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History of Irrigation Sciences in Uzbekistan

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Abstract--- *This article provides information on the scientific achievements, historical experience and development of theories in the field of irrigation in the territory of Uzbekistan. In order to understand the concepts of sciences that are important in the construction of ancient hydraulic structures, it was analyzed and covered in comparison with the classification of sciences by Ahmad Tashkprizade. The article also provides information on some of the most advanced achievements in the field of irrigated agriculture and construction of hydraulic structures, which are unique to Uzbekistan. Reading this article gives a clear idea of the main features of the development of science in the history of irrigation in Uzbekistan.*

Keywords--- *Irrigation, Irrigated Agriculture, Tashkprizade, Aqueduct, Koriz (Underground Water System), Nilometr, Usturlob, Water Trough, Doldarga, Padlock with Lock, Sardobamirabs (Water System Inspector).*

I. INTRODUCTION

In today's world of globalization and the growing need to preserve national values, as all sectors feel the need for reform, the development of the irrigation sector, which we are considering, remains one of the main requirements of the time. In the last century, it has not been recognized that the supply of natural resources to the economy depends on natural or environmental laws and regulations. Over the years, experts began to argue that the development of production depends on a single nature, in particular environmental laws. Significantly, based on the study of historical sources, we have seen that our people pay special attention to these criteria, and the preservation of nature has risen to the level of value.

From ancient times in the territory of Uzbekistan irrigators, mirabs and farmers have developed methods of rational use of natural water resources in mountainous and desert areas. During the multi-acre irrigation activities, the population effectively used and improved the irrigation hydraulic structures and hydraulic systems due to the condition and diversity of water sources due to their long range and intensity, water flow rate, human and natural climatic conditions.

II. THE MAIN PART

Materials and Methods

The history of the formation of irrigated agriculture in the territory of Uzbekistan, the construction of ancient hydraulic structures and the peculiarities of irrigation equipment have been studied through such works as "The History of Irrigation In Kharazm" by Ya. Ghulomov, "Geography of ancient hydraulic structures of Uzbekistan" by A. Nizomov, and "Basics of Melioration" by A. Makhamedovs. Researchers V.L. Vyatkin and V.V. Barthold's

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research materials on irrigation in Ancient Uzbekistan also played an important role.

Special attention was paid to the medieval sciences classified in Ahmad Tashkprizade's "Mawduot al-Ulum" in order to clearly imagine the development of the sciences (sciences) necessary for irrigation engineers in the ancient East. This is because "Mawduot al-Ulum" is an important source of inspiration not only for the 16th century, but also for many scholars in later times.

The subject of this study was based on historical analysis. The topic was written using historical, objective, systematic, analytical-comparative, scientific methods and principles of knowledge.

Result and Discussion

Water has long been a matter of life and death in the territory of Uzbekistan, and the history of irrigated agriculture dates back to 2.5-2 thousand years BC in the Khorezm, Zarafshan oases and the Fergana Valley. Hydropower plants built in these regions on the basis of complex engineering solutions, in particular, precise mathematical, geometric, geographical calculations, testify to the fact that our country has highly qualified specialists in this field.

In the Middle Ages, the basic supply of the population and economic development increased the demand for artificial irrigation, and as the irrigation systems improved over the centuries, a layer of mirabs emerged. They have the skills to know when and how to plant crops, when to irrigate crops, crop rotation, and natural fertilization.

During this period, great strides were made in the field of irrigation. They are of several types and according to their functions:

1. Hydraulic structures of barrier value - busy and dam;
2. Hydro-technical facilities of collecting and storage importance - swimming pool, padlock, dashkok (a hydroelectric plant that collects rainwater), sardoba, natural water resources.

Certainly, in ancient times it was not easy to achieve such success. This is due to the evolution of knowledge in the field accumulated over the years. In order to better understand the current historical situation, we will study the sciences classified in the 16th century Isomiddin Ahmad Tashkprizade's work "Mawduot al-Ulum" and analyze what kind of science was needed from the engineers of that time in the construction of irrigation systems and hydraulic structures.

Section 4 of Tashkprizade's classification of sciences is called "Theoretical Philosophy", which requires the study of natural sciences for the effective organization of agriculture. The science of natural sciences has a number of subdivisions, and in agriculture, mainly the science of veterinary medicine, the science of plants, the science of animals, the science of agriculture, the science of minerals (ores) have been used.

In the Middle Ages, the effective work of irrigation engineers, especially in the construction of hydraulic structures, was important mathematical sciences, classified in Tashkprizade. The acquisition of the following sciences, which are part of the mathematical sciences, has acquired an important feature. These are: 1) The science of geometry - the science of construction, the science of the center of gravity, the science of gravity, the science of measuring areas, the science of weight and measurement (criteria), the science of the mechanism of carrying out

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necessary constructions in empty spaces.

The fact that these sciences of those times were carefully mastered by engineers-irrigators living in our region accelerated the development of the field. In particular, let's take the aqueduct “JuiArzis”, one of the oldest hydraulic structures in Uzbekistan. Although the structure is located on the top of the ancient Afrosiab fortress, it is known that it drank water from several canals, pools, wells and springs. According to experts such as V.L.Vyatkin, V.V. Bartold, A.Muhammadjanov, the Afrosiyob fortress was also irrigated by JuiArzis.

JuiArzis meansin Persian “Juy” - ditch, canal, “arziz” - tin, lead. The bottom and sides of the canal, mounted on arched pillars, were reinforced with lead, and flowed from south to north, over the lower part of the defensive wall, over the market. JuiArzis may have flowed 10 feet higher than the defensive trench and market area remained at the bottom of the aqueduct. Due to the long preservation of the structure, precise calculations were made during its construction [1].

According to the classification of sciences of the Middle Ages, in addition to mathematical sciences in the construction of a number of hydraulic structures - cisterns, dams, reservoirs, dams, agricultural and water management, it was important to acquire and develop the following sciences, which are part of astronomy. These are: the science of calendaring (the most important thing in building time), the science of meteorology, the science of shadow (shadow) measuring instruments, the science of geography, the science of rainfall and its volume, the science of climatic features, the science of season (change) and region, the science of the seasons, the science of the use of the stylus, the science of calculating the quarter of a circle.

It should be noted that although the instrument was used to study the movement of more stars, it was also important in the construction of hydraulic structures (dams, canals, cisterns, canals), including measuring the level of the earth's surface [2]. Following the development of such sciences, sufficient experience in the field of irrigation has been accumulated in history. Take the “Khanbandi Reservoir” as an example. Built in the 10th century, the “Khanbandi Reservoir” was built in the narrowest part of the Pistalitog canyon in the Forish district of Jizzakh region and can hold more than 1.5 million m3 of water. The reservoir was built to irrigate crops in the summer by collecting floodwaters from the Osmonsay and Ilonchisay rivers flowing from Mount Nurata. The dam of the reservoir is made of granite stones and special mixtures of water-resistant. The height of the dam is 15.25 m; the length is 51.57 m at the top, 24.35 m at the base [3]; which was. Due to the Khanbandi reservoir, about 1,500 hectares of land on the border of Kyzylkum with Mirzachul have been developed. This structure has also been preserved to this day because it was built on the basis of accurate calculations and scientific experience.

Another branch of science of that period, which was recognized in the classification of Tashkprizade, is the “Knowledge of Number”. The science of calculating depressions and slopes, the science of algebra and algebra, the science of measuring air levels, which are present in the components of this science, have further accelerated the evolution of the irrigation system. These sciences have been very useful, especially in the construction of corridors.

The term koriz is a Persian-Tajik combination of the words “kax” - straw, “rez” - dark. To check that the sewage was flowing properly, the experts threw kax (straw) into the first well, saw the straw in the water coming out of the last well, and checked that the water was flowing smoothly, the amount of water. The construction of such an

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irrigation facility was extremely difficult and complicated. In addition to the laborious manual labor, it required a very precise determination of the accumulating layer of groundwater, the changes that occur in the level of these waters during the seasons, and the slope in the relief of the discharge area. Irrigation workers, who are experienced in digging ditches, first dug several wells in a checkerboard pattern from the higher ground of the slope to the groundwater. The water in the wells was periodically marked. Groundwater was pumped out and ditches were dug in February, when the water level in the wells was at its lowest. The work began with the determination of the slope, leveling. Because accurate and correct determination of the slope of the land played a decisive role in the construction of the sewer route and the flow of groundwater through the sewer to the surface.

The practice of water distribution, collection and flow direction management in land irrigation is also considered to require experience. For example, the “Doldarga” hydraulic complex is a wooden device used to control the water in the Zarafshan and Fergana valleys. A small ditch separates from the anchor, the head of which is regulated by a special tool. This control is only installed when the water level in the ditch is higher than the water level that flows out of the ditch. It is a simple pipe with a length of 50-60 cm to 2 m and a diameter of 5-10 cm to 30 cm. The pipe is installed vertically in the hole at the head of the ditch. When necessary, they close the hole and prevent water from flowing into the ditch [4].

Another such hydraulic device is a water pipe. A saddle is a simple, straight water lifting device that moves under the influence of water on a wheel or using animal power (horse, donkey, and camel). These types of structures can be of different sizes and constructions. Usually they are made of wood. Simple construction wheels have two wheels with a diameter of 2-3 meters, which are fastened horizontally to a wooden shaft. There will be a certain distance between the wheels. Rapidly flowing water turns under the influence of a blade mounted on it, resembling a mill wheel [5]. Along the perimeter, ceramic jugs are installed on it, which are filled when submerged in water and then poured into a wooden trough. Water flows down the slope from the wooden bar, falls into the ditch and is used to irrigate the fields.

In our region, there was also a small hydro-facility, which is typical for our people - locked pools. They were built mainly to collect spring water in the foothills and use it when needed. Such pools are not built on the ground, but rather directly on the ground, often on a hill where a spring boils, or on any bank of a ravine. For this purpose, a comfortable platform with a height of 60 meters and a width of 40 meters will be selected, and a wall with a height of 2 meters of stone and grass will be built on three sides. The thickness of the walls is 3 meters at the bottom and 1.5 meters at the top. Two ears are left on the upper and lower opposite sides of the pool to allow water to enter. The mouth of the pipe, which runs under the pool wall, is covered with a stone or rectangular wooden cover with a hole in the middle in the shape of a millstone. The diameter of the hole should not exceed 20 centimeters. When water is connected to the pool, the hole is closed with a 3-meter pole wrapped in a cloth at the end. The pole rises vertically from the water. When the pool is full of water and you need to get the water out, a person climbs over the pool wall and pulls the pole. This “mechanism”, which is cleverly designed to remove water from the pool, is called a “lock”, and a pole with a cloth wrap at the end is called a “plug”. They act as a lock when collecting and discharging water into the pool. That is why such structures are called “locked pools” [6].

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The most advanced hydraulic structures that our people have acquired in the field of irrigation are cisterns. In the deserts, snow and rainwater accumulate in pits, which are surrounded by high altitudes, and large puddles are formed. By collecting the water in the gullies in smaller volumes in deeper places, special water structures - cisterns - were built along the caravan routes and sometimes on the springs. The cisterns are mostly filled with snow and rain, streams or groundwater (sewers). The main purpose of covering the surface is to protect the cistern water from contamination and evaporation. According to historical facts, there were 44 sardobas in Movarounnahr in the Middle Ages. In the springs, the construction of the cistern was very complicated and time consuming, with a dome-shaped top, a pool diameter of 14-15 meters and a depth of 10-15 meters. The walls and dome are made of baked brick and plaster, and the foundation is made of scraped stone. Wood was almost never used to build the cistern. The bottom of the sardoba is in the shape of a circle, 3 layers of cattle, camel skin, 3 layers of felt, one layer of plaster, the top is covered with quality bricks to prevent water leakage.

Speaking about the history of the development of irrigation science in Uzbekistan, it is worth mentioning the famous encyclopedic scientist - Ahmad Farghani (789-870). Ahmad Farghani'sNilometr water metering structure is the most famous irrigation miracle of the Middle Ages. The Nilometer was built by the Abbasid Caliph al-Mutawakkil in 861 on the island of Rawza near Cairo to measure the water level of the Nile. In the works of some Oriental authors it is called Miqyas an-Nile.

The Nilometer water metering facility is in the form of a square well, which is connected to the Nile by three underground waterways. In the middle of the well is an octagonal column covered with white marble (about 10 m high). The column has a large level that allows you to measure the water level, which is divided into smaller levels. The large Arabian elbow unit is about 54 cm, and the small one is 1/24 of it (qiraat), or 2.25 cm. This structure allowed measuring the river water level with great accuracy. In all member countries of the World Meteorological Organization, the water levels of water bodies (rivers, lakes, reservoirs, and even seas and oceans) are measured on the same principle [7]. In fact, nilometers existed from the time of the Pharaohs, but Al-Farghani perfected and restored this device and caused it to survive to this day.

III. CONCLUSION

In Central Asia, including Uzbekistan, as in ancient Egypt and Mesopotamia, the culture of irrigated agriculture has been formed since the millennium BC. The first large hydraulic structures built on the territory of Uzbekistan - the use of aqueducts - began at the same time as the ancient Romans. The transition to farming required people to use new and convenient water sources and create additional, more efficient ways of working. All this, of course, required skilled farmers, experienced mirabs, hard-working sailors who were masters of their craft. Over the centuries, knowledge in this area has been refined, and the skills and competencies that have stood the test of time have been formed and improved.

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