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ЦЕЛЕСООБРАЗНОСТЬ ПРОЕКТИРОВАНИЯ ГОЛОВНОГО СОЛЕОТВОДЯЩЕГО ТРАКТА С ИСПОЛЬЗОВАНИЕМ ГИС-ТЕХНОЛОГИЙ

EXPEDIENCY OF THE DESIGN OF THE MAIN SALT OFFTAKE TRACT WITH APPLICATION OF GIS-TEHNOLOGIES

Өзбекстандын аймагында таза суунун тартыштыгы менен экологиялык абалдын начарлашынын шарттарында жана глобалдуу алганда да суу ресурстарын сарамжалдуу пайдаланууну камсыздоо маанилүү проблема болуп калууда. Борбор Азиянын эң башкы дарыялары Аму дарыя менен Сырдарыя тарыхый биздин аймакта жашаган элдердин жашоосун улаган жалпы байлык болуп калган. Бул эки дарыянын суусу Арал деңизине куят.

Амударыянын оң жээгиндеги суу сактоочу комплекс коллекторлордун жана суу агызуучу тракттардын системасы катары кызмат кылат жана ал Зарафшан менен Кашкадарыя суу бассейндеринин, Бухара жана Төрткүл оазистеринин, Каракалпакстандын оң жээги менен эки өзөндүн ортосундагы чогулган көлдөрдүн коллектордук-дренаждык сууларынан толот. Ошондой эле алардын агын сууга айланышын жана натыйжада туздардан арылышын камсыздайт.

Биз иштеп чыккан тракттын варианты долбоордун алдында жана долбоор учурунда иштелип чыккан негиздемелерден кийин иш жүзүнө ашырууга сунушталат.

Ачкыч сөздөр: *айлана чөйрөнү мониторингден өткөрүү, айыл чарбасы, ГИС-технлогиялар.*

В условиях ухудшения экологической обстановки и дефицита пресной воды в нашем регионе и в глобальном масштабе важной проблемой становится обеспечение рационального использования водных ресурсов. Две главные трансграничные реки Центральной Азии Амударья и Сырдарья исторически являются общим благом и источником жизни для народов нашего региона. Сток этих рек обеспечивает водой бассейн Аральского моря.

Водоохранный комплекс правобережья представляется как система коллекторов и водоотводящих трактов – приемников коллекторно-дренажных вод с бассейнов Зарафшана и Кашкадарьи, Бухарского и Турткульского оазисов, Правобережной Каракалпакии и наливных озер междуречья, с тем, чтобы обеспечить их проточность и, как следствие – распреснение.

Предлагаемый вариант тракта после проведения предпроектных и проектных обоснований, изысканий может быть рекомендован к его реализации.

Ключевые слова: *мониторинг окружающей среды, сельское хозяйство, ГИС- технологии.*

An important problem in terms of the environmental degradation and water scarcity in our region and on a global scale is to ensure the rational use of the fresh water resources. The Amudarya and Syrdarya, two major transboundary rivers in the Central Asia, have historically been a common good and a source of life for the peoples of the region. It is through these rivers the water is provided in the Aral Sea basin.

In the arising situation the water preserving complex of the right bank seems as a system of collectors and drainage tracts – receivers of collector and drainage waters

from the pools of Zarafshan and Kashkadarya, Bukhara and Turtkul oases, right-bank Karakalpakstan and off- channel lakes of the zone between two rivers to provide their flowage and, as a result, obtaining of more fresh water.

The proposed version of the tract can be recommended for implementation after carrying- out of the pre-project and project evaluations and studies.

Keywords: *monitoring of environment, hydrology, agriculture, GIS-technologies.*

Uzbekistan gives priority to sustainable development and environmental security. The proof of this is the Program of action recently adopted in our country for the protection of the environment for 2013-2017. The government of Uzbekistan will allocate about $ 2 billion for implementation of this program aimed at further ensuring a favorable environment, the rational use of natural resources, the introduction of the environmental bases of sustainable development in the sectors of the economy.

As mentioned, the death of the Aral Sea is one of the largest global environmental catastrophes in the modern history. Every year, it becomes clear that the problem of the drying of the Aral Sea, and especially the impact on the natural and environmental, social and humanitarian situation, gene pool, health becomes destructive and irreparable.

It is necessary to organize activities under the auspices of the UN to prevent the complete destruction and protection of preserved natural and ecological system of the Aral Sea region, ensuring minimum living conditions for the people, keeping the remaining flora and fauna. These key issues are the focus of the note submitted by the President of the Republic of Uzbekistan, Chairman of the IFAS, as an official document to the UN General Assembly.

Uzbekistan consistently calls upon the international donors to assist in the implementation of the Program of measures to eliminate the consequences of the drying of the Aral Sea and prevent

ecosystems disaster in the Aral Sea area, which is fully consonant with the Millennium Development Goals, in particular achievement of the environmental sustainability, fight against diseases, improving maternal and child health.

An important problem in terms of environmental degradation and water scarcity in our region and on a global scale is to ensure the rational use of water resources. The Amudarya and Syrdarya, two major transboundary rivers in the Central Asia, have historically been a common good and a source of life for the peoples of the region. It is through these rivers the water is provided in the Aral Sea basin.

The water resources in the Republic of Uzbekistan are very unevenly distributed and there is an acute lack of it on the vast plains. The proportion of the total water intake of the Republic of Uzbekistan in accordance with the schemes of the basin is 63.02 billion m^3, including from the Amu Darya - 26.9 billion m^3, from the Syr Darya - 10.5 billion m^3, from the small rivers - 16.18 billion m^3 and from the underground and waste waters - 9.42 billion m^3 [1-3].

Over the past ten years due to the water resources scarcity and change of the reservoirs operation mode of the transboundary rivers' upper reaches, low level of technical condition of water supply systems, the actual intake in the whole country was in the range of 57.74 billion m^3, i.e. 90% of the integrated volume according to the selected scheme. From the total water intake: 87% are used in the agriculture, 4% in the municipal sector, 7% in the energy, 1% in the industry, 1% in fisheries and other industries.

As expected for a range of climate scenarios for 25 years we should not expect a significant change in the volume of water resources in the upper watershed. However, in connection with the operation of the overlying reservoirs on the transboundary rivers in energy regime it is expected only flow variability, both within-year and in the long-term perspective.

At the same time, while maintaining the current level of water consumption per

capita, the annual additional need of the public utility in the water resources due to the annual growth of the population will increase by 16-20 mln. m^3. In connection with the development of the industry it is also expected an increase of the industry's needs. The growth of the water consumption of these industries, first of all, should be covered by reducing the operating losses in these sectors, as well as
by reducing the intake limit of the
agriculture.

According to calculations of the Ministry of Agriculture, while maintaining the efficiency of the water management systems and irrigation network, in order to cover the biological needs of the crops, as well as the demand of the other sectors of economy, the needs in the water resources in the Republic makes about 69.4 billion. m^3, including the agriculture 59.9 billion. m^3.

An important problem in terms of the environmental degradation and water scarcity in our region and on a global scale is to ensure the rational use of the fresh water resources. The Amudarya and Syrdarya, two major transboundary rivers in the Central Asia, have historically been a common good and a source of life for the peoples of the region. It is through these rivers the water is provided in the Aral Sea basin. In this situation, plans to build in the neighboring countries of new large hydropower plants with giant dams by world standards cause concern. The implementation of such plans, according to many competent experts, will lead to a breach of natural river flow, transfer to the energy regime that is fraught with the most dangerous environmental and socio- economic consequences. It will dramatically disrupted the already fragile water and ecological balance in the Central Asia as a result of the impact of new hydraulic works on the natural water regime, environment, flora and fauna, etc. [2-3].

For achievement of meliorative wellbeing of the irrigated lands of the right bank, judging by the project studies and generalizations of these supervisions, the drainage (for the purpose of salts removal) has to reach 20-25% of the water intake [4,5]. Thus the total amount of the returnable waters which are subject to utilization on the right bank can make 4,9-6,8 km^3/year. The existing system of the returnable waters utilization has underwent changes. Since 1996, it is forbidden to dump returnable waters to the Amu Darya in order to maintain waters quality of the river at the admissible level of the sanitary and hygienic norms for drinking water supply. Besides, according to this agreement (1996) the water division of the cross-border waters inflowing to the middle flow

across the Amu Darya is distributed equally between Turkmenistan and Uzbekistan. Across the Amu Darya in a year, average on water content, inflowed to the middle flow 63,1 km^3/year and in a year of 90% supply it made 47-48 km^3/year[5-8].

Achievement of meliorative wellbeing of a right bank according to the design practices is based on the construction and operation of the Right-bank collector. However, if the Right-bank collector is also a rod element of the meliorative actions, in more general case achievement of ecological wellbeing of the Amu Darya river, irrigated massifs, pasturable grounds and in general the land fund of a right bank requires creation and realization of a complex of the water preserving actions. At the heart of a complex of the water preserving actions it is supposed to create the system for removal of salts in the regional receiver of salty waters, the Aral Sea, more specifically in its western part which gradually turns into the brine lake.

In the arising situation the water preserving complex of the right bank seems as a system of collectors and drainage tracts – receivers of collector and drainage waters from the pools of Zarafshan and Kashkadarya, Bukhara and Turtkul oases, right-bank Karakalpakstan and off-channel lakes of the zone between two rivers to provide their flowage and, as a result, obtaining of more fresh water.

The marginal waters of the water preserving complex the volume of which can reach about 7 km^3/year, can be also utilized for melioration of the woods, fishery, recreation, etc.

The main contribution of a metamorphization of the river waters of the basin of the Amu Darya river - vaporizing concentration to which they are exposed after a fence for irrigation in agriculture and in evaporated form, as well as re-saturated by the soluble salts from soils and in mix with ground waters, come back to the natural drains rivers. Such order of formation of the hydrochemical mode will remain also in the future, but at reduction, as expected, of the streamflow formation and at increasing of the water intake for household needs, a mineralization of river water (perhaps to the initial gradations of the ground waters) will raise. In the basin of the Amu Darya river such order of a metamorphization of the natural waters occurs practically everywhere.

The main source of salts on the farmlands is the irrigating water, more often it is saltish. The drainage systems are unproductive and superficial that leads to maintenance of a mirror of ground waters above of the critical depth, and their mineralization also exceeds critical values. All that in total leads to restoration of the salts accumulation in the soils during the irrigation interval, to increase of salinity of the soil solutions and eventually to oppression of the cultivated cultures. To some extent their fatal final is prevented by the washing mode of irrigation, what causes high water consumption of the agriculture. Such is a salt situation in the territories commanded to the Takhiatash water-engineering system.

As already noted, the drainage waters of the middle and lower basin of the Amu Darya river do not have a single flow receiver and are flattening on the entire basin area. In this area, according to the analysis of the satellite imagery were formed and continue to form numerous local salt collectors (Figure 1).

Within Akchadaryinskaya and Khorezm-Sarykamyshsky deltas of the Amu Darya, commanded to the Tuyamuyunsky water-engineering system, the salt factor is less menacing than in northern territories of Karakalpakstan. The salt factor is weaker in Karshinskaya and Bukhara oases that is traced by a little bigger productivity of the cotton and its a little smaller water-retaining capacity.

Thus the salt factor on the considered objects of the middle and lower flow of the Amu Darya has gained a cyclic character and in the conditions of the expected shortage of water it can come to the fatal end, unless emergency measures are taken for elimination of its reasons.

The involved collector and drainage network drains the mineralized waters either to Amu Darya, or dumps on lowlands of the right bank. Because of that the lands of desert grounds sustain losses. So not only the salt off-taking from the irrigated and built up territories, but also from desert pastures requires realizing a package of measures. The structural component of this package of measures is provided by the Right-bank collector, an initial plan and characteristics of which were elaborated by designers in the eighties of the last century.

Figure1. Sample of the local salt collectors in the Bukhara region

The changed geopolitical, water management and institutional conditions, technical technological capabilities and ecological imperatives require a considerable modernization of the initial plan. First of all, it is connected with the route of a collector: it must be in the borders of Uzbekistan. Not less important: it needs to be laid to the western deep-water residual reservoir, the Aral Sea. In the upgraded version of the right-bank collector, it is offered to support the essential level of its fish capacity and, generally, a biological productivity of the landscapes interfaced to it.

In a year, average by water content, the collector drain in a residual reservoir from the Aral Sea is expected in limits of 3-4km^3 when a water mineralization of about 10-12 g/dm^3. Such quality of water will allow, apparently, to stabilize a reservoir mirror on the area of 3000-4000 km^2.

The collector and drainage drain formed in the middle and lower flow of the Amu Darya river is estimated in cubic kilometers and it deserves attention regarding utilization and elimination of ecological damages. It is obviously expedient to begin elimination of the outlined gap. According to the above it is formed one of the main goals of research, namely development of the main tract concept of the scheme for networks of water - and salt removing of the basin in the Amu Darya river on the basis of the integrated GIS-technologies with application of materials of space shootings and three-dimensional modeling methods. These objectives are achieved across the territory of Uzbekistan.

The scheme of a tract laid through the dried bed of the Akchadarya was considered for further analysis as more perspective.

One of the main objectives of the GIS technologies using in the implementation of projects in the field of hydro-ecology and environment protection is the ability to use it to develop more rational, efficient and optimal management decisions.

As part of research to develop the concepts of salt removing networks have been used the digital topographic bases developed by us on the scale of 1: 200 000. The digital topographic base is

developed on the basis of the general requirements to the process of creating and updating the digital topographic maps, the main requirements to the digital topographic maps, including requirements to the completeness of the initial information, to its

actualization, accuracy and consistency of the information [9]. The digital topographic base is developed in the ArcGIS

environment. In order to simplify the analysis procedure while laying the trace of the salt removing tract it has been developed a three-dimensional model of the terrain. For greater clarity, the vertical scale has been enlarged by 1000 times (1m in vertical is equal to 1km in horizontal). When choosing a trace of the salt removing tract it was used the brainstorming techniques with the assistance of highly qualified hydrologists. It was constructed the vertical profiles of the salt removing tract which allowed to specify the track and avoid the elevated areas in order to provide a gravity-flowing.

The figure 2 shows the diagram of the main water and salt removing tract in a perspective view. The vertical scale is enlarged by 1000 times (1m in vertical is equal to 1km in horizontal).

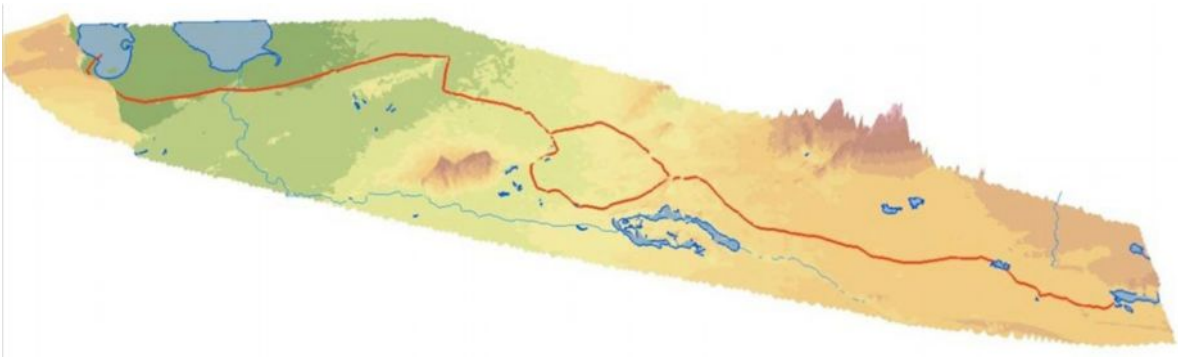

Figure 2. Diagram of the main water and salt removing tract version in a perspective view. Vertical scale is enlarged by 1000 times

The offered modified tract needs in the pre-design and design justifications and researches before to receive permission for realization. From the point of view of ecological requirements, a necessity for implementation of such offers is obvious. Other options, versions, concepts, projects, etc. are not excluded, but ecological, social and economic situation becoming aggravated in the region, especially during implementation of the construction plans for the grandiose hydroelectric power stations in the neighboring states, makes necessary its fastest consideration and realization.

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