WATER RESOURCE MANAGEMENT IN UZBEKISTAN AND RAISING ITS EFFICIENCY

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Abstract

The aim of this study is learn and analyze activity of distributing and managing the use of water resources by level of Water User Association (WUA) and explore possible measures to improve current water management in Uzbekistan with the reference to Japan's experience. On this paper authors try to learn and analyze activity of distributing and managing the use of water resources by level of Water User Association and find out some idea or concepts which can be potential application for Uzbekistan agriculture. state of the beekeeping industry, as well as factors affecting the dynamics of its development in the five leading honey exporting countries. The paper shows some sectoral features of the functioning of beekeeping and the dynamics of the sale of its products, organizational and economic mechanisms for the interaction of agricultural producers and processing enterprises.

Keywords: *Water User Association (WUA), water management, Aichi canal, water shortage.*

Introduction. During last two decades the share of agriculture in GDP decreased from 30% to 17% while provided steady growth in absolute volume of production. According to local indicator, the national economy is close to the structure of the economies of the dynamically developing countries of the world where agricultural production does not exceed 10% of GDP. An average annual growth rate in agriculture sector in last 5 years stabilized around 7 percent.

Structure of Agricultural land of Uzbekistan consists of three main types of regions (Sultanov et. al, 2008):

- mountainous regions - the area are more than 20 percent of the territory of the Republic. Dry farming (wheat, barley, peas, flax), horticulture and viticulture, spring and autumn seasonal grazing, farming, specializing in the production of meat and wool.

- irrigating farming region, where about 20% of the region Ferghana Valley, Mirzachul, Dalverzin desert, Chirchik - Akhangaran, Kashkadarya and Surkhandarya Sherobod valleys, including the Lower Amudarya zones. There are mainly produce cotton, wheat, rice, corn, potatoes, vegetables, melons and gourds, fodder crops, orchards and vineyards, mulberry and berries.

- desert-pasture regions, which is 60 percent of the national territory. The area consists of desert and dry plains. Mainly some part of Bukhara and Kashkadarya regions, Karakalpakistan and Navoi regions lands, and some area in the central part of the Ferghana Valley.

In order to achieve the projected parameters, government of Uzbekistan identified as the key objectives of the agrarian policy within the scope of WIS-II :

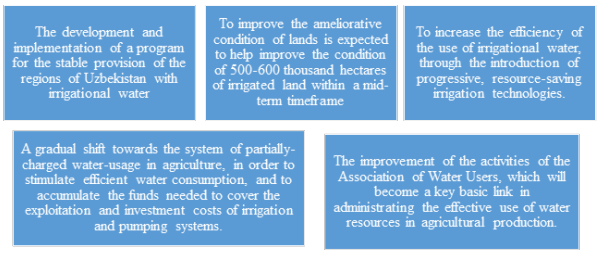
- the deepening of structural reforms within the agrarian sector and the diversification of agricultural production;

- the acceleration of the processes of the modernization and the technical and technological renewal of the agrarian sector, and of the infrastructure facilities and businesses that process agricultural products;

- the development and improvement of the infrastructure of the agro-food market;

- to increase the financial stability of farm entities, the liberalization of agricultural policy, and to strengthen the protection of the rights of agricultural producers through the following measures

- the improvement of mechanisms for the effective usage of land and water resources in agriculture (Figure 1).



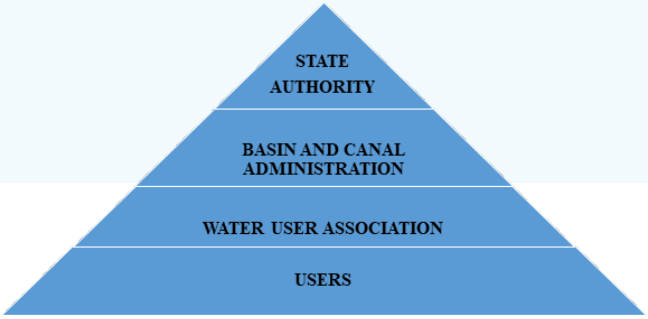
Source: WIS-II, 2013

Figure 1 - Mechanisms of effective usage of water resources in agriculture

Most of the water resource comes from outside of the country. Two observation area located in Syrdarya River Basin, which has area 444 thousand square km. River flows through four neighboring republics of Central Asia: Uzbekistan, Kazakstan, Tadjikistan and Kyrgystan. The eastern part of the basin occupies a mountainous region, which has hosted the Naryn River and the Kara Darya River, where Syrdarya River forming. Numerous tributaries of the Syrdarya River also starts in the mountainous area. A large part of the population lives on the fertile mountain valleys and adjacent plains of the middle reaches of the river. And there are a number of large cities with developed industry as Tashkent, Chirchik, Andijan, Fergana. In the western part of the basin till the Aral Sea stretch of desert, and life here is concentrated only in the oases along the Syrdarya. In 1970's The Syrdarya basin was made of 50% of industrial and 42% of agricultural products, including 40% of cotton in Central Asia.

Water management system in Uzbekistan consists of 4 level (Figure 2), in which on the top located Cabinet of Ministers, Ministry of Agriculture and Water Resources and its regional structures on behalf of State authority. As a result of water reform in Uzbekistan, a hydrographic (basin) approach has been recognized in legislation and basin organizations have been set up in 2003. However, in Uzbekistan, as result of reforms in water sector, basin organizations in the form of Basin Irrigation System Authority (BISA), consisting of a Canal Management Organization (CMO) and Irrigation System

Authority (ISA) have been established. BISA serves as a territorial body of the Central Water Management Administration responsible for a unified policy in water resources regulation and use in a basin. In Uzbekistan, out of 10 BISAs created in 2003 (to replace 12 administrative organizations at provincial level).



Source: Duxovniy, 2015

Figure 2 - Water resource management system in Uzbekistan.

BISAs consist mainly of ISAs and Provincial Hydro-geological expeditions. In addition, there are Pumping Stations departments, and Canal (systems) Management Organizations (CMO). The Main Canal Management Organization is a subdivision of BISA and is responsible for implementation of technical policy along the respective canal system. The ISA is a unit of BISA responsible for management and use of water resources in the appropriate irrigation system and also directly deals with the water users, and WUAs.

According to Kobia (2011) Water User's Association (WUA) is a group of farmers, all served by common source of water, join together to allocate all served by a common source of water. The aim of establishment WUA was to develop a participatory irrigation management concept for increasing water use efficiency through the involvement of stakeholders as much as possible in the various management activities. WUA allows farmers to perform activities that are more difficult or impossible to do individually. The creation of WUA is justified by the participatory approach in water management to allow farmers to efficiently concentrate their efforts and means for joint actions aimed at optimum utilization of water resources on irrigated and reclaimed lands. The purpose of involving WUA in improving water resource management is not only to increase water supply of irrigation water to farmers' fields but also improve the quality of irrigation management practiced by farmers. Physical improvement when accompanied by improved irrigation management lead to improved irrigation efficiency, farming practice changes and increased economic benefit.

Most of the water resource comes from outside of the country. 2 observation area located in Syrdarya River Basin, which has area 444 thousand square km. River flows through four neighboring republics of Central Asia: Uzbekistan, Kazakstan,Irrigated agriculture remains one of the most important sectors of the Uzbek economy, contributing to 19% of the country's GDP and, most importantly, providing almost 40% of the rural population with employment (World Bank, 2013). Uzbekistan is considered one of the oldest regions in the world that practices irrigated agriculture. According to research conducted by nationally famous historians and archaeologists, construction of canals in the country began as early as the middle of the 2nd millennium BC (Bartold, 1965). Today the country uses 88% (2012) of water for agriculture. There are major rivers called Amudarya and Syrdarya as a main source for the country. The impact of climate change is expected to aggravate the situation, resulting in reduced snow and glacial reserves in the mountains – virtually the only source of water for most of the irrigated croplands throughout Central Asia (Hagg et al., 2007; Aleksandrova et al., 2014) So due to climate change the amount of water is not enough. The other fact is, Water user associations have a greater role on water use efficiency because they are last managers and final delivers of water to users (farmers).

About 80% of Uzbekistan's water supplies come from neighboring countries, primarily via the Rivers Amu Darya and Syr Darya. (Mirzaev, 1996) Climate change is expected to aggravate water availability in the country through reduced snow and glacial reserves in the mountains – virtually the only source of water for most of the irrigated croplands throughout Central Asia (Hagg et al., 2007; Aleksandrova et al., 2014) In 2011, about 20% of water in the main canals and 35% of water in secondary and tertiary canals (WUA level) is lost, mainly due to poorly functioning irrigation facilities. (Hamidov et al., 2015).

Problem of outdated irrigation canals has become a serious issue in the region, particularly in Uzbekistan is mentioned by Hamidov (2015). In his paper, Hamidov (2011) stated the poor infrastructure has an impact on productivity, timely allocation of water to users ability and willingness to pay for irrigation service fee, and thus contribute to WUA income. This in turn renders WUA's inability to maintain the infrastructure and leave them as weak organization with lack of effective rules and regulations.

Problem statement. Uzbekistan is dependent on water resources comes from outside of the country. In this situation water amount is limited, because the main resources of water comes from two major rivers Amudarya and Syrdarya, where besides Uzbekistan, neighboring Central Asian countries as Kazakhstan, Kyrgyzstan, Tajikistan and Turkmenistan are also the users of these water resources. Due to highest amount of irrigated lands and population in the region demand for water resources is higher than others. Another reason the country is located at the downstream of two rivers, in which last consumer of water resources. These situation optimistically notes that there is a high demand for rational usage of water resources inside the country. In these case, water management system in WUA level is the key point to improve the critical issues with water resources, in which this level is the last distributor of water resources. Based on previous studies (Abdullaev, Dukhovniy, Hamidov, Sultanov) the most of water lose appeared in this level. That's why water management in this level plays important role in decreasing waste of water resources on delivery.

Materials and methods. For the research (a) field survey with questionnaire prepared, (b) qualitative and quantitative (statistic) analysis used as a methods. 3 provinces were selected in Uzbekistan as case study area. 10 WUA's were selected in each area. Aichi canal in Aichi prefecture of Japan was studied as a modern irrigation system. Field survey was conducted on August 2015 in Japan and in Uzbekistan on September-October 2015. Throughout the data-gathering phase of this study, author carried out face to face meeting and data collection by questionnaire. Main tasks is of the study: to analyze the current water use situation at the WUA level based on data and information obtained through the

field survey and to propose the measures to improve the water resource management system.

Study area in Uzbekistan. Kashkadarya Province (Uzbek: Qashqadaryo viloyati) established in 1924 which is located in the south-eastern part of the country in the basin of the Qashqadaryo River and on the western slopes of the Pamir-Alay mountains. It borders with neighboring countries like Tadjikistan and Turkmenistan, and also Samarkand, Bukhara and Surkhandarya provinces of Uzbekistan. The area is about 28400 km². The population is estimated to be around 2.4 million in 2005 (stat.uz), and 57% of people live in rural areas. The province centre is Karshi city (177000 inhabitants in 2005). Other major towns include Beshkent, Chirakchi, Guzar, Kitab, Koson, Mirishkor, Muborak, Kamashi, Shahrisabz, Shurbazar, and Yakkabog.

Main Natural resources include significant petroleum and natural gas reserves, with the Mubarak Oil and Gas Processing Plant as the region's largest industry. Other industry includes wool processing, textiles, light industry, food processing and construction materials. Major agricultural activities include cotton, wheat, various crops and livestock. The irrigation source of water are Kashkadrya and Amudarya rivers which plays important role in agriculture of the province. The largest water reservoir called Tollimarjon which collect water from Amudarya with pumping stations.

Tashkent Province (Uzbek:Toshkent viloyati) established in 1938, and located in the northeastern part of the country, between the Syrdarya River and the Tien Shan Mountains. It is bordered with countries like Kyrgyzstan,Tajikistan and Sirdaryo and Namangan provinces of Uzbekistan. The area is about 15300 km² with population around 4.5 million people in 2012 (stat.uz). There are Uzbeks, Kazaks, Tadjiks, Tatars, Koreans, Russians and other nationalities living in province.

Province has 15 administrative districts. The centre is Tashkent city which is about 2.3 inhabitants in 2012 (stat.uz) and it is also the capital of the country. Transportation infrastructure, with over 360 km of railways and 3771 km of surfaced roads. Tashkent has a large international airport, which is the main air gateway to the country.

Other major cities are Angren, Omlaliq, Ohangaron, Bekobod, Gazalkent, Keles, Yangiyul, Yangiobod, Nurafshon, Parkent. The climate of the province is continental climate with mild wet winters and hot dry summers. Natural resources include copper, brown coal, molybdenum, zinc, gold, silver, rare earths, natural gas, petroleum, sulfur, table salt, limestone, and granite.

Province is the most economically developed in the country. Industry includes energy production, mining, metallurgy, fertilizers, chemicals, electronics, textiles, food processing and footwear. There are some big companies such as JS company "Olmaliq mining combinatory", "Uzmetkombinat", JSC "Maksam Chirchik", JSC "Ammofos Maksam", JSC "Ohangaronsement", JSC"Uzbekkumir", JSC"Ohangaronshifer".

The main Agricultural crops are vegetables, fruits, cotton, wheat, melons and gourds and livestock. Province produced 10.1 thousand tons meat, 36.8 thousand tons milk, 71.4 million eggs, 239.7 thousand tons cotton, 631.1 thousand tons wheat, 138.8 thousand tons potato, 777.4 thousand tons vegetables, 109.9 thousand tons fruits in 2011 (stat.uz).

Sirdarya Region (Uzbek: Sirdaryo viloyati) is established 1963 and located in the center of the country on the left bank of Syrdarya River. It borders with countries like Kazakhstan, Tajikistan, and provinces Tashkent and Jizzakh. It covers an area of 4300 km², and is mostly desert, with the starving steppe taking up a significant part of the region's area. The population is estimated to be around 700 thousand people 2011 (stat.uz). Agriculture plays important role in regional economy of the province. Main agricultural crops are cotton, grain, silk, vegetables and horticulture, poultry and livestock. Province has one of the largest hydroelectric power plants, which is one third of the country's electricity. Other industries are represented by construction materials and irrigation equipment.

Study area in Japan. Aichi water canal was chosen for current research. This canal gives water for 3 Land improvement districts which distribute water for agriculture, industry and communal usage. Aichi Prefecture is located roughly in the center of the Japanese archipelago and is bordered by Mie, Gifu, Nagano, and Shizuoka Prefectures. Aichi faces the Pacific Ocean to the south, bordered by the Ise and Mikawa coastlines. Located in the western part of the prefecture is the Nobi Plain-the second-largest plain in Japan-which was created by the Kiso River. The plain is bordered on the east by the Owari Hills, which extend southward where they form the Chita Peninsula. The Yahagi River flows through the center of Aichi, from the Mikawa Mountains to the Okazaki Plain, which was formed by the river. In the east the Toyohashi Plain was formed by the flow of the Toyo River, running from the Shitara, Yana, and Yumihari Mountains. The Atsumi Peninsula is an extension of the Toyohashi Plain. The climate of Aichi is influenced by the Kuroshio Current, a Pacific Ocean current, and is generally mild as a result. The average annual rainfall in the mountainous part of Aichi is relatively high compared to that of the plains and peninsular regions. Aichi canal is first large scale development project in Japan on agricultural development after World War II which cost US$ 7.0 million.

The Aichi Project for consists of:

a) Irrigation component;

b) Drinking water supply component;

c) Industrial water supply component;

d) Hydroelectric power component.

Aichi Prefecture began supplying big amount of water for agriculture and industrial use in 1961 when Aichi canal constructed. Currently, the 35 municipalities within the prefecture are divided into 4 districts, each receiving its water from dams constructed on the Kiso River, Yahagi River and Toyogawa River.

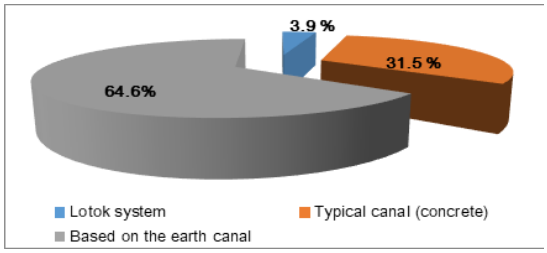
Results and discussion. It was noted that among 30 respondents 46.6 percent managers have university or high education degree. Most of them are graduated from Agricultural schools. It helps them to work on agriculture. The only manager has finished vocational school degree. More interesting fact is all respondents are male. The longest period for respondents who has been managing the Association is 10 years. Some of them started their work from last year.

Table 1

Respondents age distribution		Respondents education level		
Age level	Respondents number	University degree	Professional college degree	Vocational school degree
30-39	8	5	3	
40-49	9	2	7	
50-59	12	6	5	1
60-69	1	1		

n=30 *Source*: Authors field survey, September - October 2015

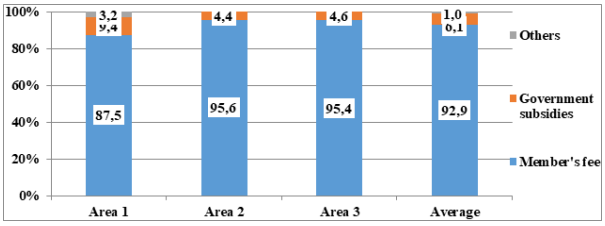
Figure 3 demonstrates about current irrigation network



Source: Authors field survey, September - October 2015

Figure 3 - The structure of irrigation network, in percent.

Financial statement of WUA was analyzed based on a response of section "Finance" of the questionnaire from 28 WUA out of 30, in which two of all sample WUA did not wish to respond financial aspects of their activities. According to the results, average revenue per one WUA is amounted about 106.5 mln. sums and its main source is member's fee, which is an average 92.9% of all income. Members fees are differ from WUA to WUA, depending on size of lands, farmers, main activities and types of crops. As the main source of income of WUA is member's fee, it's collection is the main problem for WUA, which is main condition of contracts between WUA and members. This problem caused by certain obstacles, which many farmers in this WCA have not received payments from the state for their previous years products and it usually takes up to one year to receive full payments. Another reason is that this payment is less in priority compared to other mandatory payments such as fertilizer, fuels, credits from banks or leasing contracts. Partially, it is also subsidized by state budget at an average 6.1% of all revenues.



Source: Authors field survey, September - October 2015

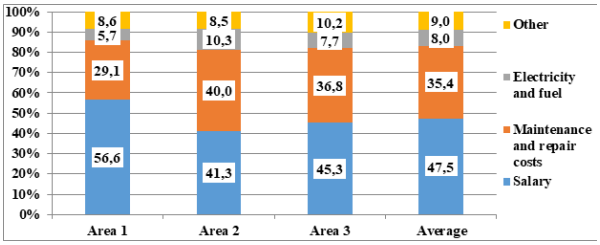
Figure 4 -Structure of revenue, as a percent to all revenues

Subsidy from government is provided mostly for the priority crops, such as cotton and wheat. The other sources consist of financial and technical assistance to certain WUA, covered by special international or domestic projects. Practical interest observed in structure of revenue in selected areas, which demonstrates significant difference (figure 4).

Contracted budget per one WUA is amounted in average 69 mln.sums in Area 1, 119.7 mln. sums in Area 2 and 129.3 mln.sums in Area 3, while actual budget reached to 55.4 mln., 98.9 mln. and 104.3 mln. sums respectively. Only four WUA's actual budget exceeds the contracted budget, which are due to government subsidy and other sources.

The share of fee collection vary from 28% to 99%, only in one WUA in sample achieved more than 100 percent fee collection from members. Area 1s' revenue is diverse with existence of other source of income besides member's fee and subsidy, and share of government subsidy is twofold more than Area 2 and Area 3.

WUA as a nonprofit organization its budget should be distributed in accordance with improvement of its efficiency without earning any profit. Budget of WUA is directed in four main groups of expenditure, in which salary fund for employees gets almost half of the budget. The second significant expenditure is maintenance and repair cost of equipment, owned by WUA is about 35.4% of all expenditures Share of salary vary between at least 30% to at most 73%, while maintenance and repair cost varies between 18 and 55 percent respectively. Average expenditure per one WUA is amounted about 106.5 mln. sums.



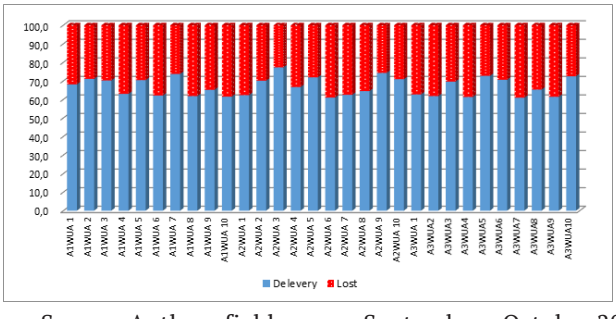
Source: Authors field survey, September - October 2015

Figure 5 - Structure of expenditure, as a percent to all revenues.

Provincial structure of expenditure differs significantly. Area 1 pays more than half (56.6%) of its budget to salary, which is compared to rest of areas more than at least 10% points (figure 5). However, amount of resources directed to improve assets and equipment need to be sufficiently balanced, which is comparatively lower than other areas.

Average expenditure per WUA between areas differs significantly, where Area 1 spends about 55.4 mln sums, Area 298.9 mln. sums and Area 3 the most 104.3 mln sums. These gaps between areas can be explained by the number of farmers and size of irrigated lands.

As a conclusion, there is an obvious lack of execution of contracts, which is insufficient collection of member's fee. Allocation of resources in proper way directs WUA to manage efficiently and distribute fairly of water resources among the water users. This requires establishing a position of economist in WUA and to purchase modern technologies to manage water resources efficiently.



Source: Authors field survey, September - October 2015

Figure 6 - Water delivery and lost.

The results of analysis indicated that water loss on delivery are different in each area. Average lost is 33.05 %. According to Hamidov et al., mainly because of poorly functioning irrigation facilities WUA lose 35 % of water. And 13 WUA out 30 feel water shortage. Water loss (L) is identified as difference of received volume of water from main canals (R) and delivered volume of water in fact (D) in percent to total received volume of water (R) (as a formula: R-D=L/R*100)

Aichi canal project. The Aichi Canal Project is one of the large scale project which proposal by local farmer and high school teacher (Mr. Kuno and Mr.Hamajima). Project finished in 1961. It took 4 years only. The project to provide water agricultural water, industrial water, domestic water for Aichi prefecture.

Goal of the project was:

- to increase food production and the improvement of agriculture of region
- to increase of population standard of living of region
- to develop industrial sector of region
- producing energy by construction of a new power plants (Yoshio Hayakawa , Hiroshi Izume)

Due to economic growth of the region, industrialization and urbanization the demand for water increased, and the canal capacity became evident. Because of time is passes canal body damaged, eroded and sedimentation happened. Then Aichi Canal Second Phase Project started in 1983 and finished 2004.

Advantages of the project were as follows:

1. Reconstruction of the canal segments. (double-way flumes)
2. Construction of regulating reservoirs.
3. Reconstruction of lateral canals into pipelines.
4. Introduction of distant monitoring and controlling and modernization of management facilities. (Hiroshi Izume at all).

New reconstruction of the main canals into double-way flumes helps to easy maintenance. Regular maintenance such as cleaning inside the waterways, removal of sediment from the waterways can be done while water is running through either way of the flume.

Construction of regulating reservoirs goal is storing and using the unused water that flows down to main canal. When the arrival water volume is low It helps to provide a stable supply for water downstream and effective use of water resources.

Reconstruction of lateral canals into pipelines provide water to fields in short time. It also helps stable supply of water for agriculture. Due to reducing unused water, non-arriving water volume, and management water will use effectively (no waste water). Reduce of time and labor on distribution.

Introduction of distant monitoring and controlling helps for on time information about volume of water, effective use of water resources (highly accurate water distribution implementation), supplementation for flow volume change. The system is introduced to the main canal, which was mostly open channel of about 112 km in length with 152 points of division. Due to modernization of management facilities the operations and maintenance workforce reduced from 87 staff (1961) members to only 39.

Water managements systems differs from country to country. These differences are due to geographical location of countries, climate, level of development, human resource capacities and level of information technology. However author intended to compare water management system in Uzbekistan and Japan.

Conclusion. Based on our results water shortage happening in study area (3 provinces). Thirteen WUA out of thirty feel water shortage. Main cause is water loss. Water loss happening mainly because of poorly functioning irrigation facilities WUA and main part (64.6%) of canal is based on earth type.

The next is lack of modern measuring and monitoring tools getting on-time information about water amount. WUA staff use traditional techniques for getting data. WUA staff needs to check the water level of water facilities such as water intakes frequently to stabilize water amount.

WUA wishes: to get money on time for service to have constant front of work for machinery, to own money for duly repair of reclamation machinery, petroleum products and salary as well.

After observation of advanced irrigation system in Japan we recommend some application as an idea which might be helpful to improve Water resource management of Uzbekistan by level of WUA:

Potential applications: a)buffering system (pons, small reservoirs). Construction of regulating reservoirs, ponds goal is storing and using efficiently the water that becomes unused when there is sufficient water. When the arrival water volume is low, the system helps to provide a stable supply to downstream and effective use of water resources.

b)Distant monitoring and controlling (Measurement system). Introduction of comprehensive, distant monitoring and controlling system helps on- time information about the volume of water, effective use of water resources (highly accurate water distribution implementation), supplementation for flow volume change.

c)doubling canal. New reconstruction of the main canals into double-way flumes enables to easy maintenance. Regular maintenance such as cleaning inside the waterways, removal of sediment from the waterways can be done while water is running through either way of the flume.

d)construction of lateral canals into pipelines. The application provides water to fields in a short time. It also contribute to stable supply of water for agriculture. By reducing unused water, non-arriving water volume, and management water will lead to an effective water use (no waste water). Reduction of time and labor work on distribution is also expected.

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