ICT TOOL TO IMPROVE AGRICULTURAL WATER PRODUCTIVITY IN UZBEKISTAN

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Extended Abstract

In Uzbekistan, 98% of total agricultural production is produced by the irrigated agriculture consuming 85% of water resources, of which only 20% are formed within the country. The increasing deficit of water due to the climate change, trans-boundary problems and population growth is one of the restricting factors for sustainable economic development. Wide use of water-saving irrigation technologies could be one of the ways to combat these challenges, however currently only 10% of the irrigated lands are under such technologies.

To facilitate introduction of irrigation water saving technologies, rational water use and increased water productivity a Mobile Application TOMCHI has been developed within the framework of the National Water Resources Management Project financed by the Swiss Agency for Development and Cooperation and implemented in partnership with the Ministry of Water Resources of Uzbekistan and Agency of IFAS. TOMCHI in Uzbek language is meaning “drop of water”.

The Mobile Application tool designed as a virtual Extension Service for Farmers providing the following tools: (i) access to comprehensive information on applicable in the local context water saving technologies, relevant legislation and best practices; (ii) estimation of respective costs of certain water saving technique implementation; (iii) feedback mechanism and (iv) platform linking water users with local producers and service providers of available water saving technologies.

Mobile application TOMCH – as a consultancy platform for Farmers/Water Users based on web-portal of the Information Analytical and Resource Center of the Ministry of Water Resources of the Republic of Uzbekistan. Regulatory documents

This unique and innovative application is a first step in introduction of ICT tools in daily operations of the Ministry and its subordinated bodies at basin, irrigation system and irrigation district levels, Water Consumer Associations and farmers to promote improved access to knowledge, data collection and real time information exchange. Along the way are water knowledge portal being developed in partnership with the Information Analytical and Resource Center of the Ministry of Water Resources of Uzbekistan, online water resources monitoring tool, unified national agricultural water scheduling software and development of the comprehensive water management database and decision support system of the Ministry.

Keywords: ICT, water saving technologies, agricultural water productivity, rural transformation, digitalization, innovations, mobile application, database, decision support system, water knowledge portal.

Background: Uzbekistan, Water Resources and Irrigation

Along with Liechtenstein, Uzbekistan is one of the only two doubly landlocked countries in the world. Uzbekistan has an area of 448,920 square kilometers. Uzbekistan lies between latitudes 37° and 46° N, and longitudes 56° and 74° E. It stretches 1,425 kilometers from west to east and 930 kilometers from north to south. Bordering Kazakhstan and the Aral Sea to the north and northwest, Turkmenistan to the southwest, Tajikistan to the southeast and Kyrgyzstan to the northeast, Uzbekistan is one of the largest Central Asian states and the only Central Asian state to border all the other four. Uzbekistan also shares a short border (less than 150 km) with Afghanistan to the south.

Uzbekistan is Central Asia's most populous country. Over 33,905 million people live in Uzbekistan (1 January 2020) – about half of total population in Central Asia. Rural population is 49,5% and urban – 50,5%. The most territory of Uzbekistan has a continental, dry (arid) climate, with little precipitation expected annually (100–200 millimeters). The average summer high temperature tends to be 40 °C, while the average winter low temperature is around −23 °C. Less than 10% of its territory is intensively cultivated irrigated land in river valleys and oases. The rest is vast desert (Kyzyl Kum) and mountains.

In Uzbekistan, available water supply is formed by renewable surface and underground waters of natural origin, as well as by return water of anthropogenic origin. Water resources are mainly formed in the transboundary river basins. Only 9.6% of total runoff of transboundary rivers in the Aral Sea basin is formed within Uzbekistan. In

1) All are representing National Water Resources Management (NWRM) Project in Uzbekistan, funded by Swiss SDC, e-mail: info@nwrmp.uz

other words, Uzbekistan is quite dependent from other riparian countries from the point of view of available water resources.

Figure 1. Map of Uzbekistan

The total land area in the Republic of Uzbekistan is 44,892 thousand hectares, which are divided into 8 categories depending on the purpose and procedure for using land, including: agricultural land; lands of settlements; lands for industry, transport, communications, defense and intended for other purposes; lands of environmental protection, health and recreation; lands of historical and cultural significance; lands of the forest fund; lands of water fund; land stock.

Agricultural lands belong to fertile lands, are considered the main means of national wealth, agricultural production and ensuring food security of the country. The total area of agricultural land is 20,236 thousand hectares, of which arable land is 3,988 thousand hectares, perennial plantings - 383.1 thousand hectares, fallow lands - 76 thousand hectares, hayfields and pastures – 11,028 thousand hectares, other lands – 4,760 thousand hectares. Due to the arid climate, agricultural production is almost entirely dependent on irrigation, and only about 752,900 hectares (18%) of arable land are rainfed.

The current annual water demand of all sectors of the economy is about 64.2 km^3 (see table 1 below). In the long run, the demand for drinking water supply from industry, industry and rural areas will increase, while in irrigated agriculture it will decrease due to water-saving technologies and measures to increase fertility.

Table 1. Actual and prospective water consumption (demand) by sectors in Uzbekistan (million m^3 per year)

Water consumers (by priority)	Total water requirement	including by source		
		Surface Water	Underground Water	Return Water
2018				
Domestic utilities	5320	2200	3120	0
Industry	1885	855	1030	0
Rural water supply	485	415	70	0
Fisheries	640	460	0	180
Energy	770	770	0	0
Irrigated Agriculture	55100	50000	1100	4000
Total	64200	54700	5320	4180
2030				
Domestic utilities	6200	2450	3750	0
Industry	3500	1580	1920	0
Rural water supply	950	810	140	0
Fisheries	640	460	0	180
Energy	780	780	0	0
Irrigated Agriculture	48000	46800	700	500
Total	60070	52880	6510	680

Source: Scheme for the Integrated Use of Water Resources of the Republic of Uzbekistan until 2027. Consolidated explanatory note. Association "Vodproekt" under the Ministry of Water resources of the Republic of Uzbekistan. Tashkent. 2018.

At the level of 2030, the total required water volume for Uzbekistan should not exceed 60.1 km^3 per year. According to the Basin Master-Plans (Schemes), the limit (quota) of Uzbekistan as a whole for the basins of the Amudarya and Syrdarya rivers is 63.02 km^3 / year with a 100% availability. In case of less water availability in dry years, water withdrawal limits are reduced.

The country's total annual water withdrawal in the 1980s was about 66.1 km^3. After gaining independence, Uzbekistan clearly shows a tendency to decrease in water consumption and water withdrawal. In particular, during the period 2011-2015, the total water intake amounted to about 53 km^3 per year (Table 2). However, in 2016-19 it was at a level of about 55 km^3 per year. In the dry year 2021, the water intake was only about 45 km^3.

Table 2. Dynamics of actual water withdrawal from rivers (million m^3)

1960		1980		1990		2000			2010	2018		2021	
Total	Irrigation	Total	Irrigation	Total	Irrigation	Total	Irrigation	Total	Irrigation	Total	Irrigation	Total	Irrigation
30780	27900	64910	55510	56611	58156	53265	35687	56611	44718	54700	50000	45300	39000

It should be noted that the population of the republic from 1980 to the present time has grown from 15 million people to more than 35.2 million people. As a result of population growth, the specific indicator of water consumption per person significantly reduced. An analysis of the use of the water withdrawal limit shows that since 2005 Uzbekistan receives water on average 85.0%, and in dry years, like 2008, 2011 and 2021 about 70-75% of the total annual limit.

Present-day irrigated farming remains one of the most important economic sectors in Uzbekistan, which provides 17% of GDP; but what is the most significant that it is the factor of social stability under ensuring 30% of employment (as of 2021). Thanks to understanding of the social value of irrigation and the wise state policy in the water sector over years of independence, Uzbekistan has managed to maintain its irrigation potential.

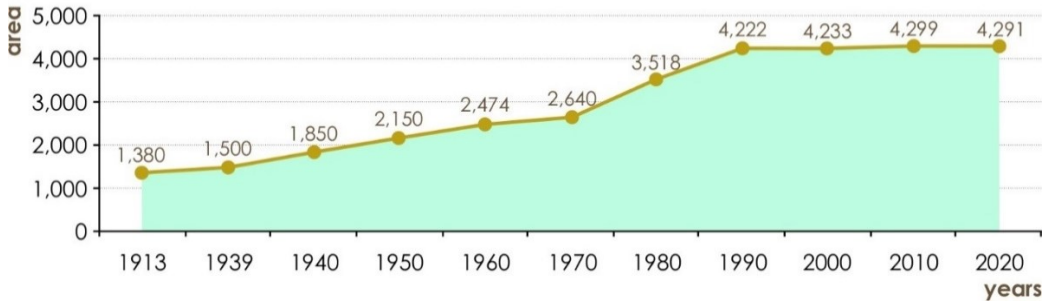

Figure 2. Trends of Irrigation Development in Uzbekistan (area, 000' hectares)

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In Uzbekistan, a total length of the inter-farm and on-farm irrigation networks amount to 27,868 km and 154,957 km, respectively. 60 percent of inter-farm canals and 77 percent of on-farm canals have an earth (not lined) channel.

The area of more than 2.2 million hectares is irrigated by pumps that consume electricity of 7,5 billion kWh a year. The following examples show a scale of pumping irrigation: the Karshi Pumping Cascade lifts 200 m^3/sec of water up to 157 m essentially for irrigation of 335,000 hectares in the Karshi Steppe; a cascade of pumping stations along the Amu-Bukhara Canal lift 216.4 m^3/sec of water up to 115 m for irrigation of 315,000 hectares. The Ministry of Water Resources is funding operation and maintenance of 1687 pumping stations where 5284 pump units with total annual capacity of 59.6 billion m^3 of water.

On October 9, 2019 there was released Decree of the President of the Republic of Uzbekistan "On measures to further improve the water management system". By this document priority areas under leadership of the Ministry of Water Resources by the end of 2022 were identified:

- Timely and high-quality development of the Concept for strategic development of water resources in 2020–2030;

- Phased (starting from 2020) implementation of mechanisms for covering a part of the operational costs for the delivery of water by water consumers;
- Bringing the share of land irrigated using water-saving technologies to at least 10 percent of the total area of irrigated land by actively assisting agricultural producers to introduce water-saving irrigation technologies, expanding the production of modern irrigation systems by attracting private investment;
- Institutional, technical and technological development of water management, integration of science with production in this area.

Mobile Application TOMCHI

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Mobile Application TOMCHI is software designed to work using smartphones and other mobile devices. It works in smartphones running on Android and iOS platforms. For smartphones running on the Android platform, the application can be downloaded from the Google Play Market, and for smartphones running on the iOS platform from the Apple Store (Figure32).

Figure 3. Mobile Application TOMCHI (just use the Google Play Market)

Mobile Application (MA) TOMCHI includes information on modern water-saving technologies for irrigation, such as drip, sprinkling and subsoil, also water-saving methods for traditional for Uzbekistan furrow irrigation, such as alternating irrigation and dry inter-row irrigation, short-furrow irrigation and variable-sprinkler irrigation. The MA suggests to use various technical means for furrow irrigation widely used in Uzbekistan, such as the use of flexible irrigation hoses, discrete irrigation, irrigation using furrow-shielded polyethylene film and the use of moisture-retaining hydrogels.

The MA (Interface in Uzbek language) provides information on methods for determining the irrigation time/scheduling for different crops, information on field activities/cultivations that contribute to water conservation. Also, the MA provides information on local manufacturers who produce water-saving irrigation systems, information on service providers for the implementation of water-saving irrigation systems, as well as information on incentives for the implementation of water-saving irrigation systems supported by Government of Uzbekistan.

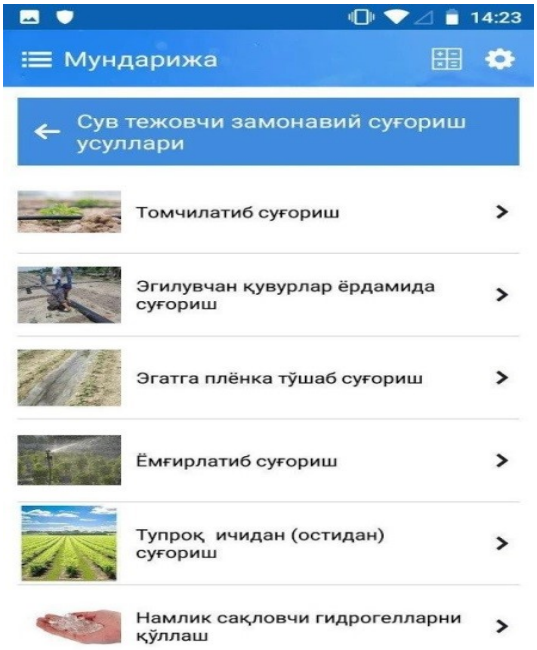

Figure 4. MA “Tomchi”: Section “Modern Water-Saving Irrigation Methods”

The sub-section “Modern Water-Saving Irrigation Methods” provides detailed information on modern advanced water-saving irrigation methods, such as drip irrigation, sprinkler irrigation, subsoil irrigation, the use of flexible polyethylene hoses and films for furrow irrigation, irrigation using water-retaining hydrogels (Figure 4).

Mobile application TOMCHI includes a number of sections. The first one is section “Water-saving irrigation methods”, which consists of two sub-sections:

- “modern water-saving irrigation methods”;

- “water-saving methods of traditional irrigation”.

Thus, the sub-section focuses on the most popular technologies of advanced irrigation which in recent years have been actively stimulated by the government for agricultural irrigated lands in Uzbekistan. It also provides information on the use of moisture-retaining hydrogels for the efficient use of water (soil moisture conservation) when growing crops.

Each part of the sub-section describes in detail the presented irrigation method, its advantages, the conditions for their applicability, the constituent elements of the irrigation method, the rules for the design, specifics of construction and operation of certain irrigation system. The sub-section “Water-Saving Methods of Traditional Irrigation” provides information on water-saving methods of traditional surface furrow irrigation (gravity irrigation), in particular, water-saving methods (irrigation by alternating water and dry rows, irrigation using short furrows and irrigation with a variable stream).

Section "Enterprises". This section provides information on the main local manufacturers who produce elements of water-saving irrigation systems. The section includes detailed information and contacts of the main manufacturers / factories, design organizations and service providers. The section also provides examples of the most successfully implemented in local conditions technologies and results and lessons from functioning water-saving irrigation systems.

Section “Governmental Incentives to Support Water Conservation”. The section highlights governmental efforts to stimulate wide practical introduction of water-saving irrigation systems, in particular drip irrigation systems. In Uzbekistan, farmers (agricultural producers) using traditional irrigation methods to grow crops usually do not pay for water, but pay a Unified Land Tax. For farmers using water-saving irrigation technologies, in particular, introducing a drip irrigation system, a privilege has been established by Government for exemption from the payment of a Unified Land Tax for a period of 5 years.

The section also provides information on the provision of soft loans and subsidies (in the amount of 50% of the installation cost) to farmers who are going to install drip or other water-saving irrigation methods. At the same time, the information in this section is constantly updated in the light of new decisions by the government to promote water conservation.

Section “Setting Schedule of Irrigation”. This provides information for certain farmer on determining the timing of irrigation for crops based on a visual assessment of changes in soil conditions and crops grown at the particular field. That is done on the basis of instrumental measurements of changes in soil moisture, which farmer should put into MA. The section also provides recommendations on methods for assessing changes in soil moisture using various laboratory devices, such as thermostats, remote sensors and cameras to determine the suction pressure in plant leaves.

Section “Promotion of Measures for Water Conservation”. This provides information and recommendations on measures that effectively contribute to water conservation. The section provides information on soil cultivation measures both before sowing and during the vegetation of plants, which contribute to reducing water infiltration into the deep layers of the soil.

Information is also provided on measures that contribute to reducing the evaporation of moisture from the soil surface. As such, measures are presented for tillage (inter-row cultivation of the soil) and the use of various materials to cover the soil surface (mulch) and measures to reduce the wind force over the surface of the irrigated field (use of forest strips). Section “Calculator”. In this section, users who want to install water-saving irrigation technologies at their irrigated fields, in particular, a drip irrigation system, can determine the approximate cost of purchasing and installation of drip irrigation system.

The calculator takes into account various types of crops and various options for planting schemes. At the same time, in drip irrigation systems for orchards and gardens, irrigation hoses with special drippers are suggested, for field drip irrigation systems that are designed to irrigate field crops with a wide-row planting pattern, irrigation hoses with ordinar droppers are used.

Knowledge about the price of drip irrigation systems allows farmers to make decisions on attracting investments for introducing drip irrigation systems and successfully conclude contracts for the installation of drip irrigation systems. The section of the mobile application “Useful Links” provides information about the legal framework (legislative acts) useful for farmers' water management. This section also presents various newsletters, recommendations and guidelines promoting the rational use of water resources.

The latest version of the mobile application also presents the “News” section, which publishes various interesting information and stories about effective methods of using water resources. This section is updated daily with new information from around the world.

Thus, the use of various information and communication technologies in the field of water use such as the Tomchi mobile application improved the awareness of water consumers about water-saving irrigation methods and, along with government measures to stimulate the use of water-saving technologies, contributed to an increase in the efficiency of water use in agriculture. At the same time, the area of irrigated land in Uzbekistan, where water-saving irrigation technologies are used, has increased about 5 times over the past 3 years, and the volume of water resources used has been reduced by 20% throughout the country.

Telegram group is one of the main channels for direct communication with the large audience of farmers and WST producers. The number of subscribers of the "Tomchi” channel coupled with the group “Tomchi experts" is steadily growing, though the audience, as well as the thematic area, is very specific 7 to 10 posts are published daily totaling to around 3000 per year. Most of the articles are prepared as a response to the requested questions asked in the group. Having understood that TOMCHI expert group is the place for getting answer to any urgent question, the number of subscribers radically increase from 2170 at the end of 2020 approaching to 4500 in December of 2021.

The number of videos in TOMCHI YouTube channel is steadily growing due to project's own videos created and videos related to the topic collected by the project staff. The number of videos has grown significantly after collaboration with the water saving technology producers was established. The country's largest producers contact the project requesting to place the videos with their projects on installing WST in various regions for various crops, making the channel one of the main video platforms for knowledge sharing and promotion of WST. The videos are also uploaded on national video Streaming platform mover.uz, which is free of change.