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Water Supply And Irrigation System Of Bukhara City In The Late 19th And Early 20th Centuries

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Abstract

This article analyzes the irrigation system of the Bukhara oasis in the late 19th and early 20th centuries, its formation, functioning mechanism and socio-economic significance. The main attention is paid to the use of water resources of the Zarafshan River, traditional irrigation methods (ditches, dams, water diversion structures) and the problems of water shortage. Control over water and land resources in the Bukhara emirate, their impact on social stratification are also covered. The article examines the changes that occurred in the irrigation system under the influence of the Russian Empire, in particular the expansion of cotton cultivation and the redistribution of water resources, on a scientific basis.

Key words: Bukhara oasis, irrigation system, Zarafshan River, water resources, ditch, dam, watershed, mirab, water shortage, agrarian system, social stratification, cotton farming, Russian Empire.

1. Introduction

The Central Asian regions, in particular the Bukhara oasis, have long been one of the regions based on irrigated agriculture. The natural and climatic conditions of this region — low rainfall, hot climate, and geographical location close to the desert — made the development of an artificial irrigation system a necessity. Therefore, a complex irrigation system was formed in the oasis over the centuries, the main source of which was the Zarafshan River[1]. In the late 19th and early 20th centuries, this system became an important factor not only in economic, but also in social and political life. Through the irrigation system, land fertility was ensured, the standard of living of the population was determined, and social stratification was formed. At the same time, the entry of the Russian Empire into the region during this period brought new changes to the irrigation system[2].

1. Materials and Methods

This study aimed to investigate the historical development, structure, and socio-economic impact of the irrigation system in the Bukhara oasis during the late 19th and early 20th centuries. The research was conducted using archival documents, historical maps, and literature sources related to water management, irrigation techniques, and socio-economic conditions in the region[3]. Primary research materials included historical reports on the Zarafshan River, records of canal and ariq construction, administrative documents of the Bukhara Emirate, and descriptions of local irrigation practices. Secondary sources comprised scholarly articles, monographs, and historical studies on Central Asian irrigation and agrarian systems. Research methods were applied in several directions[4].

Firstly, **historical-analytical methods** were used to trace the formation and evolution of the traditional irrigation system, including canals (ariqlar), weirs (tog‘onlar), and water distribution structures (suv ayirg‘ich inshootlari). The study analyzed how these systems were operated, maintained, and supervised by mirobs and local authorities, and how water resources were allocated across various agricultural lands[5].

Secondly, **comparative analysis** was carried out to examine differences in water management practices under the Bukhara Emirate and the subsequent influence of the Russian Empire. Archival materials and historical records were compared to identify changes in water allocation, introduction of new irrigation projects, and shifts in crop patterns, particularly the expansion of cotton cultivation[6].

Thirdly, **socio-economic analysis** methods were employed to assess the impact of irrigation on land ownership, social stratification, and economic inequality. The study examined how access to water determined agricultural productivity, wealth distribution, and the social status of landowners and peasants[7].

Finally, **case-study analysis** was used to highlight specific examples of water scarcity, canal maintenance, and disputes over water allocation in the Bukhara oasis. Historical maps and local reports were used to reconstruct the spatial organization of the irrigation network and to identify patterns of water distribution between upper and lower reaches of the Zarafshan River[8].

2. Results and Discussion

In the late 19th and early 20th centuries, the main water source of the Bukhara oasis was the Zarafshan River. Water was distributed not through natural flows, but through artificially dug ditches and canals. However, due to insufficient water resources, water shortages were often observed in the regions [9]. This river was considered the only main water source for the oasis, and its waters were distributed not through natural flows, but through an artificially created irrigation system. This system consisted of large canals, ditches with their branches, and hydraulic structures that controlled the water. Water was first diverted from the river to the main canals, and then delivered to agricultural lands through small ditches. However, this system was not perfect. First of all, the water volume of the Zarafshan River changed sharply depending on the seasons[10]. If the water increased in the spring months, then in the hot summer period, the water volume decreased. It was precisely the summer season that was the most important period for agriculture, so water shortages were acutely felt. In addition, as a result of excessive use of water in the upper reaches of the river, the volume of water reaching the downstream, that is, the Bukhara oasis, has further decreased. The technically insufficient development of the irrigation system has also exacerbated the problem. Canals were often dug out of the ground, and most of the water was absorbed or evaporated along the way. As a result, the water did not reach the areas it was supposed to reach in full. The remote areas of the oasis were especially affected. Historical sources record that in some years the water shortage became so severe that disputes arose between farmers over water use[11]. For example, in villages located in the lower

reaches of the oasis, there were cases when water arrived late or did not arrive at all. For this reason, a system of alternating water intake was introduced, and water was supplied to each area at certain intervals. In addition, due to water shortages, farmers were forced to switch to crops that require less water. Another important aspect is that control over water resources has become a determining factor in social and economic dominance. Land located near water was valued highly because it was fertile and yielded stable crops. Conversely, in areas where water did not reach, farming became difficult and some lands were abandoned[12].

The irrigation system in Bukhara relied mainly on traditional methods:

- Canals;
- Dams;
- Watersheds.

These systems had been developed over centuries and were based on manual control and distribution of water. Despite the difficult natural conditions, farmers achieved stable crop production through this system [13].

Canals are the most important link in the irrigation system, through which water from the river was delivered to agricultural lands. Water was carried to each field or garden through a network of small canals branching off from large main canals. For example, in the agricultural areas around Bukhara, each village had its own internal canal system, through which water was distributed according to a specific order.

Dams played an important role in controlling the flow of water. Temporary or permanent dams were built to divert water from the river in the desired direction or to raise the water level. For example, during the spring flood, dams were used to collect water reserves and use them for irrigation in the summer months. This method allowed for efficient use of water.

Water-diverting structures served the purpose of fairly distributing water to different areas. With the help of these structures, water was divided into several canals and distributed in a fixed amount to each area. In practice, this process was controlled by “mirabs”, who distributed water on a rotating basis. For example, in some villages, water was supplied to one area at night and to another during the day.

Despite the difficult natural conditions - low rainfall, hot climate and water scarcity, local farmers have achieved sustainable crop production through this traditional irrigation system. For example, as a result of rational use of water, wheat, barley and horticultural products have been grown. In some cases, even in conditions of water shortage, productivity has been maintained by reducing the area sown or changing the type of crop.

In the 19th century, the Bukhara Emirate controlled water and land resources by the state and local authorities. The irrigation system was a central element of the agrarian system and directly influenced land ownership and social stratification. The right to use water determined economic superiority [14]. Land in the emirate was divided into different categories - state lands (amlok), waqf lands owned by religious institutions, and private property. However, the actual value of land ownership largely depended on the level of water supply. Lands accessible to water were considered fertile and profitable, so such areas were often concentrated in the hands of representatives of the upper classes - officials, the rich, and priests. Control over the irrigation system was exercised through special officials - mirabs. The mirabs were engaged in the distribution of water, maintenance of canals, and the establishment of queues. They were often subordinate to local authorities and had great authority in determining the procedure for water use. For example, in years of water scarcity, the mirabs decided how much water would be given to which areas, and these decisions directly affected the farmers' harvests.

The right to use water effectively determined economic advantage. Whoever had regular access to water had a higher yield and a higher income. Conversely, farmers living in water-scarce areas were forced to become dependent or abandon their lands. For example, in some villages, water was more widely exploited by landowners upstream, leaving farmers in the lower regions suffering from water shortages.

Control over water and land resources also increased social stratification. While the population living near water and owning irrigated land became richer, those living in areas far from water lagged behind economically. As a result, social inequality in society increased, and this became an important feature of agrarian relations.

In the late 19th and early 20th centuries, the influence of the Russian Empire increased, and changes occurred in the irrigation system:

- water resources were redistributed to expand cotton cultivation;
- new irrigation projects were discussed;
- water shortages and limited technical capabilities remained [15].

First of all, water resources were redistributed to expand cotton cultivation. Land previously used for more food crops (wheat, barley) was gradually converted into cotton fields. As a result, the waters of the Zarafshan River were mainly directed to cotton-growing areas. This led to a lack of water for food crops in some villages. For example, farmers located in the lower reaches of the oasis suffered more from such changes in water distribution.

New irrigation projects also began to be developed during this period. Russian engineers and specialists put forward proposals to improve the water system in the oasis, dig new canals and reconstruct existing ones. For example, it is planned to regulate water intake from the Zarafshan River, deliver water to remote areas, and expand irrigated land. However, most of these projects have not been fully implemented or have been slow due to financial, technical, and organizational problems. One of the most important aspects is that despite all the changes, the problem of water shortage has remained. The seasonality of river water, excessive use of water in upstream areas, and limited technical capabilities have reduced the efficiency of the irrigation system. Since the canals were dug out of the ground, a large part of the water was lost along the way, and the lack of modern hydraulic structures did not allow for full control of water. As a result, these changes in the irrigation system, on the one hand, stimulated economic (cotton) development, but on the other hand, exacerbated socio-economic problems. The redistribution of water resources has increased inequality between regions, and some farmers have had difficulty managing their farms due to water shortages.

3. Conclusion

In the late 19th and early 20th centuries, the irrigation system of the Bukhara oasis was formed based on the waters of the Zarafshan River, which operated through artificial canals, ditches, and hydraulic structures. Although this system relied on traditional methods, it played an important role in the life of the oasis and served the sustainable development of agriculture. However, the limited water resources, insufficient technical capabilities, and natural factors reduced the efficiency of the irrigation system. As a result, water scarcity became a constant problem, which exacerbated socio-economic inequality. Control over water and land resources became one of the main factors of stratification in society. Also, under the influence of the Russian Empire, the irrigation system was directed towards economic interests, in particular, the development of cotton cultivation. This led to the redistribution of water resources, which further exacerbated social and economic problems in some regions.

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