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Component 1: «National policy framework for water governance and integrated water resources management»

FULL COSTS RECOVERY ON OPERATION AND MAINTENANCE OF IRRIGATION SYSTEMS IN THE PILOT RIVER BASINS

Project report

Tashkent 2019

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ABBREVIATIONS AND ACRONYMS

APS	Administration of pumping station
BISA	Basin Irrigation Systems Authority
CDW	Collector drainage water
DID	District Irrigation Department
EC	Efficiency coefficient
ET	Evapotranspiration
FIS	Fergana Irrigation System
FL	Fuels and lubricants
GT	Groundwater table
HF	Hydrotechnical facilities
IDS	Irrigation and Drainage System
ISA	Irrigation System Authority
KMCOM	Karshi Main Canal Operation Management
LLC	Limited Liability Company
MAWR	Ministry of Agriculture and Water Resources
MCOM	Main Canal Operation Management
MTP	Machine and tractor park
MTR	Material and technical resources
O&M	Operation and maintenance
OD	Operation department
OM	Operation Management
PS	Pumping stations
PU	Pump units
RCE	Republican Commodity Exchange
RMW	Repair and maintenance works
RP	Regional product
SF	Salary fund
SFC	South Fergana Canal
SUE	State Unitary Enterprise
WCA	Water Consumers Association
WUR	Water utilization rate

ABSTRACT

This report has been prepared in accordance with the objectives of activity 7.5 - supporting river basin organizations in conducting an economic analysis of water use and the application of full cost recovery principles; in developing financial and economic incentives for water conservation and improvement of water productivity in rural areas of the Component No. 1: "National Framework Concept for Water Management and Integrated Water Resources Management" of the European Union Program of "Sustainable Water Management in Rural Areas of the Republic of Uzbekistan"

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INTRODUCTION

The water infrastructure in the Republic of Uzbekistan is maintained from the state budget in the form of operational expenses of water management organizations. The state, through the pricing system for agricultural products and taxes, withdraws the costs of water management from water consumers, and then finances its activities through the state budget. The dynamics of the costs of financing water management show that there is an increase in financing from the state budget. However, analyzing the investments at comparable prices, and taking into account inflation and rising prices for electricity and material and technical resources, a different picture emerges. Despite the increase in funding, physical volumes of maintenance work on the water infrastructure are in fact reduced.

The volume of works on cleaning and maintenance of the subsurface drainage decreased several times - from 3.5 to 1 thousand kilometers per year. The situation with renewing and repairing concrete flumes is even worse. Undoubtedly, the change in the operating system greatly complicated the activities of water management bodies, especially since it coincided with a sharp reduction in the number of water managers working at the level of district organizations. Many regional inter-farm canals turned into abandoned aryks (canals) (Ismail Jurabekov, Viktor Dukhovny, Water is our past, present and future. “Narodnoe Slovo” Newspaper, May 28, 2018).

For the normal functioning of water management and efficient management and rational use of water resources, full cost recovery for the operation and maintenance (O&M) of the irrigation systems is required. It is known that the state of basic production assets is the main criterion characterizing the technical level of any production, including water management. High rates of renewal of fixed assets characterize the indicators of technical progress and reliability of the production means. Conversely, low rates of renewal of fixed assets, or the lack of growth, determine the physical and moral deterioration of the production means, their low reliability and high maintenance costs.

The constant shortage of financial resources at water management enterprises does not allow maintaining the technical condition of water management facilities. As a result, the level of material and technical support of water management organizations remains low.

To implement a full reimbursement of the costs of the irrigation system O&M, an analysis of the actual O&M costs at the lower and upper levels of the irrigation system was performed and an estimate of the required O&M costs at the lower and upper levels of the irrigation system was carried out while ensuring their efficiency. In this document, a feasibility of full reimbursement of the O&M costs by water consumers at the lower and upper levels of the irrigation system was assessed. The estimation of the total economic value and value of water in the pilot river basins has been carried out and based on this assessment, recommendations on the full cost recovery of O&M for irrigation systems are given.

COSTS OF O&M OF IRRIGATION SYSTEMS IN PILOT RIVER BASINS

2.1. Financing of water management in Uzbekistan.

Financing of water management in Uzbekistan is carried out:

– from the state budget in the form of operating expenses of water management organizations;

– capital investments in the framework of the State Program, implemented by the Land Amelioration Fund for irrigated lands under the Ministry of Finance;

– from centralized investments from the State budget;

– foreign investments in the form of a loan guaranteed by the Government of the Republic of Uzbekistan;

– due to farmers' fees for WCA services.

The main sources of Land Amelioration Fund for irrigated land are revenues from the unified land tax and targeted budget funds.

Decree of the President of the Republic of Uzbekistan No. PP-3405 of November 27, 2017 approved a program of comprehensive measures for the development of irrigation, improvement of ameliorative condition of irrigated land and rational use of water resources for the period of 2018-2019. In accordance with this Resolution, the Ministry of Finance and the Ministry of Economy of the Republic of Uzbekistan are entrusted to ensure the allocation of the necessary funds during 2018-2019 to carry out the approved forecast parameters of irrigation and land improvement activities to be carried out at the expense of centralized investment funds, the Land Amelioration Fund for Irrigated Lands and the State Budget of the Republic of Uzbekistan.

The annual formation of the State Program and Territorial targeted programs is carried out in accordance with the «Regulations on the procedure for the formation, development, examination, approval and implementation of projects for the amelioration of irrigated lands» (approved by the Cabinet of Ministers No. 261 at November 28, 2008).

It should be noted that the work on the reconstruction and rehabilitation of water facilities within the framework of the State Program is carried out both at the government facilities and at WCA facilities. A technical supervision of the quality of land reclamation works in places, their compliance with the established standards and design parameters as well as the control measurement of the volume of work performed, are carried out by the Regional Land Reclamation Technical Support Group of the Management department of the Land Amelioration Fund of the Irrigated Lands.

State Unitary Enterprise (SUE) "Suvqurilishinvest" of the Ministry of Water Resources performs a function of a customer for the construction and reconstruction of irrigation facilities, carried out at the expense of capital state investments, repair and restoration of inter-district and inter-farm collectors and other ameliorative facilities.

2.1.1. Planning and financing of repairs

To ensure a technically sound condition and reliable operation of irrigation systems, operational water management organizations carry out maintenance and repair work on water management facilities by their own means. Maintenance of bulk and complex objects is done by contractual works with specialized organizations. Objects requiring rehabilitation and reconstruction are included in the territorial targeted programs, and are implemented by the Land Amelioration Fund under the Ministry of Finance and SUE "Suvqurilishinvest" of the Ministry of Water Resources.

Whereas the planning and management of water resources is carried out in accordance with the "Regulations on the procedure for water use and consumption in the Republic of Uzbekistan" approved by the Decree of the Cabinet of Ministers No. 82 from March 19, 2013, however a unified regulatory document, which regulates the procedure for planning and conducting maintenance and repair and maintenance works (RMW) of the irrigation and drainage system is absent.

Therefore, the Order of the Ministry of Agriculture and Water Management of the Republic of Uzbekistan (MAWR) No. 202 from September 7, 2006 obliges operational water management organizations to establish a commission of 5 people headed by the deputy chief of production for continuous monitoring of the implementation of current and capital repairs of gauging stations, hydraulic structures, administrative and production buildings, pumping stations, machinery and mechanisms in operational organizations and sets the main tasks of the commission:

- Development of repairment schedules for gauging stations, hydraulic structures, administrative and industrial buildings, pumping stations, power equipment and communication lines, machinery and mechanisms at the beginning of the planning year and their approval by the MAWR;

- Monitoring the implementation of all types of repair work in a timely manner and within the established cost estimates;

- Identify defects of gauging stations to be repaired, hydraulic structures, administrative and industrial buildings, pumping stations, power equipment and communication lines, machines and mechanisms, and drawing up defective acts;

- Ensuring the drafting of defective acts of electric motors, pumps, transformers and other equipment sent by the organization to factories and other repair enterprises in advance for the execution of works on the basis of the conclusion of the commission

- Collecting old parts, replaced on the basis of established regulatory documents every quarter, drawing up acts under strict control, and putting unserviceable parts into scrap metal at the conclusion of the commission.

- Conducting a monthly monitoring of the repaired objects to establish the main capital costs, assets, parts and materials.

In fact, when operational water management organizations plan conducting RMW, the current technical condition of structures and the list of defects are not taken into account, i.e. practical planning of RMW is not performed. As mentioned above, water management organizations estimate expenditures within the allocated limits of budget allocations for the corresponding financial year. According to expert estimates of water management organizations the actual amount of financing the O&M of the irrigation and drainage systems amounts to 70-75% of the requirement.

The following is an analysis of operating costs for O&M of irrigation systems in the pilot basins.

2.2. Analysis of actual costs of O&M in the Aksu . asin

The irrigation system in the Aksu River basin is one of the subsystems of the integral Amu-Kashkadarya irrigation system. A “Hisarak” reservoir was built on the Aksu River, which provides water for Kitab, Shakhrisyabz and Yakkabag districts of Kashkadarya Province into a total irrigated area of 48,796 ha (Figure 1). In dry years, the Aksu River feeds the Kashkadarya River basin.

The operation of the Amu-Kashkadarya irrigation system involves the Amu-Kashkadarya BISA, the Karshi Main Canal Operation Management (KMCOM), the OM of the Hisarak and Chimkurgan reservoirs, the APS and the OM of the Kashkadarya province. Amu-Kashkadarya BISA, APS and OM of the Kashkadarya province, OM of the Hisarak reservoir and the ISA are involved in the operation of the Aksu subsystem.

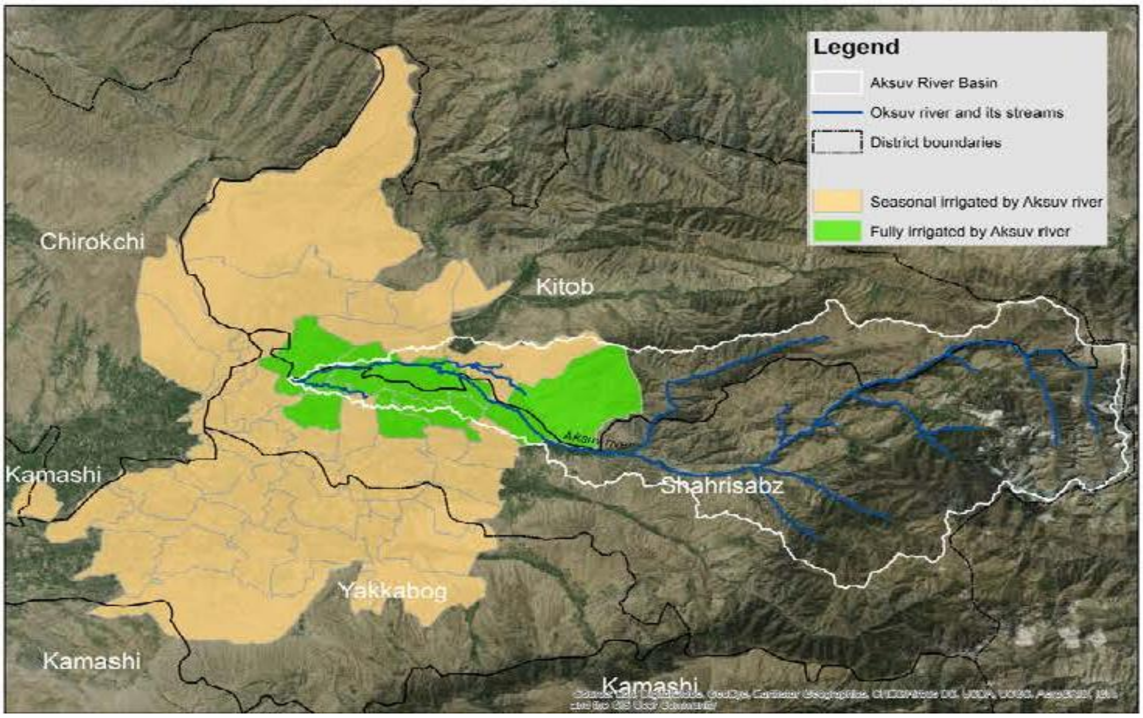

Figure 1. Map with location of the Aksu basin.

For an objective assessment of the transportation and water distribution costs and maintenance of the irrigation and drainage infrastructure in the Aksu River basin in working condition, it is necessary to take into account the share of costs of the Amu-Kashkadarya BISA, OM of the Hisarak reservoir, APS and OM of the Kashkadarya province and the Aksu ISA. Considering the above, we estimated the costs of O&M in general for the Amu-Kashkadarya irrigation system and then separately for the Aksu subsystem.

An analysis of the financing costs of water management shows that there is an increase in state budget financing in monetary terms (Table 1). The growth of O&M financing compared with the previous year ranges from 3–12% for the Hisarak reservoir to 11–34% for BISA.

Organization	2015	2016	2017
Amu-Kashkadarya BISA	21,400,992.80	23,743,269.70	31,882,030.50
Dynamics of financing, %		10.94	34.28
APS	27,306,678.60	45,819,534.80	53,912,080.80
Dynamics of financing, %		67.80	17.66
OD	6,740,386.60	7,911,337.50	9,887,067.80
Dynamics of financing, %		17.37	24.97
OD of Hisarak reservoir	4,284,132.50	4,454,610.80	5,013,242.90
Dynamics of financing, %		3.98	12.54
OD KMC	383,565,792.10	438,982,851.30	512,876,690.80
Dynamics of financing, %		14.45	16.83
TOTAL	**443,297,982.60**	**520,911,604.10**	**613,571,112.80**

Table 1. O&M costs of the Amu-Kashkadarya Irrigation System (thousand soums).

However, taking into account inflation and rising prices for electricity and material and technical resources, from the viewpoint of comparable prices, a different picture emerges. Despite the increase in funding, physical volumes of maintenance work on the water infrastructure are reduced. For example, in the cost structure for the O&M of the APS of the Kashkadarya province, the share of expenses for the repair of pumping units (PU) is only 0.4%, for repair of vertical drainage wells (VDW) 0.1% and for repair of irrigation wells (IW) 3% (Figure 2).

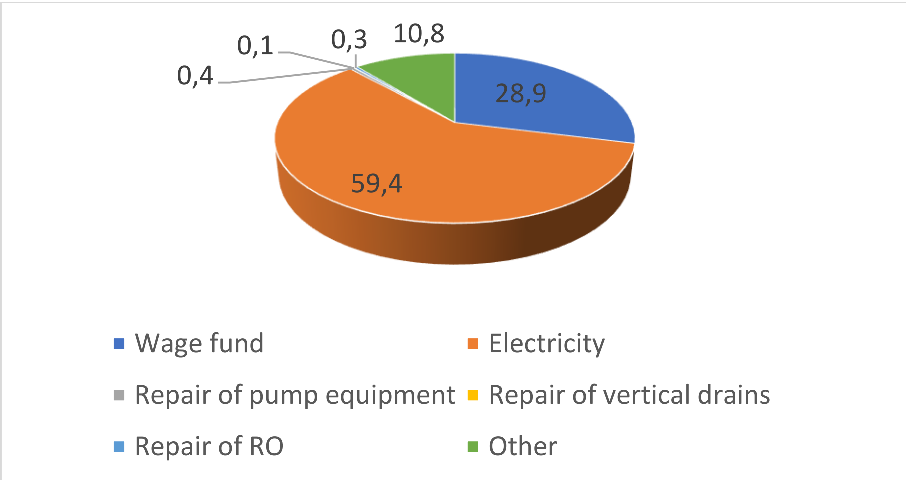

Figure 2. Structure of the O&M costs for APS of the Kashkadarya province for 2017.

Also, there is a decrease in the physical volume of repair work. The number of repaired PUs decreased from 77 units in 2016 to 59 in 2017. The number of repaired vertical drainage wells decreased from 24 units in 2015 to 19 in 2016 and to 18 in 2017. Similarly, the number of repaired IWs decreased from 91 units in 2015 to 75 in 2016 and to 72 in 2017 (Figure 3).

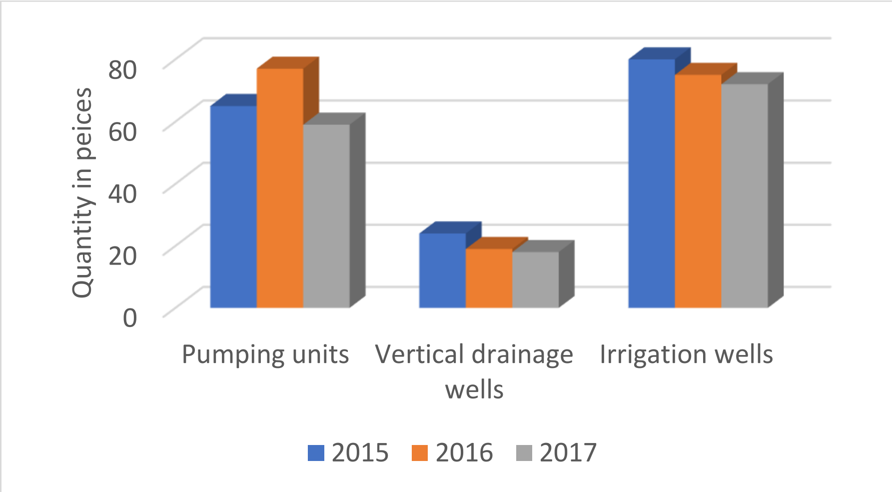

Figure 3. Repairment of pumping units and wells in the APS of the Kashkadarya province.

In the cost structure for O&M of the Aksu UIS, the costs of cleaning the canals are 2.1%, for repair of hydraulic structures 3.1%, for repairs of HP 0.2% (Figure 4).

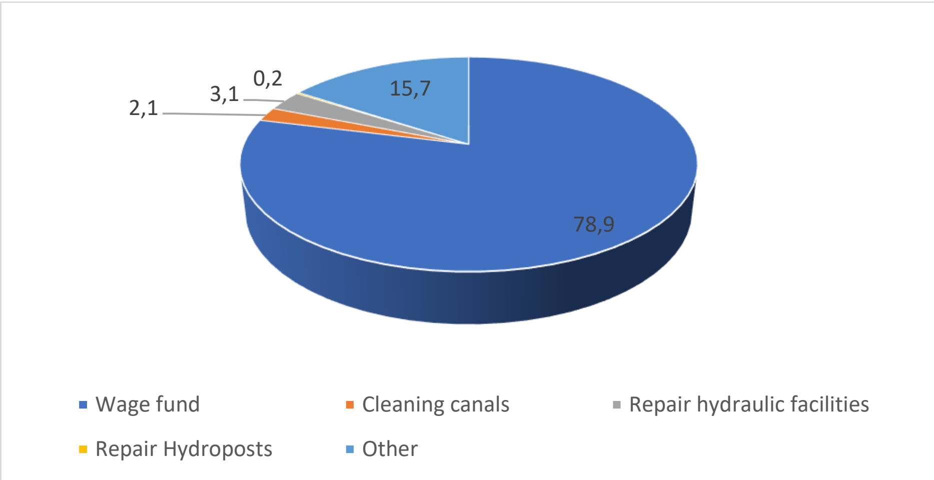

Figure 4. Structure of O&M costs of the Aksu UIS in 2017, %

In general, there is a decrease in the volume of work in the Aksu UIS on the repair of the hydraulic structures (Figure 5).

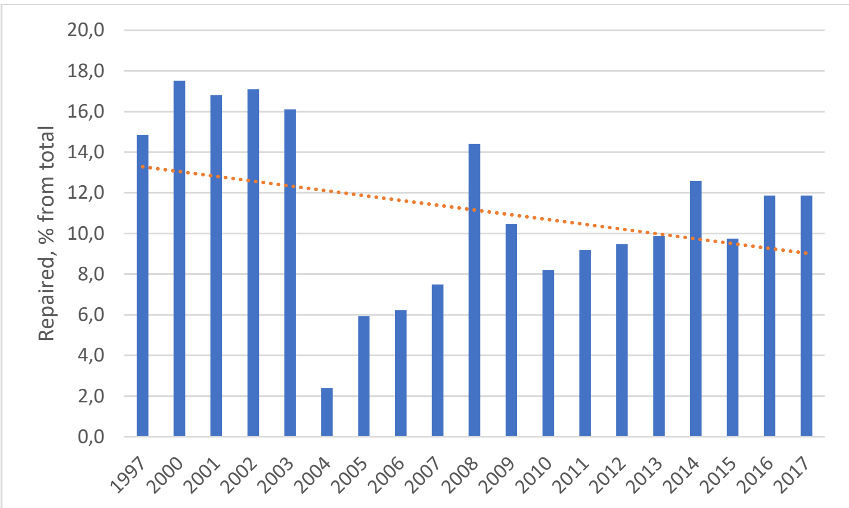

Figure 5. Dynamics of the repairment works of HF in the Aksu ISA

The constant shortage of financial resources at water management enterprises does not allow them to carry out RMW in the necessary volumes and maintain the proper technical conditions of the water management facilities.

The annual water intake within the Amu-Kashkadarya irrigation system ranges from 5,209.9 to 5,716.1 million m³ (Table 2).

Source	2015	2016	2017
Amu Darya	3647.72	3752.05	4171.29
Zarafshan	158.59	255.41	169.61
Kashkadarya	1041.38	851.85	1035.66
From underground	107.82	101.82	103.14
Collector-drainage discharge	254.43	317.29	236.48
Water intake in the system, million m³	5209.9397	5278.42	5716.18
Water supply at the WCA border, million m³	3671.44	3719.71	4028.19

Table 2. Water intake and supply within the Amu-Kashkadarya irrigation system, million m³

The cost of 1 m3 of water supplied at the WCA border in the Amu-Kashkadarya irrigation system during 2015 to 2017 increased from 124 to 152 UZS/m3 or by 22.5% (Figure 6).

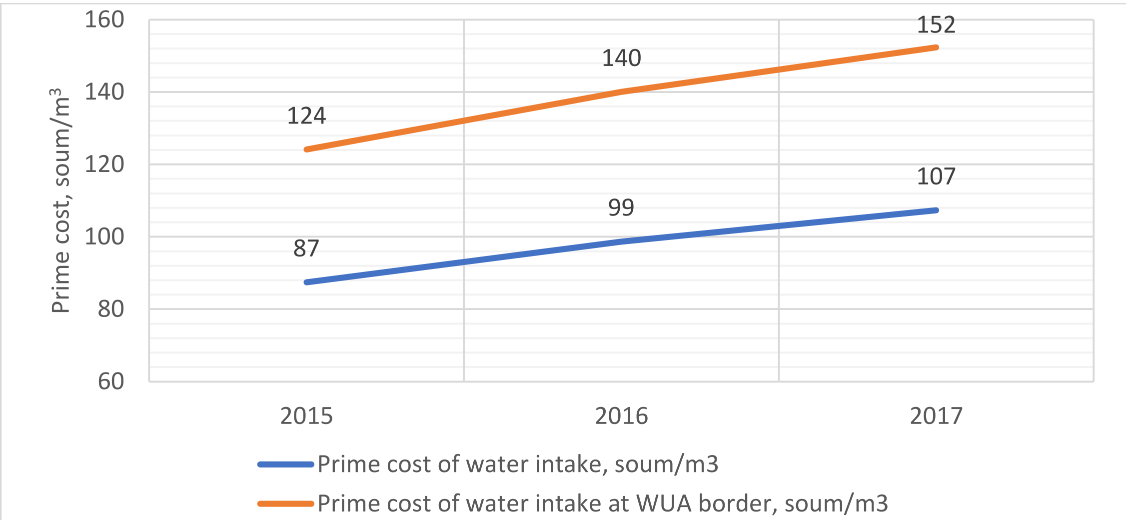

Figure 6. Cost of water intake and supply within the Amu-Kashkadarya irrigation system.

Estimation of O&M costs in the Aksu subsystem.

For an objective assessment of the O&M costs of irrigation systems in the Aksu Basin, we take into account the share of costs of organizations involved in water management in proportion to the area of the Aksu Basin serviced by these organizations - the OM of the Hisarak reservoir 100%, administration of the Amu-Kashkadarya BISA 9.5%, APS 9.5%, OM 9.5% and Aksu ISA 60% (Table 3).

Source	2015	2016	2017
Amu Kashkadarya BISA, 9.5 %	188,037.17	190,963.50	150,296.53
APS, 9.5 %	3,762,390.25	4,352,855.81	5,121,647.68
OM, 9.5 %	640,336.73	751,577.06	939,271.44
OD of Hisarak reservoir, 100 %	4,284,132.50	4,454,610.80	5,013,242.90
Aksu ISA, 60 %	2,026,603.38	2,184,863.28	2,410,513.02
TOTAL by Aksu	**10,901,500.02**	**11,934,870.45**	**13,634,971.56**

Table 3. Costs for O&M in the Aksu . asin (thousand soums).

The annual water intake within the Aksu subsystem ranges from 358.4 to 399.2 million m^3 (Table 4).

Source	2015	2016	2017
Hisarak reservoir	356.84	329.8	366.61
From underground	21.71	28.63	32.61
Water intake in the system, million m^3	378.55	358.39	399.22
Water supply in the WCA border, million m^3	306.3	290.0	323.0

Table 4. Water intake and supply within the Aksu subsystem, million m$^{3.}$

The cost of 1 m^3 of water supply at the WCA border in the Aksu subsystem increased from 35.6 soums in 2015 to 42.2 soums in 2017 or by 18.5% (Figure 7).

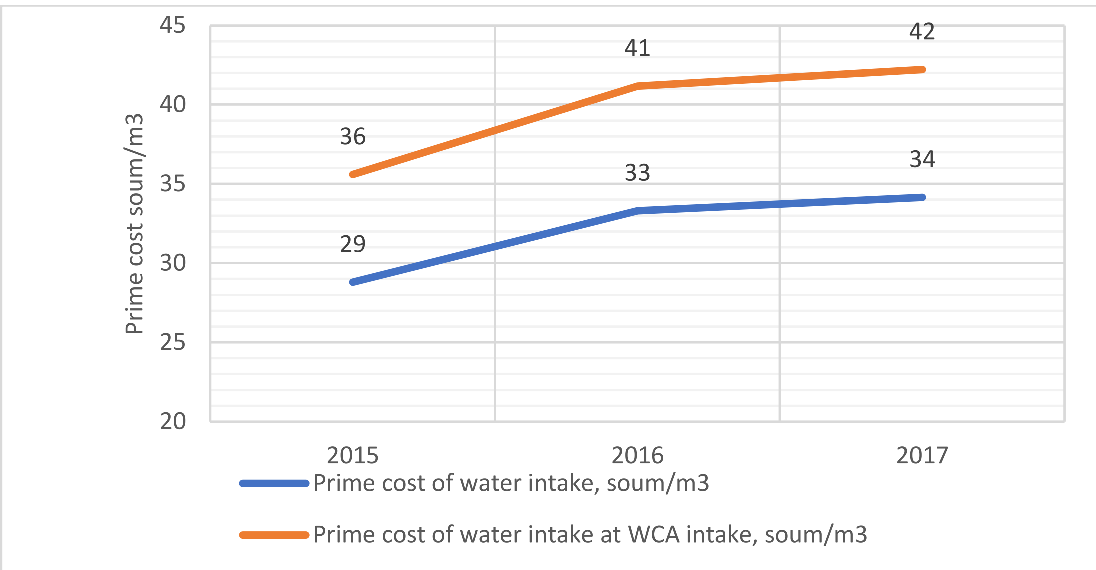

Figure 7. Cost of water intake and supply within the Aksu subsystem.

2.3. Analysis of actual O&M costs in the Shakhrikhansayay . asin.

The Fergana Valley located in the Karadarya River basin and left bank of the Syrdarya River is a holistic irrigation system, looped back and feeding each other by main canals - the Big Fergana Canal, Big Andijan Canal and the South Fergana Canal (SFC), which will be called the Fergana Irrigation System (FIS). Shakhrihansay is considered to be one of the FIS subsystems. Shakhrikhansay originates from the Andijan reservoir and provides water to the areas of Kurgantepa, Zhalaquduk, Khuzhaobod, Buloqboshi, Asaka, Shakhrikhan and Markhamat districts of the Andijan, Kuvasoy, Kuva, Oltiarik, Kushtepa, Toshloq, Fergana districts of the Fergana province. SFC is considered to be one of the diversions of Shakhrikhansay. Figure 8 shows a location of the Shakhrikhansay Basin.

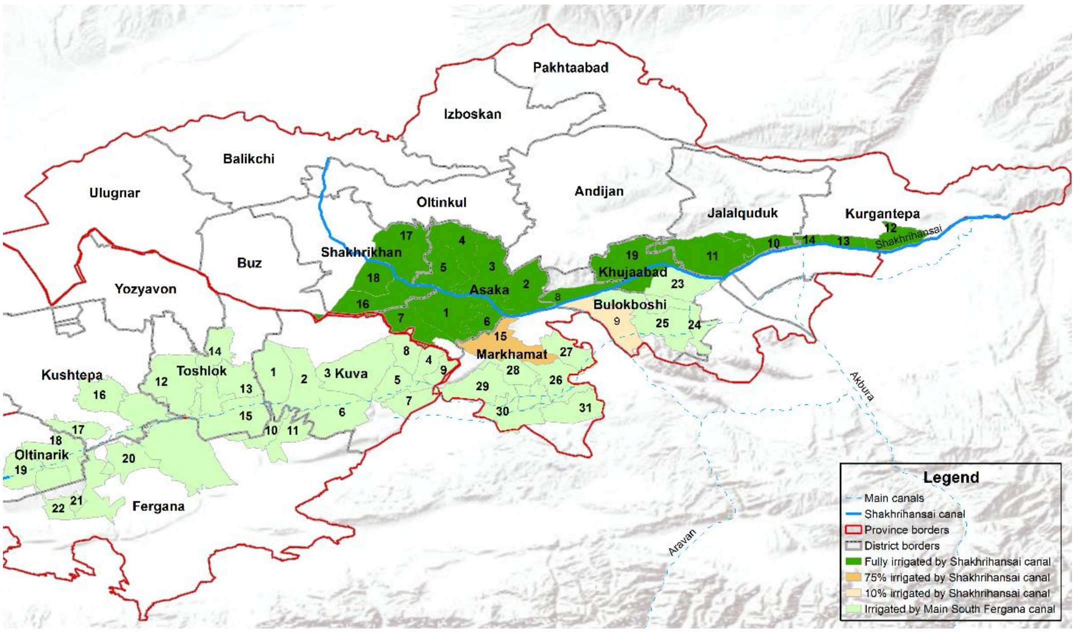

Figure 8. Location of the Shakhrikhansay . asin.

The Naryn-Karadarya, Syrdarya-Sokh BISAs and the Department of Main Canals of the Fergana Valley operate the Fergana irrigation system, which includes the OM Big Fergana Canal, OM Big Andijan Canal and OM SFC, OM of the Andijan reservoir, APS of the Andijan and Fergana provinces. OM SFC, “Shakhrikhansay” and “Isfayram-Shakhimardan” ISA systems are involved in the operation of the Shakhrikhansay subsystem.

For an objective assessment of the cost of water transportation and distribution, and maintenance of the irrigation and drainage infrastructure in the Shakhrikhansay Basin in working condition, it is necessary to take into account the share of costs of the Naryn-Karadarya and Syrdarya-Sokh BISAs, OM SFC, OM of the Andijan reservoir, APS of the Andijan and Fergana provinces, ISA «Shakhrikhansay» and «Isfayram-Shakhimardan» and OM of the Andijan and Fergana provinces.

Considering the above mentioned, first we estimated the O&M cost in general for FIS and then separately for the Shakhrikhansay subsystem.

This analysis of financing water management shows that in monetary terms there is an increase in state budget financing (Table 5). Compared with the previous year, the increase in funding for O&M ranges from 8.2-9.9% in the OM of the Fergana province to 21.1-22.3% in the OM of the Andijan province.

Organizations	2015	2016	2017
OD Andijan reservoir	6,682,985.50	8,848,385.40	10,083,811.10
Dynamics of financing, %		10.5	12.6
Department of main canals management of the Fergana Valley	10,113,429.40	11,181,855.80	12,594,536.80
Dynamics of financing, %		10.5	12.6
« Naryn-Karadarya» BISA	17,002,579.80	19,673,305.10	23,259,388.60
Dynamics of financing, %		15.7	18.2
«Syrdarya-Sokh» BISA	24,144,056.00	27,098,628.90	33,316,441.70
Dynamics of financing, %		12.2	22.9
Fergana province APS	73,972,987.90	98,551,142.00	100,793,108.10
Dynamics of financing, %		33.2	2.3
Andijan province APS	85,490,040.20	103,441,948.40	105,232,631.80
Dynamics of financing, %		21	1.7
OD Andijan province	2,296,507.00	2,780,247.80	3,401,382.30
Dynamics of financing, %		21.1	22.3
OD Fergana province	3,743,955.60	4,050,577.10	4,450,547.40
Dynamics of financing, %		8.2	9.9
TOTAL	**223,446,541.40**	**275,626,090.50**	**293,131,847.80**

Table 5. O&M costs (thousand soums) in FIS.

In the O&M cost structure of the OD SFC, the costs for cleaning the channels are 0.3%, for repairs of hydraulic structures 2.6%, and for repairs of HP 0.1% (Figure 9).

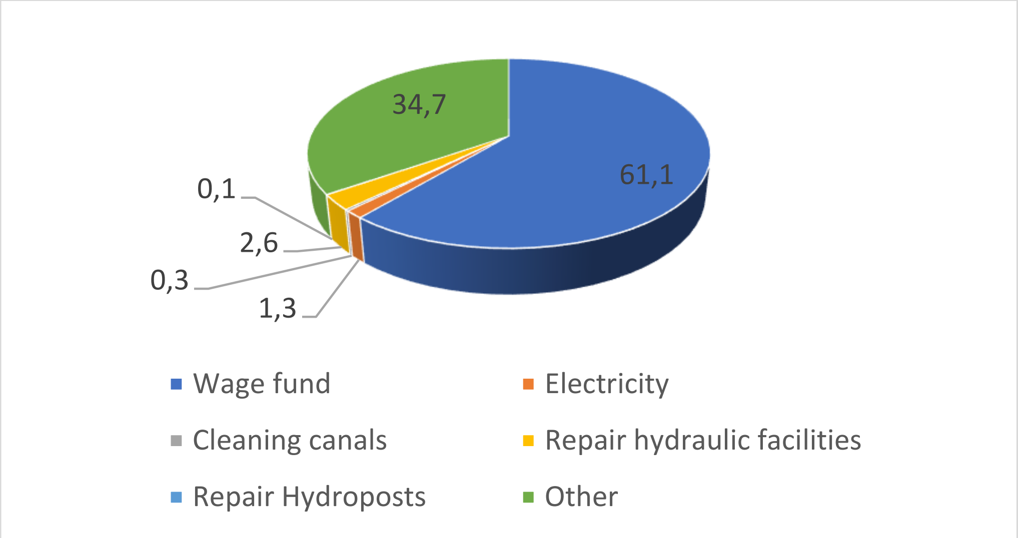

Figure 9. O&M cost structure of the OM SFC

In 2015, the number of repaired HF amounted to 8.7% to the total, while in 2017 it decreased to 6.8% (Figure 10).

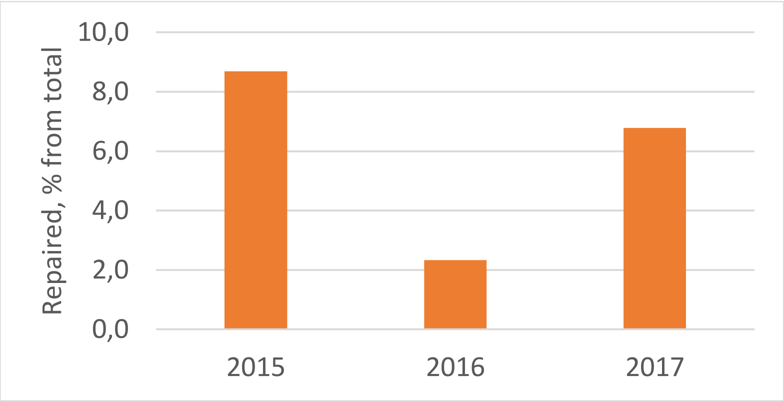

Figure 10. Dynamics of repairment of HF in the OM SFC.

In the O&M cost structure of the "Shakhrikhansay" ISA, the share of the costs for cleaning the canals is 3.0%, of repairing HF 3.7%, and HP 0.2% (Figure 11).

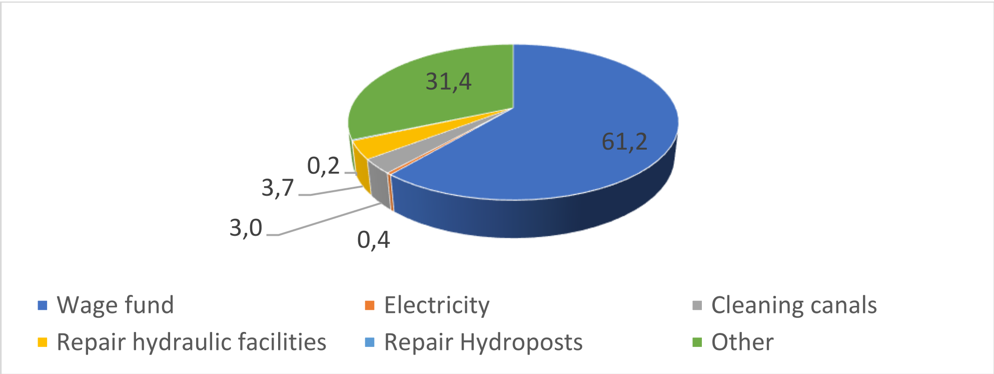

Figure 11. O&M cost structure of the "Shakhrikhansay" ISA

The number of repaired hydraulic structures in 2015 amounted to 7.0%, while in 2017 it decreased to 6.2% (Figure 12).

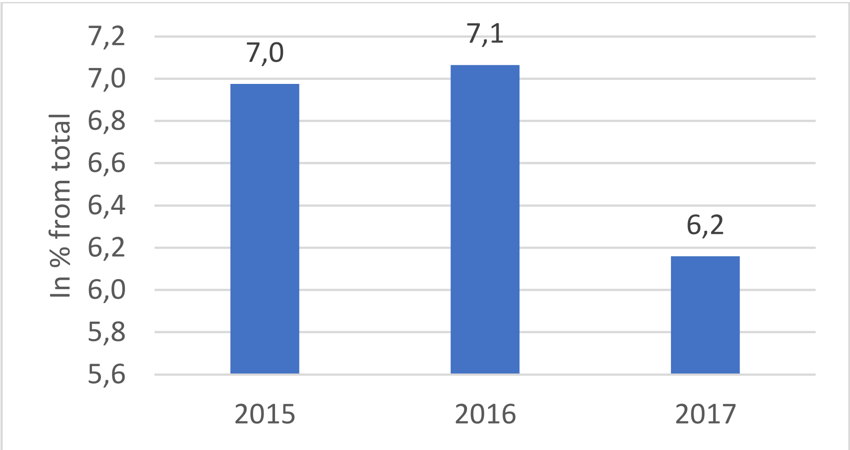

Figure 12. Dynamics of repairment of HF by the Shakhrikhansay ISA

In the costs structure of the APS of the Andijan province, the share of energy costs is 69.7%, of repairing pumping units 0.02%, vertical drainage wells 0.02% and irrigation wells 0.0% (Figure 13).

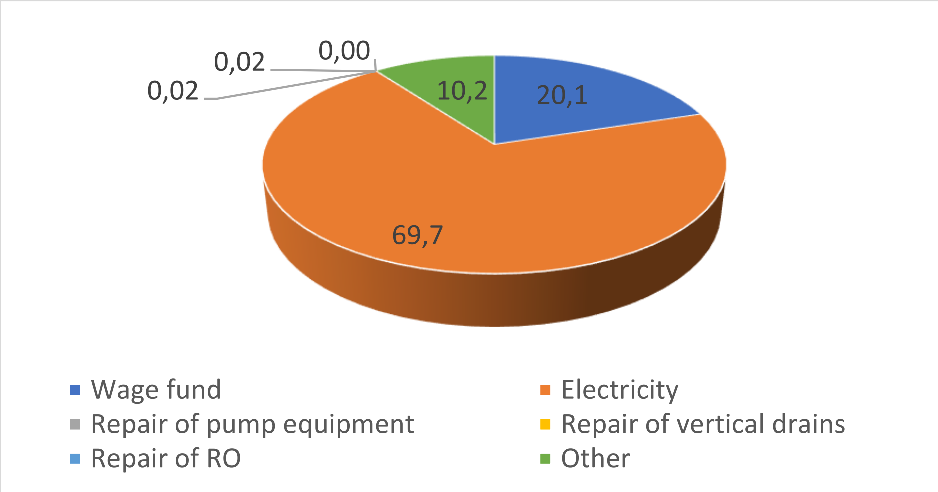

Figure 13. Structure of costs for O&M of APS in the Andijan province.

The number of repaired PUs decreased from 330 units in 2015 to 296 units in 2017. The number of repaired VDWs decreased from 218 units in 2016 to 58 units in 2017, and the number of repaired RMs from 13 in 2015 to 11 in 2016 and to 6 in 2017 (Figure 14).

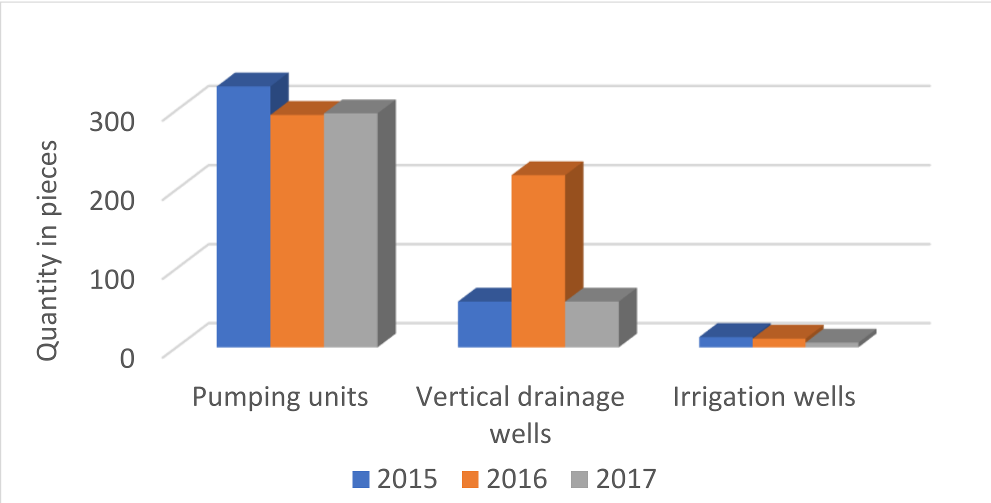

Figure 14. Repairment of pumping units and wells of the APS of the Andijan province.

The annual water intake into the FIS ranges from 7298.5 to 7487.6 million m³ (Table 6).

	2015	2016	2017
Within the zone of the Naryn-Karadarya BISA	3075.32	3110.0	3110.0
Within the zone of the Syrdarya-Sokh BISA	4223.2	4377.6	4363.1
Water intake in the system, million m³	7298.52	7487.6	7473.1
Water supply at the WCA border, million m³	4965.91	5094.56	5084.7

Table 6. Water intake and water supply into the FIS, million m³

The cost of 1 m³ water supply at the WCA border of the FIS increased from 45.0 soums in 2015 to 57.6 soums in 2017, or by 28.1% (Figure 15).

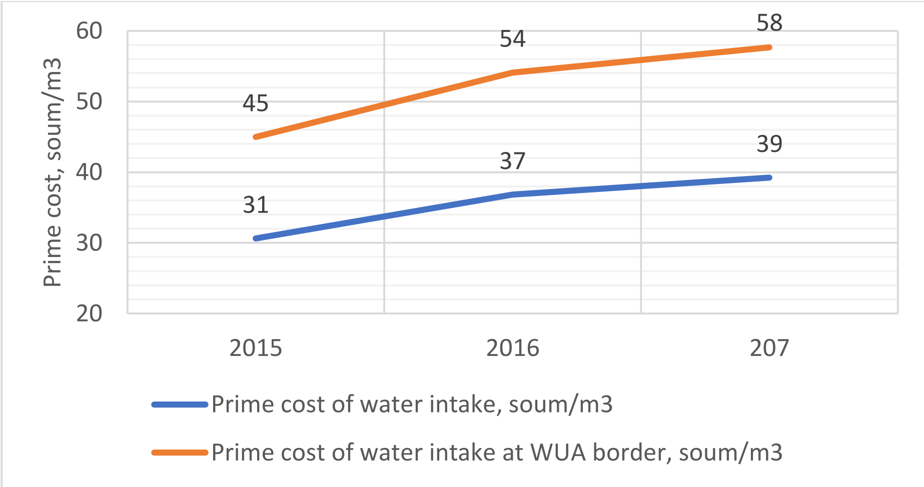

Figure 15. Cost of water intake and water supply in the FIS.

Estimated O&M costs for the Shakhrikhansay subsystem.

In order to make an objective assessment of the O&M costs for irrigation systems in the Shakhrikhansay Basin, we accounted for the share of the costs of organizations involved in water management in proportion to the area of the Shakhrikhansay Basin serviced by the following organizations – OM of Andijan reservoir 31%, OM of SFC 100%, administration of the Naryn-Karadarya BISA 21%, APS of the Andijan province 21%, OM of the Andijan province 21%, Shakhrihansay ISA 100%, administration of the Syrdarya-Sokh BISA 15%, APS of the Fergana province 15%, OM of the Fergana province 15% and Isfayram-Shakhimardan ISA 58% (Table 7).

Organizations	2015	2016	2017
OD of Andijan reservoir, 31 %	2,071,725.51	2,742,999.47	3,125,981.44
OD SFC, 100 %	3,402,548.00	3,735,948.10	4,268,007.80
Administration of the Naryn-Karadarya BISA, 21,4 %	138,132.14	156,935.21	190,431.61
Administration of the Syrdarya-Sokh BISA, 15,3 %	78,610.40	95,755.80	122,545.40
APS Fergana province, 15.3 %	11,317,867.15	15,078,324.73	15,421,345.54
APS Andijan province, 21.4 %	18,294,868.60	22,136,576.96	22,519,783.21
OD of the Andijan province, 21.4 %	491,452.50	594,973.03	727,895.81
OD of Fergana province, 15.3 %	572,825.21	619,738.30	680,933.75
APS Shakhrihansay, 100 %	3,321,429.10	3,973,138.30	4,515,968.50
APS Isfayram-Shakhimardan, 58 %	4,975,520.31	5,484,945.80	6,081,924.95
Total	**36,368,029.50**	**45,161,251.59**	**47,056,924.56**

Table 7. O&M costs by Shakhrikhansay subsystem (thousand soums).

The annual water intake within the Shakhrikhansay Basin ranges from 2049.2 to 2209.2 million m^3 (Table 8).

Sources	2015	2016	2017
Shakhrihansay, inlet	2380.03	2307.17	2428.6
Andijan, outlet (-)	329.966	319.865	336.7
Water intake, Kyrgyzstan (-)	57	54	61
Oqbuyra		16.8	34.3
Aravonsoy	51.4	82	127.8
Underground water	4.33	4.33	4.2
Isfayramsay	6.5	6.5	5.9
Margilansay	2.7	2.3	2.44
Oltiariksay	3.6	3.4	3.2
Underground water	0.2	0.17	0.15
CDD	0.52	0.41	0.33
Water intake within the system, million m^3	2062.314	2049.215	2209.22
Water supply at the WCA border, million m^3	1403.20	1394.29	1503.15

Table 8. Water intake and water supply in the Shakhrikhansay Basin, million m^3.

The cost of 1 m^3 of water supply at the WCA border in the Shakhrikhansay subsystem increased from 25.2 soums in 2015 to 30.5 soums in 2017, or by 21.0% (Figure 16).

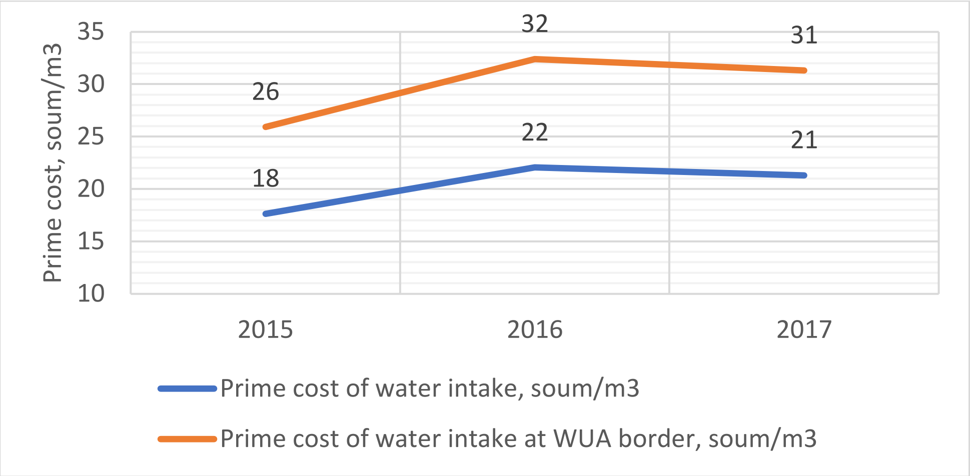

Figure 16. Costs of water intake and water supply in the Shakhrikhansay subsystem.

2.4. Estimation of required O&M costs at the lower level of the irrigation system.

The costs of the O&M of the irrigation and drainage network within the WCA are financed from fee payments of water consumers for services. According to Naryn-Karadarya and Amu-Kashkadarya BISAs, the actual WCAs expenses for O&M in 2017 amounted to 10-15 thousand UZS/ha. One of the main reasons for low O&M costs is that the majority of water users have not realized their responsibility for the joint management of O&M of irrigation and drainage systems.

It is known that one of the main tasks of WCAs is the maintenance of irrigation and drainage systems, land reclamation equipment and other hydraulic structures in order to maintain them in working conditions. However, the funds that are actually collected from water consumers are only sufficient mainly to cover the costs of workers' salaries and social contributions. At present, the WCA cannot fully fulfill its function, and activities are limited only by the water supply to farmers. Due to lack of funds, maintenance of the irrigation and drainage infrastructure is barely performed. This negatively affects their performance and hence, water availability and ameliorative condition of irrigated areas.

In the process of budget estimation for a WCA, there may be friction between an engineer who needs to have sufficient funds to carry out O&M activities and water users who wish to pay as little as possible for irrigation services. In this regard, the WCA should carefully and accurately determine the amount of required expenditures on the O&M of irrigation and drainage systems, which will be sufficient for carrying out preventive maintenance.

WCA expenses usually consist of the following costs:

Operating costs include:

• Wage fund;
• Fund of material incentives;
• Deduction on social insurance;
• Office costs;
• Fuel and lubricants;
• Payment of debts for the past year;

Maintenance costs:

• Purchase of equipment;
• Repair of vehicles and land reclamation equipment;
• Repair and construction of hydraulic structures;
• Cleaning channels and collectors;
• Reserve Fund;
• Depreciation;

When calculating the cost of repair and restoration works conducted through contracts, the following costs of the contractor are taken into account:

• Material costs;
• Expenses for labor remuneration of production character;
• Social insurance contributions related to production;
• Depreciation of fixed assets and intangible assets for production purposes;
• Other production costs.

The need for machinery and Fuels and lubricants (FL) is determined on the basis of the technical characteristics of the reclamation machinery. When calculating the cost of repair and restoration works made through contracts, only material costs are taken into account.

WCA costs depend upon:

– Irrigation and economic conditions - the area of WCAs, the number of water intake points from the state irrigation system, the number of water discharge points for water users, the specific length of the irrigation network, the specific length of the collector-drainage network;

– Features and design of irrigation and drainage systems - engineering or non-engineering system, equipment of hydraulic structures, including water metering structures, the share of irrigation network in concrete lining and flume network, share of subsurface drainage;

– WCA equipment with repair and construction equipment;

– Organizational structure of WCA.

It is advisable that the tariffs for WCA services will be uniform for those water consumers located in similar irrigation and economic conditions. River basins can have various irrigation systems - engineering or non-engineering, water supplied by means of a pump or by gravity. Therefore, it is necessary to develop typical WCA budgets for each river basin. The goal of developing a model budget is to estimate the required O&M costs at the lower level of the irrigation system, ensuring their efficiency in certain irrigation conditions. The standard budget takes into account the types, composition and scope of work on O&M, the cost structure and their ratio in different irrigation and economic conditions.

The budget of the WCA is compiled in an Excel spreadsheet in Uzbek. The budget consists of 16 tables and each of the tables is provided for accounting for certain expenses.

Repair and construction of WCA facilities can be carried out by the cost-manager by hired personnel. At the same time, mechanized cleaning of canals of irrigation and collector-drainage networks is a hard-voluminous job, but possession of an excavator to clean the irrigation system of a WCA must also be justified in terms of the required costs (FL, repairs, workshops, warehouses, depreciation, etc.). For most WCAs with a small amount of work on mechanized cleaning of irrigation canals and collector-drainage networks is much more effective under an agreement with contracting organizations than to own such equipment. Therefore, the mechanized cleaning of irrigation canals and collector-drainage networks is recommended to be performed in a contractual way. Also, the overhaul of concrete channels and a flume network requiring special construction equipment is expediently carried out under an agreement with a contracting organization.

The scope of work for the repair and construction of facilities, labor costs and the required amount of materials and products are recommended to be taken for standard design 1018553 - BO 95 “Water outlets into open distribution canals for a discharge of up to 200 l/s” and 1018553 - RO 95 “Regulators opened to flow rate of up to 10 m3/s on irrigation canals”.

When drawing up the staff list, the following approximate composition of line personnel is recommended:

– Hydrotechnic - 1 person per 500 ha of irrigated land;
– Hydrometer - 1 person for 4 hydrometric posts;
– Pump operator - 1 person for 2 pumping units;
– Regulator of the facilities - 1 person for 15-20 points of regulation;
– Channel inspector - 1 person per 20 km of irrigation network;
– CDS inspector - 1 person per 50 km of the drainage network;

WCA employees are paid according to a single wage schedule for labor remuneration, approved by Resolution of the Cabinet of Ministers of the Republic of Uzbekistan No. 206 dated July 21, 2009.

2.4.1 Cost of O&M of WCAs in the Aksu Basin.

A model budget is drawn up in the example of the “Guldarasoy sokhili” WCA, the Yakkabag district, representative both for the entire Aksu Basin and for the Amu-Kashkadarya irrigation system in terms of the main indicators of the irrigation system at the lower level such as the WCA size (area), specific length and percentage of the irrigation network with anti-infiltration lining, number of water inlets for water consumers per 100 ha and percentage of equipment of water points with regulatory structures, specific length of the collector-drainage network, and percentage of subsurface drainage.

The “Guldarasoy Sohili” WCA serves 287 farms, 6 Limited Liability companies (LLC), and 3 settlements (kishlaks). The area of the WCA is 14539 ha, irrigated area 2908 ha. The source of irrigation is the Hisor channel. The water intake from the Hisor channel is carried out by the Navruz, Khakiygat, Kayrokoch, Saybayr, Pishavod, R-1 and Chubron on-farm channels. The total length of the irrigation network is 41.6 km, of which 18.3 km are for general use, 22.5 km are inter-farm and 0.7 km are individual channels, i.e. serving only one consumer. The collector-drainage water is discharged by the X-1 collector network. The discharge receivers are Guldarasoy and Aminsoy. The total length of the collector-drainage network is 28.7 km.

Out of 122 water intake points, 18 or 14.7% are equipped with water-regulating structures, 14 or 11.5% with water-measuring structures.

It is recommended to include equipping 10% of the water release points with water regulating and water measuring facilities into the WCA budget each year. Also, is recommended to include cleaning of 18.3 km of the public irrigation network and 33% or 9.2 km of the drainage network every year into the WCA budget. It is advisable to clean the inter-farm irrigation network and individual irrigation channels by hand with the method of khashar. It is recommended to include 20% or 3 km of repairing of concrete canals and 20% or 1 km of the flumes into the annual budget of the WCA.

The scope of earthworks on machinery cleaning of the irrigation network is as follows:

$$18300 \text{ m} \times 0.54 \text{ m}^3/\text{m} = 9882 \text{ m}^3$$

The scope of earthworks on the machinery cleaning of the drainage network is:

$$9200 \times 0.54 \text{ m}^3/\text{m} = 4968 \text{ m}^3$$

Calculation of the cost for earthworks during the machinery cleaning of the IDS is performed for the JY-210 excavator, the most common machine in the water management organizations of Uzbekistan (Table 9).

Item	Units	Q-ty	Cost per unit, soum	Total, soum
Volume of earthworks	m^3	14850		
Norm of time spent for 100 m^3 of earthworks	moto/hour	1,1		
Time spent in total	moto/hour	163,4		
Salary of excavator driver	soum/hour	163,4	10350	1691190
Social security, 25 %	soum			422798
Insurance, 7 %	soum			118383
Fuel consumption for 100 m^3 of earthworks	liter	12,2		
Fuel consumption, total	liter	1812		
Cost of fuel	soum/ liter	1812	5000	9058500
Expenses, total	soum			**11290871**
Overhead costs, 20 %				2258174
Depreciation of an excavator*, 15%	soum			2022628
TOTAL COST	soum			**15571673**
Cost of 1 m^3 of earthworks	soum			1048
Cost of machinery cleaning of 1 km of CDS	soum			566242

Table 9. Calculation of the cost for machinery-based earthworks for cleaning IDS in the “Guldarasoy Sohili” WCA.

** To perform the above-mentioned works, the excavator will be occupied for 1 month. The amount of depreciation will also be calculated for 1 month. The carrying value of the JY-210 excavator is 161810285 soum. The annual amount of depreciation is 161810285 * 0.15 = 24271542 soum, monthly = 24271542/12 = 2022628 soum.*

Repairment of concrete channels.

The volume of a concrete on channels with the dimensions of b - 0.5 m of bottom width, h - 1.0 m depth, m - 1.5 slope and t - 10 cm of concrete thickness is 0.41 m^3. The total volume of concrete works to replace up to 10% of the total volume will be 3000 m X 0.41m^3/m X 0.10 = 123 m^3. The scope of work includes: dismantling of old concrete; alignment of the basis under facing; laying concrete when feeding it with cranes with the device of expansion joints; curing. The calculation of the cost of repairing concrete channels is given in Table 10.

№	Cost items	Units	Q-ty	Cost per unit, soum	Total, soum
1	Cost of labor - builders per 100 m^3 of concrete	man-hour	287		
	Total work time spent	man-hour	353		
	Workers salary	soum/man-hour	353	9000	3177000
2	Labor costs of machinists per 100 m^3 of concrete	machine-hour	238.17		
	Total work time of machinists spent	machine-hour	293		
	Machinists salary	soum/ machine-hour	293	10350	3032550
	Machinery: Mobile compressors with internal combustion engine with pressure up to 686 kPa (7 atm.), 5 m^3/min; bulldozers, 59 (80) kW (hp); Cranes on the road course, 10 tons; Car onboard, with a loading capacity up to 5 t; Jackhammers pneumatic; Pneumatic rammers.				
3	Total fuel consumption	liter	8788		
	Cost of fuel	soum/litre	8788	5000	43940000
4	Materials of products and construct materials:				
4.1	Concrete	m^3	123	250000	30750000
4.2	Solution heavy mortar cement	m^3	1.1	250000	275000
4.3	Poroizol cord	m^3	354	6000	2124000
4.4	Building oil insulating bitumens, BNI-IV-3, BNI -IV, BNI -V	ton	0.16	2900000	464000
4.5	Mastic bituminous roofing hot	ton	0.12	3300000	396000
4.6	Edged boards, length 4-6,5 m, width 75-150 mm, thickness 25 mm	m^3	0.66	2700000	1782000
	Total cost	soum			**85940550**
	Overhead costs 20 %				17188110
	Depreciation of cars*, 15%	soum			7750000
	TOTAL COSTS	soum			103903660
	Cost of repairing 1 km	soum			**34634553**

** To perform works on the specified volume, the special vehicle will be occupied for 1 month. The amount of depreciation will be calculated for 1 month. The carrying value of special vehicles is 6,000,000,000 soum. The annual amount of depreciation = 620000000 * 0.15 = 93000000 soum, monthly = 93000000/12 = 7750000 soum.*

Table 10. Calculation of repair costs of concrete canals in the Guldarasoy Sokhili WCA.

Annually, 800 m of the LR-60 and 200 m of the LR-100 of flume network are repaired with up to 10% of the network elements replaced. Then, the scope of work will be 80 m for LR-60, 20 m for LR-100. The work includes: dismantling trays with cleaning the ends; manual rolling of foundation; piling; preparation of the bases for the foundation and its installation; waterproofing pillars and piles; rack mounting; installation of piles and trays with laying poroizol. The calculation of the repairment cost of LR-60 flume network is given in Table 11, of LR-100 in Table 12.

№	Cost items	Units	Q-ty	Cost per unit, soum	Total, soum
1	Cost of labor - builders per 100 m³ of concrete	man-hour	67,4		
	Total work time spent	man-hour	54		
	Workers salary	soum/man-hour	54	9000	486000
2	Labor costs of machinists per 100 m³ of concrete	machine-hour	38,3		
	Total work time of machinists spent	machine-hour	31		
	Machinists salary	soum/ machine-hour	31	10350	320850
	Machinery: Cranes on the road course, 10 tons; Tracked crawlers for piles up to 12 m in length, Onboard car, with a loading capacity up to 5 t				
3	Total fuel consumption	liter	930		
	Cost of fuel	soum/ litre	930	5000	4650000
4	Materials of products and construct materials:				
4.1	Flour trays	m	80	134000	10720000
4.2	Masts	piece	13	5625	73125
4.3	Foundation blocks	piece	13	75750	984750
4.4	Sealant	Kg	30	670	20100
	Total costs	soum			**17164825**
	Overhead costs 20 %				3432965
	TOTAL COSTS	**soum**			**20597790**

Table 11. Calculation of the cost of repairing the LR-60 concrete flume network in the "Guldarasoy Sokhili" WCA.

№	Cost items	Units	Q-ty	Cost per unit, soum	Total, soum
1	Cost of labor - builders per 100 m³ of concrete	man-hour	87,8		
	Total work time spent	man-hour	18		
	Workers salary	soum/ man-hour	18	9000	162000
2	Labor costs of machinists per 100 m³ of concrete	machine-hour	48,7		
	Total work time of machinists spent	machine-hour	10		
	Machinists salary	Soum/machine-hour	10	10350	103500
	Machinery: Cranes on the road course, 10 tons; Tracked crawlers for piles up to 12 m in length, Onboard car, with a loading capacity up to 5 t				
3	Total fuel consumption	Litter	300		
	Cost of fuel	Soum/liter	300	5000	1500000
4	Materials of products and construct materials:				
4.1	Flour trays	M	20	200000	4000000
4.2	Masts	Piece	3	5625	16875
4.3	Foundation blocks	Piece	3	185000	555000
4.4	Sealant	kg	12	670	8040
	Total costs	Soum			**6345415**
	Overhead costs 20 %				1269083
	TOTAL COSTS	**Soum**			**7614498**
	Total cost of repairing 1 km of the flume network				**28212288**

Table 12. Calculation of the overhaul costs of the LR-100 flume network in the "Guldarasoy Sokhili" WCA.

Calculation of the volume of work on the construction of water outlets is given in Table 13; the construction of gauging stations of the fixed bed type in Table 14 and the repair of the water outlets in Table 15.

№	Cost items		Units	Q-ty	Cost per unit, soum	Total, soum
1	Earthworks					
1.1	Excavation		m^3	10		
1.2	Filling		m^3	18		
1.3	Backfilling		m^3	6		
1.4	Leveling		m^2	31		
2	Monolithic concrete					
2.1	Monolithic prizm of the asbestos cement pipe, concrete class B12.5		m^3	0,24	250000	60000
3	Metal structures					
3.1	Installation of the shutter	DA 350	Kg	11,2	6000	67200
4.	Other works					
4.1	Asbestos-cement pipes BT 9	D = 350 m	m	3,95	70000	276500
4 2	Rammed crushed stone		m^3	0,4	50000	20000
5	Labor input		man-hour	19		
	Total					**423700**
6	Transportation costs, 5 % of total amount					21185
			Cost of one construction			**449885**
		Cost of construction of 10 water outlets				**4498850**

Table 13. Calculation of the volume of work on the construction of a VO-3.5 water outlet in the "Guldarasoy Sokhili" WCA.

№	Cost items		Units	Q-ty	Cost per unit, soum	Total, soum
	Earthworks					
1	Soil excavation		m^3	0,8	3800	
	Concrete works					
2	Lining a fixed channel					
	bottom		m^3	0,16	250000	40000
	slope 1		m^3	0,4	250000	100000
	slope 2		m^3	0,4	250000	100000
3	Installation of rods 0,5 m		piece	1	27000	27000
	Other work					
4	Tooth dumping with a stone		m^3	0,4	90000	36000
5	Labour-intensiveness		man-hour	23		
	Total					**303000**
Transportation costs, 5 % of the amount				15150		
			Cost of one gauging station			**318150**
		Cost of construction of 10 gauging stations				**3181500**

Table 14. Calculation of the scope of work on the construction of fixed-type gauging stations in the "Guldarasoy Sokhili" WCA.

№	Cost items	Units	Q-ty	Cost per unit, soum	Total, soum
1	Earthworks				
1.1	Excavation	m^3	2		
1.2	Leveling	m^2	8		
2	Monolithic concrete				
2.1	Concreting of walls, concrete class B12.5	m^3	0,24	250000	60000
3	Metal structures				
3.1	Installing the shutters	kg	14	6000	84000
4.	Labour-intensiveness	man-hour	12		
	Total				**144000**
Transportation costs, 5 % of the amount					7200
		Cost of one gauging station			**151200**
	Cost of construction of 5 water outlets				**756000**

Table 15. Calculation of the volume of work on repair of water outlets in the “Guldarasoy Sokhili” WCA.

A sample budget by the example of the WCA “Guldarasoy Sokhili” of the Yakkabag District, is provided in a separate Excel file.

In accordance with the standard budget in the irrigation conditions of the Aksu Basin, the minimum costs for normal operation and implementation of preventive maintenance of IDS is 79,216 soums per 1 ha.

2.4.2. WCA cost for O&M in the Shakhrikhansay Basin.

A sample budget is compiled on the example of the WCA named after T.Mirzaev of the Markhamat district, representative for both the Shakhrikhansay Basin and FIS by the main indicators of the irrigation system at the lower level - the size of the WCA, specific length and percentage with the anti-filtration concrete lining of the irrigation network, number of water outlet points for water consumers per 100 ha and percentage of outlets equipped with flow regulation structures, specific length of the collector-drainage system and percentage of subsurface drainage.

The WCA T.Mirzaev of Marhamat district serves 96 farms, 2 settlements (kishlak) and has an irrigated area of 3225 ha. The sources of irrigation water are the inter-farm canals Tuyamuyun 1, Tuyamuyun 2, Toshariq and Kumariq. Water intake from inter-farm canals is carried out by the farm canals Toshariq 2, Eshonmahalla 1, Eshonmahalla 2, Lombitepa and Yangi Uzbek. The total length of the irrigation network in the WCA is 65.5 km, of which 6.3 km is for common use. The length of the irrigation canals with concrete lining is 2.05 km and of the flumes 1 km. Of the 65.5 km of the irrigation network, 46.8 belong to the I-size, 9.7 km to the II-size and 39.5 km to the III dimension type. The collector-drainage water is discharged by the Garbiy and ZhFK collectors. The total length of the collector-drainage network is 30.3 km.

Out of 226 water outlet points, 176 or 77.7% are equipped with water-regulating structures, 15 or 6.6% with measuring structures. Out of 176 outlets, 90 are in need of repair.

It is recommended to include equipping 10% of the water outlet points with water regulating and measuring facilities and repairing 10% of the water outlet structures in the WCA budget each year.
It is recommended to include cleaning of 39.5 km of an irrigation network of the dimension type III and 33% or 10 km of a drainage network in the WCA budget each year. Also, it is advisable to clean the irrigation network of types I and II by hand with the khashar method.

The scope of work on the machinery cleaning of the irrigation network is:

$$39500 \text{ m X } 0.54 \text{ m}^3/\text{m} = 21330 \text{ m}^3$$

The scope of work on the machinery cleaning of the drainage network is:

$$10{,}000 \text{ X } 0.54 \text{ m}^3/\text{m} = 5400 \text{ m}^3$$

Calculation of the cost of soil processing during the mechanical cleaning of the IDS is conducted for the JY-210 excavator, the most common machine in the water management organizations of Uzbekistan (Table 16).

Cost items	Units	Q-ty	Cost per unit, soum	Total, soum
Volume of earthworks	m^3	26730		
Normative of time for soil processing per 100 m^3 of soil	man-hour	1,1		
Total work time spent	man-hour	294		
Salary of machinist	soum/hour	294	10350	3042900
Social insurance, 25 %	soum			
Insurance 7 %	soum			
Fuel consumption for the 100 m^3 of soil processing	liter	12,2		
Total fuel consumption	liter	3261		
Cost of fuel	soum/l	3261	5000	16305000
Total costs	soum			**19347900**
Overhead costs 20 %				3869580
Depreciation of an excavator*, 15%	soum			2022628
TOTAL COST	soum			**25240108**
Cost of 1 m^3 of soil processing	soum			944
Cost of mechanical cleaning of 1 km IDS	soum			

** To perform the specified scope of work, the excavator will be occupied for 1 month. The amount of depreciation is calculated for 1 month. The carrying value of the JY-210 excavator is 161810285 soum. The annual amount of depreciation = 161810285 * 0.15 = 24271542 soum, monthly = 24271542/12 = 2022628 soum.*

Table 16. Calculation of the cost of soil processing for mechanical cleaning of the IDS in the WCA named after T. Mirzaev.

The calculation of the volume of work on the construction of water outlets is given in Table 17, on the construction of fixed bed-like gauging stations in Table 18 and on the repairment of water outlets in Table 19.

№	Cost items		Units	Q-ty	Cost per unit, soum	Total, soum
1	Earthworks					
1.1	Excavation		m^3	10		
1.2	Filling		m^3	18		
1.3	Backfilling		m^3	6		
1.4	Leveling		m^2	31		
2	Monolithic concrete					
2.1	Monolithic prizm of the asbestos cement pipe, concrete class B12.5		m^3	0,24	250000	60000
3	Metal structures					
3.1	Installation of the shutter	DA 350	кг	11,2	6000	67200
4.	Other works					
4.1	Asbestos-cement pipes BT 9	D = 350 m	пм	3,95	70000	276500
4 2	Rammed crushed stone		m^3	0,4	50000	20000
5	Labor input		чел/ч	19		
	Total					**423700**
6	Transportation costs, 5 % of total amount					21185
			Cost of one construction			**449885**
		Cost of construction of 5 water outlets				**2249425**

Table 17. Calculation of the volume of work on the construction of a VO-3.5 water outlet in the WCA named after T. Mirzaev.

№	Cost items		Units	Q-ty	Cost per unit, soum	Total, soum
	Earthworks					
1	Excavation		m^3		3800	
	Concrete works					
2	Lining fixed bed of channel					
	Bottom		m^3	0,16	250000	40000
	slope 1		m^3	0,4	250000	100000
	slope 2		m^3	0,4	250000	100000
3	Installation of rods 0,5 m		pieces	1	27000	27000
	Other work					
4	Tooth dumping with a stone		m^3	0,4	90000	36000
5	Labour-intensiveness		man/hour	23		
	Total					**303000**
Transportation costs, 5 % of the amount				15150		
			The cost of one gauging station			**318150**
		Cost of construction of 21 gauging stations				**6681150**

Table 18. Calculation of the volume of work on the construction of fixed-type gauging stations in the WCA named after T. Mirzaev.

№	Cost items	Units	Q-ty	Cost per unit, soum	Total, soum
1	Earthworks				
1.1	Excavation	m^3	2		
1.2	Leveling	m^2	8		
2	Monolithic concrete				
2.1	Concrete casting of walls, concrete class B12.5	m^3	0,24	250000	60000
3	Metal structures				
3.1	Installation of the shutter	kg	14	6000	84000
4.	Labor intensiveness	man/hour	12		
	Total				**144000**
Transportation costs, 5 % of the amount					7200
		Cost of one construction			**151200**
	Cost of construction of 9 water outlets				**1360800**

Table 19. Calculation of the volume of work on repairment of water outlets in the WCA named after T. Mirzaev.

A sample budget by the example of the WCA named after T. Mirzaev of the Marhamat district, is provided in a separate Excel file.

In accordance with the standard budget, the minimum cost for normal operation and preventive maintenance of IDS in the irrigation conditions of the Aksu Basin is 51,840 soums per ha.

ESTIMATION OF THE CAPACITY OF FARMS TO COVER O&M COSTS

To assess the potential of water consumers to cover the costs of O&M, we estimated incomes and farms expenses for agricultural activities in the areas located in the pilot basins for 2017. The costs for the production of raw cotton and grain crops are taken on average according to the calculations of the Fund for payments for agricultural products purchased for state needs under the Ministry of Finance (Tables 22, 23) and to the calculations for flow charts (approved by the decision of the Board of the MAWR No. 7/2 of October 29 2010) at current prices for MTR and services for 2017. Revenues from the sales of raw cotton and grain crops are taken at purchase prices established by the decisions of the Cabinet of Ministers of the Republic of Uzbekistan.

Costs for the production of other crops are taken according to the calculations of technological charts at current prices for MTR and equipment and services for 2017. We calculated revenues from the sale of other crops at the average annual prices for agricultural products that have been established on the dekhkan markets in the provinces located in the pilot basins for 2017

3.1. Potential of the farm enterprises to cover O&M costs in the Aksu Basin.

We estimated costs according to the recommendations of the “Fund….”, in terms of 1 ha of wheat and cotton, taking into account their actual yield in the project areas (Table 20 and 21).

Districts	Production costs per hectare, UZS	Yield, t/ha	Costs per hectare, UZS
Sharisabz	1218399	2.8	3411517
Yakkabog	1218399	3.0	3655197
Total			3533357

Table 20. Costs for the production of cotton per ha in the Aksu Basin.

Districts	Production costs per hectare, UZS	Yield, t/ha	Costs per hectare, UZS
Kitob	503498	8.3	4161627
Sharisabz	503498	6.7	3356159
Yakkabog	503498	7.4	3700940
Total			3739575

Table 21. Costs for 1 ton of wheat production in the Aksu Basin.

№	Cost items	2015			2016			2017		
		Credit for 1 ton of wheat*		In terms of 100% of costs for production of 1 ton, soum	Credit for 1 ton of wheat*		In terms of 100% of costs for production of 1 ton, soum	Credit for 1 ton of wheat*		In terms of 100% of costs for production of 1 ton, soum
		soum	%		soum	%		soum	%	
1	Remuneration of labor	11035	4.4	18392	13797	5.0	22995	15,135	5.0	25225
2	Mineral fertilizers	87780	35.0	146300	91078	33.0	151797	96,701	32.0	161168
3	Chemical and biological plant protection products	7524	3.0	12540	8270	3.0	13783	15,093	5.0	25155
4	Agro-chemical services	752	0.3	1253	1143	0.4	1905	1,251	0.4	2085
5	FL	55678	22.2	92797	69034	25.0	115057	74,069	24.5	123448
6	Shifts	40630	16.2	67717	42778	15.5	71297	45,345	15.0	75575
7	Agricultural machinery services and leasing payment	32102	12.8	53503	35874	13.0	59790	39,140	13.0	65233
8	WCA services	2257	0.9	3762	2415	0.9	4025	2,645	0.9	4408
9	Payments for electricity	2508	1.0	4180	2685	1.0	4475	2,947	1.0	4912
10	Land tax	3511	1.4	5852	3350	1.2	5583	3,670	1.2	6117
11	Deduction to the district and province Agricultural and water management	1003	0.4	1672	1102	0.4	1837	1,207	0.4	2012
12	Deduction to the Farmers Council	1254	0.5	2090	1378	0.5	2297	1,509	0.5	2515
13	Other expenses	4765	1.9	7942	3097	1.1	5162	3,387	1.1	5645
	Total	250799	**100.0**	**417998**	**276001**	**100.0**	**460002**	**302,099**	**100**	**503498**

Table 22. Costs for production of 1 ha of wheat (according to calculations of the Amelioration Fund for payments for agricultural products purchased for the state needs under the Ministry of Finance)

№	Cost items	2015		2016		2017	
		soum	%	soum	%	soum	%
1.	Remuneration of labor	118,638	11.3	125,755	11.3	136459	11,2
2.	Mineral fertilizers	356,966	34	378,387	34.0	414257	34,0
3.	Chemical and biological plant protection products	25,198	2.4	30,052	2.7	32901	2,7
	including: a) by chemical method	17,849		18,031		19741	
	b) by biological method	17849		12021		13160	
4.	Agro-chemical services	4,200	0.4	4,448	0.4	4870	0,4
5.	Shifts	64,044	6.1	67,887	6.1	74322	6,1
	including released shift	22,415		*33,943*		37161	
6.	Agricultural machinery services (MTP, ATPP and organizations having equipment)	66,144	6.3	70,113	6.3	73103	6,0
7.	Payment of leasing	62,994	6	66,773	6.0	73103	6,0
8.	WCA services	19,948	1.9	21,147	1.9	23151	1,9
9.	FL	237,277	22.6	251,513	22.6	275356	22,6
10.	Cost of plastic film	6,299	0.6	3,338	0.3	3654	0,3
11.	Payments for electricity	26,247	2.5	27,822	2.5	30459	2,5
12.	Land tax	20,998	2	22,258	2.0	24368	2,0
13.	Deduction to the district and province Agricultural and water management	4,200	0.4	4,455	0.4	4877	0,4
14.	Deduction to the Farmers Council	5,250	0.5	5,573	0.5	6102	0,5
15.	Insurance payments and other expenses	31,497	3	33,378	3.0	36543	3,0
16	Services of Monitoring Center, LLC					4874	0,4
	Total	**1,049,900**	**100**	**1,112,899**	**100**	**1,218,399**	**100**

Table 23. Costs for production of 1 ton of raw cotton (according to calculations of the Amelioration Fund for payments for agricultural products purchased for the state needs under the Ministry of Finance)

We estimated production costs of wheat, raw cotton and other crops based on flow charts at prices for MTR and equipment and services for 2017. The average cost of agricultural production is shown in Table 24.

Name	Unit, soum/ha	Note
Raw cotton	3533357	According to the calculations of the Fund for agricultural products
	5066697	Calculations of the technical schemes for 1-zone
Average	**4300027**	
Grain cereal crops	3739575	According to the calculations of the Fund for agricultural products
	2699896	Calculations of the technical schemes on open field
	2281865	Calculations of the technical schemes by inter-row of cotton
Average	**2907112**	
Corn for grain	3227369	Calculations of the technical schemes
Onion	7558562	Calculations of the technical schemes
Carrot	7824077	Calculations of the technical schemes
Tomato	15568491	Calculations of the technical schemes
Cucumber	10804922	Calculations of the technical schemes
Vegetables, average	**10439013**	
Potatoes	17241735	Calculations of the technical schemes
Watermelons	7715359	Calculations of the technical schemes
Large seed fruits	7927338	Calculations of the technical schemes
Drupaceous fruits	7005564	Calculations of the technical schemes
Pomegranate	10063661	Calculations of the technical schemes
Fruits, on average	**8332188**	
Fruit-bearing	15379757	Calculations of the technical schemes
Nonfruit-bearing	5775089	Calculations of the technical schemes
Grapes, on average	**10577423**	

Table 24. Average cost of agricultural production in the Aksu Basin, UZS/ha in 2017 prices.

We calculated the costs, incomes and profits for each crop from the average cost of agricultural production. Under the actual cropping pattern in the Aksu Basin, the weighted average cost per complex hectare is 6807801 soum/ha, revenues 32562123 soum/ha and profit 25754322 soum/ha (Table 25).

№	Name of agricultural crops	Cropping area, ha	Proportion, %	Cost, soum/ha	Yield, t/ha	Price, soum/t	Income, soum/ha	Gain, soum/ha
1	Cotton	11813	19.61	4300027	2.9	1603700	4650730	350703
2	Grain cereal crops	16940	28.12	2907112	7.3	550000	4015000	1107888
3	Vegetables	4803	7.97	10439013	39.5	2920000	115340000	104900987
4	Potatoes	3894	6.46	17241735	30.1	3057000	92015700	74773965
5	Watermelons	824	1.37	7715359	31.4	1527000	47947800	40232441
6	Fruits	9042	15.01	8332188	7.3	4251200	31033760	22701572
7	Grapes	6128	10.17	10577423	10.7	5870000	62809000	52231577
	Total	53444		6807801			32562123	25754322
8	Fodder*	6797	11.28					
	In the basin	**60241**	**100.00**					
Minimum WCA costs for O&M		soum/ha		79216			79216	79216
		%		1.16			0.24	0.31

*Benefits from fodder crops are reflected in livestock production.

Table 25. Costs and incomes for agricultural production in the Aksu Basin, in prices of 2017.

In accordance with the calculations provided in the paragraph 2.4.1, the minimum expenses of the WCA for normal operation and carrying out preventive maintenance of IDS in the irrigation conditions of the Aksu Basin are 79,216 soums per ha or 1.16% of the total costs of farmers per complex ha, 0.24% of income and 0.31 % of profit.

With the existing soil productivity in the Aksu Basin, crop yields, farmers' expenditures and incomes, the farmers are able to fully cover the O&M costs of the irrigation system at the lower level.

On average in the recent years, the water intake at the WCA border in the Amu-Kashkadarya irrigation system was 9,600 m^3/ha. To cover the O&M costs at the top level of the irrigation system, water users will incur additional costs of 9600 X 152 = 1459200 UZS/ha or lose 1459200 UZS/ha under the net cost of water delivery to the WCA border of 152 UZS/m^3.

In recent years, the water intake at the WCA border on average in the Aksu basin was 6,700 m^3/ha. To cover the O&M cost at the upper level of the irrigation system, water users will incur additional costs of 6700 X 42.21 = 282,807 UZS/ha or lose 28,2807 UZS/ha under the net cost of water delivery to the WCA border of 42.21 UZS/m^3 (Table 26).

Under the existing conditions of state order and fixed purchase prices for agricultural products, planning the area under crops and regulating the prices of production factors by the state, the additional costs of paying for the water delivery can lead to farmers dissatisfaction. To cover O&M costs at the top level of the irrigation system, farmers need to be motivated and able to pay.

Let us consider possible ways to increase the income and solvency of farmers.

In the face of declining world prices for cotton and wheat (http://www.cotton.org/, http://www.indexmundi.com/), there is no real significant increase in the purchase prices for these products.

One of the ways to increase the solvency of water consumers is the abolition of the mechanism for financing cotton and grain production costs, purchased for the state's needs through preferential loans and concluding direct contracts with procurement organizations with an advance payment of at least 60% of the cost of agricultural products, including the cotton and grain purchased for the state needs. This will enable farmers to use cash efficiently; for example, it is cheaper to purchase mineral fertilizers through a commodity exchange, conclude payments to organizations providing actual and quality services.

For example, establishment of a limited liability company "Baht-Textile" in the Navoi province with the organization of a modern cluster for the cultivation of raw cotton and the production of other types of agricultural products, deep processing and setting up competitive products by attracting existing organizations and foreign direct investment, loans and direct investments of commercial banks for one season provided very good results.

In 2017, 8,713 ha of cotton were sown in the Kyzyltepa district of the Navoi province. 305 farmers of the Kyzyltepa district concluded direct contracts with Baht-Textile LLC. "Baht-Textile" LLC transferred an advanced payment to the account of farmers in the amount of 60% of the final product value. Farmers also got 15% of the redundancy payments relative to government procurement prices. In addition, the farmers received 10% more payment for provision of excessive cotton yields stipulated in the contract. The final calculations for the raw cotton production are made before the beginning of 2018.

№	Name of agricultural crops	Cropping area, ha	Proportion, %	Cost, soum/ha	Yield, t/ha	Price, soum/t	Income, soum/ha	Gain, soum/ha
1	Cotton	11813	19.61	4300027	282807	4582834	2.9	1603700
2	Grain cereal crops	16940	28.12	2907112	282807	3189919	7.3	550000
3	Vegetables	4803	7.97	10439013	282807	10721820	39.5	2920000
4	Potatoes	3894	6.46	17241735	282807	17524542	30.1	3057000
5	Watermelons	824	1.37	7715358.5	282807	7998166	31.4	1527000
6	Fruits	9042	15.01	8332187.8	282807	8614995	7.3	4251200
7	Grapes	6128	10.17	10577423	282807	10860230	10.7	5870000
	Total					7090608		
8	Fodder*	6797	11.28					
	In the basin	**60241**	**100.00**					
Minimum WCA costs for O&M		soum/ha		79216				
		%		1.12				

Table 26. Costs and incomes for agricultural production in the Aksu Basin, taking into account payments for water delivery services, in prices of 2017.

As a result, in general the plan for the production of raw cotton in the district was overfulfilled by 107%. The average yield in the district was 3.03 t/ha. Farmers with cotton yields of 2.5 t/ha completed the year with a profit.

As a result of the creation of new capacities and the organization of cluster activities in 2019, 78% of the harvested cotton fiber will be processed inside the country, which is twice as much as in 2017. By 2020, the transition to the complete processing of cotton fiber will be completed. The press service of the president informed that the share of final products will be increased from 40% to at least 60% (http://www.press-service.uz). In 2018, cluster harvesting of cotton was established in 20 districts on an area of 164 thousand ha. In order to further expand this system, 44 initiatives out of several received proposals were selected with the necessary production capacity and financial capabilities. In 2019, it is planned to harvest cotton in 61 clusters, covering 51% of all cotton fields.

The real mechanism for increasing the income and solvency of water consumers is to establish a plan for cotton and grain procured for the needs of the state in terms of volume without rigid planning of the cropping area (as stipulated in the contracting agreement between the farmer and Baht-Textile LLC) and to enable farmers optimize cropping areas based on soil and climatic conditions, demand and prices for agricultural products and sowing of profitable crops. When optimizing crops, it is also advisable to take into account the food security of the population (Figure 17).

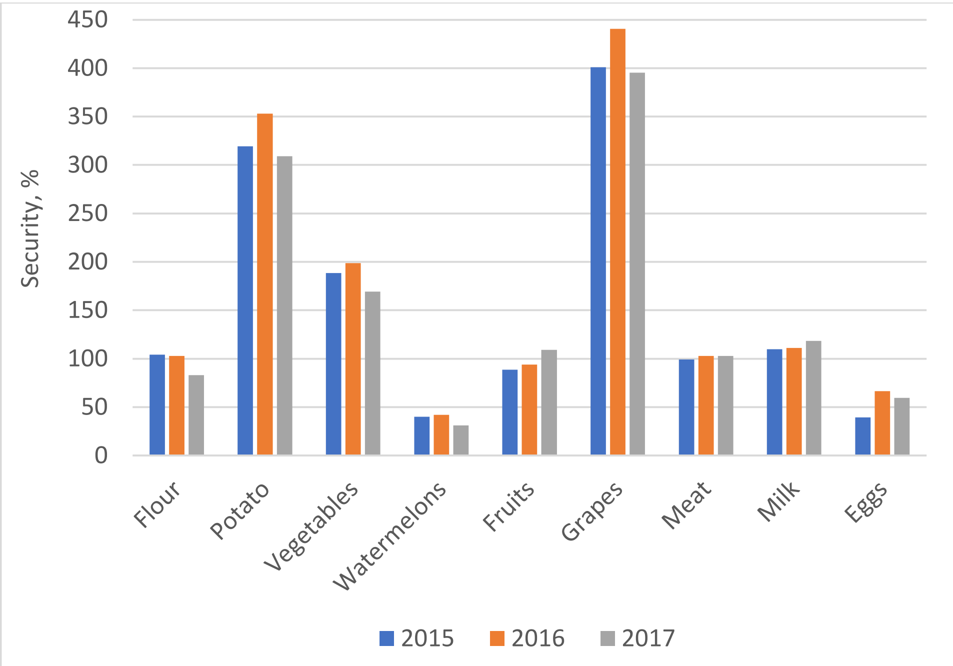

Figure 17. Food security in the Aksu Basin.

Figure 17 shows that the population in the Aksu Basin produces excessive amounts of all products except melons and eggs. The most profitable products in the basin are vegetables, which provide profit of 104618180 UZS/ha (Table 26). The provision of vegetables in the Aksu Basin with vegetables amounts to 169% and a further increase in their production will lead to a decrease of their prices. In addition, vegetables consume water 2.5 times more than melons, orchards and vineyards. The provision of meat and milk is also above than the required norm and does not need the expansion of forage crops. The provision of melons is 31% only and hence, it is advisable to reduce the areas under cotton in order to increase the area under melons and gourds. To compensate for the additional costs associated with the payment for water delivery services, and for obtaining additional profits, farmers need to increase the areas under melons at the expense of reduced areas under cotton (Figure 18).

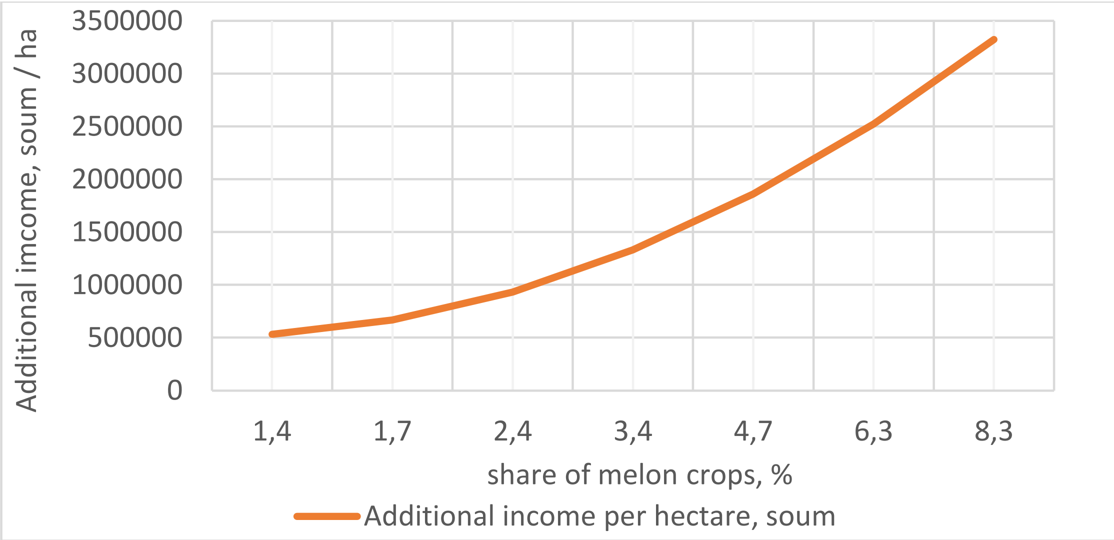

Figure 18. The dependence of income per 1 complex hectare on the share of melon crops.

Figure shows that the expansion of melons and gourds to 4% allows farmers to receive additional income of 160 thousand UZS/ha, which is more than the additional costs associated with paying for the water supply.

In conditions of paid water use, the tariffs for water delivery can be set on the basis of the full economic value of the water (see Section 4). At the current level of crop productivity and prices for agricultural products, it will be difficult for farmers to pay for water delivery services at rates set based on the full economic water value. Therefore, we consider the possibility of increasing crop yields in future. The results of calculations showed that the potential yield of cotton in the Aksu Basin is 5.1 t/ha, winter wheat 10.2 t/ha, potatoes 53.8 t/ha. It is possible to increase cotton yields by 75%, winter wheat by 39% and potatoes by 78%. Taking into account the potential yield, we estimated the costs and revenues for the agricultural production in the Aksu Basin, taking into account payment for water delivery services. If potential yield is achieved, the profit from 1 complex hectare will reach 45403942 soum, and there will be 19649620 soum of revenue more with the existing yield, thus creating an opportunity to pay for water delivery services at the tariffs set on the basis of the full economic value of water (Table 27).

№	Name of agricultural crops	Cropping area, ha	Proportion, %	Cost, soum/ha	Yield, t/ha	Price, soum/t	Income, soum/ha	Gain, soum/ha
1	Cotton	11813	19.61	4300027	282807	4582834	5.1	1603700
2	Grain cereal crops	16940	28.12	2907112	282807	3189919	10.1	550000
3	Vegetables	4803	7.97	10439013	282807	10721820	70.31	2920000
4	Potatoes	3894	6.46	17241735	282807	17524542	53.578	3057000
5	Watermelons	824	1.37	7715358.5	282807	7998166	47.1	1527000
6	Fruits	9042	15.01	8332187.8	282807	8614995	10.22	4251200
7	Grapes	6128	10.17	10577423	282807	10860230	14.98	5870000
	Total	53444				7090608		
8	Fodder*	6797	11.28					
	In the basin	**60241**	**100.00**					
Minimum WCA costs for O&M		soum/ha		79216				
		%		1.12				

Table 27. Costs and incomes for the agricultural production in the Aksu Basin, taking into account payment for services for the delivery of water while achieving the potential yield of agricultural crops.

3.2. Potential of farms to cover O&M costs in the Shakhrikhansay Basin

Calculation of wheat and cotton production costs per hectare while taking into account the yield is given in Tables 28 and 29.

Districts	Production costs per ton, soum	Yield, t/ha	Costs in terms of 1 ha, soum
Asaka	503498	7.8	3937545
Bulokboshi	503498	7.5	3766298
Djallakuduk	503498	7.9	3970890
Marhamat	503498	6.8	3414939
Huzaobad	503498	6.6	3299248
Shakhrikhan	503498	8.3	4188761
Kurganepa	503498	6.2	3130689
Kuva	503498	5.8	2896634
Oltiarik	503498	5.5	2756891
Koshtepa	503498	5.5	2755034
Tashlak	503498	6.1	3066753
Fergana	503498	6.5	3297779
Total	503498	6.1	3076392
Bulokboshi			**3350604**

Table 28. Costs of wheat production per hectare in the Shakhrikhansay Basin.

Districts	Production costs per ton, soum	Yield, t/ha	Costs in terms of 1 ha, soum
Bulokboshi	1218399	3.1	3790113
Djallakuduk	1218399	2.5	3066926
Marhamat	1218399	3.0	3632841
Huzaobad	1218399	2.6	3133186
Shakhrikhan	1218399	2.9	3538264
Kurganepa	1218399	2.6	3150684
Kuva	1218399	2.6	3114148
Oltiarik	1218399	2.5	3082376
Koshtepa	1218399	1.6	1971018
Tashlak	1218399	2.4	2953682
Fergana	1218399	1.9	2326985
Total			**3069111**

Table 29. Costs of cotton production per hectare in the Shakhrikhansay Basin.

We estimated production costs of wheat, raw cotton and other crops by flow charts at prices for MTR and services for 2017. The average cost of agricultural production is shown in Table 30.

Name	Soum/ha	Note
Raw cotton	3069111	According to the calculations of the Fund for agricultural products
	4884889	Calculations of the technical schemes for 1-zone
	5102619	Calculations of the technical schemes for 2-zone
	5103722	Calculations of the technical schemes of sowing under plastic film for 1-zone
	5140311	Calculations of the technical schemes of sowing under plastic film for 2-zone
Average	**4660130**	
Grain cereal crops	3350604	According to the calculations of the Fund for agricultural products
	2556653	Calculations of the technical schemes on open field
	2222622	Calculations of the technical schemes by inter-row of cotton
Average	**2709960**	
Corn for grain	3098728	Calculations of the technical schemes
Onion	7513921	Calculations of the technical schemes
Carrot	7779435	Calculations of the technical schemes
Tomato	14893850	Calculations of the technical schemes
Cucumber	10130280	Calculations of the technical schemes
Vegetables, average	**10079371**	
Potatoes	16777093	Calculations of the technical schemes
Watermelons	7040717	Calculations of the technical schemes
Large seed fruits	7931007	Calculations of the technical schemes
Drupaceous fruits	7009233	Calculations of the technical schemes
Pomegranate	10067329	Calculations of the technical schemes
Fruits, on average	**8335857**	
Fruit-bearing	15450626	Calculations of the technical schemes
Nonfruit-bearing	5845958	Calculations of the technical schemes
Grapes, on average	**10648292**	

Table 30. Average cost of agricultural production in the Shakhrikhansay Basin, soum/ha in 2017 prices.

We then calculated the expenditures, incomes and profits for each crop by average cost of agricultural production. The average-weighted cost per complex hectare with the actual cropping pattern in the Shakhrikhansay Basin is 5462579 UZS/ha, revenues 39904781 UZS/ha and profit 34442202 UZS/ha (Table 31).

№	Name of agricultural crops	Cropping area, ha	Proportion, %	Cost, soum/ha	Yield, t/ha	Price, soum/t	Income, soum/ha	Gain, soum/ha
1	Cotton	68711	28.72	4660130	2.5	1603700	4009250	-650880
2	Grain cereal crops	90655	37.90	2709960	6.6	550000	3630000	920040
3	Vegetables	18256	7.63	10079371	61.9	3292360	203797079	193717708
4	Potatoes	7444	3.11	16777093	36.5	3560799	129969161	113192067
5	Watermelons	1930	0.81	7040717	32.1	1687429	54166456	47125739
6	Fruits	36181	15.12	8335857	16.6	4221551	70077739	61741883
7	Grapes	5624	2.35	10648292	27.9	7633238	212967337	202319045
	Total	228801		5462579			39904781	34442202
8	Fodder*	10416	4.35					
	In the basin	**239217**	**100.00**					
Minimum WCA costs for O&M		soum/ha		***51840***			***51840***	***51840***
		%		0.95			0.13	0.15

*Benefits from fodder crops are estimated by livestock products (meat, milk, eggs).

Table 31. Costs and revenues for agricultural production in the Shakhrikhansay Basin, for 2017.

In accordance with the calculations in Section 2.4.2, the costs of WCA for preserving normal O&M of IDS in the irrigation and economic conditions of the Shakhrikhansay basin is 51,840 UZS/ha or 0.95% of the total costs of farmers per 1 complex hectare, 0.13% of income and 0.15% of profits.

With the existing land productivity, crop yields, expenditures and farm incomes in the Shakhrikhansay basin, the farmers are able to fully cover the O&M costs of the irrigation system at the lower level.

In recent years on average, water withdrawal at the WCA border in the FIS was 8,300 m^3/ha. To cover the O&M cost at the upper level of the irrigation system under the water delivery costs to the WCA border of 57.65 UZS/m^3, water users will incur additional costs of 8300 X 57.65 = 478495 UZS/ha or lose 478495 UZS/ha.

In recent years, the average water withdrawal at the WCA border in the Shakhrikhansay Basin was 12,500 m^3/ha. To cover the cost of O&M at the top level of the irrigation system at a cost of water delivery to the WCA border of 31.30 UZS/m^3, water users will incur an additional cost of 12500 X 31.3 = 391250 UZS/ha or lose 391250 UZS/ha (Table 32).

Let us consider possible ways to increase the income and solvency of farmers.

Optimization of cropping pattern. When optimizing cropping pattern, it is also advisable to take into account the food security of the population (Figure 19).

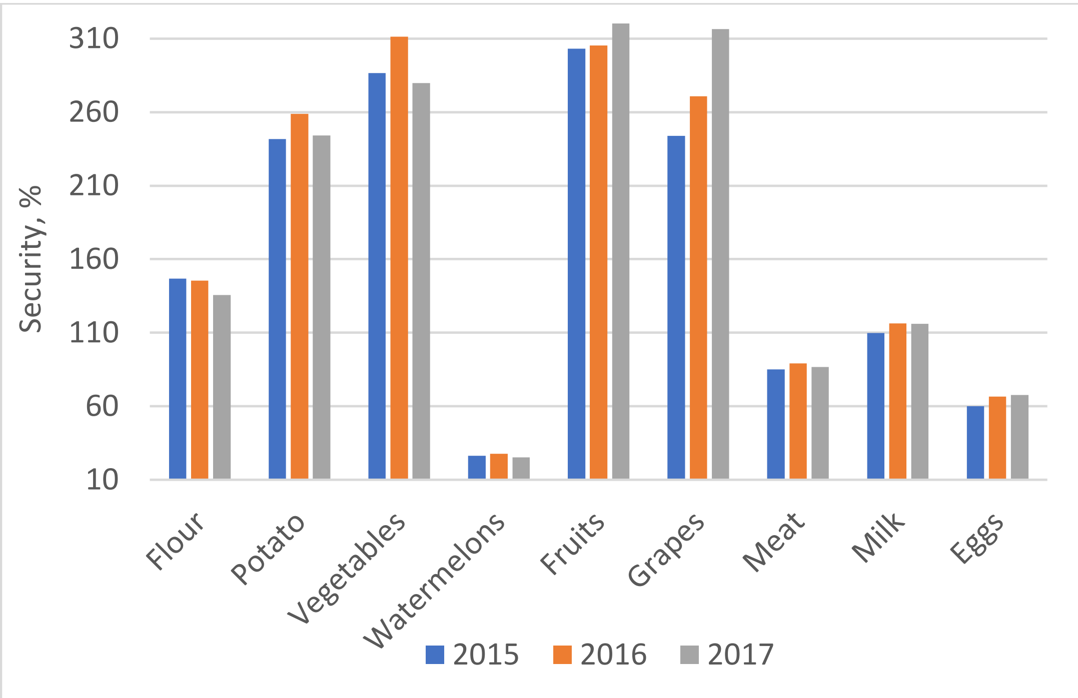

Figure 19. Food security for population residing in the Shakhrikhansay Basin.

№	Name of agricultural crops	Cropping area, ha	Proportion, %	Cost, soum/ha	Yield, t/ha	Price, soum/t	Income, soum/ha	Gain, soum/ha	Name of agricultural crops	Cropping area, ha
1	Cotton	68711	28.72	4660130	391250	5051380	2.5	1603700	4009250	-1042130
2	Grain cereal crops	90655	37.90	2709960	391250	3101210	6.6	550000	3630000	528790
3	Vegetables	18256	7.63	10079371	391250	10470621	61.9	3292359	203797079	193326458
4	Potatoes	7444	3.11	16777093	391250	17168343	36.5	3560798	129969161	112800817
5	Watermelons	1930	0.81	7040717	391250	7431967	32.1	1687428	54166456	46734489
6	Fruits	36181	15.12	8335857	391250	8727107	16.6	4221550	70077739	61350633
7	Grapes	5624	2.35	10648292	391250	11039542	27.9	7633237	212967337	201927795
	Total	228800		5871279		5853829			39904781	34050952
8	Fodder*	10416	4.35							
	In the basin	**239217**	**100.00**							
Minimum WCA costs for O&M		soum/ha		***51840***					***51840***	***51840***
		%		0.60					0.05	0.06

Table 32. Costs and incomes for agricultural production in the Shakhrihansay Basin, taking into account payment for water delivery services.

Figure 19 shows that the production of potatoes, vegetables, fruits and grapes for the population in the Shakhrihansay Basin is 2-3 times more than required. Since this production is profitable (Table 32), production surplus is exported outside the district. Cotton is unprofitable.

The provision of meat is 87%, melon 25% of the requirements and so, to compensate for the additional costs associated with the payment for water delivery services and for obtaining additional profits, areas under cotton have to be reduced while of forage and melon crops increased (Figure 20).

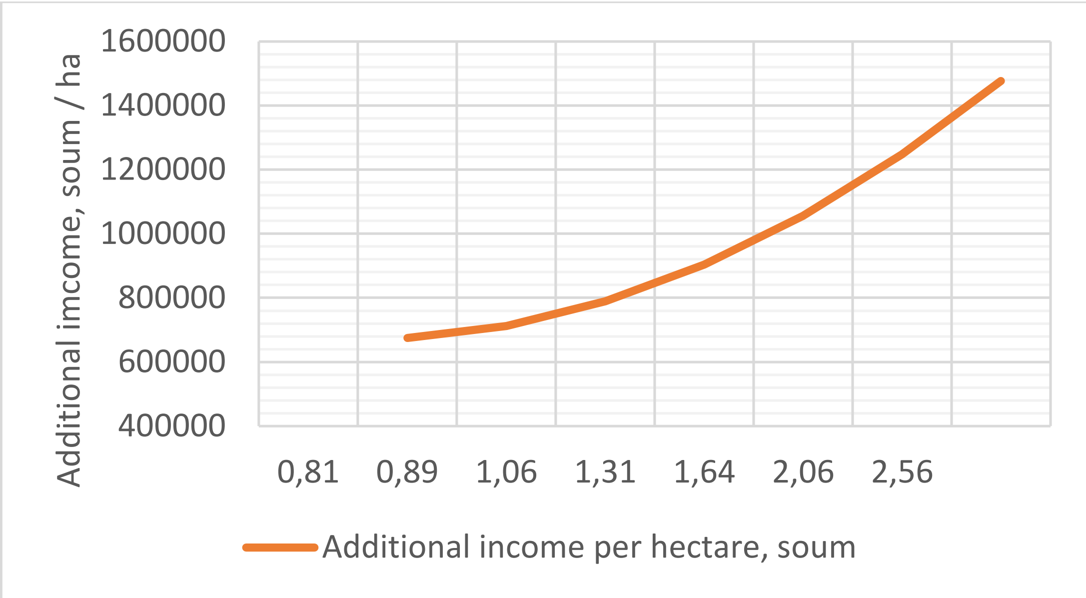

Figure 20. The dependence of income per 1 complex hectare on the share of melon crops.

As can be seen from the graph, it is sufficient to expand the areas under melons from 0.81 to 1.06% in order to cover the additional costs associated with the payment for water delivery services. With an increase in areas under melons up to 1.06% due to a reduction of cotton areas, the additional profit is estimated to be 680000 UZS/ha, which is 288750 soums more than the costs associated with water supply payments.

Let us consider the possibility of increasing crop yields and the farmers solvency for the future, when the tariffs for water delivery services will be set on the basis of the full economic value of water.

The calculation results showed that the potential yield of cotton is 4.3 t/ha, winter wheat 8.5 t/ha, potatoes 48.6 t/ha. Cotton yields can be increased by 72%, winter wheat by 29% and potatoes by 33%. Taking into account the potential yield, we estimated the costs and revenues for the agricultural production in the Shakhrikhansay Basin, taking into account payment for water delivery services. If potential yield is achieved, the profit from 1 complex hectare will reach 45451029 soum, with additional 11008827 soum from the received yield. This hence will create opportunity to pay for the water delivery at the tariffs set on the basis of the full economic value of water (Table 33).

№	Name of agricultural crops	Cropping area, ha	Proportion, %	Cost, soum/ha	Yield, t/ha	Price, soum/t	Income, soum/ha	Gain, soum/ha	Name of agricultural crops	Cropping area, ha
1	Cotton	68711	28.72	4660130	391250	5051380	4.3	1603700	6895910	1844530
2	Grain cereal crops	90655	37.90	2709960	391250	3101210	8.5	550000	4682700	1581490
3	Vegetables	18256	7.63	10079371	391250	10470621	82.3	3292359.917	271050115	260579494
4	Potatoes	7444	3.11	16777093	391250	17168343	48.5	3560798.919	172858984	155690640
5	Watermelons	1930	0.81	7040717	391250	7431967	38.5	1687428.535	64999747	57567780
6	Fruits	36181	15.12	8335857	391250	8727107	19.92	4221550.565	84093287	75366181
7	Grapes	5624	2.35	10648292	391250	11039542	33.48	7633237.873	255560804	244521262
	Total	228800				5853829			51304859	45451029
8	Fodder*	10416	4.35							
	In the basin	**239217**	**100.00**							
Minimum WCA costs for O&M		soum/ha		***51840***					***51840***	***51840***
		%		0.88					0.10	0.12

Table 33. Costs and incomes for the agricultural production in the Shakhrihansay Basin, taking into account payment for water delivery services while achieving potential yield.

ASSESSMENT OF THE COST AND VALUE OF WATER

The International Conference on Water Resources and the Environment, held in January 1992 in Dublin, the capital of Ireland, recognized that water has an economic value for all competing uses and should be recognized as an economic as well as a social good.

It should be noted that, unlike the Dublin Principles, Directive 2000/60/EC of the European Parliament and the Council of the European Union dated October 23, 2000, which establishes the basis for community action in water policy, recognizes that Water is not a commercial product like others, but rather a legacy requiring protection and appropriate treatment. For many professionals who do not have an economic education, the meaning of some of the formulated Dublin principles remains unclear. It is not clear what is meant by the statement that water is an "economic commodity" or "economic and social commodity".

The article by Peter Rogers, Ramesh Bhatia and Annette Huber, entitled: "Water as a social and economic commodity: How to apply this principle in practice" explains the essence of economic mechanisms that can be used to effectively use water both in terms of environmental protection and social and economic points of view. The general principles and methodology for assessing the cost and value of the water sector are described.

Using the methodological approaches of Peter Rojaras, Ramesh Bhatia and Annette Khabar as guidance, we estimated the value and cost of water in the pilot basins.

4.1. Estimation of the cost and value of water in the Aksu Basin

As in paragraph 2.2, first we estimated the economic cost and value of water in general in the Amu-Kashkadarya irrigation system, followed by the Aksu subsystem.

1. Determination of the total cost of water supply.

The total cost of water supply is formed by two components: transaction costs and operating costs (OC) and depreciation on fixed assets (FA). Transaction and operating costs for the Amu-Kashkadarya irrigation system are 613571112.80 thousand soums (Table 1). As mentioned above, financing of water management in Uzbekistan is carried out at the expense of the state budget, and depreciation charges are not accrued on fixed assets, depreciation is assessed annually.

We estimated depreciation: its amount is 22,867,602.58 thousand soums.

The total cost of water supply to the Amu-Kashkadarya irrigation system is defined as the sum of the O&M costs plus depreciation.

WMO costs for O&M, thousand soums	613,571,112.80
Amortization of fixed assets, thousand soums	22,867,602.58
Total costs, including depreciation, thousand soums	636,438,715.38
Total WCA cost of water supply, UZS/m^3	158.00

2. Determination of the full economic value of water.

The full economic value of water for irrigation purposes consists of the following components: the total cost of water supply and capital costs.

$$158 + 11 = 169 \text{ UZS/m}^3$$

where: 11 UZS/m^3 are capital investment in irrigation according to the Land Amelioration Fund and "Suvqurilishinvest" SUE

3. Determination of the net value of products in irrigated agriculture.

If water markets would function, the value of water in irrigated agriculture could be calculated based on the prices paid by farmers in the market. In the absence of such water markets, the value of water in irrigated agriculture can be obtained as the net value of products attributed to the use of water that is supplied for irrigation of crops. In this case it is determined from the value of water in agriculture:

$$\boldsymbol{WValue_{Agr}} = \frac{\boldsymbol{NCP_{irrig} - NCP_{without\ irrig}}}{\boldsymbol{WVolume_{irrig}}} = \frac{\mathbf{399 - 0}}{\mathbf{11000}} = 37 \text{ UZS/m3}$$

Where:

$\boldsymbol{WValue_{Agr}}$ - Value of water in agriculture

$\boldsymbol{NCP_{irrig}}$ - Net cost of products with irrigation, thousand UZS/ha/year

$\boldsymbol{NCP_{without\ irrig}}$ - Net cost of products without irrigation, thousand UZS/ha/year

$\boldsymbol{WVolume_{irrig}}$- Volume of water directed for irrigation, m^3/ha/year

Table 34 provides data for determining the value of water for agricultural activities in the Amu-Kashkadarya irrigation system.

Indicators	Plant production with irrigation	Plant production without irrigation*	Additional value / cost
Gross value of crop production (thousand soum / ha / year)	6438	0	
Production costs (thousand UZS/ha / year)	6039		
Net production value (thousand UZS/ha / year)	399		399
Estimated volume of water intake from the source (m^3/ ha / year)	11000	0	11000
Net product value at abstracted water unit (UZS/m$^{3)}$			37

*In conditions of the "Amu-Kashkadarya" irrigation system, agricultural farming is not possible without irrigation.

Table 34. Value of water in agriculture in the Amu-Kashkadarya irrigation system.

4. Determination of the net benefits from non-irrigated water use.

The benefits of non-irrigation water use occur from household consumption (drinking water and water for personal hygiene), as well as use for livestock, which results in improved health and increased incomes of the rural population. At the moment there are no experimental studies in which the additional value of these benefits would be quantified.

The approximate cost of the benefits from non-irrigation water use is estimated by livestock production as an additional premium to the value of water. According to the regional statistics in 2017, the cost of livestock products amounted to 2266626.5 million soums. We do not have data on the costs of livestock production, and so accepted the net value of livestock products to be 50% of the gross value - 1133313.25 million soums. Then the benefit from non-irrigation water use will be:

$$1133313.25 \text{ million soums} / 5716.18 \text{ million m}^3 = 198 \text{ UZS/m}^3.$$

5. Change of social tasks.

The social benefits of job creation, food availability and their low prices generated from additional production in irrigated agriculture, suggest that an additional bonus to the benefits from irrigated agriculture may be incremented. Due to the fact that the gross value of crop production is higher and the crop production cost is lower, we assume that this change increases the economic value of water for irrigation by 50% or to 19 UZS/m^3.

6. Determination of the net benefit from return water.

Annually, the Amu-Kashkadarya irrigation system uses an average of 361 million m^3 of groundwater and return collector-drainage water, which is about 6% of the total water intake. It is assumed that the average net income from return waters is 6% of the final cost of production in agriculture. This gives a calculated figure of 2.2 soum/m^3 of water directed for irrigation purposes.

7. Determination of the full economic price of water.

The estimated value of the full economic price of water directed for the needs of irrigated agriculture in the Amu-Kashkadarya irrigation system is estimated as the sum of the value of water use for agriculture, the benefits of non-irrigation water use, the benefits of social objectives and the benefits of return water as:

$$37 + 198 + 19 + 2.2 = 256.2 \text{ UZS/m}^3$$

We estimated the economic cost and value of water in the Aksu subsystem

1. Determination of the total cost of water supply.

The total cost of water supply is formed by two components: transaction costs and operating costs, and depreciation on fixed assets. Transaction and operating costs for the Aksu subsystem are 13,634,971.56 thousand soums (Table 3). As mentioned above, financing of water management in Uzbekistan is carried out from the state budget, and depreciation charges are not accrued on fixed assets, depreciation is assessed annually. The amount of depreciation is 1,980,965.67 thousand soums.

The total cost of water supply of the Aksu subsystem is defined as the sum of the O&M costs plus depreciation deductions.

WMO costs for O&M, ths. soums	13,634,971.56
Amortization of fixed assets, thousand soums	1,980,965.67
Total costs, including depreciation, thousand soums	15,615,937.23
Total WCA cost of water supply, UZS/m^3	48.35

2. Determination of the full economic value of water in the Aksu Basin.

The full economic value of water use for irrigation purposes consists of the following components: the total cost of water supply and capital costs.

$$48.35+7 = 55.35 \text{ soum/m}^3$$

Where: 7 UZS/m^3 are capital investments in irrigation, according to the Land Amelioration Fund and "SuvqurilishInvest" SUE.

3. Determination of the net value of production in irrigated agriculture.

If water markets functioned, the value of water used in irrigated agriculture could be calculated based on the prices paid by farmers in the market. In the absence of such water markets, the value of water in irrigated agriculture can be obtained as the net value of products attributed to the water for irrigation of crops. In this case, it is determined from the value of water in agriculture by the following formula:

$$WValue_{Agr} = \frac{NCP_{irrig} - NCP_{without\ irrig}}{WVolume_{irrig}} = \frac{7660 - 0}{8200} = 934 \text{ soum/m3}$$

Where:

$WValue_{Agr}$ - Value of water in agriculture

NCP_{irrig} - Net cost of products with irrigation, thousand UZS/ha/year

$NCP_{without\ irrig}$ - Net cost of products without irrigation, thousand UZS/ha/year

$WVolume_{irrig}$- Volume of water directed for irrigation, m^3/ha/year

Table 35 provides data for determining the value of water in agriculture in the Aksu subsystem.

Indicators	Plant production with irrigation	Plant production without irrigation*	Additional value / cost
Gross value of crop production (thousand soum / ha / year)	14467	0	
Production costs (thousand UZS/ha / year)	6807		
Net production value (thousand UZS/ha / year)	7660		7660
Estimated volume of water intake from the source (m^3/ha / year)	8200	0	8200
Net product value at abstracted water unit (UZS/m^3)			934

Table 35. Value of water in agriculture in Aksu subsystems.

4. Determination of the net benefits of non-irrigational water use.

The benefits of non-irrigational water use occur from household consumption (drinking water and water for personal hygiene), as well as use for livestock, which results in improved health and increases the incomes of the rural population. At the moment, there are no experimental studies in which the additional value of these benefits would be quantified.

The approximate cost of the benefits of non-irrigation water use is estimated by livestock production as an additional premium to the value of water. According to the regional statistics in 2017, the cost of livestock products in the Aksu Basin amounted to 430082.1 million soums. We do not have data on the livestock production costs, and hence assume the net value of livestock production at 50% of the gross value - 215041.05 million soums. Then the benefit from non-irrigation water use will be:

215041.05 million soums / 399.22 million m^3 = 538 UZS/m^3

5. Changes of social tasks.

The social benefits of job creation, food availability and their low prices generated from additional production in irrigated agriculture, suggest that an additional bonus to the benefits from irrigated agriculture may be incremented. Due to the fact that the gross value of crop production is higher and the crop production cost is lower, we assume that this change increases the economic value of water for irrigation by 50% or to 467 UZS/m^3.

6. Determination of the net benefit from return water.

Annually, the Aksu subsystem uses an average of 47.5 million m^3 of groundwater from irrigation wells, which is about 11.8% of the total water intake. It is assumed that the average net income from the use of return waters is 11.8% of the final production cost in agriculture. This gives a calculated figure of 110 UZS/m^3 of water directed for irrigation.

7. Determination of the full economic price of water.

The value of the full economic price of water directed for the needs of irrigated agriculture in the Aksu irrigation system is estimated as the sum of the value of water use for agriculture, the benefits of non-irrigation water use, the benefits of social objectives and the benefits of return water as:

$$934 + 538 + 467 + 110 = 2049 \text{ UZS/m}^3$$

4.2. Estimation of the cost and value of water in the Shakhrikhansay Basin.

As in paragraph 2.3, first we estimate the economic cost and value of water in the Fergana irrigation system in general, followed by the assessment in the Shakhrikhansay subsystem.

1. Determination of the total cost of water supply.

The total cost of water supply is formed by two components: transaction costs and operating costs, and depreciation on fixed assets. Transaction and operating costs for FIS are 293,131,847.80 thousand soums (Table 5). As mentioned above, financing of water management in Uzbekistan is carried out from the state budget, and depreciation charges are not accrued on fixed assets, depreciation is assessed annually. The amount of depreciation is 33,459,823.78 thousand soums.

The total cost of the water supply in the FIS is defined as the sum of the O&M costs plus depreciation.

WMO costs for O&M, ths. soums	293,131,847.80
Amortization of fixed assets, thousand soums	33,459,823.78
Total costs, including depreciation, thousand soums	326,591,671.58
Total WCA cost of water supply, UZS/m^3	64.30

2. Determination of the full economic value of water.

The full economic value of water use for irrigation consists of the following components: the total cost of water supply and capital costs.

$$64.30 + 10.3 = 74.6 \text{ UZS/m}^3$$

where 10.3 UZS/m^3 are capital investments in irrigation, according to the Land Amelioration Fund and “Suvqurilishinvest” SUE.

If water markets functioned, the value of water used in irrigated agriculture could be calculated based on the prices paid by farmers in the market. In the absence of such water markets, the value of water in irrigated agriculture can be obtained as the net value of products attributed to the water for irrigation of crops. In this case, it is determined from the value of water in agriculture by the following formula:

$$WValue_{Agr} = \frac{NCP_{irrig} - NCP_{without\ irrig}}{WVolume_{irrig}} = \frac{11389-0}{8300} = 1372 \text{ soum/m3}$$

Where:

$WValue_{Agr}$ - Value of water in agriculture

NCP_{irrig} - Net cost of products with irrigation, thousand UZS/ha/year

$NCP_{without\ irrig}$ - Net cost of products without irrigation, thousand UZS/ha/year

$WVolume_{irrig}$- Volume of water directed for irrigation, m^3/ha/year

Table 36 provides data for determining the value of water in agriculture in the FIS.

Indicators	Plant production with irrigation	Plant production without irrigation*	Additional value / cost
Gross value of crop production (thousand soum / ha / year)	16851	0	
Production costs (thousand UZS/ha / year)	5462		
Net production value (thousand UZS/ha / year)	11389		11389
Estimated volume of water intake from the source (m^3/ha / year)	8300	0	8300
Net product value at abstracted water unit (UZS/m^3)			1372

Table 36. Value of water for agricultural activities in the FIS.

3. Determination of the net benefits of non-irrigated water use.

The benefits of non-irrigational water use occur from household consumption (drinking water and water for personal hygiene), as well as use for livestock, which results in improved health and increases the incomes of the rural population. At the moment, there are no experimental studies in which the additional value of these benefits would be quantified.

The approximate cost of the benefits of non-irrigation water use is estimated by livestock production as an additional premium to the value of water. According to the regional statistics in 2017, the cost of livestock products in the FIS amounted to 2834,482 million soums. We do not have data on the livestock production costs, and hence assume the net value of livestock production at 50% of the gross value - 1417 241 million soums. Then the benefit from non-irrigation water use will be:

1417241 million soums / 7473.1 million m3 = 189 UZS/m^3.

4. Changes of social tasks.

The social benefits of job creation, food availability and their low prices generated from additional production in irrigated agriculture, suggest that an additional bonus to the benefits from irrigated agriculture may be incremented. Due to the fact that the gross value of crop production is higher and the crop production cost is lower, we assume that this change increases the economic value of water for irrigation by 50% or to 686 UZS/m^3.

5. Determination of the net benefit from return waters.

FIS uses 458 million m3 of groundwater and return collector-drainage water annually, which is about 6% of the total water intake. It is assumed that the average net income from return waters is 6% of the final cost of production in agriculture. This gives a calculated value of 82 UZS/m^3 of water directed for irrigation.

6. Determination of the full economic price of water.

The value of the full economic price of water directed to irrigated agriculture in the FIS is estimated as the sum of the value of water used for agriculture, the benefits from non-irrigation water use, social objectives and from return water as follows:

1372 + 189 + 686 + 82 = 2329 UZS/m^3.

We estimated the economic cost and value of water in the Shakhrikhansay subsystem

1. Determination of the total cost of water supply.

The total cost of water supply is formed by two components: transaction costs and operating costs, and depreciation on fixed assets. Transaction and operating costs for FIS are 47,056,924.56 thousand soums (Table 7). As mentioned above, financing of water management in Uzbekistan is carried out at the expense of the budget, and depreciation charges are not accrued on fixed assets, and depreciation is assessed annually. The amount of depreciation is 161,847.32 thousand soums.

The total cost of water supply at the upper and lower levels of the Shakhrikhansay Basin is defined as the sum of the O&M costs plus depreciation.

WMO costs for O&M, ths. soums	47,056,924.56
Amortization of fixed assets, thousand soums	161,847.32
Total costs, including depreciation, thousand soums	47,218,771.88
Total WCA cost of water supply, UZS/m^3	31.4

2. Determination of the full economic value of water.

The full economic value of water used for irrigation consists of the following components: the total cost of water supply and capital costs.

$$31.4 + 2.3 = 33.7 \text{ UZS/m}^3$$

where 2.3 UZS/m^3 is a capital investment in irrigation, according to the Land Amelioration Fund and "Suvqurilishinvest" SUE.

3. Determination of the net value of products in irrigated agriculture.

If water markets functioned, the value of water used in irrigated agriculture could be calculated based on the prices paid by farmers in the market. In the absence of such water markets, the value of water in irrigated agriculture can be obtained as the net value of products attributed to the water for irrigation of crops. In this case, it is determined from the value of water in agriculture by the following formula:

$$\boldsymbol{WValue_{Agr}} = \frac{\boldsymbol{NCP_{irrig} - NCP_{without\ irrig}}}{\boldsymbol{WVolume_{irrig}}} = \frac{\mathbf{12954 - 0}}{\mathbf{13300}} = \mathbf{973}\ \text{soum/m3}$$

Where:

$\boldsymbol{WValue_{Agr}}$ - Value of water in agriculture

$\boldsymbol{NCP_{irrig}}$ - Net cost of products with irrigation, thousand UZS/ha/year

$\boldsymbol{NCP_{without\ irrig}}$ - Net cost of products without irrigation, thousand UZS/ha/year

$\boldsymbol{WVolume_{irrig}}$- Volume of water directed for irrigation, m^3/ha/year

Table 37 provides data for determining the value of water used for agriculture for the Shakhrikhansay subsystem.

Indicators	Plant production with irrigation	Plant production without irrigation*	Additional value / cost
Gross value of crop production (thousand soum / ha / year)	18416	0	
Production costs (thousand UZS/ha / year)	5462		
Net production value (thousand UZS/ha / year)	12954		12954
Estimated volume of water intake from the source (m^3/ha / year)	13300	0	13300
Net product value at abstracted water unit (UZS/m^3)			973

Table 37. The value of water in the Shakhrikhansay agriculture subsystem.

4. Determination of the net benefits of non-irrigation water use.

The benefits of non-irrigation water use occur from household consumption (drinking water and water for personal hygiene), as well as use for livestock, which results in improved health and increased incomes of the rural population. At the moment there are no experimental studies in which the additional value of these benefits would be quantified.

The approximate cost of the benefits from non-irrigation water use is estimated by livestock production as an additional premium to the value of water. According to the regional statistics in 2017, the cost of livestock products amounted to 473873.54 million soums. We do not have data on the costs of livestock production, and so accepted the net value of livestock products to be 50% of the gross value - 236936.77 million soums. Then the benefit from non-irrigation water use will be:

236936.77 million soums/2270.22 million m^3 = 104 UZS/m^3.

5. Changing social tasks.

The social benefits of job creation, food availability and their low prices generated from additional production in irrigated agriculture, suggest that an additional bonus to the benefits from irrigated agriculture may be incremented. Due to the fact that the gross value of crop production is higher and the crop production cost is lower, we assume that this change increases the economic value of water for irrigation by 50% or to 486 UZS/m^3.

6. Determination of the net benefit from return water.

Some 5 million m^3 of groundwater and return collector-drainage water is annually used in the FIS, which is about 0.2% of the total water intake. It is assumed that the average net income from return waters is 0.2% of the final production cost in agriculture. This gives a calculated value of 1.9 UZS/m^3 of water directed for irrigation.

7. Determination of the full economic price of water.

The estimated value of the full economic price of water directed to irrigated agriculture by FIS is estimated as the sum of the value of water in agriculture, the benefits from non-irrigation water use, from social objectives and from return water:

973 + 104 + 486 + 2 = 1565 UZS/m^3.

CONCLUSIONS AND RECOMMENDATIONS ON SUSTAINABLE COST REIMBURSEMENT ON O&M AND RELATED FINANCING MECHANISMS.

1. The total economic cost and the full economic price of water in prices of 2017 are 74.6 and 2329 UZS/m^3 for the Fergana irrigation system in general and 33.7 and 1565 UZS/m^3 in the Shakhrikhansay subsystem, respectively.

2. The total economic cost and the full economic price of water in prices of 2017 are 169.0 and 256.2 UZS/m^3 for the Amu-Kashkadarya irrigation system in general and 55.4 and 2049 UZS/m^3 for the Aksu subsystem, respectively.

3. The high economic cost of water in the Amu-Kashkadarya irrigation system is related to the operation of a cascade of pumping stations with 7 water liftings on the Karshi main canal. The relatively low economic price of water from the Amu-Kashkadarya irrigation system is explained by the fact that 63.8% of irrigated land is located in the Karshi steppe with low soil fertility and hence, low land productivity.

4. With the existing cropping pattern and crop yields of the Fergana irrigation system in general and the Shakhrikhansay and Aksu subsystems, farmers are able to cover the O&M costs of irrigation systems.

5. To cover the O&M cost of the Amu-Kashkadarya irrigation system, it is required to increase the yield of agricultural crops.

6. To achieve sustainable cost recovery of O&M at the lower level of the irrigation system and to improve the financial state of WCAs, it is recommended to:

- Support and financially encourage WCAs by the authorities at all levels is required so that WCAs can play their full role in water management, rational organization of water supply and improvement of living conditions in the rural areas.

- Disseminate more information in the local media about the role of WCAs in ensuring the well-being of the rural population. One of the main reasons for the low level of collection of fees for WCA services is the fact that most of the water users do not understand their responsibility for the joint management of the O&M of the irrigation and drainage systems.

- Achieve accounting for all water consumers, not only farms specializing in the production of cotton and wheat, and collect funds from all water consumers who have land plots – from farms that specialize in animal husbandry, vegetable growing, gardening, etc., communities (makhallas), dekhkan households, industrial enterprises, etc.

- Plan cotton and grain crop production, purchased for the state needs, and no planning of the cropping areas. Provide farmers with opportunities to sow profitable cash crops.

- Abandon the practice of concessional lending as a mechanism for financing the costs of cotton and grain production procured for the state needs by entering into direct contracts with procurement organizations. Procurement organizations should transfer to farmers an advance of 60% of the production cost of cotton and grain procured for the state needs, as is the case in cotton-textile clusters.

7. To reimburse the O&M cost of state water facilities by water consumers, it is recommended to:

- Introduce paid water use and setting tariffs for water supply services.

- Justify tariffs for water supply services on the basis of an assessment of the economic price and economic value of water and solvency of water consumers.

- When setting tariffs for water supply services, take into account the costs of the supplier such as:

  – maintenance and repair of state irrigation and collector-drainage systems and structures;

  – depreciation on the full restoration of value of fixed assets;

  – obligatory payments;

  – insurance funds in case of low and ample water years;

  – profit sufficient to create funds for the expansion of production, scientific, technical and social development.

- Instead of the state order, it is advisable to make a complete transition to the cluster method for growing raw cotton and wheat with deep processing and setting up competitive final product output. Cancel the practice of state planning of cropping pattern. This will give farmers the opportunity to plan their own crop areas, including profitable crops and crops that increase soil fertility - alfalfa, legumes, etc, depending on soil and climatic conditions, demand and prices for agricultural products.

- Establish free market prices for agricultural products, allowing water users to be solvent when paying for water services;

- Increasing the responsibility of water management organizations for water supply to water users in the established volumes and terms;

- Ensuring irrigation systems with sophisticated water accounting tools with measurement and control over the supplied water.

REFERENCES LIST

1. Ikramov R., Gaipnazarov N., Guidelines for the integrated analysis of the effectiveness of irrigated agriculture. Scientific-Information Center of the Interstate Commission for Water Coordination (SIC ICWC) in Central Asia», Tashkent-1998.

2. Order of the Minister of Finance of the Republic of Uzbekistan on approval of regulations on the procedure, approval and registration cost estimates and staffing budget organizations and budget holders. No. 74 of November 14, 2014.

3. Industrial technology cards for agricultural crops and crop production, parts I and II for 2011-2015. Institute of Agricultural Mechanization and Electrification of Uzbekistan, Institute of Risks Market Reforms, Tashkent, 2011 Approved by the Resolution of the Ministry of Agriculture and Water Resources of the Republic of Uzbekistan dated October 29, 2010 № 7/2.

4. Provision on maintenance and repair of on-farm ameliorative system and structures on it in the Uzbek SSR (1987). Scientific-Information Center of the Interstate Commission for Water Coordination (SIC ICWC) in Central Asia, Tashkent.

5. Collection of elemental estimate norms for repair of land-reclamation systems and facilities (2000). Moscow.

6. Innovative technologies for agricultural crop production (Farmer's Guide). (2013). Tashkent

7. Kayumov M.K., (1989). Programming crop yields. Agropromizdat.

8. Dukhovniy V.A., Nerozin S.A., Stulina G.V., Solodkiy G.F., (2015) Programming of crop yields (Systems approach as applied to soil reclamation). Tashkent

9. Temelsu / Sheladia JV, Amu-Bukhara Irrigation Rehabilitation Project. Working Paper No. 3 - Typical WCA Budget.

10. Rogers, P., Bhatia, R., & Huber, A. (1998). Water as a social and economic good: How to put the principle into practice. Stockholm: Global Water Partnership.

For notes