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Water and Land Resources Management in the Central Asian Regions, Taking into Account Environmental Requirements for Sustainable Development

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Abstract: The article examines the causes of non-ecological management of natural water resources in Uzbekistan and Central Asian countries, substantiates the need for environmentally sound economic, technical and social management of the use of natural resources of the earth in Uzbekistan and Central Asia for sustainable development, examines examples and formulates factors determining sustainable development, optimality and effectiveness of solutions necessary for environmentally sound economic development, principles of ecological and economic management, principles of ecological and technical management and their priorities, principles of ecological and social management and recommendations based on them on ecological, economic, technical and social management of the use of natural water resources in Uzbekistan and Central Asia for sustainable development are formulated.

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1 INTRODUCTION

It is well known that natural resources in Central Asia (CA), as in many regions of the world, are used extremely unecologically. There is a lot of obvious evidence for this: the drying up of the Aral Sea, salinization of irrigated and adjacent lands, the formation of huge lakes of waste water, pollution and the threat of irreversible degradation of underground freshwater deposits, the disappearance of small glaciers and snowfields in the mountains and a significant decrease in the large regional glaciers of Central Asia. All this leads to climate change – changes in the amount of precipitation in the Aral Sea region, desertification, changes in air temperatures, the disappearance and decrease of snowfields and glaciers in the mountains – the sources of nutrition for the region's rivers, and in the future may lead to the complete disappearance of the bioecosystem in its favorable form for human life. Today, there are disappointing forecasts predicting the death of the ecosystem due to catastrophic water shortages (Asilbekova, Yarullina, Pliocene, Sherimbetov, Li, Talipov, Abdullaev, Makhmudov, Shakirov, Abdukhalikov, Tursunaliev, Usmanova, Mirshina, 2023).

To restore and preserve a favorable ecosystem, a system of social, technical and economic measures is proposed that apply to all Central Asian countries. It is appropriate to think about whether we are right when we think that government organizations are capable of solving large–scale environmental problems quickly enough, whether they have sufficient potential for this, whether their departmental regulations and instructions really provide for solving such tasks, or whether government agencies are not fundamentally created for these purposes? It is known that in countries where environmental problems were solved in some cases, this was done with the participation of the general public, i.e. ordinary citizens, specialists, public organizations, public and political figures joined together to take actions that led, for example, to the purification and restoration of the Rhine and Thames, the restoration of Lake Mono in USA, etc.. Moreover, everything was eventually decided in court, in a civilized manner, and the consciousness of fulfilled civic duty brought benefits to all participants in these events. Thus, the water problems of the Central Asian countries are not so unique that some out-of-the-ordinary actions are needed to solve them. In fact, everything is frustratingly simple - there are technologies, there are specialists, the public is ready to support these environmental actions – what is the reason? It is well known that government officials and their scientific "assistants" in the field of agriculture and water management are often more concerned about personal career advancement and access to financial allocation than about actual improvements in the rational use of water and land resources in Uzbekistan and Central Asia.

This is due to the fact that the majority of these people are accustomed to thinking traditionally, they actively or passively participate with other ministries in the struggle for budgetary funds, and that engaging in such a policy, in their opinion, is much more profitable than real, fruitful work. It is well known that you cannot teach a person to be a scientist – first of all, this means a high level of knowledge and morality.

Unfortunately, during the existence of the former USSR, our scientists working in the field of water and agriculture were usually used by certain senior officials to support costly politicized projects in order to receive huge budget funds from the state treasury, and the best scientists were often ignored for their special moral opinion. Since then, in practice, it has often been decided to build some gigantic structure or complex through lobbying, and then formally justify the possibility of this construction and its benefits in conditions where financial resources have already been allocated.

Today, there are many officials who are very far from really important problems, because they are not used to real responsibility, and for some reason they believe that the judgment of a higher official should outweigh the opinion of a competent specialist, because it happens that the colleagues of this specialist may not support him properly, based on their personal selfish goals. Since then, government departments often control themselves, and the public is practically not allowed to make decisions and information about the allocation and use of budget funds. There are many cases when an official, as a rule, is responsible only for a part of the work, without saying anything about the final result. Table 1 below shows how much water is allocated to the Republic of Uzbekistan.

Table 1: Approved volumes of water resources for Uzbekistan, km^3.

River	Trunk	Tributaries	Total	Groundwater	Collector and drainage	Total

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					drain	
Syrdarya	10,49	9,2	19,69	1,59	4,21	25,49
Amudarya	26,92	6,98	33,9	1,0	2,63	37,53
Total	37,41	16,18	53,59	2,59	6,84	63,02

The table shows that officials and the population of Uzbekistan are responsible for almost half of all regional river water resources in the region. And practically none of this amount reaches the Aral Sea – it is poured into salt discharge lakes inside the republic, replenishing groundwater and groundwater, etc.

Officials and the population from other republics are no better - for example, Kazakhstani ones initiate floodwater discharges that should go to the Aral Sea, into the Arnasai depression, instead of clearing the Syrdarya riverbed from illegal buildings and suburban areas – let nature move, they say, because man is the master in it!

And all together, the fraternal republics cherish the main "culprit" of the disaster – the expensive outdated system of transportation of irrigation water and surface furrow irrigation based on "flush irrigation with drainage" and an extremely inefficient system of agricultural technology for growing crops.

Who should be blamed – officials, nature, villagers, or the entire population combined, who bear full responsibility both by law and conscience - an interesting question!

The deplorable results of this are an ecological catastrophe – the drying up of the Aral Sea, the degradation and salinization of irrigated lands, the pollution of reservoirs with drainage waters, huge artificial lakes with salt water discharge, which is formed when much more water is taken from rivers (5 times!) than is really necessary.

Thus, huge artificial lakes are formed - "water reservoirs" – evidence of the irrational management of the water and land resources of the region.

The lack of a personal, firm, positive civic position, the habit of considering oneself a small "cog", and the politicization of many officials, scientists, specialists, and individual citizens have led to disastrous consequences in environmental management, and above all, in water use.

Our society has not yet learned how to participate competently and productively in government, since public institutions (NGOs, parties) are few in number, and a healthy public consciousness is only being formed (Ziganshina, 2020.).

Currently, a catastrophic situation has developed in the Aral Sea region and in the Aral Sea region as a whole. The sea has practically turned into a dying lake, the Syrdarya and Amudarya deltas have degraded, land is salinizing, and there are many problems associated with the irrational use of river water in the upper reaches of the rivers.

Mismanagement and wasteful use of water, especially in agriculture, have led the Aral Sea region to an environmental disaster.

Low incomes of a significant part of the population, hidden and overt unemployment, the disappearance of traditional crafts (fishing, cattle breeding), environmental tensions and the lack of high-quality drinking water put people in the most difficult conditions.

Table 3 shows how inefficiently irrigation water is used.

Thus, the problems of the Aral Sea region and the Aral Sea region are a consequence of the problems of irrational, anti–ecological water use and nature management in the Aral Sea region (Gunter, Jeremi, 1989). According to the traditional opinion in Uzbekistan, the solution to these problems can only be carried out "from above", by senior officials and the President.

Table 2: Desert depressions of Uzbekistan.

Region	Downgrading	Water level mark, m	Volume, km3	Mirror area, km2
Kashkadarya	Atchinskoe Sechankul Duhana	272,3 247,5 250	0,08 1,296 0,200	15,61 69 23
Bukhara	Dengizkul Hadicha Tudakul Solyonoe Ayakagitma Karakyr	184 226 223,5 183,4 187 184,0	3,5 0,15 1,200 0,21 7,6 0,277	310 26 210 48 870 170

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Karakalpakstan	Ayazkala Karateren	100 47	0,67 0,63	60 21
Jizzakh, Navoi	Arnasay	247	42,8	3491

Table 3: Water intake losses when using water for irrigation.

Losses/usage	Volume (thousand m3/ha/year)	% of total water intake from the source
Losses from main channels Other inter-farm losses On-farm channels: transportation losses, operational losses Water use in fields: flushing irrigation Total:	2,680 650 3,100 3,100 770 2,70 12,900	20 5 24 24 6 21 100

2 MATERIALS AND METHODS

Today, almost all the water of the Syrdarya and Amudarya rivers is used for various needs, mainly for irrigation of agricultural crops.

Since traditionally applied irrational water use technologies imply the need for such enormous water costs, any strong-willed decision that simply prohibits or restricts this practice is bound to encounter active resistance from water users who survive today somehow through the use of these irrational technologies of land and water use.

This situation has developed as a result of an anti-scientific, anti-ecological attitude towards the needs of natural ecosystems. In fact, at the stage of transporting water from the river to the field, about 40% of the water is already lost, another 30% is lost in the field, and as a result, about 70-90% of the water is lost due to infiltration, causing harm and ruin – groundwater rise, soil salinization, land flooding, ecosystem degradation, etc. There is a degradation of unique ecosystems that we must preserve and restore. Currently, elements of a similar crisis situation are observed in other parts of the world: in the United States of America, Australia, India, Iran, Pakistan, Arab countries, etc. (Panin, Sechin, Fedosova, 2014).

Such complex problems cannot be solved only "from above", because the real people responsible for the irrational conditions of water use and land use (government officials, operators, water users, farmers, the public) behave passively. They have not yet got rid of the habitual idea that "above" everything is known and will help from there - so the expected solution to problems looks like some kind of fabulous action by some boss "from above".

History teaches that reliable and real solutions to problems, as a rule, can only come from below, and support can only be provided from above, and even then when the solution is obvious, but requires financial resources that the state concentrates precisely to support such events.

In any case, the initiative to reconstruct irrigation systems and facilities and apply more advanced irrigation technologies that will solve the problem of irrational use of river water in the region should come from below, as people on the ground are suffering from problems. But for this to happen, there must be popular, accessible technical information about reliable and effective solutions.

This information will give people from below the opportunity to apply, implement and support those effective technologies that will help solve the problem. The ultimate success of applying highly efficient environmental management technologies depends on local nature users, which they must understand and accept not only with their minds but also with their hearts, (Kuzmina, 2020) they must get used to them and to the idea of their mandatory use as a necessary condition for preserving our planet healthy and habitable.

This will help people on the ground to understand and adopt the necessary information, to formulate a positive environmental position to change the situation for the better. The consumers of this information are NGOs, farmers, association of water users, large and small cooperative agricultural enterprises, representatives of government structures, etc.

3 RESULTS AND DISCUSSION

To solve any problem, it would be necessary to translate it into a technical problem, namely, to propose highly efficient, rational technical solutions that will form the basis of effective technologies for

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nature-restoring land and water use. The Republic of Uzbekistan today has a complex system of irrigation canals, hydraulic structures, reservoirs, collector and drainage structures built in Soviet times.

At the same time, the development of irrigation during the Soviet period assumed the availability of sufficient water for irrigation. This has led to the construction of hydraulic engineering water management systems that do not meet the requirements of economical use of water, water resources, and respect for the environment.

They do not differ in convenience and ease of operation, high mobility, but they have high construction costs, high costs of logistical, labor, monetary, financial and other resources.

Meanwhile, it is obvious that the basis of the system of irrigated agriculture should be based on the principle of bringing into line the actual load exerted by machinery and technology on the aquatic and terrestrial natural and climatic organism and the ability of the latter to withstand them without deteriorating. At the same time, it is necessary to focus not on the self-healing of nature, but on systematic and meticulous work to improve its characteristics using highly efficient, environmentally friendly technical systems and technologies.

For example, in regions with high humidity, relatively low evaporation, high groundwater table (UGV), and fresh water, naturally large canals – for transfer or navigation - with proper design and operation by themselves do not have significant harmful effects on the environment, since they correspond to local natural and climatic conditions.

In Uzbekistan and Central Asia, the use of a large canal in conditions of traditionally low groundwater levels and high evaporation will lead to large losses of water for filtration with high drainage or to an increase in groundwater levels and salinization of the underlying lands with insufficient drainage.

Even the lining of the riverbed (which has a very high cost) does not protect against other significant losses due to the penetration of groundwater. That is, in this case, there is a harmful effect of such a "large canal" on the environment, since the structure does not meet local climatic conditions. Let's pay attention to the dynamics of development of irrigation systems in Uzbekistan. Historically, before the massive development of the steppes for irrigated agriculture, irrigation systems were relatively small. And the composition of the crops sown, if possible, was linked to the weather and climatic conditions of a particular year, market needs, soil condition, availability of available equipment, and so on. The actual water intakes were relatively small. Therefore, the systems were designed for the maximum possible irrigation area, which assumed the cultivation of crops with relatively low water consumption and a short growing season, or a combination of them such that the total average water consumption was relatively low. Crops with relatively high water consumption and a long growing season (for example, cotton) were small (they occupied less than 15-20% of the total amount of irrigated area available to the owner and alternated with cereals, alfalfa, etc.).

Irrigation systems were built in close proximity to irrigation sources, so their reliability was also quite high. At the same time, there were practically no problems with the discharge of excess irrigation water, since the systems were built either in the floodplain of the rivers or in the foothills, where the water itself found its way into the river even if the channel did not have an engineering discharge. Thus, the technical level of irrigation systems corresponded to the level of agricultural development.

Today, the well-known "voluntarism" and technical illiteracy regarding the forms and methods of using land, water and other resources (and this is observed in many countries of the world) leads to erosion of agricultural land and pollution of surface and groundwater, primarily in conditions of irrigated agriculture.

The current catastrophic situation in the Central Asian region and the Aral crisis have developed as a result of direct copying of equipment and technologies from floodplain conditions and lands with high drainage to steppe conditions, where drainage is low, and excess water remaining after irrigation has nowhere to go. As a result, we have irrigated areas that have developed salinization processes, high groundwater levels, waterlogging, low yields, and high labor and logistical resources.

Thus, the use of the method of transporting water by large channels in an earthen channel, used in conditions of excessive moisture and low evaporation, in conditions of insufficient moisture and high evaporation, led to an environmental disaster. This should be taken into account when determining design solutions for the construction of large water transportation facilities in Uzbekistan and in Central Asia in general. The factors determining the optimality and effectiveness of technical solutions include the following:

1. The system must be such that excess or, for one reason or another, unused water can be guaranteed to be discharged into the river.

2. The channel design should exclude losses on filtration and recharge of groundwater.

3. The riverbed must be stable.

4. The lowest possible costs for water intake into the channels of the next order of magnitude should be assumed.

5. The channel should be relatively easy to operate.

6. The canal construction technology should assume its intended use already at the first stages of construction.

Currently, advanced technologies are known, which, when described in the literature, in a well-organized process of familiarization with them to the public and, on this basis, their implementation, will help solve these problems.

Today, for example, technologies are known whose implementation will help reduce agricultural water consumption by 5 times, reduce labor and fuel costs by 9-15 times, increase yields by 3-10 times, remove the risk of degradation of valuable ecosystems in Central Asia, restore the Aral Sea, etc.

These problems can be solved by applying, for example, advanced canal designs (in pipes and trays) and irrigation (sprinkling) technologies, zero-cycle tillage methods, cultivation technologies using the methods of Ponomarev, Maltsev, etc.

The principles of eco-friendly economic management should make it possible to increase the quantity of raw materials produced by 3-7 times, and the total cost of products, taking into account the final finished products and trade profits, by 10-20 times.

1. Production of agricultural products, taking into account the use of environmentally friendly rational technologies for growing crops and irrigation,

• processing to the level of an environmentally friendly semi-finished product,

• production of environmentally friendly products ready for consumption,

• trade in environmentally friendly finished products on the domestic and foreign markets.

2. Development of the production of necessary equipment for the implementation of environmentally friendly water management and agricultural work, as well as for processing and production.

3. Organization of the creation and support of local public environmental councils for public control of the introduction of innovations from specialists-representatives of the public and environmentalists.

An indicator of success is that the industrial and economic complex provides sufficient funds to equip an agricultural producer with natural regeneration means of irrigation (sprinklers, drip irrigation equipment) and transportation (water is transported from the river to the field only through pipes or trays that do not allow water loss at all (Pulatov, Mukhabbatov, 2021). This will require urgent development of the production of finished products, the profitability of which will allow the successful renewal of aquatic and terrestrial ecosystems and resources.

The principles of environmentally friendly technical management give the final result – an effective working system of structures, technologies and equipment that meets the requirements for the restoration and protection of natural ecosystems, and the necessary requirements for a technical agricultural water management system that would consume no more than 25 km^3 of river water for the entire Central Asian region (7 million hectares of irrigated land, municipal and industrial water consumption) water per year instead of 120 km^3 at present.

The main priority is to fully meet the needs of natural ecosystems, in this case the Aral Sea, the Syrdarya and Amudarya rivers and their tributaries, tugai forests in floodplains at the level of sustainable bioecosystems, restoration of valleys and bowls flooded by reservoirs, glaciers, forests in the mountains and foothills. The purpose of this particular top priority is due to the fact that the most vulnerable, conservative and inflexible element of the system is taken as the top priority.

A parallel priority is the technical agricultural and water management system. It includes reservoirs, water intake and water-regulating structures, canals, irrigation equipment, energy systems, and land areas. Since the technical system is a flexible element of the overall system, its change is necessary and already at the current level of technology and technology development is feasible in order to restore natural objects (Farmanov, Yusupova, 2020).

1. Cardinal reconstruction of the irrigation water intake and transportation system. The criterion is that water losses during transportation and irrigation should not exceed 1-2%. All losses should be beneficial for agricultural production.

2. The introduction of irrigation by sprinkling instead of furrow irrigation and the abandonment of

the "flushing" irrigation regime as anti-ecological, costly and provoking salinization of irrigated lands.

3. Organization and stimulation of the production of machinery in Central Asia for the use of advanced environmentally friendly agricultural and water management technologies (Dustnazarova, Khadzhieva, Khasanov, 2021).

4. Phased gradual elimination of all large and medium-sized reservoirs in Central Asia, as contributing to the intensive melting of glaciers (due to heat accumulation in the hot season and temperature regulation upward in winter), inefficient losses of water for filtration, including hydropower purposes. Revision of technical solutions and requirements for the design and purpose of reservoirs. Perhaps it is necessary to create reservoirs from 2 weeks to monthly regulation in farms with mandatory anti-filtration screens.

5. Organization of the creation and support of local public environmental councils for public control of the introduction of innovations from specialists-representatives of the public and environmentalists.

The principles of eco-friendly social management ensure the expected result in the involvement of the entire active population in the process of restoration and control of bioecosystems and rational use of natural resources as the main performer and interested participant. They include:

1. Support the creation of environmental NNOs as one of the main educational institutions of public environmental education and control.

2. Creation of local public environmental committees to ensure public participation in environmental management and the involvement of the general public and youth in environmental activities.

3. Creating conditions for the formation of environmental public funds to finance the adaptation and implementation of environmentally friendly, highly efficient environmental management technologies (water-restoring and soil-saving), contributing to the restoration and conservation of bioecosystems.

4 CONCLUSIONS

Based on the above, the following conclusions can be drawn:

1. Today, the water and land resources of Central Asia are being used inefficiently, which has actually led to an environmental disaster.

2. It is proposed to restore the ecological balance and high efficiency of the water-earth complex based on the use of nature-restoring technologies and environmentally friendly technical, economic and social management.

3. This includes reducing water losses, increasing soil fertility, and increasing employee responsibility in the process of environmentally sound management for sustainable development

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