THE STATE OF WATER RESOURCES USES IN UZBEKISTAN AND USE OF ARTIFICIAL INTELLIGENCE IN IRRIGATION

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Abstract.

In order to ensure stable and guaranteed water supply for households, as well as for all sectors of the economy, large-scale efforts are underway in our country to develop irrigation system, improve water management infrastructure and quality of irrigated lands, as well as the efficient and rational use of land and water resources. At the same time, due to global climate change, continuing growth of the population and increasing demand for water, the shortage of water resources is aggravated from year to year, which may become the main hindering factor for the country's development in the future.

Based on this, in order to ensure water and food security of the country by organizing effective water resources management and their rational use in the medium- and long-run, reforming the water sector and introducing market principles and mechanisms, information and communication technologies, as well as efficient use R&D potential in the sector.

Keywords*: water resources, opportunities, irrigation problems, artificial intelligence, world experience.*

Introduction.

Water is a vital element in all aspects of social and economic activity, it is the natural resource that benefits households, agricultural producers and all other productive enterprises, it is also important for maintaining the environmental balance.

Uzbekistan is classed by the UN as a "water stressed" country. Its future supply-demand balance will be affected by intensive glacier melt, which forms the main rivers of the region, as well as other climate change aspects, alongside with the growing demands of population for water and industrial growth. It is estimated that 10-20% reduction in water availability would have serious repercussions on the size of the irrigated area and the employed population reducing the gross national income.

Therefore, managing water effectively across the demands of irrigated agriculture, municipal and industrial water use, the environment and other uses is critical for ensuring sustainable economic development of the country.

In this context, the goal of water sector development in Uzbekistan is to create conditions for meeting the ever-growing needs of people, economy and environment for water, ensure efficient water resources management and use, ameliorative condition of irrigated lands, and achieve water and food security in the context of the growing water scarcity and global climate change.

Current situation in the water sector. Uzbekistan's water future will be determined both by its own efforts on managing water resources and by other important factors, such as the intensity of water supply from sources and international cooperation on using the transboundary rivers. Climate change will be an additional factor introducing greater variability in future water supply and water security**.**

The primary responsibility in responding to the call for water savings rests with irrigated agriculture, which uses 90% of the national water resources. There is a considerable scope for greater efficiencies in delivering water to farmers and for them to be more efficient and productive with the use of that water at their farm level. The existing infrastructure is aging and requires modernisation, with high costs of operation and maintenance, including high energy costs involved in pumping for irrigation.

Water resources of Uzbekistan are part of the Aral Sea basin. The main water sources of Uzbekistan are the surface flow of Amu Darya and Syr Darya rivers and their tributaries. The total average annual flow of all rivers in the Aral Sea basin is around 116.2 km3/year, of which 67.4% is from the Amu Darya river basin (78.3 km3/year) and 32.6% is from the Syr Darya river basin (37.9 km3/year). Besides, the total groundwater reserves in the Aral Sea basin is 31.17 billion m3, of which 14.7 billion m3 is located in the Amu Darya river basin and 16.4 billion m3 in the Syr Darya river basin. Approximately 80% (about 41 km3/year) of the total water resources used by Uzbekistan falls to the share of the transboundary rivers originated from the neighbouring countries. The total irrigated area in Uzbekistan is 4.3 million hectares, and agriculture is the largest water consumer with the water use share of around 90-91%. Agriculture is one of the key leading economy sectors of Uzbekistan.

Both industry and energy are actively developing in recent years and their water consumption is constantly growing. Moreover, according to the Law of the Republic of Uzbekistan "On Water and Water Use", the water demand for industry purposes is prioritized and shall be fully satisfied (without limits). It is estimated that the total water consumption for industrial needs (including energy) will increase from 2 km3/year to 3.5 km3/year by 2030.

Problems related to water resources. Today, the water industry in Uzbekistan faces new problems related to water and food security. These are: climate change, increased demand for food as a result of growth and real incomes of the population, development of industry and urbanization, all of which require additional water resources. The main problem is climate change, which has been noticeable until now, for example, an increase in the overall air temperature, especially in hot seasons, an increase in drought years, due to the high intensity of storm precipitation in certain periods. floods and torrents and other natural phenomena.

Climate change threatens Uzbekistan, as well as Central Asia, primarily due to the melting of mountain glaciers that feed the region's main rivers. In the last 50-60 years, the area of glaciers has decreased by about 30%. According to forecasts, when the temperature increases by 2 ° C, up to 50% of the volume of glaciers can be lost, and by 4 ° C this figure will increase to 78%. This shrinking of the glaciers will lead to a huge shortage of fresh water. According to some estimates, by 2050, the flow of water in the Syrdarya basin is expected to decrease by 5%, and in the Amudarya basin by 15%. In 2015, the total water deficit in Uzbekistan already exceeded 3 km3. By 2030, it can reach 7 km3, and by 2050, it can reach 15 km3/year.

In recent years, water relations between the countries of the region have improved significantly; there is a positive trend in solving the problems of transboundary water use. However, in the future, the construction of new large hydropower facilities and reservoirs in the upper reaches of Amudarya and Syrdarya, as well as the construction of water-power connection in terms of their operation in energy mode, may cause a number of problems in water supply. Central Asian region, including Uzbekistan.

Use of artificial intelligence in irrigation. The 21st-century agricultural industry is witnessing negative impacts of climate change, land and water scarcity, and more recently, a global COVID-19 pandemic. Consequently, the socioeconomic sustainability of current and future food-supply systems appears to be threatened. To combat issues due to water shortage across agricultural applications, artificial intelligence (AI)-based solutions are appearing as viable alternatives**.**

Irrigation methods and their management are critical, especially in agricultural lands of arid and semi-arid regions in the world. Smart irrigation strategies that apply water at the right time and amount have been critical for good plant growth and hence crop productivity. Such a demand is most important in a scenario where there is a growing need for production under competitive cost conditions while maintaining good product quality. Accurate quantification of water consumption by crops requires improvement of existing methods. Accordingly, the use of meteorological and soil data for decision-making in irrigated agriculture has been a fully settled reality. That said,

intelligent methods to estimate plant water stress and automatically activate irrigation systems are important for saving water and energy in the management of crops. Many techniques currently used to determine plant and soil water status require a large amount of laboratory work because they are not automated, generating high costs both because of the time and qualified professionals needed, as well as the availability of facilities in the vicinity of crops.

Scheduling & Efficiency

There is an abundance of ways in which IoT devices and AI could potentially be applied to benefit irrigation. One of the most frequently touted applications is for improved irrigation scheduling and efficiency. While soil moisture data (from either sensors or models) have long been used as a scheduling aid, AI offers the potential for machine learning of how soil moisture responds to irrigation events in scenarios with different crops, soils, environmental conditions, etc. When tied to an irrigation control system, this information can automatically implement control strategies that help minimize water usage, manage nutrient losses, or achieve more desirable or uniform soil moisture throughout the field. Similarly, AI could be applied to learn the associations between available weather, crop and soil condition data, and the corresponding irrigation recommendations of a trained agronomist, thereby automating the repetitive aspects of the scheduling process.

Taking to the Sky

In yet another example, AI could be used to automate the analysis of aerial imagery of a field. This might include diagnosing areas of crop stress due to moisture, disease, etc. AI can further identify the relationships between observed crop stress and sensor- or model-based soil moisture data. This allows such data to be used to more proactively manage irrigation activities to prevent crop stress, rather than waiting for stress to become apparent. Similarly, AI can be applied to images from a digital camera, enabling a simple cell phone or tablet to become a pocket agronomist of sorts. Smartphone-based apps that apply AI to identify insects, weeds, and diseases, by simply pointing the camera at the item of interest, are already available. In many ways, the sky’s the limit in terms of how AI could be applied for the betterment of irrigation. However, it will take time, and loads of data, to realize this potential.

Smart Irrigation Systems.

Efficient utilization of water is a challenging task especially for places where avail-ability of water is a major concern. For gaining high yields, one has to irrigate the field when needed or we can say that the exact amount and time of irrigation must be known. Nowadays with the help of new innovations in technology, we are living in the world of advanced irrigation systems called “smart irrigation.” The word smart

means, the sensors are able to sense the water requirements in plants. This ability is achieved by combining multiple technologies viz. automation, sensors, and knowledge (AI). Even though these systems are not costly in nature, due to lack of awareness, most of the farmers are adopting a traditional way of irrigation which results in inefficient utilization of water and low crop yield. Smart irrigation systems are able to save a massive amount of water, which can be utilized for other important purposes of mankind. Smart irrigation systems also ensure the reachability of water to each and every plant in an exact amount which results in maintaining the good health (by preventing them from dehydration and excessive/irregular irrigation) of the plant and makes away from diseases. It has been observed that some of the diseases in plant sare due to improper irrigation which is mostly due to the adaptation of traditional irrigation systems. Continuous observations of sprinklers/drip modules are also necessary at regular intervals to prevent them from failures. Sometimes these systems need recalibrations due to degradation in performances or damages caused by animals/environment. In this situation, some part of the field is highly irrigated while some part remains unirrigated. The main challenge in designing a smart irrigation system is the non uniformity of land and crop types.

Conclusion.

The agricultural industry faces various challenges such as lack of effective irrigation systems, weeds, issues with plant monitoring due to crop height and extreme weather conditions. But the performance can be increased with the aid of technology and thus these problems can be solved. It can be improved with different AI driven techniques like remote sensors for soil moisture content detection and automated irrigation with the help of GPS. . Not only do these autonomous robots improve efficiency, they also reduce the need for unnecessary pesticides and herbicides. In conventional strategies huge amount of labor was required for getting crop characteristics like plant height, soil texture and content, in this manner manual testing occurred which was tedious.

Yield prediction and smart irrigation systems using AI-based techniques are demanding in precision agriculture. If both yield prediction and smart irrigation systems are well equipped with AI-based technologies, then the secan prove the effectiveness in minimizing the overall agricultural cost, increasing growth in the economy and minimizing wastage of essential resources such as water, energy. These techniques are effective in reducing human efforts and fasten the planning of agricultural practices.

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