and socio-economic problems of nature management. The course of reclamation and geoecological processes in delta geosystems is mainly determined by natural patterns in small deltas. The management of socio-economic processes is traditionally carried out in administrative-territorial cells-republics, districts whose boundaries do not usually coincide with the natural (physical and geographical) boundaries. In our opinion, a promising way to resolve this contradiction lies within the basin concept in the rational use of water and land resources of irrigated areas of delta geosystems, especially relevant to unified geography - the only integrated science of natural and natural-economic systems.

Reservoir basins are at the same time universal, the most common within the irrigated areas of the modern Amu Darya delta paragenetic landscape complexes of a high degree of functional integrity, with clear boundary-riverbed shafts and specific internal structures in the form of shallow deltas. Our studies of the modern Amu Darya delta began more than forty years ago with ideas about the reservoir basin as a geosystem, which confirm S.D. Muraveysky's theoretical substantiation of the role of runoff in the formation of geographic complexes of delta geosystems. Over time, it was supplemented by the methodology of reclamation landscape science and large-scale basin mapping of irrigated lands (on the basis of topographic maps of scale 1:25, 000) with the method of relief plasticity and was formed as a basin concept of nature management of delta geosystems. The present article traces all this way, drawing on the experience of making large-scale maps of the plasticity of the relief of the modern Amu Darya delta and including the authors' scientific search based on the map of the reservoir basins of the site.

Methods and degree of study. The method of relief plasticity is the only way of applying a functionally-holistic approach to the basin physical-geographical studies of the natural and reclamation conditions of irrigated areas of the modern Amu Darya delta. Irrigated areas of the investigated object are differentiated for the first time into reservoir basins [8]. The reservoir basin is one of the most common types of functional and holistic systems within irrigated areas. As we know, the reservoir basin consists of different-age "tree-like" structures of small deltas. The "branching" structure of these deltas is formed under the influence of geographical (surface water flows) factors and reflects the geological history of delta geosystems. The structure of small deltas determines the state of the components of nature, i.e. natural and reclamation complexes are closely interconnected with the "tree-like" structures of the earth's surface.

Research results and their discussion. In the rational use of water and land resources, the image of the internal structure of the reservoir basin in the form of unidirectional system-forming flows is of paramount importance. It is these flows that determine the condition and quality of water and land resources. The structure of the soil cover is a combination of soils by relief elements. Large-scale maps of the relief plasticity of the reservoir basin show not only the different forms of the Earth's surface (alluvial plains, uplands, sands, etc.), but also their geometric structure. Therefore, the new soil maps made on the basis of the method of relief plasticity open the way to the geometrization, and then to the mathematization of soil structures in theory and practice. V.M.Friedland's words are confirmed: “The idea of soil cover structure is closest to understanding structure in mathematics” [11, p.12]. I.N.Stepanov[5] noted the importance of studying the relationship between the soil forms of delta territories and the activities of surface streams. The role of runoff as a geographical factor in delta conditions is most clearly manifested in the formation of different-age small deltas (processes of relief - and soil formation). It also affects the water-salt regime and lithologic-mechanical composition of soils,

the chemistry of surface water, groundwater, etc. Soil poisoning from the runoff factor leads to the creation of scholastic schemes.

It should be noted that runoff is of great importance in establishing the boundaries of the reservoir basin. The establishment of boundaries of natural objects is determined mainly by dramatic changes in the migration paths of salts (chemical elements), their qualitative composition, disturbances in the cycle of substances, and in these changes and disturbances runoff plays not the least role. It is also important to consider the importance of runoff from the standpoint of the functional and holistic approach. A.Yu.Reteyum [4] notes that the main methodological means in the division of the Earth's surface of the considered functional and holistic flow analysis, which is explained by their role in geosystems. However, this does not mean absolutization of their meaning: not only does the flow not stand above the system, but it is itself its product, its generation. Therefore, the role of flow in the formation of delta soils is irreplaceable.

It should be noted that soils, combined with "tree-like" forms of the Earth's surface, form multi-quality land resources. Therefore, not only the structure of soil cover, but also the condition of land resources naturally changes within small deltas. Soils distributed at the beginning of small deltas have good water-physical properties, light mechanical composition, etc. In the lower part of small deltas and in contact zones between different deltas other soils are spread, which are characterized by negative sides (have poor water-physical properties, heavy mechanical composition, etc.). A natural change in the structure of the soil cover and its condition within the small deltas makes it possible to take into account the internal structure of the reservoir basin in the basin rational use of land resources. The map of reservoir basins allows you to use for practical purposes basin geochemical method of analysis of territories. On modern soil maps, the traditional contours have been replaced by areals of soil-geological bodies, each with a beginning of coordinates and with a representative center. They are used to detect similarly shaped natural objects, to establish distances between similar points, and to calculate rates of soil formation processes. The proportional arrangement of points in bodies identical in form is symmetry, which is described not only by points, but also by axes and planes.

In recent years, the development of market relations has led to an increased interest in the problem of soil condition in agricultural practices. Therefore it is important to know what land resources each farm has nowadays. For this purpose, large-scale, preferably detailed, maps of reservoir basins with specified locations of farms are made first [9, 13, 15, 16]. It is known that if the farm is located at the end of the reservoir basin, it has negative land resources (soils are highly saline, very highly saline, heavy in mechanical composition, soil salinity processes prevail, etc.). The farms that are located at the beginning of the basin have positive land resources (their soils are slightly saline, less often medium saline, light in mechanical composition, predominant settlement processes, etc.). The farm is profitable if it is located at the beginning of the reservoir basin. The farm at the end of the basin lags behind in development year after year.

In modern conditions, specialists (economists) often do not take into account the state of land resources and their location within the reservoir basin when determining the amount of finance for the development of farms. The standardization of the amount of finances has disrupted the development of these farms. Therefore, every district these days, keeping up with the life of market relations, should have detailed maps of the relief plasticity of reservoir basins and various thematic maps (soil cover structure, degree and type of soil salinization, land resource assessment, etc.). These maps are the basis for basin rational use of land resources and for the development of agriculture. This basin approach to the development of the national economy is required of each farm district, which are in the functional and holistic system of the reservoir basin.

Systematic knowledge of soil conditions requires us, first, to produce large-scale (1:25,000 scale), even detailed maps of relief plasticity for all farms that are in a given reservoir basin. These maps are the basis for studying the state of the soil cover. Along with this, they show the direction of existing system-forming flows. Here it is important to emphasize that the direction of the flows depends on the state of the soil, that is, the flow is the second geographical factor in the formation of the qualitative composition of land resources. Therefore, efficient maps of relief plasticity, showing not only the internal structure of the basin, but also the direction of surface flows, which play an important role in the formation of soil conditions.

Analysis of the relief plasticity map shows that during the study, special attention should be paid to studying the lowest parts of the reservoir basin, that is, the inter-channel depressions and contact zones between the various deltas. They are often poorly drained or practically drainless and are areas of accumulation of chemical, liquid and solid runoff. It is known that the central parts of the reservoir basin in many cases are also the boundaries of various small delta of different ages.

V.M.Korytny [3] noted the importance of the river basin in nature management. Placement of land uses and protected landscape elements in river basins is linked to the system of moisture dissipation and accumulation, zones of groundwater infiltration and discharge, interposition of fields and framing elements relative to flows, filtering function of wetlands in relation to pollution.

It should be noted that geographers and soil scientists have always paid attention to the thematic mapping. Soil maps made up on the basis of the method of relief plasticity really show the relationship of soil conditions with the "tree-like" forms of shallow deltas and the internal structures of the reservoir basin. The quality of images of the condition of land resources determines the expected positive results of crop yields.

In the sustainable use of water and land resources in irrigated areas, it is important to study and mapping the degree and type of soil salinity [17]. It is known that the reservoir basin represents its own special, historically determined combination of small deltas, which differs from other basins primarily by its internal structures. The peculiar internal structure forms the unity of the water-salt regime, which is not found in another reservoir basin.

Large-scale topographic maps show all existing irrigation and reclamation systems. Showing irrigation and reclamation systems on maps of soil salinity degree and type is of scientific and practical importance. Because the degree and types of salinization of irrigated soils depend in many cases on the location of irrigation and reclamation systems.

The results of the work show that during mapping the degree and type of soil salinization, it is necessary to pay attention to the following: firstly, depict small deltas in "tree-like form", i.e. by existing relief elements: elevations and depressions; secondly, show all irrigation-reclamation systems, which influence on water-salt regime of soils. The depiction of these elements on thematic maps gives positive results during showing the orderly change in the degree and type of soil salinity within the reservoir basin. Thus, intra-basin differentiation of soil salinity degree and type is of great practical importance for basin rational use of water and land resources of irrigated lands, i.e. in many cases crop yields depend on the degree and type of soil salinity.

Our research shows that not only the state of land resources, but also the quality of surface water changes naturally within the reservoir basin. In basin water resources management, knowledge of surface water quality is important. The quality of surface water within a basin depends on the condition of geographic components. The study of surface water quality based on the basin method requires us to once again refer to the reservoir basin map. Therefore, the significance of the reservoir basin map is irreplaceable, especially for basin water resources management in arid territories of Central Asia. Reservoir Basin Map - scientifically argues the status and expected predicted surface water quality

within the irrigated areas. Drawing a series of natural-reclamation maps is important in studying the relationship between surface water quality and the components of nature.

Conducted studies indicate the relationship of soil (degree and type of salinity) and surface water with the structure of the Earth's surface of the reservoir basin [10]. For example, in the basin of the reservoir discharge-1 (RD-1) are distributed meadow-takyr riparian, meadow-takyr, meadow, irrigated meadow and different types of solonchaks. The soils in the basin of the reservoir discharge-3 (RD-3) are more saline than the soils in the basin of the reservoir discharge-1. Therefore, reservoir-drainage waters of RD-3 are more mineralized than those of RD-1, and their chemical composition is dominated by sodium chloride salts.

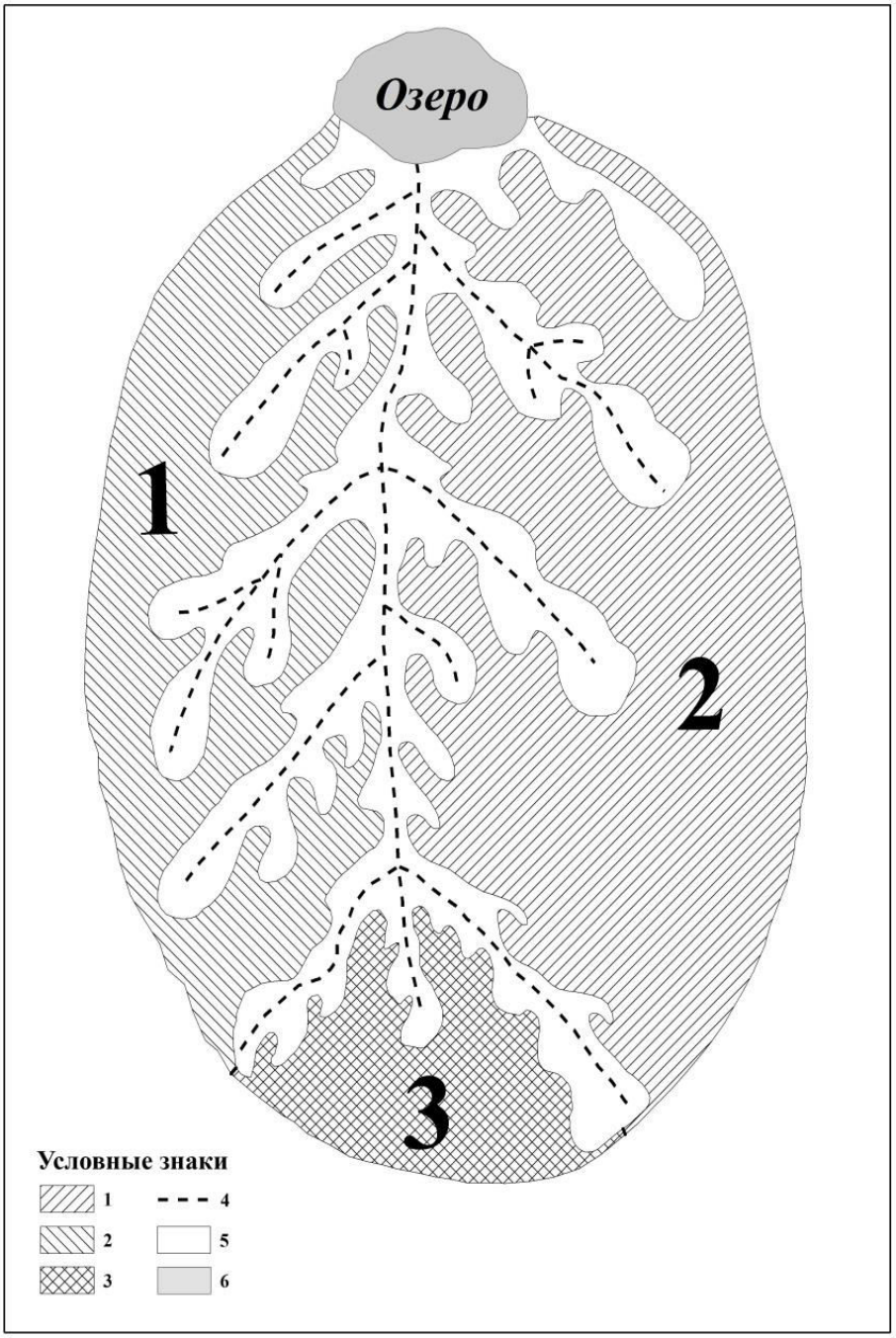

Fig 1. The internal structure of an idealized reservoir basin in the deltaic geosystems of Central Asia.

The numbers indicate: 1) the first small delta; 2) the second small delta; 3) the third small delta; 4) collectors; 5) boundaries of collector basins; 6) the lake.

Fig.1. shows the actual ground surface structures of an idealized reservoir basin in delta geosystems of Central Asia. It can be seen that the functional integrity of the reservoir basin consists of several small deltas. The boundaries of the reservoir basins are crossed by levees. Most of the basin area belongs to the western part of the second shallow delta (the eastern part is in another basin), the eastern part of the first shallow delta (the western part is in another basin), and the northern part of the third delta (the southern part is in another basin).

The analysis of hydrochemical maps of surface waters made on the basis of the method of relief plasticity shows that the condition of surface waters (RD-1, RD-3, RD-4, etc.) of the irrigated areas of the modern Amu Darya delta is deteriorating from year to year, the degree of salinity is increasing, etc. A comprehensive study of surface water conditions based on the reservoir basin map provides positive predictive results that other thematic maps do not provide.

The degree of objective study of the state of water and land resources requires us to show the importance of groundwater in determining the quality of the components of nature. It is known that groundwater affects the state of water and land resources. Therefore, when studying the state of water and land resources, showing the role of groundwater gives only positive results.

The role of relief as a geographical factor is revealed not only in certain parts of small deltas or in specific locations of the reservoir basin. The main importance of relief as a natural factor is that the relief determines the depth and direction of natural groundwater flows. Groundwater flow is a spatial expression on the geomorphological-lithological basis of the complete cycle of the hydrogeological process, confined to a specific territory with its own physico-geographical and geological-structural features [14]. Only different forms and structures of relief can change the direction of natural groundwater flows and with it carry out the transfer of substances in a different direction.

Understanding the internal regular relationships in the depth of groundwater, studying the degree of their salinity, whatever the specificity of the groundwater regime, is possible only through the study of their relationship with the elements and structure of the relief. Therefore, to study this problem, we took the reservoir basin map as the basis. Cartographic materials show that in the irrigated areas the reservoir basin has an important integral characteristic - the systemic change in the state of surface and groundwater from the watershed-levee to the lowest parts of the land from the top of the basin to the bottom. Natural changes in the quality of surface water and groundwater within the basin's reservoir depend on the condition of water and land resources. Therefore, knowledge of surface and ground water is both scientifically and practically important for the basin management of water and land resources.

Basin management of water and land resources of irrigated territories on the basis of the method of relief plasticity requires us once again to refer to the economic sides of the tasks set. The development of agriculture in recent years shows that the state of water and land resources in the area is of great importance. To study and show the area ratio of soil conditions (by degree of salinity, chemistry, etc.) in a particular reservoir basin should be the primary task of all farms that are in this basin.

Basin management of water and land resources of delta geosystems based on the method of relief plasticity requires the study of dynamic changes in the components of nature within a particular reservoir basin. When protecting water and land resources, much attention is paid to preserving and improving their condition. Here it is important to emphasize that the state of water and land resources varies naturally within small deltas and depends on the land surface structure. Therefore, the study of

the internal structures of the reservoir basin is important in solving the issues of water and land resources protection.

Analysis of the compiled series of medium-scale (1:200,000 scale) natural-reclamation maps (soil cover structure, soil salinity degree and type, groundwater depth, etc.) showed that natural-reclamation conditions change directionally from watersheds- levees to the lowest land areas and from the upper to lower basin: mechanical composition of soils becomes heavier, surface and groundwater salinity increases, soil salinity and so on. Therefore, displaying intra-basin differentiation and ordering of small deltas in the form of branching systems with points of division due to relief provides specific recommendations and measures aimed at basin management of water and land resources.

The results of our work carried out in the modern Amu Darya delta have shown that soil salinization processes always prevail in the large contact zones between different small deltas. In order to radically change the existing positive water-salt balance of irrigation-melioration systems, it is expedient to design taking into account the spatial patterns of the relief structure of small deltas. Along the levees of small deltas (Erkindarya, Uldarya, Kyzketken-Chimbay, etc.) channels of irrigation canals should be routed, and along the center of zones the collector-drainage network.

Building irrigation systems is one of the oldest forms of engineering. The largest canals in Egypt existed in the third millennium, and the irrigation canals of Central Asia in the late second and early first millennium B.C. [6, 1, 2]. Analysis of these works indicates that the location of irrigation systems corresponded to the structures of the Earth's surface. However, recently, more precisely in the second half of the twentieth century, the construction of irrigation and reclamation systems in the former Soviet Union in many cases did not take into account the ruggedness of relief. Such cases often occur in the construction of reclamation systems of rice-growing farms of the Republic of Karakalpakstan. As a result, the working capacity of drainage systems in farms deteriorates from year to year, secondary soil salinization prevails, and crop yields are reduced. Therefore, at present, the connection of existing irrigation and reclamation systems with the relief structure is not identified. Drainage, which does not correspond with the relief structures, works poorly, it is the cause of positive water-salt balance, etc. Therefore, large-scale maps of the relief plasticity of the reservoir basin are the basis for the construction of irrigation and reclamation systems.

The socio-economic importance of the basin concept in the use of water and land resources of irrigated lands is constantly increasing due to the increasing role of the water factor in the life of society. The tendency of concentration of the economy and population near the largest reservoirs of the Amu Darya lower reaches its maximum by the end of the twentieth century and at the beginning of the twenty-first century. The predominant increase in population in cities near large reservoirs is associated with outstripping economic growth of these settlements and increasing economic influence on the entire territory of the basin. This trend is particularly evident in the Khorezm region, where historically justified localization and increased concentration of the farm in irrigation and melioration systems has led to the emergence of the relationship of the territorial organization of the farm with the structures of relief. Naturally, it is more logical to solve the closely intertwined environmental, socio-economic and national problems of irrigated areas within the reservoir basin. Moreover, this applies to the water and land economy, where basin principles of management have long and everywhere been the basis of practical activities.

Here it is important to emphasize that the map of the relief plasticity of the reservoir basin clearly argues for the use of land resources for different agricultural purposes. The slightly saline, less often medium saline soils that are common at the beginning and levees of small deltas require farms to use these areas in irrigated agriculture. Lands that are at the ends of small deltas, in the contact zones

between different small deltas, and along large reservoirs should be used as pastures. A natural change in the condition of the soil within the small delta requires a cascading irrigation system [12].

In irrigated areas, reservoir basins create a natural basis for natural resource management. Therefore, within the framework of the functional concept, reservoir basins are considered as a special natural object - a natural geosystem of a high degree of integrity, combining abiogenic basis with specific series of biota functioning, as a self-regulating, paradynamic and paragenetic system, as the most suitable object for the full application of the geostructural paradigm.

The reservoir basins of irrigated areas are distinguished by several distinctive features. The main first feature of the reservoir basin is based on the universality of the basins. These are the most widespread irrigated areas of Central Asia natural complexes; almost the entire territory of irrigated massifs is a set of reservoir basins. In this regard, reservoir basins play a special geoecological role in the structure of the biosphere. Another peculiarity of the reservoir basin is that it has the boundaries of the levees (in delta conditions), objectively and clearly distinguishable on the topographic map as well. Therefore, A.K. Urazbayev [9] has connected natural boundaries of irrigated massifs with flow boundaries, i.e. flow boundaries are simultaneously reservoir basin boundaries. Consequently, it is the reservoir basins that represent the most natural basis for solving any complex natural resource management challenges and problems. The main cycles of substance cycles and migration of chemical elements are "closed" within the boundaries of the reservoir basin. The water bodies of the reservoir basin are the ultimate links in the "chains" of pollution within the irrigated massifs. In this regard, the role of the basin concept in the study of geoecological processes of irrigated areas is undoubted. Based on these characteristics, it is very important to use the basin concept for environmental management. In this aspect, the basin approach is based on the following key positions: geographical concentration (idea of the basin as a single natural-economic object); geostructural paradigm (idea of interrelation of nature components with internal basin structures); equitable economic relation (interrelations between economic relations with states of water and land resources).

Large-scale (1: 25,000 scale) soil maps (maps of soil structure, degree and type of soil salinity, etc.) of the reservoir basin should be the basis for the use of land resources for various agricultural purposes in each farm located in this reservoir basin. The content of the thematic map should always be supplemented with new actual materials, as the reclamation state of these lands from year to year is changing dramatically, that is, it is deteriorating, which urgently need to pay attention to experts, primarily economists. The development of economic aspects of the value of land resources is a priority task in a market economy.

System-structural analysis of the state of water and land resources of irrigated areas confirms the natural change in the reservoir basins (RD-1, RD-3, RD-4, etc.). These materials are the basis for basin management of water and land resources. However, in connection with the development of the market economy, academic economists should be involved in future comprehensive research work on targeted programmes. To carry out such work, it is advisable to create stationary experimental stations in the most typical reservoir basins, capable of conducting scientific work at the highest level. In our opinion, such stationary research work can be carried out in the reservoir basin of discharge-I, because it has clear natural boundaries and this object is better studied than other reservoir basins. At the same time, there are areas within this basin that are used for various agricultural purposes (cotton production, rice production, horticulture, etc.) and clearly divided rain-fed lands. The intra-basin differentiation and ordering of the landforms of small deltas within the reservoir basin of discharge-I is known to be a reflection. The energy state of the system-forming flows and determine the most important properties of the land. Therefore, their identification, idealization and study should be given an important place in natural and reclamation studies as well as in basin management of water and land

resources, i.e. grouping, typification and classification of systems, subsystems and elements of geosystems according to geometric indicators is of great practical importance.

Conclusions

1. The scientific basis for the basin management of water and land resources of irrigated lands of delta geosystems are system-functional ideas in the Earth sciences and thematic series of natural-reclamation maps, drawn up on the basis of the method of relief plasticity.
2. "Nodal" object-reservoir basin is important in the study and assessment of the structural organization of the natural and reclamation conditions of irrigated areas. Intra-basin differentiation is represented in the form of unidirectional landform elements: elevations and depressions. The reservoir basin of irrigated land of the modern Amu Darya delta consists of several small delta "tree-like" structure of small delta is the basis for determining the basin nature management within the reservoir basin.
3. Reservoir basins create a natural basis for natural resource management within irrigated areas. Basins are considered as a natural-economic system, within the framework of which it is the most logical to study human interaction with nature in the process of water and land resources use, for identifying and forecasting and protecting natural resources, etc. We know that it is the reservoir basin that has become the most common taxon of natural-economic, geoecological and natural-reclamation zoning.
4. At basin rational use of water and land resources of irrigated territories, location of irrigation and reclamation systems is of great importance. The existing irrigation and reclamation system of some irrigated massifs of the modern Amu Darya delta does not correspond to the structure of the land surface, so their efficiency is negative. At the same time, a large-scale (1:25,000 scale) map of relief plasticity is the basis for the construction and reconstruction of irrigation and reclamation systems.
5. Natural and reclamation area (reservoir basin) as an integral geosystem provides an opportunity to use the market economic policy not only within individual farms, but also as a whole. Basin principles of management of water and land resources of irrigated areas using the map of relief plasticity should be the basis for practical activities.

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