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Impact of Water Users Associations on Water and Land Productivity, Equity and Food Security in Tajikistan

S. Balasubramanya, M.-C. Buisson, P. Saikia, K. MacDonald, S. Aslamy, T. Horbulyk, C. Hannah, M. Yakubov and A. Platonov

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IWMI Contact:

Dr. Soumya Balasubramanya
International Water Management Institute
PO Box 2075
Colombo, Sri Lanka

Telephone: +94 11 288 0119
Email: S.Balasubramanya@cgiar.org

Acronyms

ACTED	Agency for Technical Cooperation and Development
ADB	Asian Development Bank
AKF	Aga Khan Foundation
ALRI	Agency for Land Reclamation and Irrigation
AO	Association Organizer
CECI	Centre for International Studies and Cooperation
DAI	Development Alternatives Incorporated
EIDHR	European Instrument for Democracy and Human Rights
EU	European Union
FFP	Family Farming Program
FTF	Feed the Future
GAFSP	Global Agriculture and Food Security Program
HYV	High Yielding Varieties of cotton
IDA	International Development Association
MEWR	Ministry of Energy and Water Resources
MLRWR	Ministry of Land Reclamation and Water Resources
MSDSP	Mountain Societies Development Support Program
PAMP II	Public Employment for Sustainable Agriculture and Water Management Project II
PMU	Project Management Unit
SDC	Swiss Agency for Development and Cooperation
SECO	State Secretariat for Economic Affairs
TJS	Tajikistan Somoni (unit of currency). Approximate rates of exchange with the US dollar were 5 TJS/USD in 2014 and 6 TJS/USD in 2015. By April 2016, the Somoni had depreciated to almost 8 TJS/USD.
T-LSMS	Tajikistan Living Standards Measurement Survey conducted by the World Bank
UNDP	United Nations Development Programme
USAID	United States Agency for International Development
USD	United States Dollars (unit of currency)

WHH	*Welthungerhilfe*
WUA	Water Users Association
WUASP	Water User Association Support Program

Summary

The International Water Management Institute (IWMI) was engaged by the United Stated Agency for International Development (USAID) through the Feed the Future initiative, to examine whether water users associations (WUAs) created and supported by USAID produced sustained increases in resource productivity, food security, and equity in southern Tajikistan, even after donor support was withdrawn.

This evaluation consists of three research components, to be implemented from 2015 to 2018. The current report presents initial insights from a series of surveys conducted in 2015 for each of the three research components. These research components are:

1. Identifying opportunities and constraints for the sustainability of WUAs;
2. Assessing the persistence and equity of impact on irrigation services, crop choice, and cotton productivity; and
3. Examining the role of women in irrigation water management to identify opportunities for enhancing food security.

USAID started supporting the creation of WUAs in Tajikistan in 2004. At that time, WUAs were developed under the Water User Association Support Program (WUASP). USAID brought its WUA activities into the Family Farming Program (FFP) in 2011, as part of the 'Feed the Future' (FTF) initiative. FTF aims to sustainably reduce poverty and hunger by promoting inclusive agricultural sector growth and improved status of women and children in Tajikistan. Feed the Future works in 12 districts of southwest Khatlon province, known as the Feed the Future Zone of Influence (ZOI).

Although it has since concluded, the Family Farming Program was a principal program under the FTF initiative in Tajikistan. The FFP focused on improving farm productivity. While a number of activities were implemented, one of the major activities was the creation of WUAs to improve timely and regular access to on-farm water for improving yields, crop diversity, and enhancing livelihoods. To this end, since 2011, USAID intensively set up WUAs in 12 districts in southern Khatlon Province, which is a major agricultural region in southern Tajikistan served by many rivers, with an extensive

network of irrigation canals which were built during the Soviet Era. Khatlon Province is a major area of intervention for USAID and is reported to have low agricultural productivity, and the highest rates of poverty and undernutrition nationwide (Family Farming Program Staff 2013b; IFAD, 2015). The Demographic and Health Survey conducted by the Republic of Tajikistan collected data on nutrition status in 2012. Those data show that 27% of the children under the age of 5 are stunted (Statistical Agency, Republic of Tajikistan, 2012; World Bank, 2012). Around 78% of the population of Khatlon lives below the national poverty line (IFAD, 2015).

WUAs created by USAID (hereafter referred to as 'USAID WUAs') are delineated along hydraulic boundaries, and established using community based approaches that provided members with training in levying, paying and collecting fees; preparing repair and maintenance plans; preparing governing rules; and conflict resolution. This approach, which is different from the traditional method of delineating WUAs along *jamoat* (third-level administrative divisions, similar to communes or municipalities, in Tajikistan) boundaries, is hypothesized to improve the timely and equitable distribution of water on farms. Such improvements in on-farm water delivery could impact yields, crop choice and activities of agricultural workers.

Component 1: Identifying opportunities and constraints for the resilience of WUAs

To understand whether and how USAID WUAs are performing after donor support was withdrawn, a component of this evaluation focuses on studying the functioning of WUAs.

A review of project documents, donor interviews and two sample surveys are used to identify threats to WUAs. The review of documents, donor interviews, and the first survey was implemented in early 2015 in southern Tajikistan. The WUA survey collected data on governance, membership, organizational characteristics, functions and power, capacities and capabilities, disputes, water delivery, repairs and maintenance, and finances for a sample of 141WUAs (supported by USAID, other donors or the local government/self-started) in 164 *jamoats*. A second survey will be implemented in 2016.

Chapter 4 presents the methods used and preliminary results from the first survey of WUAs, highlighting some key challenges to the functioning of WUAs that will be studied further within this research component. The analysis suggests that community involvement in the setting up of WUAs has become a standard practice, and is acknowledged and understood by all donors as being important for increasing the success of the WUAs. The extent of donor support and the time for creating the WUAs vary across WUA models, with USAID WUAs benefitting most from extended donor support. However, a number of factors that are likely to affect the functioning of the USAID WUAs detrimentally were also identified.

- Most of these WUAs are quite young and, will take time to achieve functional maturity.
- Of particular interest is the lack of clarity on the division of responsibilities between the WUA, farmers and the *Vodkhoz* (local government agencies providing water services) for the repair and maintenance of primary, secondary, and tertiary watercourses.
- Another important point pertains to the fee structures set up at the inception of WUAs: the purpose, calculation, and enforcement of WUA membership fees, irrigation service fees, and other tariffs are not clear, and there is an inconsistency in the understanding between WUAs, and between WUAs and farmers.
- Finally, financial data suggest that USAID WUAs had larger revenues with similar expenditures per hectare, and lower debts in 2014. However, as the nature of the support offered to WUAs changed from 2015, tracking the performance of these WUAs in 2016 will provide important insights on factors that threaten the functioning of WUAs.

Component 2: Assessing the persistence and equity of impact on irrigation services, crop choice, and cotton productivity

To examine the persistence and equity of impact of USAID WUAs on irrigation services, crop choices and cotton productivity, one component of the evaluation focuses on *dekhan* farms, an important production systems for many agrarian households in Khatlon. This

component involves two farm-level surveys, and compares farms irrigated by USAID WUAs (treatment group) to farms irrigated either by non-USAID WUAs or irrigated without any WUA (control group).

In order to build comparable treatment and control groups, a pre-sampling survey of *jamoats* was undertaken to collect data on the characteristics of *jamoats* that would not be affected particularly by treatment. Then, a propensity score was calculated for each *jamoat,* using variables such as demographic attributes, agricultural attributes, land use and farm attributes, and irrigation attributes. USAID and non-USAID *jamoats* were selected by matching on propensity scores. Using this process, 40 jamoats irrigated by USAID WUAs; and 40 *jamoats* irrigated either by other WUAs or irrigated without the presence of a WUA were selected. Within each selected *jamoat*, stratified random sampling was used to select 25 *dekhan* farms. Farms were stratified on the type of canal they lie on (primary, secondary or tertiary), and their location along the canal (head, middle, or tail end). This stratification allows for causal inference in variation of impacts across space. No farm in the sample can belong to both the treatment and control groups.

A baseline survey was implemented in 2015 to collect data on the 2014 cropping season. A follow-up survey will be implemented in 2017 to collect data on the 2016 cropping season. Both surveys will collect data on indicators pertaining to irrigation services, crop choices and market orientation, and cotton cultivation. These indicators were chosen to understand whether irrigation services improve in the treatment group, and if crop production choices and profitability change when irrigation services change.

A difference-in-different methodology will be used to compare these indicators for the treatment and control groups between the baseline and follow-up survey.

Chapter 5 of this report presents the study design, methods used and preliminary results from the baseline survey conducted on 1,957 *dekhan* farms (individual or family farms in Central Asia). These differences indicate the main impact indicators to be pursued through this research component. While definite conclusions cannot be drawn until the follow-up survey is conducted, preliminary evidence from analysis of the baseline survey suggests that:

- USAID interventions might have led to better irrigation services in the treatment group when compared to irrigation services in the control group. The irrigation of cultivated areas is higher in the treatment group; farms located in the treated group irrigated 97.5% of the area cultivated in 2014, while farms in control group irrigated 92.5% of the cultivated areas. Irrigation charges per hectare paid for the cotton crop are higher in the treatment group than the control group. Cotton farmers in the treatment group also perceived their irrigation services to be timelier, and water to be more adequately available, than did cotton farmers in the control group.
- Analysis of crop choices suggests that the treatment group farms cultivated a larger number of crops in 2014 than those in the control group. Productivity in the treatment group appears to be higher than in the control group; with yield for some key food crops higher on treatment farms than on control farms. Treatment group farms also appear to be more market oriented than the control group farms, being able to sell a greater proportion of their harvest, likely due to their higher yields. Further, variability in yield of key crops such as wheat and maize tends to be lower in the treatment group than in the control group.
- Finally, analysis of the economics of cotton production suggests that treatment farms are far more likely to cultivate cotton than control farms but devote much smaller cropped areas to it. While treatment farms are more likely to adopt high-yielding varieties (HYV) than control farms, the difference in yields between the treatment and control groups is not significant when farms cultivate HYV variety. However, for cultivating traditional varieties of cotton, treatment farms gain higher yields than control farms. Input costs are higher per hectare of cotton cultivated in the treatment group than in the control group; this difference applies to both HYV and traditional varieties of cotton.

Component 3: Examining the role of women in irrigation water management to identify opportunities for enhancing food security

In this research component, the roles, opportunities and constraints in water management experienced by women working in agriculture in Khatlon will be explored. The unit of analysis is the household, and the respondents will be females in agriculture.

Two surveys will be implemented to collect data on gender-based division of agricultural labor, including water management, and practices surrounding cultivation and the consumption of produce from kitchen gardens and presidential plots, with the intent of better understanding the role of women in the household in promoting food security.

Chapter 6 of this report presents qualitative research undertaken to design this component. Focus group discussions were conducted with female *dekhan* farm managers, female agricultural laborers on *dekhan* farms, and a few other key informants to identify the key types of data that will be collected through the course of this component.

From this qualitative research, it appears that the involvement of women in water management is significant and has increased over the last two decades, which contradicts a prevailing perception that water management is primarily the role of males.

- Beyond the irrigation of kitchen and presidential plots, women now apply water to *dekhan* farm plots, assist in the cleaning of canals, work actively with irrigation service providers, and develop solutions to overcome water challenges.
- However, the participation of women in water management varies depending on a number of factors, including the presence of male family members, and challenges such as lack of capital, knowledge, physical ability, age, and health.
- Women also face a number of gender-specific constraints working in agriculture, such as negative impacts on their health, a lack of child care support, and the need to complete housework.
- With a few exceptions, challenges to water management outlined by female agricultural laborers appeared to hold true for women in both upstream and downstream *jamoats*, and in different irrigation service provider contexts.
- It appears that women working on their own plots participate more in irrigation water management than women working as wage laborers. However, women working as wage laborers may be involved in water management to a greater

extent than reflected by the current discussions, as they may also tend kitchen gardens or presidential plots at home.

Follow-up work

The purpose of this baseline work is to enable the subsequent quantitative measurement and estimation of impacts due to the USAID intervention. The scope of impacts of USAID WUAs on access to on-farm water, productivity, food security, and equity, as well as factors related to financial and institutional sustainability of the WUAs have been identified in this baseline report. These preliminary findings will be used to design follow-up surveys and additional qualitative studies to collect data that will then be used to measure and estimate the sustainability of these impacts.

These preliminary findings will also be used to guide analysis using geospatial tools. Data from 2010, 2014 and 2016 will be used to examine changes in land use and to contextualize the results from the impact evaluations.

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1 Introduction to the Evaluation

This evaluation examines whether water users associations (WUAs) created and supported by the United States Agency for International Development (USAID) produce sustained increases in resource productivity, food security, and equity in southern Tajikistan, even after donor support is withdrawn. WUAs created by USAID (hereafter referred to as 'USAID WUAs') are delineated and organized along hydraulic boundaries using community based approaches, in contrast to traditional methods of organizing WUAs along administrative boundaries.

USAID started supporting the creation of WUAs in Tajikistan in 2004. At that time, WUAs were developed under the Water User Association Support Program (WUASP). In 2011, USAID brought its WUA activities into the 'Feed the Future' (FTF) initiative, which aims to sustainably reduce poverty and hunger by promoting inclusive agricultural sector growth and improved status of women and children in Tajikistan. Feed the Future works in 12 districts of southwest Khatlon province, known as the Feed the Future Zone of Influence (ZOI).

One of the principal components of the FTF initiative was the Family Farming Program (FFP), which focused on improving farm productivity. Although it has since concluded, the Family Farming Program implemented a number of activities. One of the major FFP activities was the creation of WUAs to improve timely and regular access to on-farm water for improving yields, crop diversity, and enhancing livelihoods. Since 2011, USAID has intensively set up WUAs in 12 districts in southern Khatlon Province, which is a major agricultural region in southern Tajikistan served by many rivers, with an extensive network of irrigation canals that were built during the Soviet Era. Khatlon Province is reported to have low agricultural productivity, and the highest rates of poverty (78% of the population in Khatlon lives below the national poverty line) and undernutrition (27% of children <5 year are stunted) nationwide (Statistical Agency, Republic of Tajikistan, 2012; World Bank, 2012). Southwest Khatlon is a major area of intervention for USAID.

The International Water Management Institute (IWMI) was engaged by USAID to design a series of studies that measure impacts of USAID WUAs on water access and improved productivity at different scales—WUA, farm, and household.

Thus, three separate, but interrelated, research components have been designed to identify impacts and the factors that may compromise the gains over time.[1] The unit of observation in each of the three components is at a different level, as impacts, opportunities, and constraints can be different at different scales. Across the three research components, spatial, temporal, and gender-based impacts will be highlighted.

1.1 Identifying Opportunities and Constraints for Resilience of WUAs

This component examines the opportunities for, and threats to, the functioning of irrigation WUAs in southern Tajikistan. The unit of analysis is a WUA.

Two rounds of surveys will be implemented on WUAs in Khatlon Province and in Districts of Republican Subordination (DRS) provinces. The first survey was implemented at the beginning of 2015, where data from 141 WUAs were collected; a second survey will be implemented with each of these WUAs at the end of 2016. In the 2015 survey, data on governance, membership, organizational characteristics, functions and power, capacities and capabilities, disputes, water delivery, repairs and maintenance, and finances were collected for the cropping season of 2014. The 2016 survey will collect data on similar parameters for the 2016 cropping season. Examining the changes between the two datasets will shed light on factors that may compromise the functioning of WUAs over time.

This component will use descriptive analysis to examine changes in functioning, operations, conflict resolution, and financial solubility between 2014 and 2015, for USAID WUAs and non-USAID WUAs. Emphasis will be given to understanding whether the successes, failures and threats are the same for USAID WUAs and other WUAs. This information will be useful for guiding policies to strengthen WUAs, in order to increase resilience to external and internal threats.

Chapter 4 of this report describes the design and methodology for this component, and then presents preliminary results from the first round of data collected, highlighting some key

[1] These studies are described in Chapter 4 (WUAs); Chapter 5 (*dekhan* farms) and Chapter 6 (households).

challenges to the functioning of WUAs that will be examined further through the course of this component.

1.2 Assessing the Persistence and Equity of Impacts on Irrigation services, Crop Choice, and Cotton Productivity

This research component examines whether USAID WUAs produce sustained and equitable improvements in irrigation services, cropping diversity and cotton productivity after active donor support is withdrawn. The unit of analysis for this study is the *dekhan* farm.

Two rounds of surveys on the same sample of farms will be needed to collect the data required to estimate the magnitude, distribution, and persistence of impacts. The first survey—called the baseline survey—was conducted at the beginning of 2015 on a randomly selected sample of 1,957 *dekhan* farms; the second survey—called the follow-up survey—will be conducted in 2017. In the baseline survey, data on cotton cultivation, crop choice, water fees, governance, memberships, and conflicts were collected for the 2014 cropping season. The follow-up survey will collect data on similar parameters for the 2016 cropping season.

After both sets of data are collected, a difference-in-difference identification strategy will be used to examine whether impacts on various food security and water security indicators are different for farms served by USAID WUAs (treatment group), in comparison to those served either by other irrigation WUAs or farms irrigated but not served by WUAs (control group). The sample for the study was randomly selected, with the treated and control groups selected using a propensity score, and farms within selected groups stratified on their irrigation canal location (head, middle, tail) and on the type of canal they are irrigated by (primary, secondary, tertiary). This allows for identifying not just the average impacts, but also the spatial distribution of changes in food security. If poorer farmers are more likely to be disadvantageously located, the distribution of impacts needs to be understood to comment on equity. The design of this study enables the inferring of equity in improvements to food security.

Chapter 5 of this report presents details of the study design and methodology for this component of the research. Preliminary results pertaining to irrigation services, cropping choices, and cotton

productivity are reported from the analysis of data collected in the baseline survey. The follow-up survey will be used to confirm these preliminary results.

1.3 Understanding the Role of Women in Agriculture and Water Management towards Enhancing Food Security

This research component will aim to understand the economic opportunities and constraints for women in agriculture and water management, and to identify whether these factors are different in *jamoats* serviced by USAID WUAs from those that are either serviced by other WUAs or irrigated *jamoats* without WUAs. Women have an important role to play in the production of food, through their involvement on *dekhan* plots, kitchen gardens, and presidential plots; however their responsibilities and challenges are often not systematically studied using large sample sizes.

Two rounds of sample surveys will be conducted with female respondents, the first in 2016 and the other in 2018. Data on roles and responsibilities, time allocations, working conditions, involvement in decision making, and remuneration will be collected. The study will aim to capture women in various roles, such as those working on their own farms, as paid workers, as managers, or as a member of a WUA.

A combination of descriptive and regression analysis will be used to identify opportunities for improving conditions for women, and to identify threats to their current involvement. This analysis will provide evidence for formulating investments and policy to support women in agriculture.

Chapter 6 of this baseline report presents the methodology and findings of qualitative research undertaken in 2015 to explore the roles, opportunities, and constraints in water management experienced by women working in agriculture in Khatlon. This research will be used to design the household-level study that will examine the division of agricultural labor, including water management, and practices surrounding cultivation and the consumption of produce from kitchen gardens and presidential plots. The intent of these analyses is to understand better the role of women and the household in promoting food security.

2 Analytical Framework and Impact Evaluation Design

2.1 Theory of Change, Development Hypotheses and Research Questions

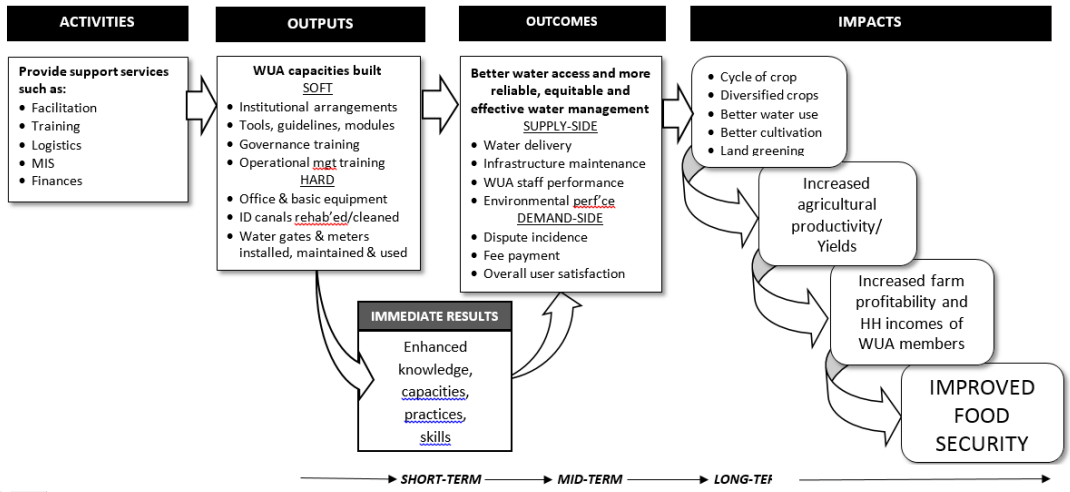
2.1.1 Theory of Change

USAID created its WUAs, under WUASP and the FFP, along hydraulic boundaries through a bottom-up process. In addition, extensive training on water delivery, governance, financial management, conflict resolution and agronomy was provided to WUA members. This approach is different from the traditional way of creating WUAs, which are typically set up along administrative lines, and driven in a top-down manner. The USAID program aimed to perform better than the traditional WUAs with respect to ensuring reliable and timely supply of water in adequate quantities, and improving distribution of water among members.

Put differently, the USAID projects' theory of change suggests the following:

- USAID's WUAs may be better placed to deliver services to their members. This implies that these WUAs may be better able to maintain infrastructure, resolve conflicts, raise revenues, and cover their costs.
- *Dekhan* farms served by USAID-created WUAs are likely to have more reliable, timely and equitable water supply if WUAs are created along hydraulic boundaries through consultation and involvement of the communities, and provided with training and decision-making skills. Since water can often be a constraining factor in production in Tajikistan, the USAID program postulates that a change in the supply of water may also impact soil fertility, crop-choice, cultivated area, cropping intensities and crop yields (see Figure 1, for the program's theory of change as postulated by USAID).
- USAID's WUAs may be more flexible in being able to meet the needs of production systems other than *dekhan* farms, through trickle down effects., even though WUAs are not explicitly created to serve household plots. Since kitchen gardens and presidential plots are usually worked by women, women in agriculture may face fewer constraints in access to water and fewer challenges in irrigation water if their plots are served by USAID WUAs.

Figure 1: Impact model change and theory of change as per FTF



Therefore, the impacts of USAID's interventions are likely to take place over the short-term as well as the longer term, and will have effects at the WUA, farm, and household level. Short-term impacts include changes in the capacities, knowledge and attitudes of the WUA, and changes in irrigation services experienced by the farms and household plots. Longer-term impacts include improvements in water sharing, crop choice, crop productivity and on-farm incomes[2].

2.1.2 Hypotheses

The principal hypothesis this evaluation intends to test, and which underlies the theory of change, is as follows:

"The WUAs formed and supported by USAID under the FFP program have led to significant improvements in water management and in providing adequate, reliable and equitable irrigation water on a sustainable basis. As a result, farmers have been able to adopt improved cultivation practices and realize higher crop yields, leading to improved farm incomes."

[2] We recognize that these changes may lead to multiplier effects on the regional economy, such as generating more employment opportunities, growth of markets and agro-based industries, and improved food security. However, our study will not be able to capture these effects econometrically.

2.1.3 Research Questions

The main research questions addressed by this study, therefore, are as follows:

1. Are USAID WUAs better able to perform than WUAs not created by USAID? What are the factors that may threaten the functioning of USAID WUAs, and are these factors common to all WUAs?
2. How consistent and equitable are the impacts of the USAID-supported WUAs on agricultural and water management outcomes?
3. To what extent and in what manner are USAID WUAs able to serve household plots, which are often farmed by women? How does this compare non USAID WUAs' performance?
4. What are the key factors, mechanisms and local specificities that help to understand and explain what did and did not work in the process of bringing about the desired change among the beneficiary groups?

Questions 1 and 2 will be answered econometrically, while question 3 will be addressed using descriptive quantitative analysis. Question 4 will be answered using several approaches such as case studies, qualitative analysis, and key informant interviews. These qualitative assessments will put the quantitative assessments into perspective, and provide relevant information for replicating the program and sustaining the program over time.

2.2 Impact Areas and Indicators

To answer Question 1, the WUA will be used as the primary unit of analysis. The following indicators will be collected and examined to understand and compare the performance and resilience of USAID WUAs with non-USAID WUAs:

a. financial performance
b. recovery of WUA membership fees
c. recovery of irrigation service fees
d. resolution of conflicts
e. repair and maintenance of irrigation infrastructure.

Since the primary beneficiary of the WUA's irrigation management services is the farm, Question 2 will be answered using the farm as the primary unit of analysis to provide econometric evidence of the impacts of USAID WUAs on land and water management. The following indicators will be collected and examined:

- the impact on water management outcomes such as:
    - adequacy, timeliness, and reliability of irrigation services
    - water disputes and resolution
    - farm level satisfaction with the irrigation service and fee payment;
    - maintenance of farm level irrigation infrastructure
- the impact on agricultural outcomes such as:
    - shifts in crop choices and number of crops cultivated
    - input use and crop yields
    - income from crop production and its share in the total household income and
    - *dekhan* farm level employment.

Since household plots (such as kitchen and presidential plots) are important production systems for producing for self-consumption, and since women play a vital role in farming these plots, Question 3 will be answered using the household as the primary unit of analysis. The study will collect data to examine the following indicators:

- source of water and challenges in irrigation of household plots
- women's labor use on household plots (and *dekhan* plots)
- women's role in irrigation management on household plots (and *dekhan* plots) and
- women's involvement in WUAs and other collectives.

Finally, analysis of the risks affecting the sustainability of the impacts at the WUA, farm and household levels will able be conducted. A focus will be provided on traditionally disadvantaged user groups (e.g., tail-enders, smallholders and women water users.) These will contextualize the findings from research questions 1-3. Data for this analysis will be collected at the WUA, farm and household levels.

2.3 Impact Evaluation Challenges and Multi-Scale Design

The identification of the impact of the interventions relies on two necessary conditions: a baseline and a counterfactual.

A before-and-after analysis of the units that received the intervention measures the impact of the intervention on the treated. The desired variables that the intervention aims to affect are identified in the beginning. The values of these variables are measured at a baseline, typically conducted before the intervention is put into place. After the intervention is completed, the value of these same variables is recorded through a follow-up survey. Thus, outcomes before the intervention are compared with the outcomes after the intervention for the same units of observation. This difference in outcome, however, cannot be interpreted as a causal effect of the intervention on the outcome, even if all other factors that might affect the change in outcomes are controlled for.

Establishing a causal link between the intervention and the outcome requires a counterfactual. A counterfactual is defined as a group that looks similar to the group that received the intervention, except that this group did not receive the intervention. Thus, the identification of the causal effect of an intervention on outcomes of interest requires a comparison of the values of the relevant outcomes before and after the intervention, between the treated group and the counterfactual group.

On the ground, however, finding the perfect counterfactual is challenging. Interventions are rarely implemented randomly. The group that received the intervention (the treatment group) likely received it due to certain characteristics it possesses; while the group that did not receive the treatment (untreated) did not have the desired characteristics for receiving the treatment. Even if these observable differences in characteristics can be controlled for, there are likely also to be unobservable characteristics that determine or influence the selection into treatment.

Thus, impact evaluations are very often based on a difference-in-differences estimator, consisting of comparing changes in outcomes over time between the beneficiaries of the project (treated group) and non-beneficiaries (non-treated, counterfactual group). When considering

these two differences together, other observable influencing variables are controlled for, to address the observable selection bias (which remains constant over time).

2.3.1 Challenge of Establishing a Baseline

In the present case, pre-program levels of farmer capacity, water management and socioeconomic status would have to be identified to establish baseline conditions for both the control and treatment groups. However, the FFP commenced in 2010, and pre-FFP conditions pertaining to farmer capacity, water management and socioeconomic status were not measured at the start of the project in 2010. Similarly, for the WUASP program, no baseline was conducted in 2003 or 2004 before the creation of the WUAs.

Establishing baseline (pre-FFP) conditions for WUAs, farms and households benefitting from USAID WUAs, and consequently, establishing baseline conditions for the appropriate control groups, is a challenge. To address this problem, a range of options was examined during the scoping visit to the project areas of the FFP in June 2014.

We considered randomizing the creation of potential future WUAs under the FFP, as this would help us capture a baseline before the WUAs were established. However, the targeted number of WUAs to be established under the FFP was reached in the first half of 2014. Thus, no randomization of upcoming intervention can be envisaged at this stage.

We considered piecing together a baseline by using data from surveys conducted between 2003 and 2011. A list of the surveys conducted by different organizations since 2003 and covering, in part, the Khatlon province was collected. These included the Living Standards Measurement Surveys of the World Bank, and a few household and *dekhan* farm surveys. Despite the fact that some of these surveys are insightful for understanding previous conditions and trends in the province, the households that were interviewed in these studies cannot be identified. Thus, we would be unable to track these households to conduct a follow-up survey. This challenge renders the use any of these datasets as a formal baseline infeasible.

We explored the possibility of reconstructing the pre-FFP conditions by asking respondents in both projects and non-projects areas, retrospectively, about their conditions prior to the commencement of the FFP. However, the literature on respondent recall suggests that this

method is unlikely to produce reliable recollections for econometric analysis. However, this method might indeed be useful for collecting qualitative information and eliciting perceptions from the beneficiaries.

2.3.2 Challenge of Constructing a Counterfactual

To identify a counterfactual, we employed the criteria used by USAID to determine the placement of its WUA creation programs.

All WUAs created by USAID are located in 12 western districts of Khatlon province, in the sub-basins of the Vakhsh and Kofarnihan rivers. These WUAs lie in the following irrigation schemes:

- Yavan-Obikiyik irrigation scheme: situated in the upstream districts of Yavan, Khurasan, Jomi and Sarban
- Vakhsh irrigation scheme: situated in the mid- and tail reaches of the Vakhsh sub-basin, and covering the districts of Bohtar, Jillikul, Vakhsh and Qumsnagir
- Lower Kofarnihan irrigation scheme: situated in the lower reaches of Kofarnihon sub-basin, and covering the districts of Qubodiyon, Shahritus and Nasiri Khusrav.

USAID created WUAs in districts where land reforms were fairly advanced. These WUAs were created in and around gravity-fed irrigation schemes.[3] Each WUA was created to have a command area of around 2,000 ha. Every USAID WUA is designed along hydraulic lines; farms along a canal line are part of the same WUA, irrespective of administrative boundaries of village and district. This implies that areas where lift irrigation is the predominant irrigation source and where collective farms still exist may have been less likely to receive support from the USAID program.

In terms of coverage, FTF covered every possible area in these 12 districts that satisfies the inclusion criteria mentioned above. In Vakhsh and Kofernihan basins, finding a satisfactory

[3] Some pockets of lift irrigation were possible within the same scheme but the main source of water supply (main canal) had to be gravity flow.

counterfactual would be challenging; it is unlikely that areas with advanced land reforms and gravity schemes would not have been treated by USAID.

2.3.3 Proposed Multi-Scale Impact Evaluation Design

Given these constraints, we established that it would be a challenge to construct a baseline at the farm, household, and *jamoat* levels. To get around this problem, we decided to focus on the persistence of impacts on water management and agricultural outcomes, by collecting data for the 2014 cropping season, and the 2016 cropping season. Since many of the impact indicators would take time to materialize, taking the difference between the two cropping seasons would provide an estimate of the stability of impacts observed using the 2016 cropping season. Additionally, at *jamoat* or WUA level, GIS data, remote sensing and secondary data will be used to rebuild a pre-2010 baseline and examine changes in land and water management.

To address the challenge of the counterfactual, seven other similar river basins were examined for identifying a counterfactual. From 164 *jamoats* in 10 river basins, propensity scores are constructed to match *jamoats* irrigated by USAID WUAs to *jamoats* that are irrigated either by other WUAs, or irrigated by gravity schemes without any WUA. The use of such extensive data allowed the implementation of an evaluation design with these features.

- The treatment group is composed of geographical units, *dehkan* farms and households that are members of the WUAs that have been created by the USAID-funded FFP or WUASP.
- The control group consists of farms and households the lie in *jamoats* not treated by USAID WUAs. These could be served by WUAs created by other organizations or by the government, or could be irrigated production systems without a WUA.

Data at the farm and household levels are collected from the 80 *jamoats* selected using propensity scores and matching methods. Data at the WUA level are collected from all 164 *jamoats*.

3 Background

3.1 Introduction

Over 70 percent of Tajikistan's 8.2 million people live in rural areas, and almost half of Tajikistan's rural population (49 percent) lives below the national poverty line. Food security poses a substantial challenge: the World Food Programme's Food Security Monitoring System indicates approximately 23% of all households are "moderately or severely food-insecure." Agricultural production in Tajikistan remains relatively low, accounting for only 21 percent of the national gross domestic product. However, the agricultural sector represents a significant source of employment in the country, particularly in rural areas, amounting to 46 percent of Tajikistan's total labor force. Increasing productivity would therefore present a significant opportunity to improve rural livelihoods and food security (DAI 2012b).

Improving access to irrigation water represents one of the major challenges to increasing agricultural productivity in Tajikistan. Khatlon Province in southern Tajikistan is served by many rivers and has the largest system of irrigation canals constructed during the Soviet Era. The primary production systems during the Soviet Era were large collectives and state farms. Irrigation water was supplied to farms by district water resource authorities, or *Vodkhoz* offices, and the maintenance of the canals was shared between the *Vodkhoz* and the large farms. Following the disintegration of the Soviet Union in 1991, the collective farm system was gradually broken up after a series of land reforms in order to create mid- to small-size plots for private households. These plots became known as *dehkon* farms. With a change in production systems, the number of farms that had to be supplied with water increased; however, resulting from the devastation of Tajikistan's civil war, irrigation water infrastructure and management had deteriorated.

In 2010, USAID launched the FFP and began developing WUAs, as support for irrigation water management was deemed a critical activity. In 2011, the FFP was incorporated into the FTF

initiative when USAID chose to focus its activities in Khatlon Province.[4] Consequently, many USAID WUAs were created and established between 2011 and 2013 in 12 districts of Khatlon Province, comprising the FTF Zone of Influence.

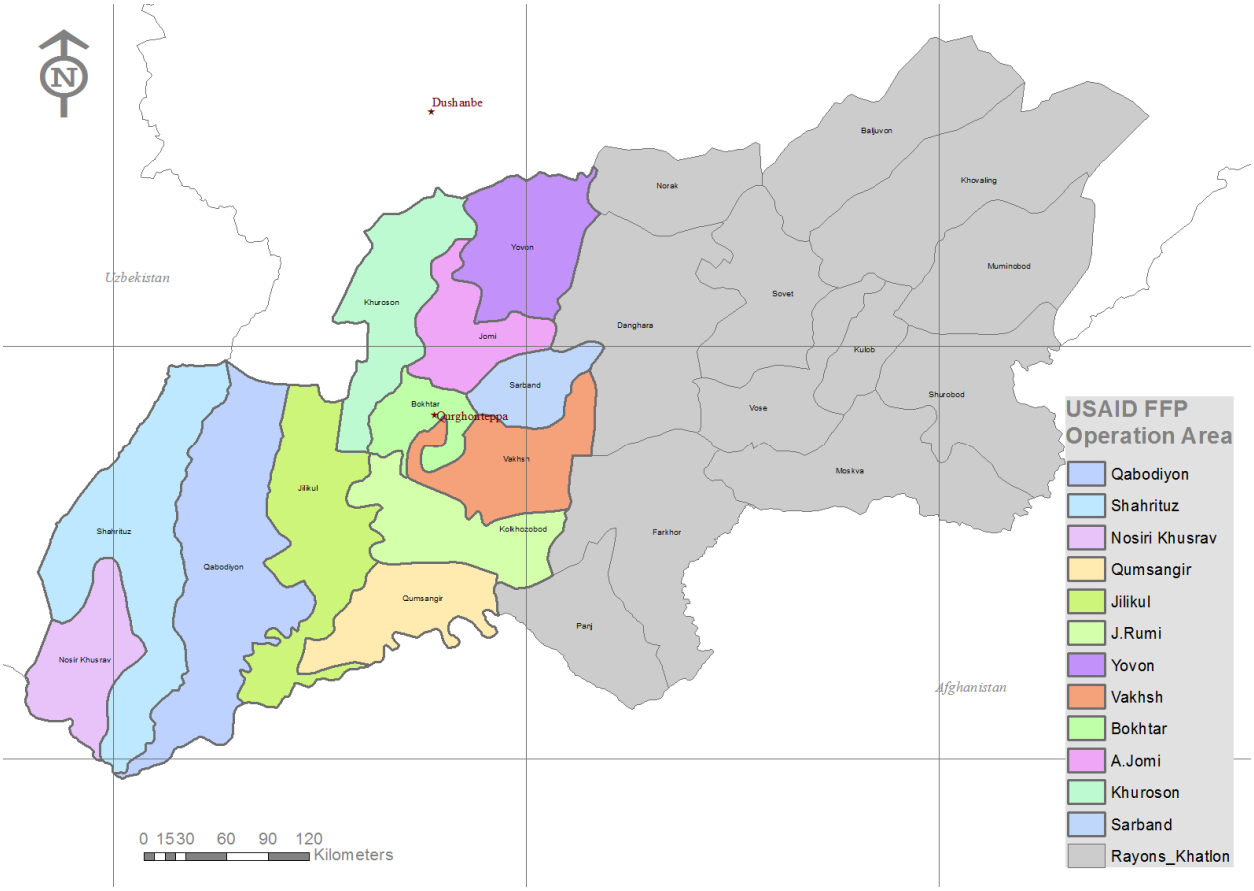
The following FFP activities to support improved irrigation water management were implemented: 1) establishment of WUAs by incorporating collective decision making among farmers, and building local capacity through training water users in effective water management; 2) fostering a supportive environment for the development of WUAs and water management reforms through the promotion of new irrigation policies, building relations with all levels of government, and public outreach; and 3) rehabilitation of irrigation canals and other infrastructure.

3.2 Establishing WUAs

The principle behind WUA establishment in Tajikistan is to bring about a more efficient supply of water to the newly created *dekhan* farms, and to create a structure that would help delineate responsibilities between farmers and local governments with regard to maintaining irrigation infrastructure.[5] Under the FFP, WUAs were formed between 2011 and 2013 in 12 target districts of Khatlon Province: Nosiri Khusrav, Shahrituz, Qubodiyon, Jilikul, Qumsangir, Rumi, Vakhsh, Bokhtar, Sarband, Khuroson, Jomi, and Yovon (Family Farming Program Staff 2014).[6] The 12 districts are supplied with water from the Vakhsh and Kafernihon river basins. The primary beneficiaries of the FFP WUA support were mid- to small-scale *dekhan* farms, although some WUAs also served household kitchen gardens and presidential plots. Figure 2 shows the districts under the FFP.

[4] The FFP consisted of many other activities beyond water management. Since this evaluation only examines the impacts of the water management component of the FFP, we do not report on the other components (such as food processing, procuring credit, and so on).
[5] WUA development projects have been carried out in different regions of Tajikistan, largely financed and guided by major international donors and organizations. Depending on the organization backing or implementing the intervention, WUAs may differ in terms of scale and size, geographic organization along either administrative or hydraulic boundaries, and methods of coordination with government officials, as well as training and infrastructure support. There are currently around 400 WUAs that have been organized and registered in the country.
[6] In the early stages of the FFP, two WUAs were created in Kulob and Vose districts. However, no further WUAs have been developed in either district since that time.

Figure 2: USAID districts in Khatlon Province under FTF



Source: Family Farming Program Staff 2013c

A defining quality of USAID WUAs in Tajikistan is the geographic organization of WUA service areas according to hydraulic boundaries, typically 2,000 ha in size.[7] Prior to USAID involvement, WUAs were conventionally organized along administrative boundaries—primarily along boundaries of *jamoats*—and not much attention was given to farmer consultations during WUA formation. The theory underlying USAID's change in approach maintained that organizing WUAs along hydraulic boundaries, as opposed to administrative boundaries, would

[7] Additionally, USAID has worked solely with farmers who use gravity schemes as the dominant method of irrigation.

more adequately supply water to different plots of land along a watercourse (Vermillion 2014; Family Farming Program Staff 2013b). Furthermore, USAID's approach held that WUAs created along hydraulic boundaries, in conjunction with bottom-up efforts to involve local communities through training and demonstrations that enable them to organize themselves into formal associations with popularly elected officers, were better suited to promote equitable and timely distribution among water users (Svendsen and Sharofiddinov 2014; DAI 2011a).

The process of constructing a WUA through the FFP model involved multiple steps, typically spanning a period of three months. Following several initial meetings and consultations between program staff and the local communities in intended project areas, the WUA organization process was carried out through capacity building activities between trained Association Organizers (AO), technical specialists, and other FFP Irrigation Water Management staff. These activities included informal and formal trainings, site visits to other areas with functional WUAs, and focus group discussions, as well as the distribution of informative manuals and booklets. Besides farmers, district and *jamoat* officials also participated in these exchanges (Family Farming Program Staff 2013a, 2013b). Established WUAs received continued support throughout the duration of the project through grants awarded based on the need for irrigation infrastructure. The FFP trainings generally covered a five-part curriculum consisting of financial management, WUA organizational structure and formation, water conflict management, maintenance plans for irrigation systems, and community organization (DAI 2012b; DAI 2011b; US Government 2012).

Integrated Water Management staff worked with local farmers to develop their own bylaws and standards for electing WUA officers and sub-structures (e.g., Water User Groups (WUGs), audit and conflict resolution committees, and so on), as well as methods to access credit and calculate water delivery costs through performance-based budgeting (USAID Family Farming Program for Tajikistan 2014). Training activities on grant management and WUA membership fee collections were provided to train farmers to invest in irrigation maintenance and infrastructure. Grant management trainings offered instruction on types of grants available, the application and evaluation process, implementation process and compliance (Family Farming Program Staff 2014). The FFP WUAs were formalized by registering them with district tax authorities. WUA offices served as a center of operations for newly created associations, and were supplied with

office equipment and computers provided by USAID.

By the end of FFP, the program had overseen the organization and registration of 56 new WUAs, as well as the strengthening of four WUAs previously formed under WUASP. In total, 60 WUAs were organized and strengthened throughout the project life span in Khatlon.[8] Additionally, the FFP had increased WUA membership fee collection rates to the project target of 60 percent, delivered 538 capacity-building and training sessions, and met project targets for increased area under improved water management and irrigation infrastructure at a cumulative size of 190,634 ha (Family Farming Program Staff 2014).

3.3 Fostering Support for WUA Development

Cooperation between program representatives and authorities at different levels of the government in Tajikistan has remained a major feature of the FFP, ranging from engagement with national entities to *jamoat* or village leadership. At the national policy level, the FFP supported irrigation sector reforms in coordination with the Ministry of Energy and Water Resources (MEWR) and the Agency for Land Reclamation (ALRI). This included engaging stakeholders in a legal analysis of the 2006 WUA law and drafting a revised version for review, as well as organizing a conference on strengthening WUAs within the broader context of water sector reform in Tajikistan (Family Farming Program Staff 2014; DAI 2011b). At a more local level, meetings were also held with *jamoat* heads and *Vodkhoz* offices to discuss the need for cooperation, and explain the objectives and implementation plans of the FFP. Developing relations and meeting with local officials and government agencies were viewed as being essential in securing a supportive network for newly formed WUAs, which promotes organizational resilience.

USAID worked closely with other international donors and organizations supporting WUA development in Tajikistan during the FFP. Following their adoption of USAID's WUA model, the World Bank worked alongside the FFP to identify successful and low-cost alternative

[8] This includes the 12 districts comprising the FTF project area, as well as the districts of Kulob and Vose, which received WUA development support in 2012 during the early stages of the FFP before its integration into FTF. Also, this does not include one drinking water association, which was also initiated under the FFP in coordination with Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH.

methods to developing WUAs that relied on local partners. In 2014, the FFP specialists conducted trainings for three local nongovernmental organizations (NGOs) under a World Bank program called Public Employment for Sustainable Agriculture and Water Resources Management Project II (PAMP II) (Family Farming Program Staff 2014). The FFP staff have also provided assistance to the Swiss Agency for Development and Cooperation (SDC) with their Cooperation Integrated Water Resource Management Project (Family Farming Program Staff 2014).

On a number of occasions, the FFP made efforts to broadcast key WUA activities through local radio and television stations (DAI 2012b). Public outreach measures generally publicized the FFP success stories and highlighted cross-site visits between water users as well as irrigation rehabilitation projects.

3.4 Rehabilitating Irrigation Infrastructure

The FFP efforts to rehabilitate and reconstruct deteriorated irrigation infrastructure occurred concurrently with WUA projects, and primarily involved delivering control or distribution gates and lifting mechanisms, and coordinating the cleaning of drainage canals and irrigation canals, as well as other general maintenance. Although the FFP engineers and Integrated Water Management staff provided guidance, water users and other community members primarily carried out infrastructure rehabilitation and reconstruction projects independently. Similarly, the costs for such repairs were sourced either through grant applications or WUA membership fees. The FFP reported that in addition to grants approved by USAID for the rehabilitation of irrigation and drainage systems, WUAs contributed over 20 percent of their repair amount as a cost share during the third year of the program (Family Farming Program Staff 2013a).

By the end of 2014, USAID had disbursed a total of $2,908,061 (USD) in grants for WUA development and rehabilitation of irrigation systems. A total of 968 water control gates had been repaired and installed under FFP supervision, and 50,220 meters of canals and 84,920 meters of drainage canals were cleaned and excavated, respectively (Family Farming Program Staff 2014).

Throughout the program, the FFP technical specialists assessed the needs of canals and other irrigation infrastructure within project areas. These assessments were often conducted at the

village level, and sought to actively involve farmers and community leaders in an effort to increase self-sufficiency and spread public awareness (Family Farming Program Staff 2013b). On occasion, the FFP purchased necessary machinery for repair of infrastructure, such as water control gates or excavators, and provided them as in-kind assistance to particular villages and WUA areas (Family Farming Program Staff 2013b).

While efforts to rehabilitate sources of water predominantly addressed issues surrounding on-farm and drainage canals, water treatment also represented a minor part of the FFP activities. In one case, water from hand pump wells were tested for *E. coli* and other waterborne diseases as a way of promoting a healthier living environment for farmers (DAI 2012a).

3.5 Conclusion

Water management activities under the FFP revolved around establishing WUAs delineated along hydraulic boundaries and employed community-based approaches that provided WUA members with training in levying, paying, and collecting fees; preparing repair and maintenance plans; establishing WUA bylaws and regulations; as well as conflict resolution. This approach is hypothesized to improve timely and equitable distribution of water on farms, and such improvements in on-farm water delivery could impact yields, crop choice, and activities of agricultural workers.

However, many factors could unravel the functioning of these WUAs, particularly beyond the period of direct project support, which in turn could compromise impacts achieved. This provides the motivation for examining whether:

- WUAs are functioning resiliently over time (Chapter 4);
- the impacts achieved on-farm with respect to improvements in yield and changes in crop choice are sustained (Chapter 5); and
- these rehabilitated institutions change economic opportunities in agriculture, especially regarding gender (Chapter 6).

4 Challenges to the Functioning of Water Users Associations

4.1 Introduction

This component uses surveys and descriptive analysis to examine WUAs in southern Tajikistan, to understand the factors that might affect the functioning of these institutions over time. A first survey of WUAs was carried out in 2015; a second survey of the same WUAs will be implemented in 2016.

The earliest efforts to reform the post-Soviet era water sector began in 1996 and were headed by the World Bank. The 'Agriculture Recovery and Social Protection Credit' program made the first effort towards introducing user charges for irrigation, and began a dialogue on the formulation (in the future) of associations that would organize irrigation locally, and finance them through irrigation and membership fees.[9]

The World Bank's Farm Privatization Support Program between 1999 and 2005 made some of the earliest efforts to create and organize WUAs. These efforts were also coordinated in the World Bank's Rural Infrastructure Rehabilitation Program between 2000 and 2007. USAID put into place a WUASP between 2004 and 2011. A law on WUAs was passed in 2006 in coordination with donors and the government, as there were no laws to support and protect WUAs.[10] The law stipulated that the primary function of the WUA was to ensure maintenance and management of secondary and tertiary irrigation canals, by organizing local water users and collecting membership fees to ensure the maintenance of infrastructure in exchange for access to water resources.

Despite these efforts, in the early years, a few challenges in particular, threatened the functioning of WUAs, especially as active support from donors was phased out. Salaries of WUA staff used to be paid from the project funds, which resulted in WUAs ceasing to operate after the project ended. A second particular problem involved operations, and repair and maintenance, with confusion about the responsibility of the government and WUAs, and the farmer's role in these

[9] Implementation Completion Report, Agriculture Recovery and Social Protection Credit, World Bank. June 25, 1998.
[10] "Water User Associations" Law of the Republic of Tajikistan, #378, November 8, 2006.

activities. These issues were perhaps not surprising. WUAs are decentralized resource management systems. Such local-level institutions, in a formerly centralized state, are likely to face considerable challenges.

More recent efforts to support WUAs were made in 2011, where amendments related to approaches for collecting irrigation service fees and the property rights of the WUA over irrigation infrastructure were made. No studies have been carried out to identify whether these changes have brought about any improvements to reduce the challenges to the functioning of WUAs. Additionally, the challenges might not be the same for all types of WUAs. For example, WUAs supported by the *jamoat* might have different experiences than those supported by USAID or the World Bank, as the modalities of setting up these WUAs are often different.

To understand the factors that might threaten the functioning of WUAs, a review of project documents was undertaken and interviews were conducted with donors. This review provides a foundation for identifying specific areas that could create challenges for the survival of WUAs. Simultaneously, a survey was implemented in early 2015 in southern Tajikistan, in which data on governance, membership, organizational characteristics, functions and power, capacities and capabilities, disputes, water delivery, repairs and maintenance, and finances of WUAs were collected. WUAs were asked to report on these parameters for the 2014 calendar year. In a separate survey (reported in Chapter 5), *dekhan* farms were interviewed to understand their perspective on governance, disputes, repairs and maintenance, and payment of fees, again for the 2014 calendar year.

This chapter reports the findings from the review, which will provide a foundation for examining specific factors that might hinder the survival of WUAs. Then, the findings from the WUA survey and the *dekhan* farm survey are brought together to highlight some key challenges. The WUA survey collects data from the perspective of an organization that provides a service to farmers. The *dekhan* farm survey collects data from the perspective of the receivers of the service. Understanding these different perspectives can also shed light on the challenges faced by WUAs.

A second round of data on governance, disputes, water delivery, repairs and maintenance, and finances will be collected from WUAs at the end of 2016, again through a survey. Examining the

two WUA datasets together will provide an understanding of whether the challenges have increased in seriousness, especially after active donor support has ceased in areas supported by USAID.

4.2 Data and Methods

4.2.1 A Review of WUA Approaches

A systematic review of project proposals, reports, and evaluations for WUA-related projects and programs in Tajikistan was undertaken as the first step. The systematic review follows a protocol of document selection based on an eligibility criterion, review of qualified documentation, and synthesis of information, described by 3ie (3ie 2015). The following criteria were used in determining which WUA-related approaches would be reviewed:

1. WUA projects would be conducted in large-scale irrigation schemes of any project in Tajikistan.[11]
2. The project would provide sufficient evidence for on-the-ground work that leads to the development of WUAs or strengthening of existing WUAs, in the form of technical assistance or institutional organization, or a combination of both.[12]
3. The documentation would include detailed information that can be compared across all WUA development approaches on the following factors: name of the donor project, project implementers, dates and duration of implementation, geographic location, approximate project budget, approximate number of WUAs created, approximate number of existing WUAs that were strengthened, description of institutional improvements, and description of technical improvements.

IWMI staff collected formal academic publications about WUAs in Tajikistan, such as assessments of WUA development in Tajikistan, donor project documentation, such as WUA development protocols, and quarterly and final project reports. A consultant from ALRI was

[11] Projects that deal solely with rural drinking water supply and sanitation were not included in the review.
[12] As such, broad, policy-based or legal-based programs were excluded from the analysis, as well as those that only provided rehabilitation of irrigation infrastructure that is associated with WUAs during disastrous events.

hired to collect the initial documentation database, by sending formal letters to request project reports and materials from the major international donors. Additional documentation was collected using Google and Google Scholar search databases. Databases of the major donor organizations, such as the Asian Development Bank (ADB), World Bank, and USAID, were mined for reports that included the term "Water User Association". In all, 22 projects, implemented by seven donors, were chosen for review. These projects, along with their descriptions, are listed in Table 1.

Additionally, a semi-structured interview protocol was developed (Annex 1) to fill in data gaps pertaining to the selection of communities for WUA development, the level of involvement with local governments, and the nuanced experiences and perspectives that could not be gained from the project documentation alone. This interview was conducted with major donor organizations involved in WUA development and key knowledge sources such as ALRI. The interviews were conducted with the Aga Khan Foundation, The Mountain Societies Development Support Programme (MSDSP), *Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ), Swiss Development Corporation (SDC), *Helvetas*, USAID, World Bank, Welthungerhilfe, United Nations Development Programme (UNDP), Sarchashmaye Hayot, Tajik Branch of the Scientific Information Center of the Interstate Commission for Water Coordination of Central Asia (SIC-ICWC), and ALRI under the Government of the Republic of Tajikistan.

4.2.2 Designing a Study of WUAs

WUAs supported by USAID lie in predominantly gravity-fed areas of three irrigation schemes – Yavan-Obikiyik, Vakhsh and Lower Kofarnihan. To have a larger sample of WUAs, and to understand similarities and differences in challenges, seven other irrigation schemes across three major agricultural provinces of Tajikistan were purposely identified: with four schemes in Khatlon Province (Panj, Parkhor-Chubek, Kyzylsu-Yakhsu and Danghara); one scheme in the District of Republican Subordination Provinces (Hissar); and two in Sughd Province (Isfara and Khojabakirgan-Aksu).

The 10 irrigation schemes cover 164 *jamoats*. A short interview was administered to officials at the *jamoat* offices to document all WUAs registered and functioning within its administrative boundaries; 150 WUAs were identified.

Table 1: Projects and donors reviewed

ID	Initiating agency	Donor	Implementer	Project name	Start year	End year	Duration (years)	Budget (USD)
1	Asian Development Bank(ADB)	Asian Development Bank	Ministry of Land Reclamation and Water Resources (MLRWR), Project Management Units (PMUs)	*Irrigation Rehabilitation Project*	2003	2010	7	28.67 million
2	ADB	Asian Development Bank	MLRWR, PMUs	*Agriculture Rehabilitation Project*	2005	2011	6	49.97 million
3	ADB	Asian Development Bank, Global Environment Facility under the Central Asian Countries Initiative for Land Management	Ministry of Agriculture, PMUs	*Rural Development Project*	2007	2014	7	15.28 million
4	ADB	Asian Development Bank	MLRWR, PMUs	*Building Climate Resilience in the Pyanj River Basin*	2013	2015	2	21,550
5	Aga Khan Foundation (AKF)/Mountain Societies Development Support Programme (MSDSP)	Canadian International Development Agency	AKF	*Community-based Agricultural Development Sector for Tajikistan*	2004	2009	5	Not specified
6	*Welthungerhilfe* (WHH)	World Bank, German Federal Ministry for Economic Cooperation and Development, European Union, European Commission EIDHR	WHH/German Agro Action with local NGOs and the government	*6 WUA projects (2-3 years each) in Penjikent District*	2006	2015	9	300,000 (est. per project)
7	Swiss Development Corporation (SDC)	SDC	IWMI, Scientific Information Center of the Interstate Commission for Water Coordination of Central Asia (SIC-ICWC), MLRWR	*Integrated Water Resources Management Project in the Ferghana Valley*	2001	2011	10	12.85 million
8	SDC	SDC/Agency for Technical Cooperation and Development (ACTED)	*Deutsche Gesellschaft für Internationale Zusammenarbeit* (GIZ), *Helvetas*	*National Water Resources Management in Tajikistan*	2014	2018	4	7.4 million

9	United Nations Development Programme (UNDP)	UNDP	European Union (EU), UNDP, the government, Irrigated Agriculture Consulting	*Promoting Integrated Water Resources Management and Fostering Transboundary Dialogue in Central Asia*	2009	2012	3	300,000 (est.)
10	USAID	USAID	WUASP collaboration, ACTED, Center for International studies and Cooperation(CECI), Cooperative for Assistance and Relief Everywhere (CARE), local NGOs	*John Ogonowski and Doug Bereuter Central Asia Farmer-to-Farmer Program*	2003	2008	5	Not specified
11	USAID	USAID/Winrock	Winrock	*Water Users Association Support Program*	2004	2011	7	8.2 million (in Tajikistan)
12	USAID	USAID	DAI	*Family Farming Program*	2010	2015	5	7 million
13	World Bank	World Bank	PMU	*Agriculture Recovery and Social Protection Credit*	1996	1997	1	50 million
14	World Bank	World Bank	Riverside Technology, Inc., PMUs	*Farm Privatization Support Project*	1999	2005	6	23.5 million
15	World Bank	World Bank	Riverside Technology, Inc., MLRWR, PMUs	*Rural Infrastructure Rehabilitation Project*	2000	2007	7	24 million
16	World Bank	World Bank/ /Global Environment Facility grant	PMU	*Community Agriculture and Watershed Management Project*	2004	2012	8	16.75 million

17	World Bank	World Bank	ADB, USAID, State Secretariat for Economic Affairs (SECO), Ministry of Melioration and Water Resources Management, Sughd *Oblast* Water Resources Management Department, PMU	*Ferghana Valley Water Resources Management Project*	2005	2014	9	24.21 million
18	World Bank	World Bank	PMU	*Public Employment for Sustainable Agriculture and Water Resources Management (PAMP I)*	2010	2011	1	10.26 million
19	World Bank	World Bank /Global Agriculture and Food Security Program (GAFSP)	PMU	*GAFSP supplement to PAMP I*	2010	2011	1	30 million
20	World Bank	World Bank	PMU, ALRI	*Second Public Employment for Sustainable Agriculture and Water Resources Management (PAMP II)*	2013	2020	5	45.9 million
21	World Bank	World Bank	PMU	*Environmental Land Management and Rural Livelihoods Project*	2013	2018	5	16.88 million
22	World Bank	Climate Investment Funds	CDE, ADB, World Bank, and European Bank for Reconstruction and Development	*Pilot Program for Climate Resilience*	2014	2018	4	40.85 million

A questionnaire was designed to collect data from WUAs in early 2015 (Annex 2). It was administered to the WUA chairs or managers. If these individuals were not available, the engineer or treasurer of the WUA was interviewed.[13] Data on the following were collected: land use and crop production, functions and powers, governance and membership, training and skills, infrastructure and maintenance, fees and finances, water delivery, and water disputes. Respondents were asked to report on the factors as of 2014. One hundred and forty one WUAs answered the questionnaire, of which 74 WUAs were created by USAID (Table 2). All but one USAID WUA lie in Khatlon Province, of which 64 lie in FTF's Zone of Influence; while 9 (older) WUAs are located outside the Zone of Influence. WUAs not created by USAID are located in Khatlon, Sughd, and DRS provinces, including 14 WUAs that are located in FTF's Zone of Influence. All USAID WUAs in the sample were financed and created by USAID directly. All non-USAID WUAs were financed by other donors (e.g. World Bank, ADB, UNDP) but were created by Project Management Units (PMUs) that are typically staffed with government officials.

Table 2: WUAs in the study

PROVINCE	KHATLON		SUGHD	DRS	TOTAL
	FTF Zone	Non-FTF Zone			
USAID created	64	9	1	0	74
Created by others	14	21	26	6	67

A second survey will be administered to WUA officials towards the end of 2016 to collect information about governance and membership, infrastructure and maintenance, fees and finances, water delivery, and water disputes.

4.3 Results

4.3.1 Challenges Identified by Donors

Table 3 reports a few important characteristics in the creation of WUAs, organized by donor type, and is based on the literature review and the interviews conducted.

[13] This happened in 10% of the interviews.

Table 3: Setting up WUAs—assessment and assistance

Donor	Average time for WUA setup	Selection criteria	Assessment protocols	Community's role	Technical assistance
ADB	Not specified	Not specified	Not specified	Irrigation and drainage schemes are designed by those served by WUAs	Infrastructure, irrigation and drainage systems are rehabilitated
AKF/MSDP	5-6 months	Establish a village organization; submit a request to the MSDSP regional office before selection into program	MSDSP assesses the area and feasibility of the project (financial, water shortages, health risks)	*Mirob* (water manager) as well as membership fees determined at first general meeting	Not specified
WHH/GAA	4-5 months	WHH project-derived questionnaire assessing land area, agriculture, irrigation services and population; a formal request from local farmers to establish a new WUA	WHH and *Vodkhoz* assess areas; local authorities, farmers and other stakeholders involved	Unclear	Minimal
SDC	1-2 years, with continued support from the *jamoat*	Willingness of community, level of agricultural development, and level of willingness of *jamoat*	Infrastructure, land, technologies used, policy dialogue, ownership, sustainability, tariffs, and capacity are assessed	Communities are engaged in the design of the WUA	Infrastructure support, agricultural machinery
UNDP	6 months, plus continued support for setting up the WUA; 1 year to fully develop infrastructure, and provide technical support and agricultural machinery	Communities with hydrological boundaries that allow for WUAs no less than 500-1,000 hectares and are willing to pay a membership fee	Not specified	Unclear	Infrastructure support, agricultural machinery
USAID	3 months, followed by continued support	Areas irrigated by gravity schemes, willing communities and support from local government	Irrigation and geographic information system (GIS) specialists assess the current state of irrigation management	Communities elect a WUA head and committee	Infrastructure support, agricultural machinery
World Bank	3 months, followed by continued support	WUA feasibility and the potential for institutional sustainability	Preliminary inventory of irrigation management; develop a strategy for community participation	Unclear	On-farm and off-farm infrastructure supported

All WUAs are created with the involvement of the community. They may either be involved in designing the structure of the WUA (such as in case of SDC) or be brought together by a local NGO to elect a committee (such as in the case of USAID and AKF). The need for communities to be involved in the setting up of WUAs is acknowledged and understood by all the donors as being important for increasing the success of the WUA.

Almost all the donors also provided technical support, but there is variation in the extent of support. For example, ADB rehabilitated irrigation and drainage infrastructure, while donors such as the World Bank, AKF, and USAID provided some infrastructure support, primarily in the form of replacing water gates. The type of support provided is likely a function of the state of the infrastructure when WUAs were created. The fact that this was taken into account is also a positive factor for increasing the chances of WUAs functioning to serve the needs of their farmers.

The time taken to set up a WUA also varies, with the SDC approach taking about a year, and the World Bank and USAID approaches taking about three months. Most donors continue to provide support even after the WUAs are created and functional, notably USAID, World Bank and SDC. This is an important factor, as new local organizations are likely to require support to weather challenges that need to be solved through collective action and rule enforcement.

Table 4 reports a few factors that repeatedly came up in the interviews with donors; these factors are likely to affect the functioning of the WUAs detrimentally. One point pertains to fee structures set up at the inception of WUAs, which have implications for financial health over time. Another point concerns the division of responsibility among various actors at inception, and the implications it has as WUAs mature.

4.3.1.1 Responsibilities of the donor, WUA, and the jamoat

One point pertains to the roles of the donor, WUA, and the *jamoat*. For example, aid agencies hire experts from local NGOs to create WUAs, along with support from the *jamoat*. The development banks, on the other hand, create project management units staffed with national and *jamoat* officials. The exact nature of responsibilities of the donor, WUA, and the *jamoat* is often not clear. While being less of a challenge during the setup of WUAs, this is likely to have

Table 4: Setting up WUAs—governance

Donor	Fees	Election	Rule enforcement	Agencies involved in setting up the WUA
ADB	Irrigation service fee	Not specified	Not specified	Employment of government officials and local NGOs through the PMU
AKF/MSDP	Service fee, salary for *Mirob*, and a water tariff; sometimes fees may be per capita, per household or a flat tax per household	During one of the first general meetings, villagers will elect a *Mirob* as well as decide on fees	*Mirob* (poor farmers exempt from paying)	MSDSP
WHH/GAA	Membership fees for the organizational maintenance of the WUA, such as staff salaries, as well as to support their financial scope of action and ability to provide services, such as the cleaning of channels	All WUA presidents democratically elected	Not specified	WHH, *jamoat*
SDC	Membership fees are separate from water tariffs, which are also paid to the WUA; membership fees are collected for services provided by the WUA, for example, restoration of infrastructure, as well as for WUA management, salaries and electricity	Not specified	WUA (the fees are adjusted so that the farmers who are better off pay to cover the costs of those who cannot afford to pay)	International NGO selected by bidding process; local government involved in policy dialogue
UNDP	Fees go towards WUA officials' salaries. In each WUA, there are four salaried positions. The farmers themselves decide on how the salaries should be calculated. These salaries respect the national minimum wage law.	WUA members elect administrative roles	Depends on the WUA, differs from WUA to WUA	Local NGO experts, *jamoats*
USAID	Membership fees pay WUA staff salaries among other expenses; they are usually determined by the size of the individual member's land area, for example, TJS 10 or TJS 20 per hectare	Dependent on WUA structure	Conflict resolution committee and the audit committee generally intervene in such cases	Local NGO experts, *jamoats*
World Bank	Membership fees, which are defined and organized by WUA members with help from local NGOs	Dependent on WUA structure	Dependent on WUA structure	Government officials and local NGOs

consequences especially for repair and maintenance of waterways and irrigation infrastructure over time. Depending on the type of donor, these challenges could vary.

A related point pertains to the roles of the *Vodkhoz* and the WUA. In nearly all the interviews conducted with donors, there were several concerns about the role of the *Vodkhoz* in relation to that of the WUA. During the Soviet period, the *Vodkhoz* was established to provide water for irrigated, collective and state farms. Following Tajikistan's independence in 1991, the *Vodkhoz* continue to administer the provision of irrigation water and collection of fees for providing this service. Today, the role of the *Vodkhoz* in relation to the WUA is unclear. Interestingly, however, the role of the *Vodkhoz* did not appear to be incorporated in project proposals examined by the research team. Only some donors mentioned the need to clarify this relationship in the interviews conducted.

The main discrepancy of this relationship appears to be based on fees. According to interviews conducted, most often, farmers will pay the *Vodkhoz* not knowing how they are being charged or how they should keep a record of the payments made. Sometimes, WUAs collect the irrigation service fees using receipts issued by the *Vodkhoz* and then submit these receipts to the *Vodkhoz*. So, WUAs are actually performing the role of the *Vodkhoz*. WUAs are becoming less trusting of, and less willing to cooperate with *Vodkhozes*, who they accuse of trying to control the WUAs' operations. Such WUAs have little faith in the 'WUA Support Centers' at *Vodkhoz* offices. Conversely, the *Vodkhoz* do not trust WUAs for similar reasons. This conflict appears to be prevalent across most donor and government official experiences. However, the nature of this conflict could vary according to whether the WUAs were initiated by the *jamoat* versus through mobilization efforts being made by a donor with the assistance of a local NGO. For example, WUAs created by *jamoats* themselves may enjoy more cooperative relations with the *Vodkhoz,* especially if the *Vodkhoz* was involved in mobilizing the group.

4.3.1.2 Confusion over fees

Another point of contention and challenge among donors is in relation to fees, either membership fees or irrigation service fees. According to the interviews conducted, one donor representative mentioned that, when asking farmers about WUA-related fees, their responses varied widely. This may lead to the conclusion that the fees are generally not very well known and/or not

transparent. Fee structures also vary from WUA to WUA. For example, for some WUAs, there is an annual membership fee, but also monthly irrigation fees. Other WUAs have different sets of fees, which depend on the type of land tenure.

WUA fees are often collected for the payment of WUA board or staff salaries and the operations of maintaining the administration of the WUA. WUA fees are also used for maintenance and rehabilitation of irrigation systems. They could be used sometimes for payment of irrigation service fees, which are supposed to go to the *Vodkhoz*. Additionally, three donor representatives stated that tariffs were very important in terms of financial sustainability of the WUA. The purpose, calculation, and enforcement of membership fees, irrigation service fees, and tariffs were unclear from both the project documentation and responses received from the semi-structured interviews. It is assumed that these aspects of WUA operations are different depending on the WUA, and the donor scheme used.

4.3.2 Challenges Faced by WUAs

In this section, descriptive findings are presented using the data collected from the WUA study. These findings are presented by the type of WUA; we distinguish between USAID WUAs that were funded and created by USAID; and non USAID WUAs that were funded by other donors (such as the ADB, World Bank, UNDP) but were created by PMUs that are typically staffed with government officials at the district and/or jamoat level. These findings echo the challenges identified by the donors in section 4.3.1, and also provide evidence of a few more challenges.

4.3.2.1 WUAs are relatively inexperienced

The average WUA is around 3.9 years old, with non-USAID WUAs marginally older than USAID WUAs (Table 5). USAID WUAs also get much longer support, around 1.89 years (23 months) in comparison to 0.7 years (~ 8 months) for non USAID WUAs.

Table 5: Age of WUAs and years of support provided

		USAID-treated	Non-USAID-control	TOTAL
Age of WUAs in 2015 (*years)*	Mean	3.7	4.0	3.9
Years of donor support	Mean	1.89	.73	1.3
Total number of WUAs by each group		74	67	141

Table 6: WUA structure and spread

(Number in each group)	USAID-treated	Non-USAID-control	Total
Exactly matches *jamoat* boundaries	18	30	48
Spills across *jamoat* boundaries	28	11	39
Completely falls within *jamoat* boundaries	28	26	54
Total number of WUAs	74	67	141

USAID WUAs are also likely to be structured around hydraulic boundaries that do not necessarily match administrative boundaries (Table 6). Among 48 WUAs that exactly match jamoat boundaries, 30 (63%) were non USAID, with only 18 (37%) USAID. In contrast, of the 39 WUAs that spill across administrative boundaries, only 11 were non-USAID (28%), compared to 28 USAID (82%). The spread of the WUAs may have implications for repair and maintenance. For example, WUAs that spill across *jamoat* boundaries may need more coordinated approaches, if two *jamoats* have to be involved in the repairs.

Table 7: Area served by WUAs

		USAID-treated	Non-USAID-control	Total
Total service area (ha)	*Mean*	1718	1656	1688
Cultivated area (ha)	*Mean*	1697	1620	1660
Actual irrigated area (ha)	*Mean*	1656	1396	1533
Ratio of irrigated to service area	*%*	96	84	91
Number of WUAs	N	74	67	141

Service areas of WUAs are somewhat similar, with the USAID WUAs serving marginally larger areas (Table 7). The cultivated areas in the USAID and non-USAID WUAs are also similar. Cultivated areas are larger than irrigated areas, indicating that not all cultivated area is irrigated. The ratio of irrigated area to service area is somewhat different: 96% for USAID WUAs in contrast to 84% for non USAID WUAs. This may be regarded as a measure of better performance on part of the USAID WUAs

These results suggest that WUAs are quite young in age and experience, and have similar service areas, but different irrigated areas. The challenges identified could ease with time; however, some challenges could be attributed to broader institutional features, which would require systematic policy support.

4.3.2.2 Division of responsibilities for the repair and maintenance of irrigation infrastructure

WUA officials were asked to indicate the agency responsible for carrying out repair and maintenance of various types of irrigation infrastructure.

Fifty-seven percent of USAID WUAs, 63% of no-USAID WUAs stated that the primary canals are maintained by the district irrigation department (Vodkhoz); however 26% of USAID and 18% of non-USAID WUAs also did not know who was responsible for the repair and maintenance of these canals (Figure 3).

Figure 3: Responsibility for the repair and maintenance of primary canals

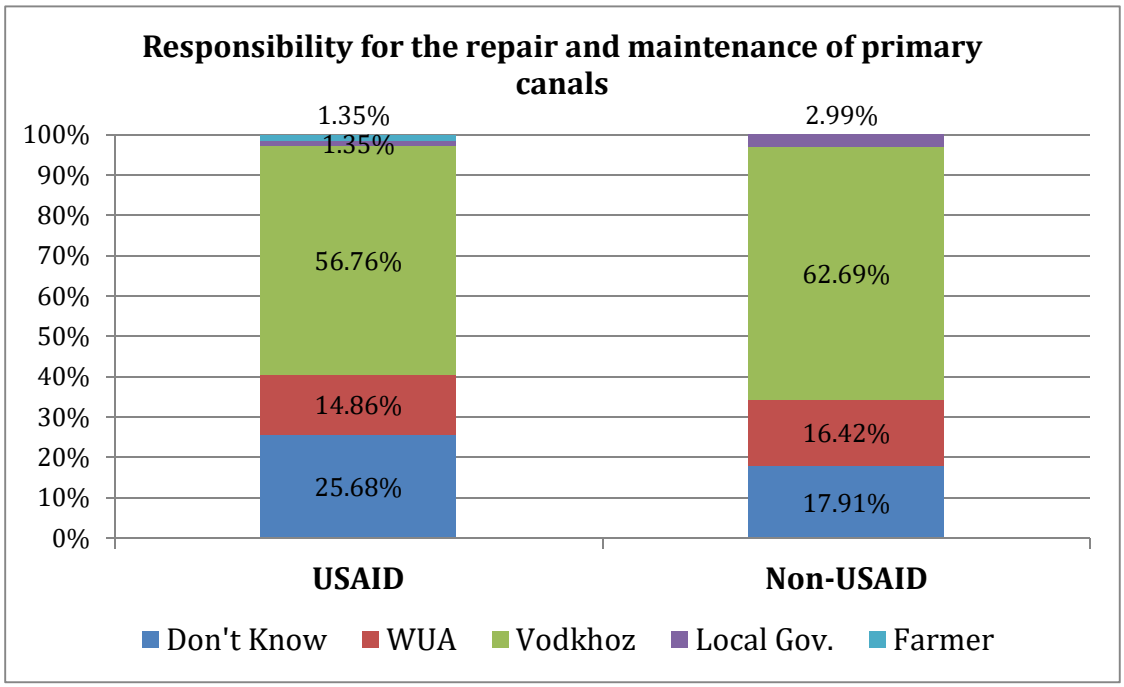
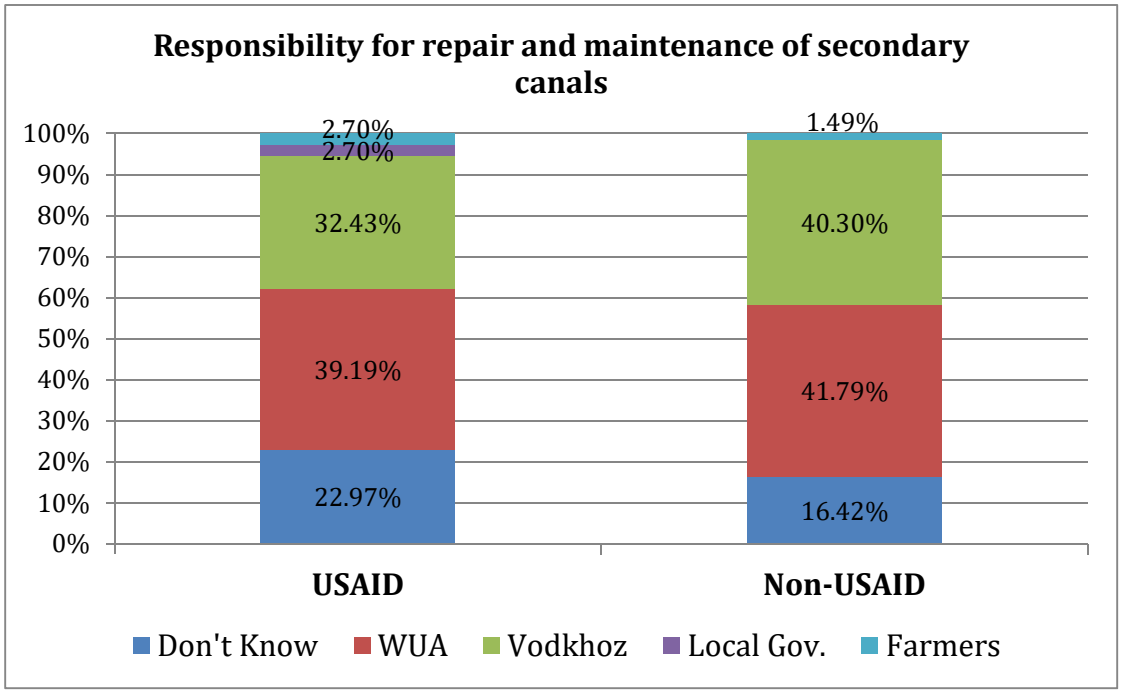


Figure 4: Responsibility for the repair and maintenance of secondary canals

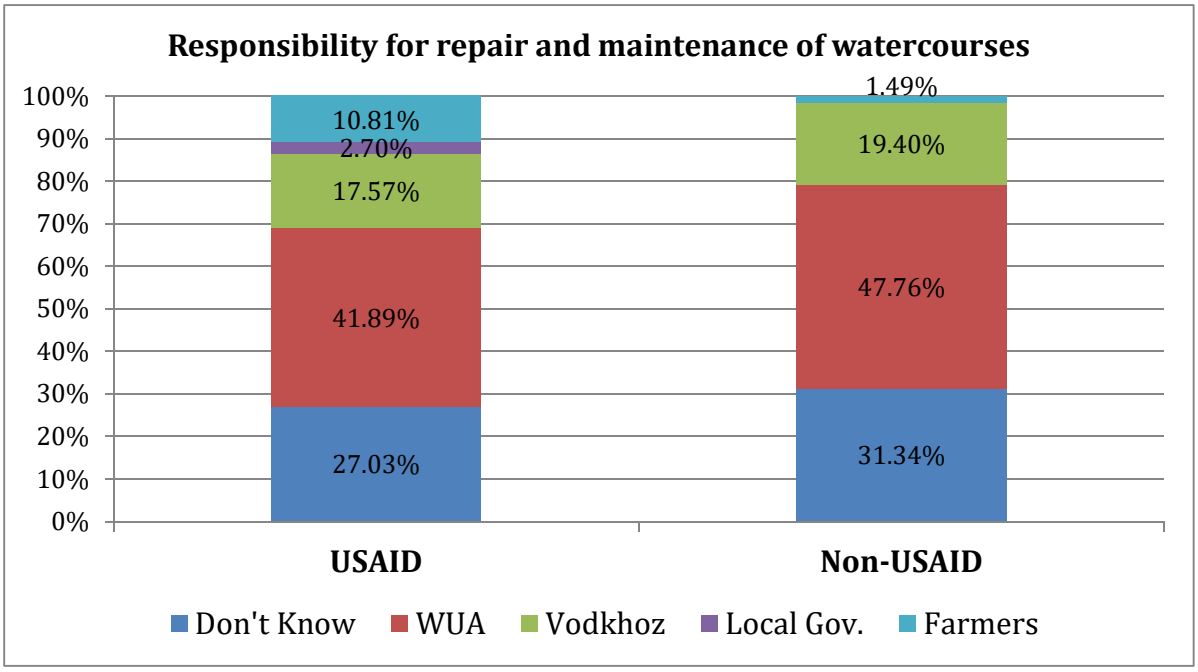


In the case of secondary canals, 39% of USAID WUAs and 42% of non-USAID WUAs responded that the WUA was responsible for the maintenance of secondary canals; however, 32% of USAID and 40% of non-USAID WUAs thought that the responsibility of the maintenance of the secondary canal lies with the *Vodkhoz* (Figure 4). Here too, 23% of USAID WUAs and 16% of non-USAID WUAs did not know who was responsible or the repair and maintenance of these secondary canals.

This discrepancy in the perceived roles of various agents merits further exploration, as this has a bearing on the role of the WUA in maintaining primary and secondary canals. If the distribution of responsibility between the irrigation department and the WUA is different for different types of WUAs, exploring the reasons for these differences would be essential for understanding the factors that affect sustainability of these institutions. However, if these differences are indicative of a lack of clarity on the role of the WUA and the irrigation department, then efforts could be made to communicate these roles more clearly and specifically.

A particular issue pertains to the maintenance of tertiary canals (also called watercourses). When WUAs were questioned about the repair and maintenance of these canals, 42% of USAID WUAs stated that it was the responsibility of the WUAs, and 48% of non-USAID WUAs also stated that it was the responsibility of the WUAs (Figure 5). However, a sizable share of USAID and non-USAID WUAs were not aware of whose responsibility it was to maintain watercourses, with 27% of USAID and 31% of non-USAID WUAs claiming to be unaware.

Figure 5: Responsibility for the repair and maintenance of watercourses



These results emphasize that there is a lack of clarity on how repair and maintenance responsibilities are split between the Vodkhoz, the WUA, and the individual farmers. The number of "don't know" responses, and the split responses between the WUA and the Vodkhoz need to be examined further to understand if can be attributed to localized differences between the way responsibilities are shared, or to gaps in information sharing.

4.3.2.3 Role and structure of irrigation service fees and membership fees

There appears to be a lack of clarity on the method used for levying irrigation services fees. In the study of WUAs, 52% of WUAs reported that irrigation fees are levied by crop type and area, and only 21% of the surveyed WUAs reported that these fees are levied by area. When the farms were surveyed, 80% of the farms claimed that they paid their fees by area alone. This discrepancy highlights the importance of clarifying the fee structure across the farms, WUAs, and the *Vodkhoz*.

Table 8 shows the types of fees collected by the WUA. As the interviews with donors suggest, not only do WUAs collect membership fees, but they also collect irrigation service fees, with

97% of USAID WUAs and 100% of non-USAID WUAs carrying out these tasks. However, there appears to be some lack of clarity on which fees should be retained and which should be remitted to the *Vodkhoz* (Table 9). Membership fees, technically, are to be retained by the WUA. Yet, only 70% of USAID WUAs indicated that they retained the membership fees; however, 79% of non-USAID WUAs reported retaining these fees. On the other hand, irrigation service fees, which are supposed to be handed over to the *Vodkhoz*, appear to be retained by 52% of non-USAID WUAs, but only by 22% of USAID WUAs.

Table 8: Types of fees collected

Does the WUA collect or receive the following fees?	USAID-treated	Non-USAID-control	Total
Irrigation service fee	97%	100%	99%
WUA membership fee	93%	100%	96%
Total WUA responses	74	67	141

Table 9: Types of fees retained

Does the WUA retain the following fees?	USAID-treated	Non-USAID-control	Total
Irrigation service fee	22%	52%	37%
WUA membership fee	70%	79%	74%
Total WUA responses	69	67	136

Recovery of fees at the WUA level also varied with the type of WUA. USAID WUAs were, on average, able to recover 74% of the fees set for collection, with non-USAID WUAs achieving 65% (Table 10). Cost recovery per hectare is higher for USAID WUAs (TJS 69/ha) and lower for non-USAID WUAs (TJS 52/ha). The indebtedness of USAID WUAs to the State Water Provider is also lower than of non-USAID WUAs. Since USAID WUAs are new, it is likely that farmers are more amenable to paying fees. At the same time, this could be due to USAID WUAs using either membership fees or donor grants to cover irrigation charges.

Table 10: Irrigation fees in WUAs

Irrigation service fee (ISF) recovery in 2014	Unit	USAID-treated	Non-USAID-control	Total
Number of members paying ISF	*Farmers*	348	378	362
Total ISF set for collection	*TJS*	154,770	110,995	134,300
Total ISF actually collected	*TJS*	113,968	72,321	94,493
ISF recovery rate	*%*	74	65	70
Mean irrigated area per WUA	*ha*	1656	1396	1533
Service costs recovered	*TJS/ha*	69	52	62
Debt to Vodkhoz	TJS	93,735	155,502	122,293
Irrigation debt out of total debt	%	96	99	97
Total WUA responses		N=74	N=67	N=141

These issues need to be further explored in the second study of WUAs. If WUAs are using membership money for paying irrigation fees, then this could detrimentally impact the timely and adequate delivery of on-farm water within the WUA. On the other hand, if WUAs are keeping irrigation fees that are owed to the Vodkhoz, then this may impact the financial standing of the WUA with the Vodkhoz, leaving it vulnerable.

4.3.2.4 Financial performance

Table 11 provides a breakdown of the source of revenue by WUA type.

Table 11: Sources of revenue for types of WUAs

WUA revenues by key income sources	Unit	USAID-treated	Non-USAID-control	Total
Total revenue in 2014	TJS	252,091	172,258	215,871
Same in dollar equivalent	USD	52,519	35,887	44,973
WUA's irrigated area	ha	1656	1396	1533
Revenue per unit of area	TJS/ha	220	156	191
Same in dollar equivalent*	USD	46	33	40
By sources of income (%)				
Irrigation service fee	% of total	68	74	70
WUA membership fee	% of total	12	25	18
From WUA businesses	% of total	0	0	0
Grants from the government	% of total	1	0	.4
Donor grants	% of total	20	1.3	11
Total WUA responses		N=59	N=49	N=108

USAID WUAs earned significantly more revenue in 2014 than the other two types of WUAs (around USD $53,000) (Table 11). However, a significant share of the revenues comes from donor grants, amounting to 20% of revenues. WUA membership fees comprised only 12% of the revenues. This is in contrast to non-USAID WUAs, where WUA membership fees comprised 25% of the revenue. Money from WUA businesses formed was not an important source of revenue for either category of WUA. With USAID scaling back direct support from its WUAs, it is unclear how the magnitude and composition of revenues will change in the near future. Membership fees may have to be increased in USAID WUAs, as donor financial support is phased out.

Table 12 provides a breakdown of WUA expenditures. Salaries contribute to around half of the operational costs of both types of WUAs, with USAID WUAs having the lower salary share. Payments to governments in the form of fees and taxes also form a similar share. Repair and maintenance formed 17% of the costs of USAID WUAs, and a marginally lower 12% of the costs of non-USAID WUAs. The costs per hectare of irrigated area are the same for USAID and non-USAID WUAs. Identifying how expenditures on repair and maintenance change as sources

of revenue change will be important for understanding how USAID organizations change over time.

Table 12: Expenditures of WUAs

WUA expenditures in 2014	*Unit*	USAID-treated	Non-USAID-control	Total
Salaries	*%*	46	55	50
Energy (electricity, diesel)	*%*	2.5	2.2	2.3
Repair and maintenance work (no labor)	*%*	17	12	15
Expanding local irrigation area	*%*	.4	1.2	.8
Payments to government (fees, taxes)	*%*	27	28	27
Administrative costs (e.g. office)	*%*	14	10	12
Total operational costs	*TJS*	54,982	51,438	53,513
Mean irrigated area per WUA	*ha*	1656	1396	1533
Total costs per hectare	*TJS/ha*	45.8	45.3	45.6
Total WUA responses		N=65	N=46	N=111

Table 13 provides information on the debt of WUAs. Fifty of the 74 USAID WUAs reported to have debts in 2014, with 66% reporting that they had their debts annulled in the past. While more USAID WUAs had debts, the total debt is lower than that in non-USAIDWUAs—the average debt of a USAID WUA was TJS 93,735, while that of non-USAID WUAs was TJS 155,502.

Table 13: Debts of WUAs

WUA debts	USAID-treated	Non-USAID-control	Total
Number of WUAs with debt to Vodkhoz	50	43	93
Percentage of WUAs with debts annulled in the past	66%	23%	46%
Total WUA debts to Vodkhoz (TJS)	93,735	155,502	122,293

These results suggest that USAID WUAs had larger revenues with similar costs per hectare, and lower debts in 2014. However, as the nature of the support offered changes, tracking the financial progress of the WUAs and the implications for salary payment, and repair and maintenance, are useful and important indicators for examining sustainability.

4.4 Insights and Areas for Further Work

This work suggests that there are a number of factors that are likely to affect the functioning of WUAs over time, which are common to all types of WUAs. There are a few additional challenges facing USAID WUAs, which have been recipients of grants that form an important part of their revenues. To understand these dynamics further, a second, more focused, interview/survey of WUAs will be implemented to examine the following themes:

- Support from the *Vodkhoz* and district irrigation department: the roles of the *Vodkhoz* and the district irrigation department in supporting the WUAs need to be understood. WUAs will be asked questions about their interaction with these government agencies, the manner in which they coordinate activities, and any disputes and misunderstandings that have taken place. A few interviews may also be held with a few *Vodkhozes* and district irrigation departments to understand their perspectives on the challenges of working with WUAs.
- Financial performance: detailed information on the expenditures and revenues of WUAs in 2016 will be collected. We will also collect information on how the sources of revenues and types of expenditure have changed since 2014, and whether WUAs are facing any particular challenges after the withdrawal of donor support.
- Disputes: data on the nature and type of disputes will be collected. The WUA survey of 2014 suggested that most disputes are between the WUA and the farmers on the payment of fees. However, most farm respondents reported that most disputes occur between farmers on the same canal. This needs to be explored further.
- Fee structures: greater clarity on the types of fees collected, the purpose of collection, and the nature of their structure and magnitude is needed. Besides pursuing these questions through the WUA study, we will also speak with a few *Vodkhozes* and district irrigation departments on the challenges they face with fee collection and recovery.

We will examine whether these issues are common to both types of WUAs or whether they are especially applicable to USAID WUAs. From the WUAs, *Vodkhozes*, and the district irrigation departments, we will elicit suggestions for improving efficiency and performance of these irrigation systems and water management organizations.

5 Assessing the Persistence of, and Equity in, Impacts on On-farm Water Delivery, Crop Yield, Crop Diversity, and Livelihoods

5.1 Introduction

This chapter examines the impacts of USAID WUAs at the farm level. In this chapter:

- the treatment group consists of farms that are located in *jamoats* where irrigation services are provided by USAID WUAs;
- the control group consists of farms that are located either in *jamoats* where irrigation services are provided by other (non-USAID) WUAs, or provided directly by the government; and
- the treatment and control groups are mutually exclusive; that is, no farm can belong to both groups.

Three types of development outcomes are considered.

- The impact on quality of irrigation services: USAID WUAs were formulated using community driven approaches, and designing each of them along sub-units that are hydraulically compatible rather than along administrative boundaries. This approach could increase the reliability, timeliness and equity in the delivery of water to the farm. Indicators such as perceived timeliness of water delivery, respondents' satisfaction with water supply services; nature and number of disputes reported; and satisfaction with dispute settlements will be used to measure impacts.
- Impact on non-cotton cropping choices: If USAID WUAs improve on-farm water delivery, this may enable farmers to grow more crops in a year; or have flexibility to choose from a greater variety of crops. Indicators such as number of crops grown on the farm in a year; areas cultivated under different crops; and yields of different food crops will be used to measure impacts on crop choices.
- Impact on cotton cultivation: Understanding the profitability of cultivating cotton, and the factors that prevent farmers from moving away from cotton cultivation are

important for understanding how cropping choices are likely to change. The ability to move away from cotton production is contingent on whether better access to water also impacts the profitability of cotton cultivation. Indicators such as the yield of cotton; cropped area; and input use will be examined. In addition, data on reasons for farmers cultivating cotton will also be collected.

Impacts on irrigation services and associated impacts on cropping choices are often not spatially or temporally uniform. Farms that are spatially at an advantageous location—such as those at the head of secondary canals—are likely to do better in terms of access to water, other things being equal. However, if USAID WUAs were designed to take into consideration hydraulic principles, then spatially disadvantaged farms (those at the tail end for instance) served by USAID WUAs should do no worse than their counterparts served in the control group. If this holds true then the irrigation services and copping choices should be less disparate among the treatment group than in the comparison group.

Changes in crop choice and cropped area are likely to take place over substantive time periods rather than immediately. However, improvements in irrigation services can be observed in the short term. This study will attempt to link observed changes in irrigation services to observed changes in crop choice, cropped areas, and crop yields.

To carry out this analysis, a two-period study was designed which collects data from a sample of *dekhan* farms stratified by location. This survey was implemented in 2015; however data on the 2014 cropping season were collected. Data on irrigation services, WUA membership and participation, and canal and watercourse repairs were elicited from respondents, most of whom were farm managers. In addition, data on non-cotton crop choices, quantity of harvest, quantity of sale, and quantity retained for self-consumption were also collected. Finally, data on the cotton cultivation in 2014 were elicited as well—respondents were asked to report on input use, production techniques, harvests, and sales.

The survey implemented in 2015 forms the ‘baseline’ component of this study. In 2017, a follow-up survey will be administered to collect data on the same parameters for the 2016

cropping season. These two datasets will be examined together in the future to understand the persistence of impact on irrigation services and cropping choices. A difference-in-difference strategy will be employed to estimate the impacts.

In this chapter, we provide details of the study design, the sampling strategy, and report some preliminary results by examining the baseline data. These results should not be interpreted as impacts, but rather as a snapshot for the types of analyses that would be conducted to estimate the persistence of impacts when the data from the follow-up survey are also available.

A summary of the findings in this chapter is as follows.

- Farms benefiting from USAID interventions might have access to better irrigation services when compared to irrigation services in the control group. The propensity to irrigate cultivated area is higher in the treatment group; farms located in the treated group irrigated 97.5% of the area cultivated in 2014, while farms in control group irrigated 92.5% of the cultivated areas. Irrigation charges per hectare paid for the cotton crop are higher in the treatment group than the control group. Cotton farmers in the treatment group also perceived their irrigation service to be timelier, and water to be more adequately available than did cotton farmers in the control group.
- Analysis of crop choices suggests that the treatment group farms cultivated a larger number of crops in 2014 than those in the control group. Productivity in the treatment group appears to be higher than that in the control group; with yield for some key food crops higher on treatment farms than on control farms. Treatment group farms also appear to be more market oriented than the control group farms, being able to sell a greater proportion of their harvest, likely due to their higher yields. Further, variability in yield of key crops such as wheat and maize tends to be lower in the treatment group than in the control group.
- Finally, analysis of the economics of cotton production suggests that treatment farms are far more likely to cultivate cotton than control farms but devote relatively

smaller cropped areas to it. While treatment farms are more likely to adopt high-yielding varieties (HYV) than control farms, the difference in yields between the treatment and control groups is not significant when farms cultivate the HYV variety. However, for cultivating traditional varieties of cotton, treatment farms gain higher yields than control farms. Input costs are higher per hectare of cotton cultivated in the treatment group than in the control group; this difference applies to both HYV and traditional varieties of cotton.

5.2 Study Design

The treatment group is defined as *dekhan* farms in *jamoats* that receive water from a USAID WUA. The control group is defined as a combination of farms in *jamoats* that are served by other WUAs and farms in *jamoats* that are irrigated but not served by any WUA.[14] This design allows for the estimation of the average effect of the USAID intervention, by using the treated *dekhan* farms and combining *dekhan* farms in *jamoats* with other WUAs and farms in *jamoats* without any WUA.[15]

Thus, the study design samples *jamoats* first and then samples farms within selected *jamoats*. The cluster unit in the study is the *jamoat*, and all of the standard errors are clustered in all econometric and statistical analyses to correct for overcommitting a Type I error (incorrect rejection of a true null hypothesis in the statistical tests).

[14] An alternative method of defining the control group would have been to distinguish between *jamoats* that have WUAs developed by either other donors or the government; and *jamoats* that have gravity irrigation but no WUAs (thus, having two comparison groups). This was our first preference, but proved to be difficult to implement. There are very few *jamoats* with irrigation schemes but without WUAs. Thus, this control group was merged into one.

[15] The USAID program focused primarily on developing WUAs, and training them in irrigation water management. USAID also financed the repair of physical infrastructure in some WUAs, but this was not the main activity. WUAs in the control group may also have benefitted from infrastructure rehabilitation, but this is harder to trace. To check whether we estimate the impact of WUAs, and not of physical infrastructure, we will control for rehabilitation work performed by USAID during creation of WUAs, and not control for such rehabilitation in the control *jamoats* . This will provide a conservative estimate of the impact of USAID WUAs.

Power calculations were conducted to determine the number of treatment and control clusters, and the number of observations within a cluster. The means, standard deviations (σ_y) and intra-cluster correlations (ρ) used for the sample size analysis were derived from the Tajikistan Living Standards Measurement Survey (T-LSMS) conducted by the World Bank in 2003. The T-LSMS 2003 was preferred to the T-LSMS from 2007 and 2009 due to a larger sample of rural households from Khatlon Province. Conventional rates of 0.8 and 0.95 were used for the coefficient of determination and the level of confidence (R^2=0.8 and confidence =0.95).

The minimum detectable effect (MDI) size was calculated for several sample designs. The following formula was used to consider selected *jamoats* and *dekhan* farms within selected *jamoats*.

$$MDI = 2.487\,\sigma_y \sqrt{(1-R^2)\left[(1-\rho)\left(\frac{1}{a_t b_t}+\frac{1}{a_c b_c}\right)+\rho\left(\frac{1}{a_t}+\frac{1}{a_c}\right)\right]}$$

The power analysis was conducted with seven outcome variables available in the T-LSMS database, which are of interest to the present impact evaluation: proportion of households irrigating their main agricultural plot; proportion of households that believe their main plot receives adequate water supply; yields of wheat, potato, onion and tomato (metric tons per hectare); and total household income (per month).

A sensitivity analysis was subsequently carried out with a different number of control and treatment *jamoats* (respectively a_c and a_t), and a number of *dekhan* farms per *jamoat* (b_c and b_t), to identify the minimum detectable effect size, given several designs (sample size, number of *jamoats*, and the number of *dekhan* farms per *jamoat*). These results are displayed in Annex 3.

Based on the results, the sample design included 2,000 *dekhan* farms from 40 *jamoats* irrigated by USAID WUAs (referred to as the treatment group), and 40 *jamoats* that are

irrigated either by WUAs initiated by stakeholders other than USAID or are irrigated but not served by any WUA (referred to as the control group). In each *jamoat*, 25 *dekhan* farms are randomly selected.

The data collected through this sample design detect an impact of the USAID WUA intervention equivalent to 20.69% of the standard deviation of the household monthly income, or equivalent to 27% of the standard deviation of the wheat yields in the case of the analysis based on the entire sample.

5.3 Selecting the Sample

5.3.1 Selecting *Jamoats*

It is likely that USAID focused on rehabilitating WUAs in *jamoats* with gravity schemes and where land reforms had taken place; thus, it is likely that treatment is not randomly assigned.

To select the appropriate control group(s) for the treatment group using a randomized process, a pre-sampling survey was conducted of all *jamoats* in Tajikistan where irrigated cultivation of wheat and cotton were predominant agricultural activities. The USAID interventions were based in three irrigation schemes where land privatization has reached an advanced stage; seven other gravity schemes were chosen where cotton and wheat are the predominant agricultural activities, and where land privatization had matured. In this survey, data from 164 *jamoats* in Khatlon (116), Sughd (21) and DRS (27) provinces were collected; these *jamoats* were spread across 25 districts. Information on land use and agricultural practices, irrigation infrastructure and schemes, and the presence and characteristics of WUAs was collected from the administrative office of each of the *jamoats*.

Based on data from the *jamoat* survey, propensity scores were constructed to calculate the probability of each *jamoat* being treated by USAID. Demographic attributes, agricultural attributes, land use and farm attributes, and irrigation attributes were used to construct

these scores. A complete list of attributes that were used to construct the propensity scores and the model of treatment can be found in Annex 4.[16]

Using the propensity scores, *jamoats* served by USAID WUAs were matched to *jamoats* not served by USAID (either served by other WUAs or irrigated but without a WUA), without replacement to their nearest neighbor, to select 80 *jamoats* in all - 40 treated by USAID, and 40 with either WUAs not setup by USAID or irrigated *jamoats* without WUAs. The differences between the treatment and control groups on unmatched and matched variables for the selected *jamoats* is displayed in Annex 5. These tables suggest that the control group is appropriate for making comparisons with the treatment group.[17] The list of 40 treatment *jamoats* and 40 control *jamoats* selected can be found in Annex 6.[18]

5.3.2 Selecting *Dekhan* Farms

Consolidated lists of irrigated *dekhan* farms were not available in any government office at the national level. Therefore, enumerators were hired to conduct a census of all *dekhan* farms from the selected *jamoats*, collecting information on the name of the farm and the name of the manager of the farm. Farms were characterized by the type of canal each received water from (primary, secondary, tertiary); and its location along the canal (head,

[16] The propensity score also takes into account ethnic composition of *jamoats*, the number of rural health centers and schools, and the number of agricultural markets in the *jamoat*. It also takes into account whether land reforms have been completed, and the number of years of tenure of the current *jamoat* leader. These could affect selection into treatment, and hence were accounted for while selecting the treated and control groups.

[17] An alternative strategy could have been to choose 27 *jamoats* served by USAID WUAs, 27 served by non-USAID WUAs, and 27 irrigated but not served by a WUA. This strategy did not yield appropriate matches. Many treatment *jamoats* were not matched to the two types of control *jamoats*, leading to few matches. Comparing the attributes of the *jamoats* with USAID WUAs, non-USAID WUAs, and irrigated *jamoats* not served by WUAs revealed that the nature of differences between *jamoats* with USAID WUAs and *jamoats* with non-USAID WUAs were similar to those observed between *jamoats* with USAID WUAs and irrigated *jamoats* without WUAs, and *jamoats* with non-USAID WUAs and irrigated *jamoats* with no WUAs. The size of the population of irrigated *jamoats* in the country (164) was too small to enable parsing into three groups.

[18] When data from the 2017 survey are also collected, controls will be used to distinguish between *jamoats* with non-USAID WUAs (22) and irrigated *jamoats* without a WUA (18).

middle or tail). The type of canal determines the quantity of water flowing through it; the location on a canal influences the quantity and timeliness of water received. These characteristics together make up nine types of farms (primary, head; primary, middle; primary, tail; secondary, head; secondary, middle; secondary, tail; tertiary, head; tertiary, middle; and tertiary, tail).

A stratified random sampling method using these two characteristics was used to select 25 *dekhan* farms from each of the selected *jamoats*. This structure randomly selects the nine types of farms in proportion to their numbers in the population, and allows for econometrically identifying the impacts of USAID WUAs on spatially-disadvantaged farms, which are at greater risk of not receiving adequate water in a timely fashion (especially tail-enders on tertiary canals).

5.4 Data Collection Tools

5.4.1 Baseline Survey in 2015

The first farm survey was implemented in 2015 to gather data for the 2014 cropping season from the sample of farms determined in sections 5.2 and 5.3.

The questionnaire was split into ten sections: farm details, cotton crop data, other crops, water charges, irrigation infrastructure and maintenance, disputes and conflict resolution, governance, capacity building and training, farm assets, and household demographics (Annex 7).

The section on water charges collected information on all payments made by the farm for irrigation. Information on the amounts paid, the agency the fees were paid to, and arrears was collected. The section on infrastructure maintenance examined the repair and maintenance of the watercourses and distributary canals. Respondents were asked to report on whether various types of repairs had taken place in 2014, the agency responsible for undertaking the repairs, and the farm's own contributions (in kind, time and money) towards those repairs. The disputes and conflict resolution section elicited the number of

conflicts their farm had been involved in during 2014, nature of the conflict, the person/agency the conflict has arisen with, and details about who had resolved the conflict and the time taken to resolve it. The governance section collected data on farm membership in irrigation organizations, membership charges, meetings, elections, and trust in these organizations. These data are used to examine impact on irrigation services.

The section pertaining to other crops asked respondents about all other crops grown on the farm in 2014. Respondents were asked to name the crops grown, the area cultivated, the harvested amount, the share of harvest retained, and the number of water applications made for that crop. In the interest of time, data on other inputs were not collected. This information will be used to examine impacts on cropping choices.

The section on cotton collected crop economic data for the 2014 cotton crop from farms that cultivated cotton that year. Detailed data on all inputs—fertilizers, seeds, labor, machinery, and water—were elicited. While designing the study, it was observed that around 60-70% of farms continue cultivating cotton. Anecdotal reports suggest that despite the law mandating cotton cultivation being relaxed, access to inputs for non-cotton crops is linked to cotton cultivation. Additionally, cotton stalks are reported to be an important heating fuel during the cold winters. Understanding the factors that may prevent farmers from shifting away from cultivating cotton is important, as they are likely to affect non-cotton cropping decisions as well.

The questionnaire was administered to the farm manager or to the farm member who was most knowledgeable about the farm's practices. The interview lasted about 90 minutes, on average. No monetary payments were made to respondents; instead, brochures providing information on practices to improve yields of various crops were distributed to respondents.

5.4.2 Follow-up Survey in 2017

A second farm survey will be implemented in 2017 to the same sample as in the baseline survey. This survey will collect information on non-cotton crops, the cotton crop, water

charges, irrigation infrastructure and maintenance, disputes and conflict resolution, governance, capacity building and training, farm assets, and household demographics. Data pertaining to the year 2016 will be collected.

This questionnaire will be administered to the same person who answered the baseline questionnaire and it will be similar in length. Again, no monetary payments will be offered; other forms of appreciation for time spent answering the questionnaire will be explored.[19]

5.5 Background of the Farms in the Study

Before examining impacts, it is necessary first to verify that farms in the treatment and control groups are similar. If the farms in the treatment group are different than those in the control group, the impacts could be attributed to those differences, rather than to the USAID WUAs intervention. Using indicators such as the age of the farm, number of certificate holders on the farm, area of the farm, and sources of irrigation for the farm, we conducted t-tests to check for statistically significant differences between the treatment and control groups. We do not find significant differences in farm characteristics between the two groups. This indicates that the treatment and control groups are similar, allowing for comparisons between the two to estimate impacts on irrigation services, cropping decisions, and crop choices.

In the tables in this section, we report the difference in the means of the treatment and control groups (the column labeled "Coeff") along with the standard error of the difference (Column labeled 'Std Err'). A "***" is used to depict that the difference is significant at 1%, a "**" to indicate that the difference is significant at 5% and a"*" to indicate that the difference is significant at 10%.

[19] Two waves of data are collected to control for vintage effects. Since USAID WUAs are all young, they have been supported financially and institutionally through their inception. Effects observed in a cross section may simply be due to the recent nature of the intervention. However, two rounds of data, and the use of a difference-in-difference estimator, will control for such effects.

Of the farms surveyed, 68.6% are individual *dekhan* farms operated by a single household and 16.9% are collective *dekhan* farms with several households involved. Most farms surveyed were created in the last 5 years (59.6%), and less than 15% of the farms were in existence before the Law 'On *Dekhan* (Peasant) Farms' voted in 2002 (Law No. 48, 23 April 2002). The average age of the farm was 6.2 years, with no statistically significant differences in the age of farms between the treatment and control groups at either 1%, 5% or 10%.

While we do not find any significant differences in the number of members associated with the farms between the treatment and control groups (Table 14, row 1), we do find a significant difference in the number of certificate holders at the 1% level; farms in the treatment group have half a certificate holder less than those in the control group; this difference, while small, is significant at 1% (Table 14, row 2). The *dekhan* farms hire, on average, four to five permanent shareholders (called *sahimdors)*, and here, no significant differences between the treatment and control groups are found at 1%, 5% or 10%. Finally, the number of households associated with the farm are not statistically significant between the treatment and control groups at any of the three levels.

Table 14: Members of the *dekhan* farm (n=1,957)

			Treatment value minus Control value	
	Mean	Std Dev	Coeff.	Std Err.
Average number of members associated with the farms	6.68	6.01	-0.44	0.27
Average number of certificate owners	5.94	5.69	-0.53***	0.26
Average number of *sahimdors* working permanently on the farm	4.63	4.49	0.23	0.20
Average number of households affiliated with the farm	3.20	4.35	0.07	0.19

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

No statistically significant differences between the treatment and control groups are found while examining the area of the farms, and the cultivated area (Table 15, rows 1 and 2).). However, a larger number of medium-size farms can be found in the treated group.

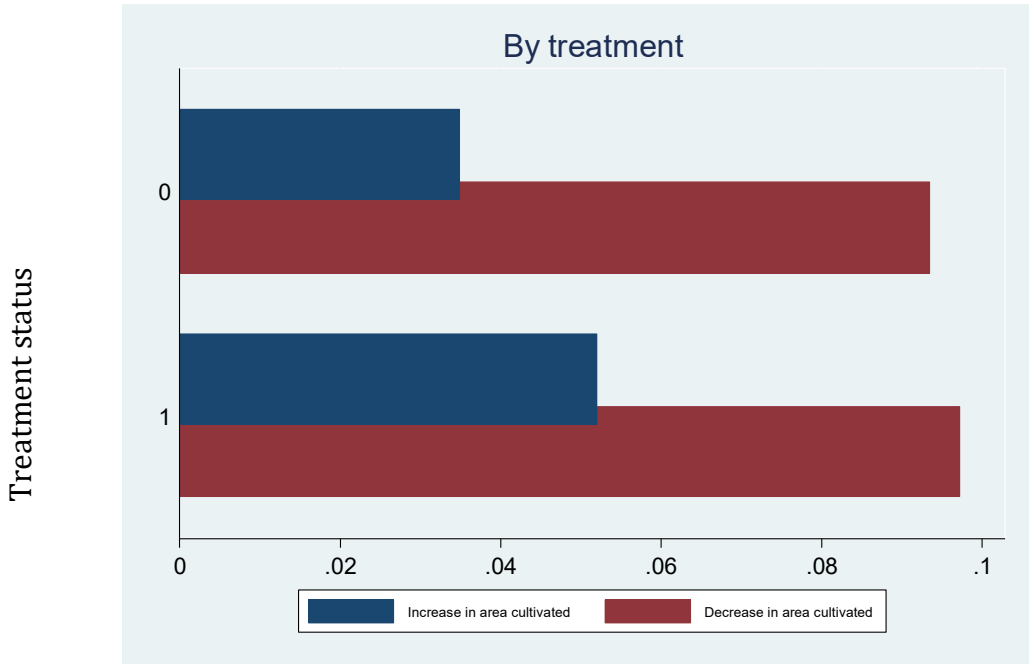
Table 15: Farm area and cultivated area (n=1,957)

			Treatment value minus Control value	
	Mean	Std Dev	Coeff.	Std. Err
Area of the farm (based on certificate ownership) (ha)	5.47	13.23	-0.41	0.59
Cultivated area (ha)	4.24	8.67	0.22	0.39

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

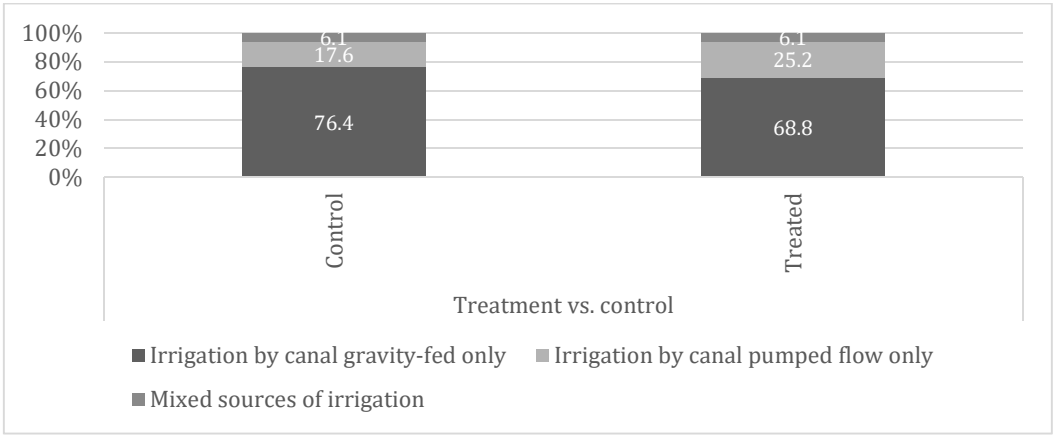
The area cultivated by the *dekhan* farm is quite static, only 14% (n= 274) of the farms saw an evolution in the area cultivated since their establishment. More specifically, 4.4% of the farms increased the area cultivated, while 9.5% decreased the area of cultivation. These changes are more prevalent for older and larger farms. The reason given by farmers for increasing the area cultivated over time is mostly inheritance or evolution of the farm membership. However, the second most important reason is the addition of land which was not cultivated before, following an improvement in land quality or access to water. In contrast, when the area cultivated decreased, the separation of farm members is the most popular reason, but the degradation of the condition of the land is the second reason. Increases in the area cultivated are more frequent in the treatment group than in the control group (Figure 6): 5.2% of the farms increased their cultivated area in the treatment group, compared to 3.5% in the control group. However, differences are not significant at 1%, 5% or 10%.

Figure 6: Changes in the cultivated area by treatment (1=treated; 0 = control) (n= 1,957)



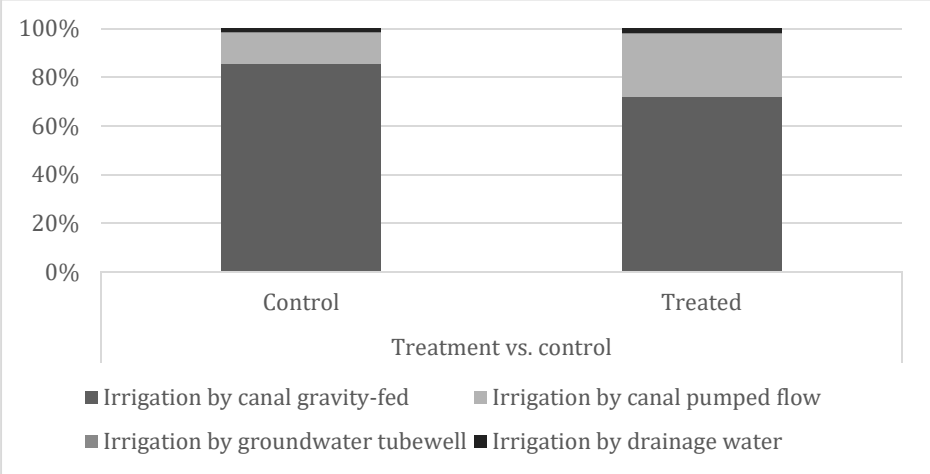
Treatment and control groups are irrigated by similar irrigation sources. A large majority of the *dekhan* farms use a single source of water for irrigating their entire cultivated area, with 72% of farms using water from a gravity-fed canal alone, 21% using water pumped from a canal only, and 6% using mixed sources of water. No clear differences can be found between the treatment and control groups (Figure 7).

Figure 7: Type of irrigation by treatment (n =1,957)



Around 79% of the areas of the *dekhan* farms surveyed are irrigated by a gravity-fed canal scheme. Other sources of irrigation consist of canal flow pump, covering almost 20% of the cultivated areas; and groundwater and drainage water irrigating 0.3% and 1.4%, respectively, of the cultivated areas. Irrigation using groundwater and drainage water is marginal. In Figure 8, no statistically significant difference can be identified in the share of areas irrigated by different sources, between the treatment and control groups, at the usual levels.

Figure 8: Percentage of cultivated areas irrigated by different sources of water (n = 1,957)



In conclusion, comparing the treatment and control groups on key parameters such as age of the farm, area of the farm, and sources of irrigation for the farm, does not yield statistically significant differences. The difference in the number of certificate holders on the farm is significant, but the difference is very small.The two groups are comparable, indicating that the sampling strategy was able to perform sufficiently well in finding an appropriate and comparable control group.

5.6 Preliminary Results of Key Outcomes

In this section, we first report the preliminary results pertaining to irrigation services, then for crop choices, and finally yields for cotton.

5.6.1 Irrigation services

Preliminary results suggest that irrigation services might be better in the treated group than in the control group. The propensity to irrigate cultivated area is higher in the treatment group, while irrigation charges per hectare paid for the cotton crop are higher in the treatment group than the control group. Cotton farmers in the treatment group also perceived their irrigation service to be timelier, and water to be more adequately available, than cotton farmers in the control group.

More than 95% of the area cultivated in the entire sample was irrigated, which confirms the essential role of water for agriculture in those landscapes. For 90% of the farms, the entire cultivated area was also irrigated. A significant difference can be seen between treated and control group (at 5% level): farms located in the treated group irrigated 97.5% of the area cultivated in 2014, while farms in control group irrigated 92.5% of the cultivated areas. This indicates a higher propensity to irrigate cultivated areas in the treated group. Keeping these existing differences in propensity to irrigate in mind, we examine irrigation services for the cotton crop, and then examine irrigation services for crops other than cotton. The cotton crop is used as a marker to examine impacts of irrigation services, as it is a water-intensive crop that is cultivated by 56% of the farms in the sample.

5.6.1.1 Irrigation services for cotton crop

The following indicators were examined to understand differences in irrigation service for the cotton crop between the treatment and control groups.

Number of applications for irrigating cotton in 2014

The number of irrigation applications refers to the number of times water was brought to the farm to irrigate the cotton crop in 2014. Examining the total number of applications by treatment reveals 1.08 more applications for treated farms than control farms, and this difference is significant at 1% (Table 16, row 1). Accounting for the area cultivated with cotton reveals a difference of 0.33 applications/ha between the treated and control group

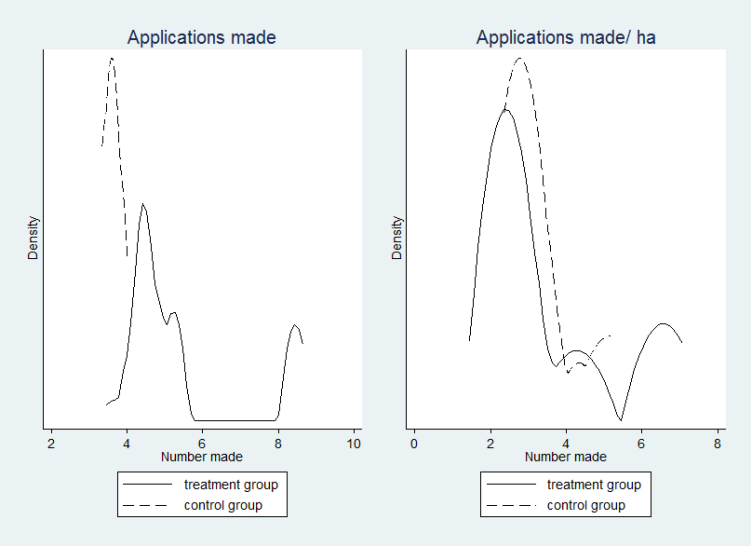
(Table 16, row 2), which is not a statistically significant difference at the 10% level. While one might be tempted to conclude that this implies that farms in the treatment group cultivate larger areas of cotton; this is not the case either, as the difference in area cultivated for cotton between the treatment and control groups is 0.14 ha, a difference that is not statistically significant. It appears that the difference in the number of applications made between the treatment and control groups needs to be explored by understanding the perceptions around timeliness and adequacy of the irrigation service.

Table 16: Water applications and charges by treatment for the cotton crop (n=1,098)

			Treatment value minus Control value	
	Mean	Std Dev	Coeff.	Std Err
Total number of water applications	4.67	10.81	1.08***	0.63
Total number of applications/ha	3.38	9.91	0.33	0.86
Total water charges (TJS/year)	660.81	1,680.64	-79.42	183.14
Total water charges per hectare (TJS/ha/year)	223.44	431.32	27.69	31.50

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

Figure 9: Differences in distribution of water applications by treatment (n= 1,098)

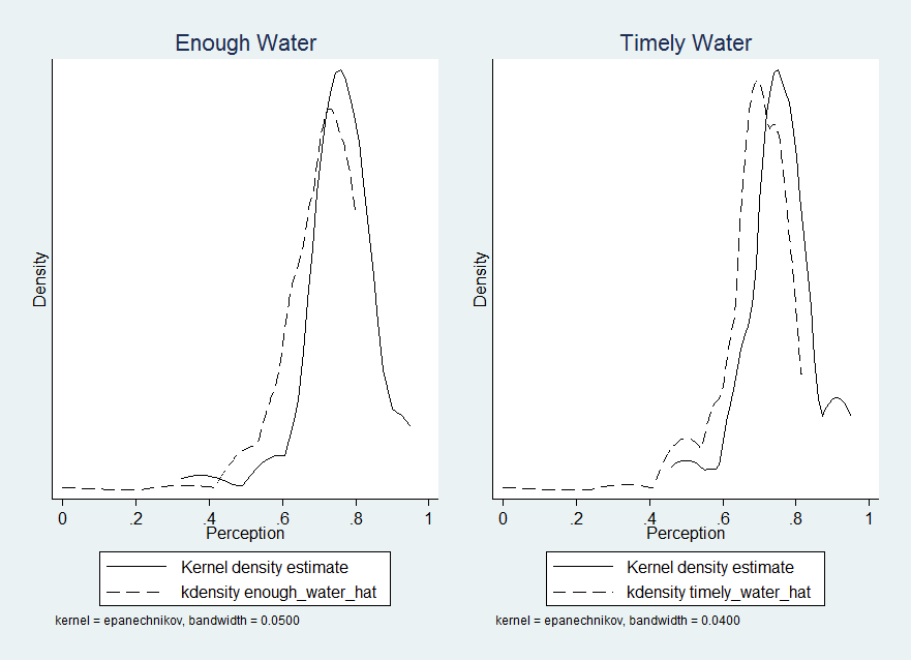


Spatial variability in the number of applications could be different between the treatment and control groups. To examine if the number of applications and applications per hectare differ spatially between the treated and control groups, we regressed the number of applications of water for cotton cultivation on the treatment status (treated farm=1; control farm=0), a set of indicator variables controlling for canals (primary, secondary, tertiary), a set of variables controlling for farm location (head, middle, tail), and interaction terms between treatment status, canal, and farm location. The coefficients and standard errors were used to calculate the predicted values of the number of applications, when accounting for treatment, location, and type of canal. The densities of the number of applications and applications per hectare were then plotted separately for the treatment and control groups (Figure 9). In this regression graph, the y-axis reports the frequencies of the value on the x-axis. The bold line reports the frequencies observed in the treatment group, and the dotted line reports the frequencies observed in the control group. We do not find much evidence of a statistically significant difference in variability of the number of applications between the treatment and control groups, as displayed in Figure 9.

Timeliness of irrigation services, and adequacy of water for cultivating cotton in 2014

To examine the stated perceptions of cotton farmers on the timeliness or irrigation services[20], and whether the farmers perceive that adequate amounts of water were available for irrigating cotton, regression graphs are used. The frequencies of responses are reported separately for the treatment and control groups. There is a significant difference between the perceptions of respondents in the treatment and control groups. Cotton cultivating farmers in the treatment group perceive water to be more adequately available than those in the control group. The farmers in the treatment group also perceive irrigation services to be timelier than those in the control group (Figure 10).

Figure 10: Perceptions of cotton farmers on adequacy of water and timeliness of service (n = 1,098)

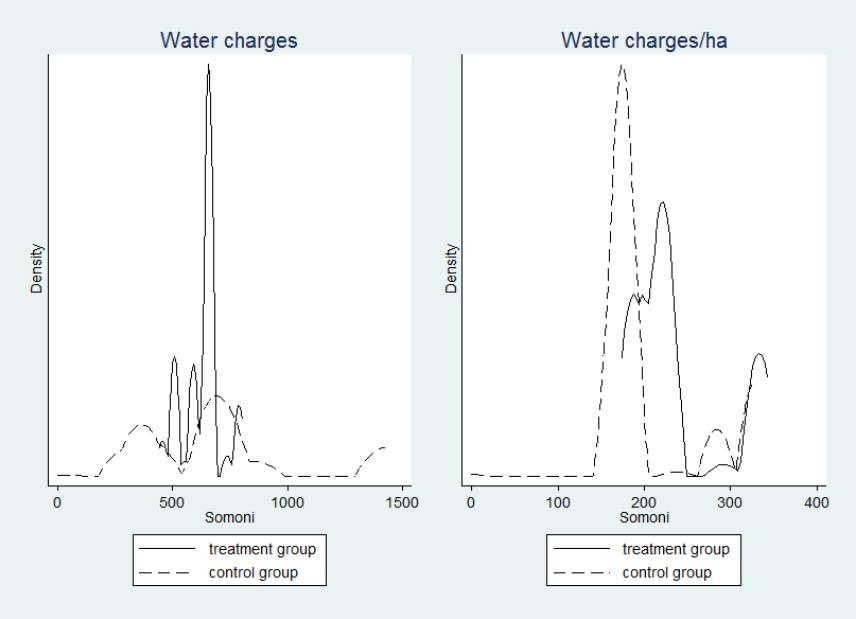


[20] Here too, the perceptions are regressed on the treatment status (treated=1; non-treated=0), a set of indicator variables controlling for canals (primary, secondary, tertiary), a set of variables controlling for farm location (head, middle, tail), and interaction terms between treatment status, canal, and farm location to calculate the predicted values. Frequencies for the treatment and control group are plotted separately.

Water charges for cultivating cotton in 2014

Water charges for treated farms are marginally lower than those for control farms (Table 16; row 3); but these differences are not significant. However, irrigation charges per hectare of cotton are higher in the treatment group than in the control group, but this effect is not significantly different at the 10% level. The frequencies of water charges and water charges per hectare of cropped area are plotted separately for the treatment and control groups in Figure 11, using regression graphs.[21] We find that farms in the treated group are paying systematically higher charges per hectare of cotton cultivated. This is an important result, because one of the aims of USAID's intervention was to get farmers to pay higher irrigation fees.

Figure 11: Distribution of water charges by treatment (n = 1,098)



[21] Here too, the charges and charges per hectare are regressed on the treatment status (treated=1; non-treated=0), a set of indicator variables controlling for canals (primary, secondary, tertiary), a set of variables controlling for farm location (head, middle, tail), and interaction terms between treatment status, canal, and farm location to calculate the predicted values.

5.6.1.2 Applications for other crops

Number of applications for irrigating non-cotton crops in 2014

Farms in the treatment group applied one fewer application than those in the control group, but this difference is not statistically significant at the usual levels (Table 17).[22] There is no significant difference in the number of applications per crop cultivated; or in the number of applications per hectare of cropped area between the treatment and control groups.

Table 17: Water applications for other crops (n = 1,445)

			Treatment value minus Control value	
	Mean	Std Dev	Coeff.	Std Err
Total number of water applications/year	12.73	14.61	-0.99	1.62
Number of applications/crop	4.53	4.66	0.49	0.45
Number of applications/ha of cropped area	11.93	24.64	0.53	1.89

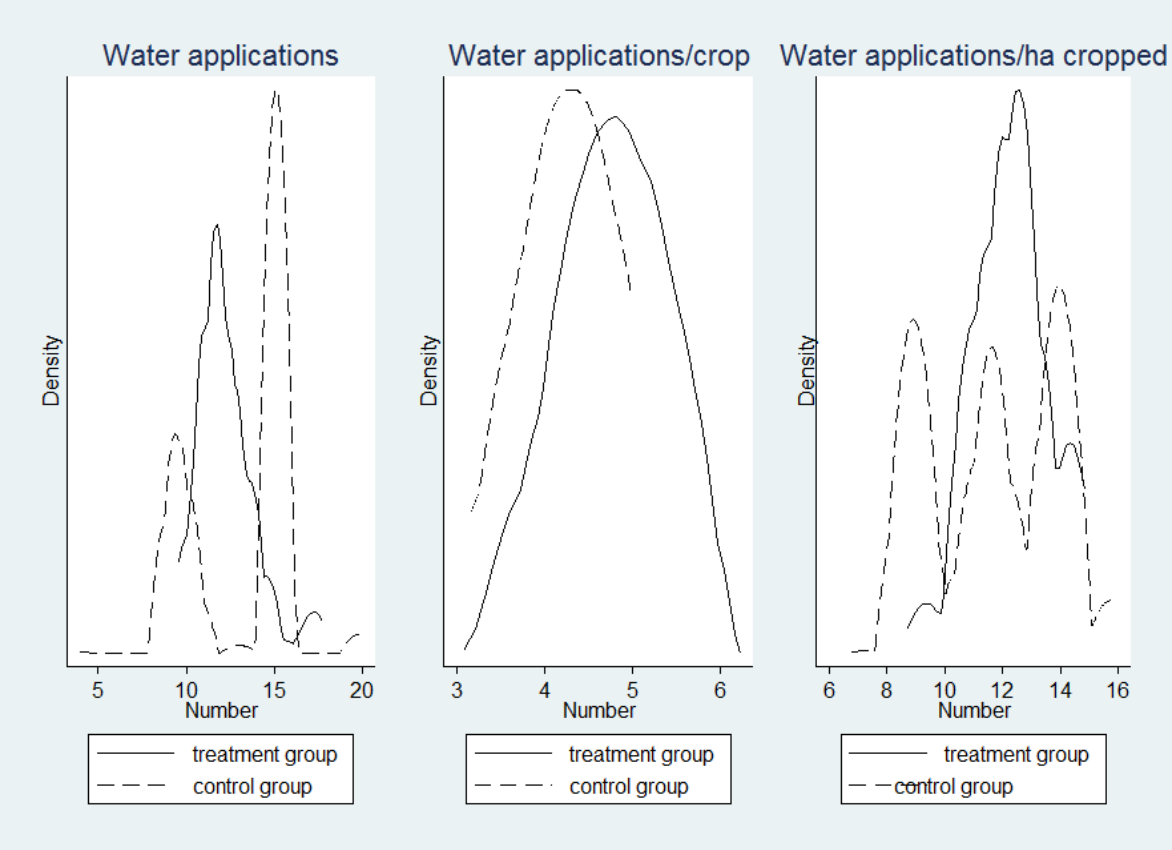
Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

Examining the frequencies of water applications by treatment and control groups indicates (Figure 12) that, in the treated group there is less variability in the total annual number of water applications than that for control farms.[23] While the number of irrigation applications per crop is distributed similarly for the treatment and control groups, the density function of the treatment group lies to the right of that control group, indicating that though the difference is not statistically significant, the treatment group is bringing water more times

[22] This difference could be due to different types of crops cultivated on treatment and control farms.
[23] Here too, the charges and charges per hectare are regressed on the treatment status (treated=1; non-treated=0), a set of indicator variables controlling for canals (primary, secondary, tertiary), a set of variables controlling for farm location (head, middle, tail), and interaction terms between treatment status, canal, and farm location to calculate the predicted values. The regression graphs are then constructed separately for the treatment and control group.

per crop year than the control group. The density of the number of applications per hectare of cropped area is remarkably less variable than that of the control group. The highest shares of water applications per hectare of cropped area are found on treated farms alone.

Figure 12: Distribution of water applications for other crops (n= 1,445)



These results suggest that treated farms use systematically more water applications, and more water applications per hectare of cropped area as well. This could be linked to the finding (reported in section 5.6.2) that treated farms cultivated more crops in 2014 than control farms.

5.6.1.3 Summary

The preliminary evidence suggests that USAID WUAs may have had some modest success in improving irrigation services for cotton, mainly through the timeliness and adequacy of

the services. For non-cotton crops, preliminary evidence suggests that USAID WUAs are supporting the cultivating of more non-cotton crops in a year than those observed in the control group.

5.6.2 Crop choices

The expected impact of the USAID intervention on crop choices is theoretically ambiguous. Cotton production was mandatory in the USSR, and these mandates existed up until a few years ago. If USAID WUAs improve water supply by increasing the quantity of water available on the farm, then farms may expand cotton cropped areas, continue growing, or revert to producing cotton, especially if it is easy to sell. On the other hand, if the treated WUAs are able to improve not just quantities of water supply, but are also able to provide farmers with flexibility in access to water, then farmers may diversify and cultivate other crops. These impacts may not be spatially uniform. For example, farms at the head of canals or on secondary canals may have more flexibility in accessing water than farms on tertiary canals or at the tail end, leading to a wider range of crops being grown on spatially advantaged farms.

Analysis of crop choices is undertaken by examining the number of different types of crops grown in the cropping season of 2014, the share of the cropped area (area under each crop/total cropped area), yields (metric tons of harvest/ha of cropped area), and the share of harvest retained. Examining whether a crop is grown for consumption or for sale is important to understand the pathways through which populations become more food secure.[24]

Results in this section suggest that the treatment group farms cultivated more types of crops in 2014 than did farms in the control group. Productivity in the treatment group appears to be higher than that in the control group, and treatment group farms appear to be more market oriented than the control group farms. Further, variability in the yield of key

[24] Farmers may grow a crop and buy food from the sales revenue earned. On the other hand, they may grow a crop to retain a share for self-consumption. These have different policy implications.

crops such as wheat and maize tends to be lower in the treatment group than in the control group.

5.6.2.1 Number of crops cultivated

We constructed an index of the number of crops cultivated on the farm in 2014 for the entire sample of 1,957 farms. A simple t-test of the number of crops against the treatment status indicates that the farms in the treatment group cultivated around the same number of crops as those in the control group (Table 18). Controlling for the size of the cropped area in 2014, the difference in the number of crops between the treated and control farms per hectare cultivated is not statistically significant at 1% or 5%, but is at the 10% level. However, the size of the difference is very small and is likely due to the area of control farms being slightly larger (though not significantly) that those of the treatment farm. This result should not be taken to mean that the treatment group cultivates fewer types of crops necessarily, just yet.

Table 18: Number of crops by treatment

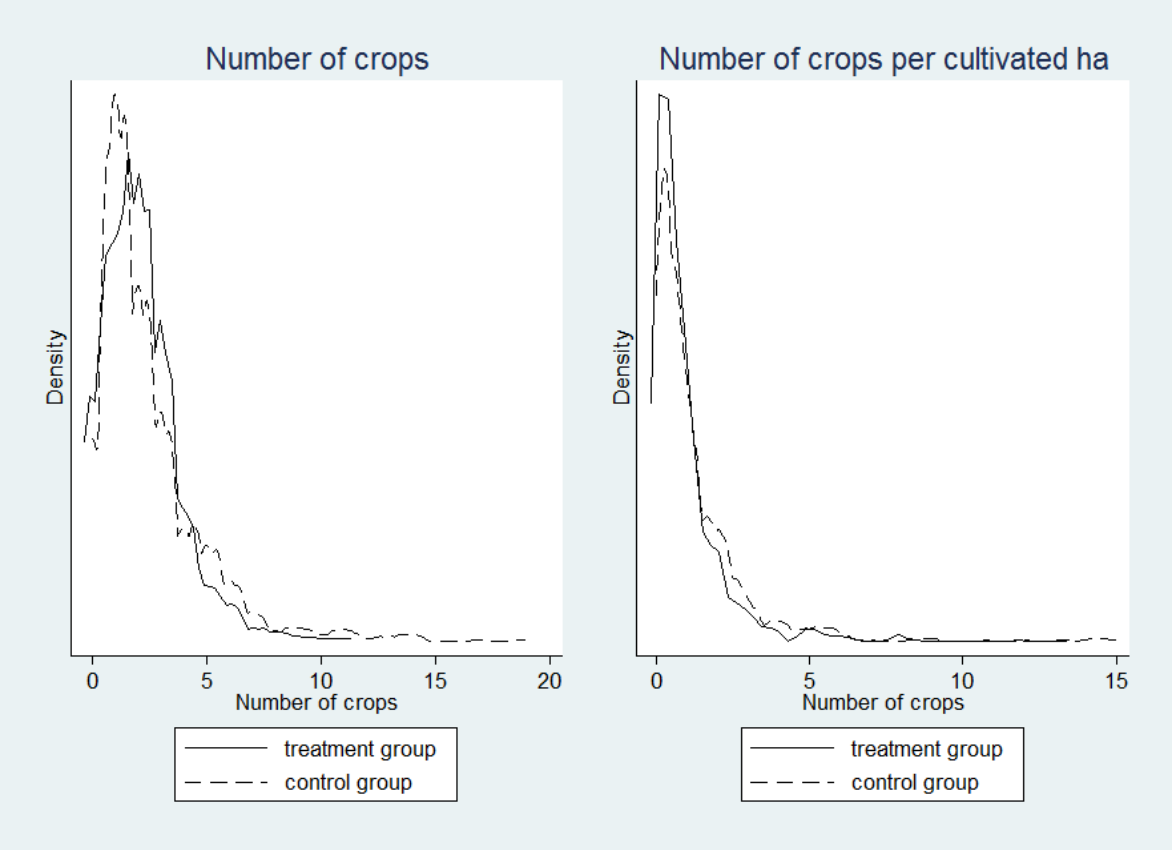
			Treatment value minus Control value	
	Mean	Std Dev	Coeff.	Std Err.
Number of crops grown	2.29	2.07	-0.32	0.23
Number of crops grown/hectare cultivated	1.07	1.45	-0.27	0.12*

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

To examine whether the frequencies of the number of crops differ spatially between the treated and control groups, we regressed the number of crops on the treatment status (treated=1; non-treated=0), a set of indicator variables controlling for canals (primary, secondary, tertiary), a set of variables controlling for farm location (head, middle, tail), and interaction terms between treatment status, canal, and farm location. The coefficients and

standard errors were used to calculate the predicted values of the number of crops. The frequencies of the number of crops were then plotted separately for the treatment and control groups. These results are displayed in Figure 13. The frequencies of the number of crops per hectare of cropped area is not very different between the treatment and control groups; in fact they overlap considerably. However, the number of crops grown in 2014 on the treatment farms is slightly higher than those on the control farms. There is also less variability in the frequencies of the number of crops grown in the treatment group.

Figure 13: Spatial distribution of the number of crops by treatment



5.6.2.2 *Area, yield, and share retained of major crops*

The share in cropped area, yields, and share of harvest retained for a few major crops that were cultivated by at least 10% of the sample farms in 2014 are presented in Table 19.

The treatment group devotes 14% less of its cropped area to cultivating wheat than does the control group, a difference that is significant at the 1% level. Yet, wheat yields for the treatment group are no different than those for the control group. The treatment group retains 6% more of the wheat harvest for consumption than the control group, a difference significant at 10%.

For maize, the treatment and control groups devote similar shares of cropped area; yet the yields for the treatment group are 0.5 tons/ha higher. The treatment and control groups retain similar shares of the harvest for consumption.

Table 19: Area, yield, and share of harvest retained, by treatment

Crop	Obs	Fraction of farm cropped area under each crop				Yield (metric tons/ha)				Share of harvest retained			
				Treatment value minus Control value				Treatment value minus Control vale				Treatment value minus Control value	
	Obs.	Mean	Std Dev	Diff	Std. Err	Mean	Std Dev	Diff	Std. Err	Mean	Std Dev	Diff	Std. Err
Maize	323	0.26	0.24	0.01	0.03	3.34	2.10	0.52	0.32*	0.70	0.41	-0.03	0.07
Wheat	1,134	0.45	0.36	-0.14***	0.04	2.43	1.19	-0.06	0.14	0.83	0.30	0.06*	0.03
Tomato	299	0.13	0.36	-0.07	0.05	16.09	11.79	-1.38	1.85	0.53	0.42	0.15**	0.07
Onion	219	0.15	0.26	-0.04	0.05	4.86	2.16	-0.06	0.84	0.42	0.42	0.00	0.09
Potato	232	0.12	0.18	-0.00	0.03	15.04	12.13	-1.26	1.60	0.59	0.41	0.06	0.07
Melon	290	0.27	0.26	-0.07	0.07	9.91	7.02	1.32	1.03	0.47	0.39	-0.09	0.08
Clover	231	0.29	0.28	-0.06	0.05	8.93	9.17	1.62	1.32	0.82	0.32	-0.00	0.04
Fodder	355	0.29	0.28	-0.06*	0.04	8.11	8.67	1.44	1.05	0.84	0.30	-0.02	0.04

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

Considering tomatoes, the treatment and control groups devote similar shares of cropped area to their cultivation, and no significant differences in average yields are observed; yet the treatment group retains a lower share of the harvest for consumption.

For fodder, the treatment group devoted 6% less of their cropped area than the control group, this difference is significant at the 10% level. No significant differences in yield or share retained are observed.

These results suggest that productivity is higher in the treatment group than in the control group, and that treatment farms are more market oriented than control farms.

To examine whether the distribution of shares in cropped area, average yields, and share of harvest retained is the same between treatment and control groups for maize, wheat, tomatoes and fodder, these indicators were regressed on the treatment status (treated=1; non-treated=0), a set of indicator variables controlling for canals (primary, secondary, tertiary), a set of variables controlling for farm location (head, middle, tail), and interaction terms between treatment status, canal, and farm location. The coefficients and standard errors were used to calculate the predicted values of the cropped areas, yields, and shares of harvest retained. Regression graphs reporting the frequencies were then plotted separately for the treatment and control groups. The results are presented in Figures 14-17. In each of these graphs, the y-axis displays the frequencies of the values on the x-axis. The results in Figures 14-17 reinforce the findings in Table 19.

Figure 14: Maize: area cultivated, yield, and share of harvest retained

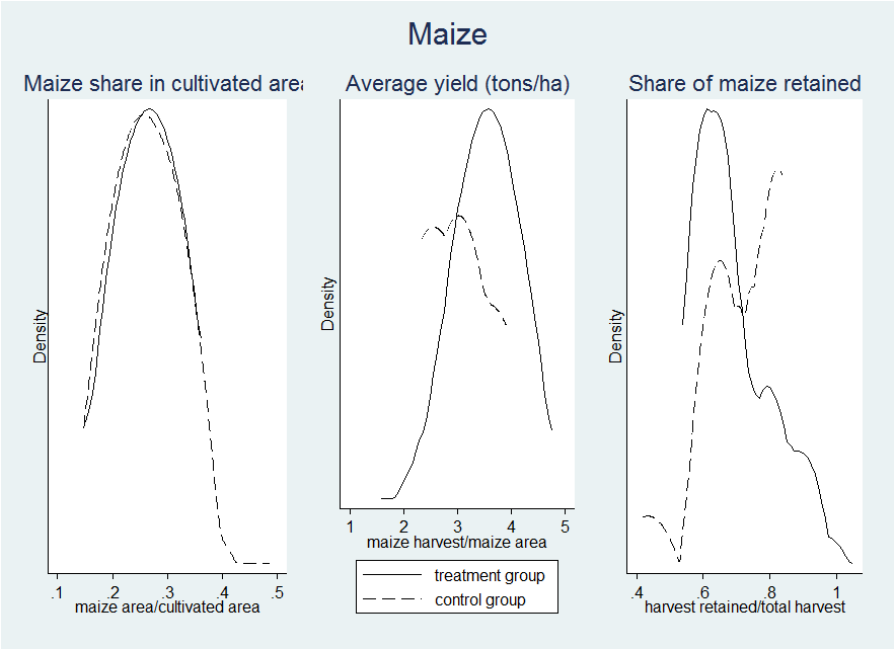


Figure 15: Wheat: area cultivated, yield, and share of harvest retained

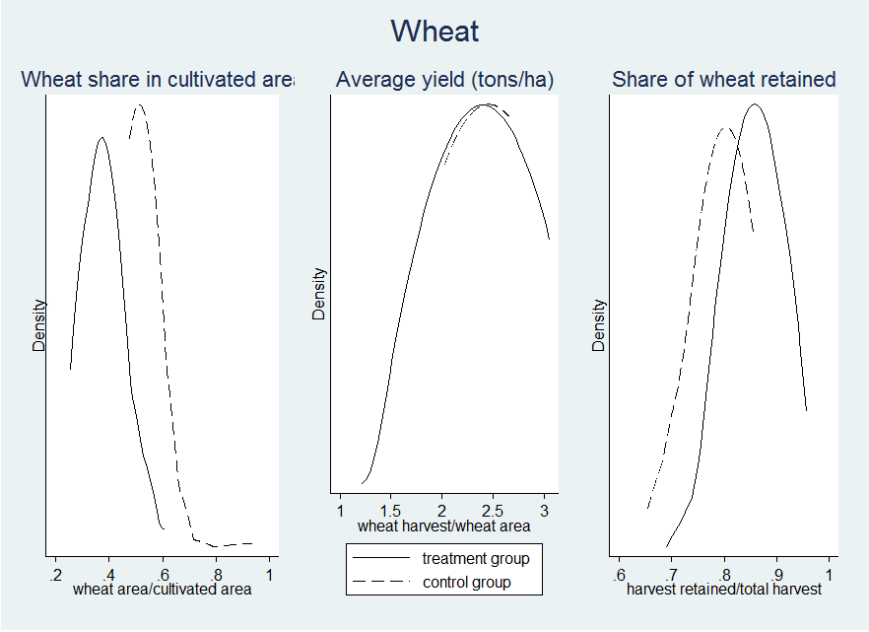


Figure 16: Tomato: area cultivated, yield, and share of harvest retained

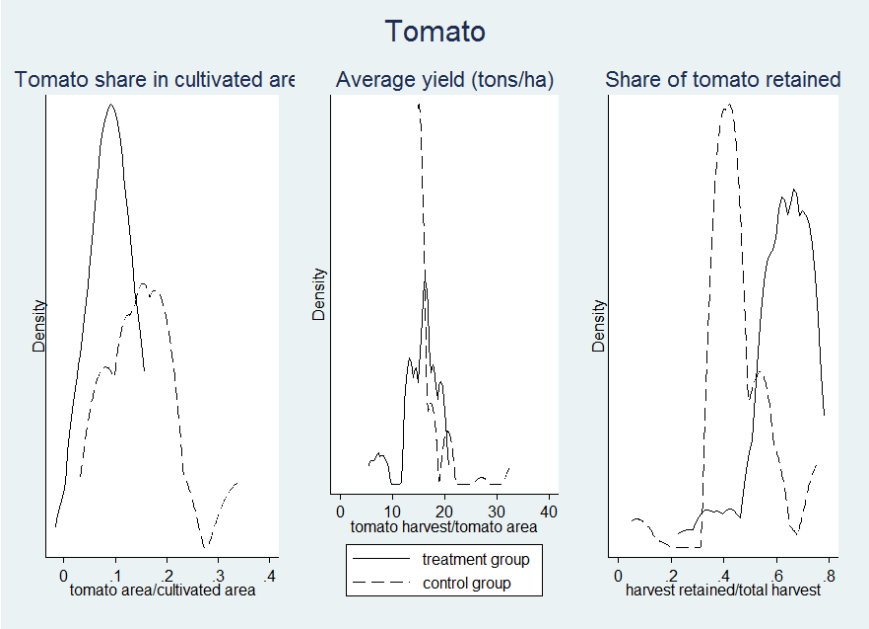
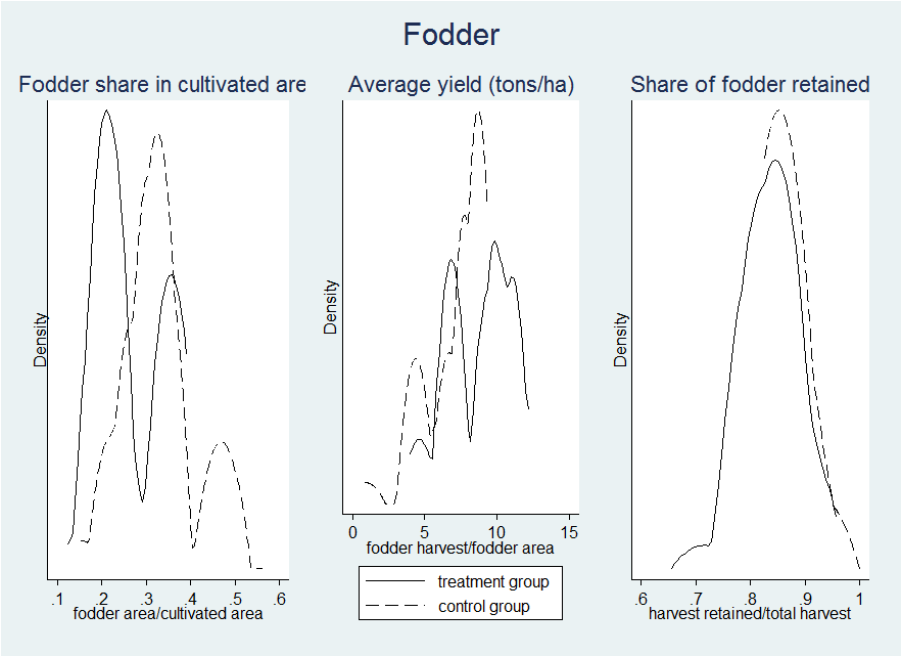


Figure 17: Fodder: area cultivated, yield, and share of harvest retained



5.6.2.3 Summary

The treatment group farms cultivated a larger number of crops in 2014 than those in the control group. Productivity in the treatment group appears to be higher than in the control group, and treatment group farms appear to be more market oriented than the control group farms. Further, variability in yield of key crops such as wheat and maize tends to be lower in the treatment group than in the control group. This evidences suggests that the treatment group is systematically different in its orientation towards agricultural markets than is the control group. Whether these differences can be attributed to USAID WUAs will be determined after the follow-up survey.

5.6.3 Cotton: Cultivation, Yields, and Inputs

Cotton remains the crop with the largest cropped area, with 56% of farms in the sample cultivating cotton. Understanding the economics of cotton cultivation thus becomes important, in order to gauge if cotton cultivation is likely to expand or contract. In the 2014 survey, we collected detailed information on cotton cultivation to understand whether it is profitable. In the follow-up survey, we will collect information on the factors that encourage or discourage farmers to cultivate cotton. In this section, we report on the number of cotton cultivating farms and areas under cotton cultivation; cotton yields; and cotton inputs.

Preliminary results suggest that treatment farms are far more likely to cultivate cotton than control farms (significant at 1%), but devote much smaller cropped areas to it (significant at 5%). Treatment farms are more likely to adopt high-yielding varieties (HYV) than control farms (significant at 1%). However, the difference in yields between the treatment and control groups is not significant when farms cultivate HYV variety. When cultivating traditional varieties of cotton, treatment farms gain higher yields than control farms, a difference that is significant at the 1% level. Input costs are higher per hectare of cotton cultivated in the treatment group than in the control group; this difference applies to both HYV and traditional varieties of cotton and is significant at the 1% level. Per hectare farm

expenses for irrigation, machinery, fertilizers and pesticides are higher in the treatment group than in the control group and the difference is significant at the 1% level for each of these types of input costs.

5.6.3.1 Number of cotton cultivating farms and area under cultivation

Out of the total sample, 56% of the farms cultivated cotton in 2014 (Table 20). This proportion is significantly higher in the case of the treatment group, where 66% of the farms cultivated cotton compared to only 46% of control group farms. Because treated and control *jamoats* share a large number of similar characteristics, this difference in propensity to cultivate cotton needs to be further investigated to determine whether the USAID intervention itself can explain a higher frequency of cotton cultivation.

Table 20: Cotton cultivation (n=988)

	Observations	Mean	Std Dev	Treatment value minus Control value	
				Coeff.	Std. Err
Proportion of *dekhan* farms cultivating cotton	1,991	0.56	0.49	0.19***	0.02
Area under cotton cultivation (in 2014) (ha)	1,113	3.38	4.63	-0.25	0.28
Percentage of the total area cultivated that is allocated to cotton cultivation	1,111	67.16	22,99	-3.02**	1.40
Proportion of adoption of HYV of cotton	988	0.55	.49	0.17***	0.03

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

While more farms in the treatment group cultivate cotton than in the control group, the area allocated to cotton is roughly the same in both groups, and the difference is not significant. Among cotton cultivating farms, plots of 3.4 ha are dedicated to cotton, which represents 67% of the total cultivated area of each farm. However, *dekhan* farms located in the control group allocate a larger share of their cultivated areas to cotton as compared to treated *dekhan* farms, and the difference is significant at the 1% level. It seems that treated

farms have more diversified cropping choices; while cotton is cultivated by a larger share of farms, a relatively smaller share of the cultivated areas are devoted to it, and a larger share is devoted to other crops, as compared to the control group.

5.6.3.2 Cotton Yields

We now consider the yields harvested and distinguish between the cotton varieties. Among farms cultivating cotton, 49% use HYV; 39% mentioned cultivating traditional varieties; and almost 12% were not aware of the variety they cultivated.[25] The adoption of HYV seeds for cotton is 17 percentage points higher for treated farms as compared to control farms. Possibly, areas of USAID intervention benefitted from training, improved access to information or to markets which supported the spread of HYV. It is also likely that more assured access to water makes farms in treated *jamoats* more amenable to using HYV.

Table 21: Cotton yields (n=988)

Cotton yields (metric tons/ha)		Mean	Control	Treatment	Treatment value minus Control value	
					Coeff.	Std Err
Mean		2.72	2.61	2.80	**0.18*** **	0.03
Traditional varieties		2.62	2.52	2.71	**0.19** **	0.09
High Yielding Varieties		2.84	2.79	2.87	0.08	0.09
Traditional - HYV	Coeff.	**-0.219*** **	**-0.27** **	**-0.15***		
	Std Err	.06	0.09	0.09		

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

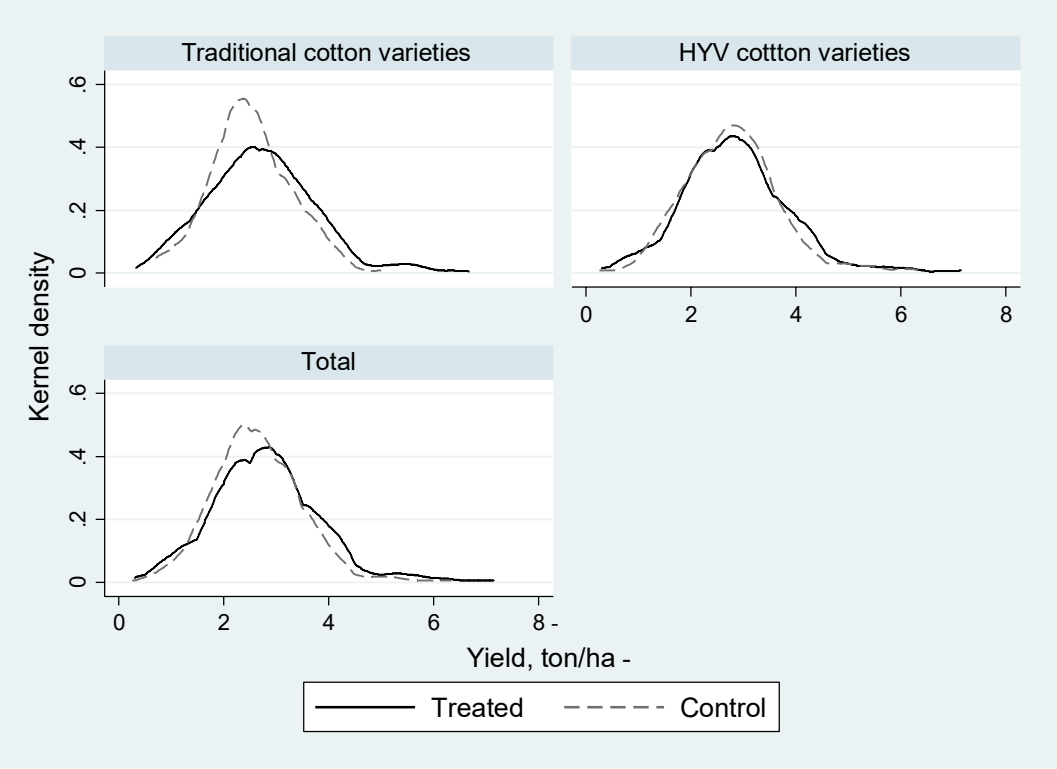
The mean cotton yield with all varieties grouped together is 2.72 metric tons per hectare of raw unprocessed cotton (Table 21). Behind this average, there is a shortfall of 181 kg/ha on

[25] This high number of farmers unable to indicate the variety of cotton they grow could be due to a lack of precision in the local terms used for seed types. We will explore this further during the follow-up survey.

control farms as compared to treated farms. This difference is significant at the 1% level, and indicates that higher yields were obtained in 2014 in treated *jamoats*. When these results are disaggregated by the type of variety cultivated, as expected the yields of HYV are significantly higher, but more interestingly the gap between treated and control yields differs for HYV and traditional varieties. In the case of traditional varieties, treated farms reach higher yields and the difference is significant; however, in the case of HYV, the yield difference between treated and control groups is minimal and not significant. This means that treated farms cultivating traditional cotton varieties perform better in terms of yields than control farms cultivating the same variety, and reach yields close to that obtained with HYV. However, when HYV cotton varieties are cultivated, treated farms perform as well as control farms.

These results are further reinforced by the distributions presented below (Figure 18). Control group farms are systematically lower in achieving cotton yields than treated farms, for traditional varieties of cotton, but not so in the case of HYVs of cotton.

Figure 18: Distribution of cotton yields



5.6.3.3 Inputs

Since the yield of cotton is higher in treated areas, we examine input costs. Farms in the treatment group spent TJS 625/ha more than farms located in control areas, and this difference is significant at the 1% level (Table 22). This difference is caused by higher costs of fertilizers, pesticides, machinery and irrigation.

Table 22: Input costs of cotton cultivating farms (n=988)

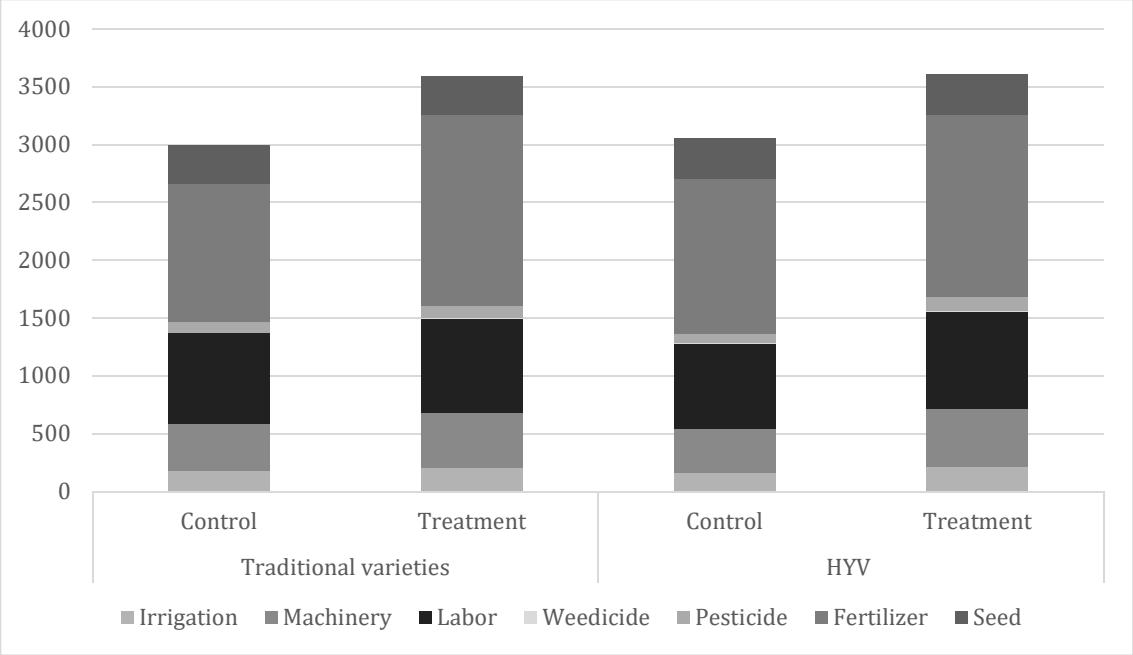
Input costs per hectare (TJS)		Mean	Std Dev	Treatment value minus Control value	
				Coeff.	Std. Err
Irrigation		194.43	145.21	**38.32*** **	8.85
Machinery		447.87	459.58	**89.48*** **	28.02
	Machinery for harvesting	0.08	2.57	-0.19	0.16
	Machinery for spraying	144.95	202.08	**29.10** **	12.34
	Machinery for tilling	302.73	362.24	**60.31*** **	22.11
Labor		787.70	804.64	74.28	49.30
	Labor for harvesting	433.19	603.43	47.03	36.96
	Labor for weeding	76.70	276.75	16.48	16.92
	Labor for sowing	91.02	137.12	-1.32	8.39
	Labor for tillage	189.30	212.89	18.12	13.02
Herbicide		6.48	38.22	-0.27	2.34
Pesticide		103.85	158.82	**36.54*** **	9.68
Fertilizer		1449.43	1025.01	**377.00*** **	61.91
Seed		342.43	189.06	12.38	11.57
Total		3301.25	1682.21	**624.70*** **	102.27

Source: Survey data collected by authors in 2015, pertaining to the 2014 cropping season
The column "Coeff" reports the treatment group value minus the control group value. The Column labeled "Std Err" reports the standard error of the t-test.
*** implies that the difference is significant at 1%; ** implies that the difference is significant at 5%; * implies that the difference is significant at 10%.

To check if the higher costs of cultivation for the treatment group can be attributed to its higher propensity to cultivate HYV cotton, input costs were broken down by type of cotton cultivated (Figure 19). The input costs are higher for HYV than for traditional cotton

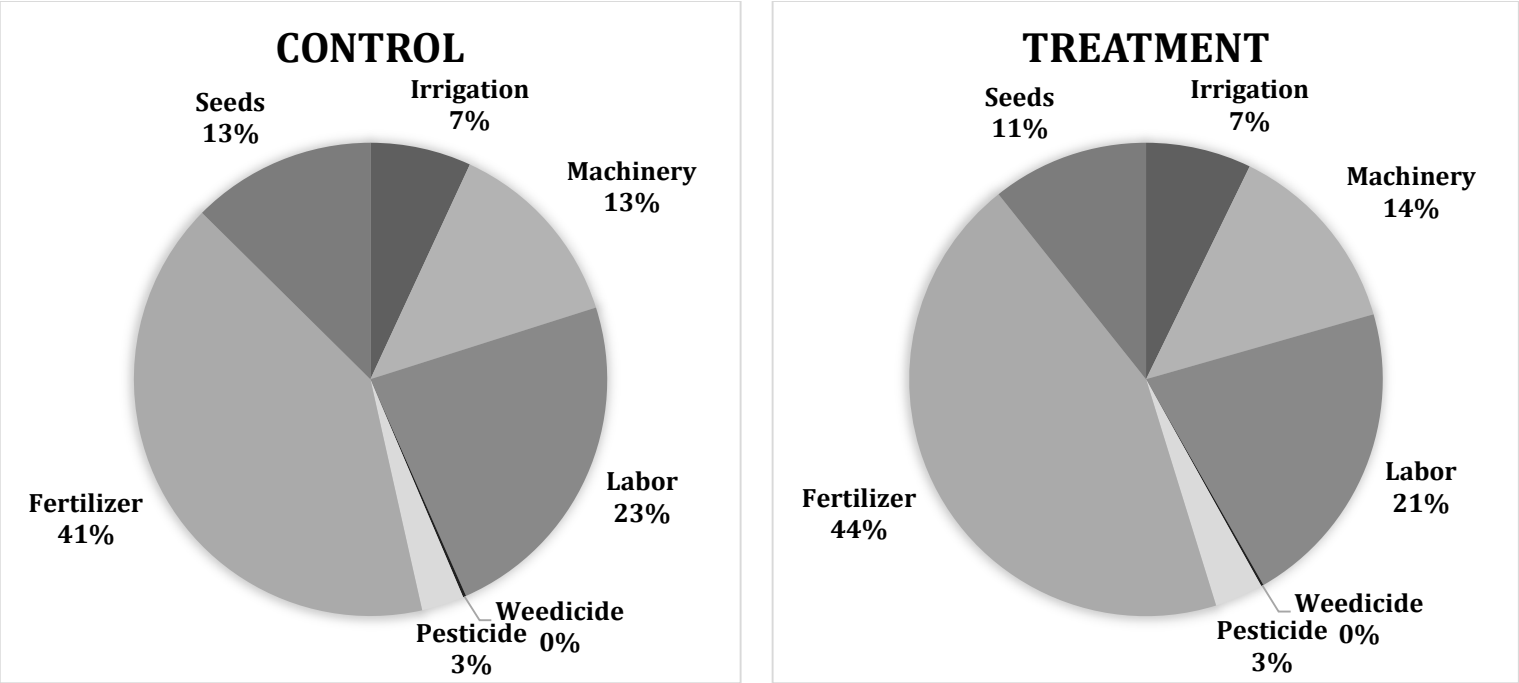
varieties, but the gap in the total input cost between treatment and control groups remains for both traditional varieties of cotton and HYV (Figure 19).

Figure 19: Input costs (TJS/ha) by treatment and variety



Finally, even if the cost per hectare of cotton is higher in treated farms, the composition of input costs remains quite similar (Figure 20). Fertilizers have the largest share and account, on average, for 43% of the total input costs. The share of the costs attributed to fertilizers is slightly higher in the case of treated farms as compared to control farms, and this difference is significant at the 1% level. Labor accounts for 22% of the total costs, consisting of sowing, weeding, tillage, and harvesting. Here, the share attributed to labor costs is slightly lower in the case of treated farms than in non-treated farms, due a lower use of hired labor for sowing, but the difference is not statistically significant. Machinery and seeds account for 13% and 11%, respectively, of the total cost share. Finally, irrigation is the smallest category of input costs and accounts for 7% of the total costs.

Figure 20: Input costs of cotton cultivators



5.6.3.4 Summary

Preliminary results suggest that treatment farms are far more likely to cultivate cotton than control farms but devote much smaller cropped areas to it. While treatment farms are more likely to adopt high-yielding varieties (HYV) than control farms, the difference in yields between the treatment and control groups is not significant when farms cultivate HYV variety. However, for cultivating traditional varieties of cotton, treatment farms gain higher yields than control farms, a difference that is significant at the 1% level. Input costs are higher per hectare of cotton cultivated in the treatment group than in the control group; this difference applies to both HYV and traditional varieties of cotton and is significant at the 1% level. These results suggest that cotton cultivation on treatment farms using HVYs may not be economically attractive. In the follow-up survey we will attempt to understand the motivations for cotton cultivation.

5.7 Summary of the Findings and Implications for the 2017 Survey

This chapter first aimed to present the methodology employed to assess the impact of the USAID WUAs at the farm level on agricultural development outcomes after donor support is withdrawn, with a focus on the persistence of the farms and on equity. The methodology is based on a comparison between treated and control groups, to be made between the baseline survey conducted (that collected data on the 2014 cropping season) and the follow-up survey that will collect data on the 2016 cropping season. In order to build comparable groups, the sampling design of the baseline survey used a matching approach to select the *jamoats* surveyed, and a stratified random sampling was used to select the *dekhan* farms surveyed.

The second objective of this chapter was to present the preliminary findings from the baseline survey, and especially the existing difference between farms treated by the USAID WUA intervention and non-treated farms. These differences cannot be attributed to the treatment based on the data collected so far, but indicate the main areas of interest for the follow-up survey and subsequent impact assessment.

Preliminary results suggests that USAID interventions might have led to better irrigation services in the treated group as compared to irrigation services in the control group. The propensity to irrigate cultivated area is higher in the treatment group; farms located in the treated group irrigated 97.5% of the area cultivated in 2014, while farms in control group irrigated 92.5% of the cultivated areas. Irrigation charges per hectare paid for the cotton crop are higher in the treatment group than in the control group. Cotton farmers in the treatment group also perceive their irrigation service to be timelier, and water to be more adequately available than do cotton farmers in the control group.

Analysis of crop choices suggests that the treatment group farms cultivated more types of crops in 2014 than did farms in the control group. Productivity in the treatment group appears to be higher than that in the control group; with yield for some key food crops higher on treatment farms than on control farms. Treatment group farms also appear to be

more market oriented than the control group farms, choosing to sell a greater proportion of their harvest, likely due to their higher yields. Further, variability (across farms) in the yields of key crops such as wheat and maize tends to be lower in the treatment group than in the control group.

Finally, analysis of the economics of cotton production suggests that treatment farms are far more likely to cultivate cotton than control farms but devote much smaller cropped areas to it. While treatment farms are more likely to adopt high-yielding varieties (HYV) than control farms, the difference in yields between the treatment and control groups is not significant when farms cultivate HYV variety. However, for cultivating traditional varieties of cotton, treatment farms gain higher yields than do control farms. Input costs are higher per hectare of cotton cultivated in the treatment group than in the control group; this difference applies to both HYV and traditional varieties of cotton.

In light of these findings, we will collect data on irrigation services, market access and reasons for cotton cultivation in the follow-up survey. The data from the two surveys will allow us to examine the persistence of impact, the equity of the observed impact and its spatial distribution. The impact on the cropping diversity and yields will be of particular interest considering the preliminary findings. In addition, and beyond these medium-term indicators, the impacts on the profitability of the farm and on agricultural incomes will have to be considered.

6 Role of Women in Irrigation Water Management

6.1 Introduction

While WUAs primarily serve *dekhan* farms, it is thought that households that do not own *dekhan* farms may still be impacted by WUA activities through their receipt of irrigation water for kitchen gardens and presidential plots. In many cases, these household plots are connected to the same irrigation schemes as larger *dekhan* farms, with the effect that families' ability to irrigate their kitchen and presidential plots may be subject to the same constraints in water access as *dekhan* farms or receive the same benefits from improved water management provided by WUAs. Crops from kitchen and presidential plots, as well as those from *dekhan* farm plots provide essential sources of nutrition for rural households, and challenges or opportunities in plot cultivation as a result of water management practices may have an impact on household food security.

It is understood that in Tajikistan women play a central role in the cultivation of crops on kitchen gardens and presidential plots. Therefore, their ability to access and effectively use irrigation water and engage with irrigation service providers, such as WUAs, may have important impacts on the yields of household plots. In order to fully understand the magnitude and extent of WUAs' impact on agricultural productivity and irrigation across different plots, crop cultivation and water management as performed and perceived by women at the household level should be explored.

The nature of women's involvement in agriculture has varied over time. In the early 1900s, women's participation in agriculture was largely reserved to the cultivation of household gardens and orchards, but with collectivization under the Soviet Union, women progressively worked alongside men in the fields. Since independence, the high rates of male labor migration from rural areas have left women to take on new tasks and more responsibilities both on *dekhan* farms and in managing household agricultural production. As such, a strong knowledge of women's experiences in crop cultivation and water management is key to understanding overall agricultural opportunities and constraints, especially at the household level. Such information

would also provide insight into how women may benefit and engage with WUAs, which is essential for the design of effective interventions.

With this in mind, a gendered analysis of the current roles of women in agriculture, as well as practices surrounding crop cultivation and irrigation water access and management at household level is proposed. This analysis will occur in the form of a household survey targeted at women and will primarily collect information on the use of household farm land, agricultural inputs and outputs, the gendered division of agricultural labor (including water management) among household members, housing and assets, income generating activities and sources of income, participation in community groups, as well as crop consumption and overall food security.

To inform the design of the household survey and identify key issues for exploration, qualitative research was conducted in August 2015 in Khatlon Province which aimed to deepen our understanding of constraints faced in household water management as well as the significance and evolution of women's role in agriculture.

The existing literature provides a limited understanding of the experiences of women in Tajikistan who work in agriculture, with few studies focusing on their access to land and irrigation water or roles in production. Notable sources that address these topics include Nozilakhon Mukhamedova and Kai Wegerich's 2014 paper "Land Reforms and Feminization of Agricultural Labor in Sughd Province, Tajikistan," the 2009 World Bank study "Agricultural Activities, Water, and Gender in Tajikistan's Rural Sector," Tatiana Bozrikov's 2008 "Review of Gender Situation in Cotton Sector of Tajikistan," as well as the Women's Empowerment in Agriculture Index (WEAI) for Tajikistan developed under the Feed the Future initiative. While these studies provide for a baseline understanding of key issues related to women working in agriculture, few are focused on Khatlon Province, one of the most populous and agriculturally productive regions of Tajikistan. Few of these studies offer in-depth explanations of the specific tasks women complete and the constraints they face in carrying out agricultural responsibilities, especially water management.

This chapter presents the findings of the qualitative research related to women's participation in irrigation and water management, as a key part of agricultural production. In arid Tajikistan, the effective use of water management techniques and access to irrigation water are crucial to the

success of any harvest and can have resulting impacts on household nutrition. However, the field of water management has historically been dominated by men. In the context of male out-migration and the absence of qualified male family members, this chapter explores the extent to which women are also beginning to take on new responsibilities in water management. Understanding women's role in this activity has particular implications for identifying if and how women may become more involved or benefit from community based water management initiatives, like WUAs.

Specifically, after a brief presentation of the study methodology, the following sections review the extent to which women working as farm managers, members, and wage laborers are engaged in the following key aspects of irrigation water management: application of water on different farm plots; receipt of timely and adequate irrigation water; maintenance of irrigation infrastructure; interacting with irrigation service providers; and responding to water challenges.

6.2 Qualitative Research Design

Focus group discussions and key informant interviews were used to gather qualitative data for analysis. All research as part of this qualitative data collection was conducted in Khatlon Province, which corresponds to the geographic focus of USAID's FTF initiative and water management interventions. Within Khatlon, two *jamoats* were selected for each of the following three contexts: (1) presence of WUAs established by USAID; (2) presence of WUAs established by other donors; and (3) no WUAs present (area served only by official government irrigation authorities).

The aim of speaking with women in these three contexts was to explore the possibility that their experiences in agriculture, and especially water management, may differ depending on the type of irrigation service provider dominant in their *jamoat*. With this approach, challenges that occur regardless of the specific type of irrigation service provider may also be understood.

The two *jamoats* selected for each context are located along the same main canal system, with one at the canal head and the other at the tail. This approach intended to ensure that the perspectives of women who are in spatially advantaged positions (head of canal) and spatially disadvantaged positions (end of the canal) were included. Additionally, a spatial examination of

the qualitative data was intended to identify any major differences in the experiences of women working on farms at the head and at the tail end of canal systems.

The *jamoat*s selected for the location of focus group discussions are presented in Figure 21. See Annex 8 for details on the selected sites.

6.2.1 Focus Group Discussions

Two sets of focus group discussions were held. One was with women who work on their own production systems, either as *dekhan* farm managers or members, and the other was with women who work as agricultural wage laborers on plots not owned by their household. As the challenges and experiences of the two groups were assumed to be markedly different based on the nature of their employment, separate focus group discussions were held for each group. (Questionnaires used as discussion guides are provided in Annexes 9 and 10.)

Discussions held with women who work on their own production systems explored how women's activities and decision-making power on kitchen, presidential, and *dekhan* plots differ. Women were also asked about the nature of their interactions with their irrigation service provider and opinions on the services provided. The discussion with female agricultural wage laborers focused on the reasons behind their employment, as well as their experiences in seeking work, performing the activities they were hired to complete, and receiving payment for their services.

In total, 12 focus group discussions took place. Six meetings were scheduled with women who work on their own agricultural production systems, but only five were held as the meeting in Ziraki had to be canceled because many participants were unable to attend. Seven focus group discussions were scheduled with women who work as agricultural wage laborers. Six meetings were also scheduled for this group, but an extra meeting was held in Ziraki to accommodate workers who were unable to participate in the scheduled meeting due to late arrival.

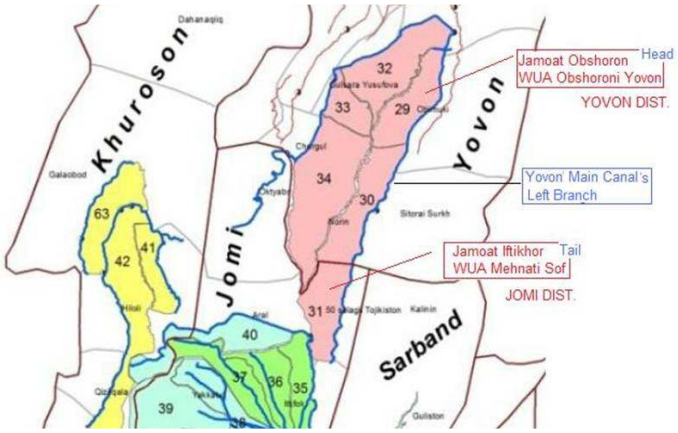
Two focus group discussions were held in school houses, four were held in WUA offices, and six were held in *jamoat* meeting rooms. The focus group discussions were facilitated in Tajik by a woman from Khatlon who had experience assisting discussion groups in rural areas, was

Figure 21: Sites for focus group discussions with women

<u>Context 1: WUAs established by USAID are present</u>

Head: Obshoron (Obi Muki) *Jamoat* in Yovon District

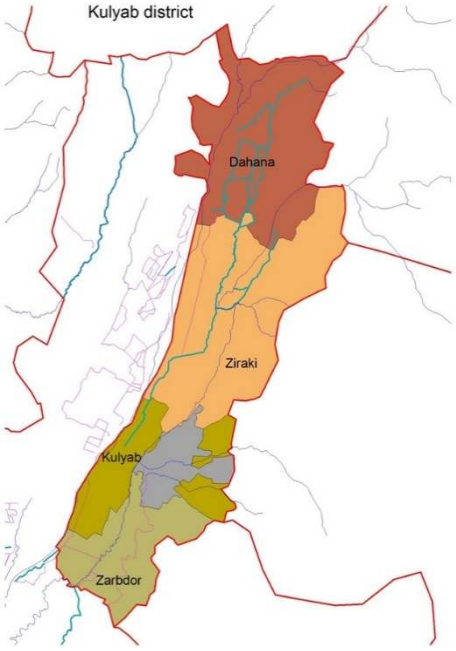
Tail: Iftikhor *Jamoat* in Jomi District



<u>Context 2: WUAs established by donors other than USAID are present</u>

Head: Saiyfuddinov *Jamoat* in Panj District

Tail: Namuna *Jamoat* in Panj District



acquainted with some *jamaot* officials, and was also fluent in English. The discussions were also observed by a representative from IWMI proficient in Tajik.

Participants were recruited at the *jamoat* level and selected based on their participation in agriculture as farm managers, *dekhan* farm members, or wage laborers. To the extent that it was possible, women were recruited from different villages.

The target focus group size was 12 to 15 participants. Actual participation rates are presented in Table 23.

Table 23: Participants in the focus group discussions

Context	*Jamoat*	District	Wage laborers	Farm mangers and members	Total
WUA by USAID, Head/Context 1	Obshoron (Obimuki)	Yovon	9	9	18
WUA by USAID, Tail/Context 1	Iftikhor	Djomi	15	12	27
WUAs by other donors, Head/ Context 2	Sayfuddinov	Panj	14	12	26
WUAs by other donors, Tail/Context 2	Namuna	Panj	14	14	28
No WUAs, Head/Context 3	Ziraki	Kulob	14	0	14
No WUAs, Tail/Context 3	Zarbdor	Kulob	15	15	30
Total			81	62	143

Basic background information was collected from participants to gain an understanding of group characteristics, including ages, levels of education, gender of the head of the household, gender of the head of the *dekhan* farm, and the type of land possessed.

Women of all ages work in Tajikistan's agriculture sector, which is a fact that was reflected by participants in our focus group discussions (Table 24). Participants were categorized as either women who worked on plots that belonged to their households, or those who worked as wage laborers on plots that are not owned by their households.

Table 24: Age profile of participants

Group	Below 20	20-29	30-39	40-49	50-59	60-69	70-79
Work on own plot	2%	16%	14%	21%	40%	5%	2% -
Wage laborers	1%	16%	19%	44%	19%	1%	0% -

In both groups, the majority of women had attended secondary school for at least some time. Several women said they had not completed secondary school due to the outbreak of civil war or lack of money for expenses associated with their education. Levels of education in the group were as follows.

Table 25: Education levels of participants

Group	None	Incomplete primary[26]	Secondary (complete and incomplete)	Completed Vocational	Higher Education (In-progress or complete)
Work on own plot	1%	0%	89%	2%	8%
Wage laborers	5%	6%	83%	1%	5%

Seventy-six percent of the participants were working on their own household plots, while 24% worked on other plots as wage laborers. Among those who worked as wage laborers, 78% were from male-headed households and 22% from female-headed households. The dominant engagement of women is on plots owned by their households, where the household head is male.

Among women who work on their own *dekhan* plots, participants were also asked about their relationship to the head of the farm, who may be a different individual to the head of the household that the woman belongs to. In total, 53% of women interviewed worked on a *dekhan* farm with a male farm manager, 42% were the farm managers themselves, and 5% had another female member of their family as the farm manager. A high number of female farm managers sampled is partly a result of the selection process, as it was attempted to have at least three female farm managers participate in each group. The relationships of participants to farm leaders

[26] Completed primary is not listed as no participants stated having completed this option. Those that completed primary school also attended at least some secondary school.

included husbands, sons, brothers-in-laws, brothers, uncles, fathers, fathers-in-law, cousins, grandsons, sisters-in-law, mothers-in-law, and even daughters-in-law.

As may be expected, the types of land owned by female wage laborers and women working on their own plots differed (Table 25).

Table 26: Women's access to production systems

Group	No land	Kitchen garden	Presidential plot	*Dekhan* lot
Work on own plots	0%	95%	68%	100%[27]
Wage laborers	6%	93%	40%	6%

On the *dekhan* farms managed by participants' households, cotton was the primary crop grown by the majority of farms, with other households growing vegetables, orchards or wheat as their primary crop.

6.2.2 Key Informant Interviews

Separate conversations with women who manage *dekhan* farms were held to supplement the information obtained through focus group discussions, and to ensure a strong understanding of the opportunities and constraints they face. Five key informant interviews were held, four at the respondents' homes and one at the *jamoat* office. A sixth key informant interview was planned for Ziraki, but the respondent fell ill and there were no other female farm managers in this *jamoat*.

Of the five interviewees, two were between the ages of 40 and 49, two were between 50 and 59 and one was 63. All had completed secondary school and one had additional vocational education. The interviewees' husbands were the heads of the household in all but one case, in which the woman herself was the head of the household. All women had *dekhan* farm plots, three had presidential plots, and three had kitchen plots. On their *dekhan* farm plots, three grew cotton as their primary crop, one grew wheat, and one grew vegetables.

[27] Only women with *dekhan* farms were selected for this group.

6.3 Findings

6.3.1 Application of Irrigation Water on Different Farm Plots

Women in Tajikistan have historically been more involved in tending small plots of land, such as presidential plots and kitchen gardens, than cultivating large fields, such as *dekhan* farm plots. The qualitative research conducted indicates that women are also more involved in the physical application of irrigation water and in decisions regarding when and how much water to apply on kitchen and presidential plots than *dekhan* farm plots, with some notable exceptions. In the section that follows, a more detailed examination of women's involvement in applying water to these three types of plots is presented.[28]

6.3.1.1 Female participation in irrigation

The majority of women who lived in a household with a kitchen garden or presidential plot were engaged in the physical application of irrigation water to these plots, including almost all the participants in Obshoron, Sayfuddinov, and Namuna. This does not, however, necessarily imply that the task is exclusively done by women in these households. The head of a farm in Namuna explained that watering the kitchen plot is a duty taken up by both women and men in her family, as they together set up the irrigation system, monitor the crops, and apply water when required. Some women in Iftikhor did apply water to their kitchen gardens, though others said that this task was completed by their husbands and no women applied water to their presidential plot in this *jamoat*. In Zarbdor, applying water was said to be done exclusively by men on both the presidential and kitchen plots, with the exception of one woman who worked alongside her son.

In comparison to women's involvement in watering the kitchen garden and presidential plot, fewer women irrigated their *dekhan* plot. Among those who did, the majority noted that this task is not customary for women and some indicated that they would prefer not to be involved. In

[28] Conversation topics with the women were exclusive to the duties they performed as part of their primary role in agriculture and wage laborers were not asked about their household's cultivation. Women who worked on their own farms were more involved in irrigation than wage laborers, and so while the examination includes information collected from both sets of focus groups, there is less information regarding wage laborers. As conversations were only conducted with wage laborers in Ziraki, the data regarding water management activities in this *jamoat* are particularly limited.

Zarbdor, Iftikhor, Sayfuddinov, and Obsohron, most women said male members of their households applied water to the *dekhan* plot. Half the wage laborers in Ziraki and all wage laborers in Zarbdor, Iftikhor, and Namuna concurred that watering the *dekhan* plot is usually done by hired male laborers or male members of the farm owner's family.

6.3.1.2 Decision making in irrigation water application

The decision of when and how much water to apply to each plot appeared to be made most often by the household member who will apply water to that plot. For example, almost all women in Obshoron, Sayfuddinov, and Namuna indicated that they decided or were consulted about when and how much water to apply to their kitchen plot, mirroring their levels of participation in applying water. Rohila, a farm manager from Namuna, said that her husband decides when and how much water to apply to their *dekhan* farm plot, because he does more work on this plot of land, including applying irrigation water, and hence has a better sense of what is needed.[29] Similarly, in Zarbdor, all focus group participants said male family members decided when and how much water to apply to the crops, as they are primarily responsible for this task. Saida in Zarbdor said that she is responsible for making this decision as she executes all irrigation activities.

There were, however, some exceptions to this pattern. In Sayfuddinov, despite women's active involvement in farm activities and irrigating their household's *dekhan* plots, male members of their households decided when and how much water to apply. In Iftikhor, while Fereshta's son applies water to the kitchen garden, her daughters and daughters-in-law decide when and how much water to apply. Jamila from Sayfuddinov stated that even though her husband is in Russia for work, she consults him on different farm activities, including watering the *dekhan* farm. However, she makes the decisions for all activities for the kitchen garden, as she manages production on this plot.

6.3.1.3 Factors limiting the participation of women in irrigation

In the case of kitchen and presidential plots, age, physical abilities, and the timing of the release of irrigation water all play a role in limiting opportunities for some women to participate in the

[29] Personal views and claims made by participants are reported in this chapter, but all of the names of specific respondents have been changed here to protect their identities.

irrigation. Women who previously watered their kitchen gardens, like Fereshta in Iftikhor, said that they are no longer involved in the activity due to their age. She says her sons now water the kitchen garden. Also, in Iftikhor, wage laborers explained that watering the kitchen garden is a task done mostly by men, as water is usually released at night between 12:00 am and 1:00 am with the flow reducing as time passes. To ensure that the plot is fully irrigated, water should be applied as early as possible and monitored for the next several hours. Such timing poses a challenge to women. In households with no male family members, women in this *jamoat* preferred to irrigate the plots during day, despite the fact that they may not receive an adequate amount of water and may run into conflicts with upstream or downstream neighbors who are also watering their plots.

In the case of *dekhan* farms, women from all groups noted that applying water to the plot was typically a task done by men – a professed norm that may in part account for the lower rate of women's participation in this activity. The roots of this norm were explained as being both historical and practical.

a) Limitations due to tradition and history: During the Soviet era, women were most often employed in jobs that required minimal technical skill, including weeding or picking crops, while men were responsible for tasks considered to be more complex, such as water management and working heavy machinery. Mavluda, a 70 year old farm manager from Sayfuddinov, explained further that at that time, the application of water to large plots was done by an *obchi,* who was given a salary for his services. To her knowledge, this position was always filled by men. While such salaried positions are no longer common, the idea that the irrigation of large fields is a job for men persists. Wage laborers in Sayfuddinov said that applying water to the *dekhan* farm crops is one of the few tasks that men are still employed to do within agriculture, as they are otherwise usually engaged in non-agricultural labor, such as making bricks or construction.

b) Limitations due to the lack of expertise: As this task has historically been done by men, many women lack the experience and knowledge needed to effectively water crops at a large scale. Jamila in Sayfuddionv and wage labors in Iftikhor both said that they did not know how to apply water to crops on *dekhan* farm plots, including how to divide the water between the furrows.

c) Limitations due to physical demands of the task: Beyond the fact that it was men who traditionally did this activity, women also described the process of applying water to crops as being difficult, indicating that they may prefer not to be involved. Women in Sayfuddinov and Obshoron noted that activities such as the digging and clearing of irrigation ditches to connect plots to nearby canals, and maintaining furrows while applying water are physically demanding and easier for men than they are for women. Wage laborers in Iftikhor also said that one must walk in cold water while applying and monitoring its flow, an activity that many feel leads to illness. Due to the difficulty of the task, farm managers may offer laborers higher wages for applying water than for tasks such as weeding.

d) Limitations due to the timing of the release of water: As was the case with applying water to kitchen plots, the timing of water flow can also be a challenge for women. In some *jamoats*, such as Namuna, water begins to flow through the canals at night, which makes it difficult for women to irrigate *dekhan* plots themselves as they have responsibilities in the home at this time and concerns about their personal safety.

6.3.1.4 Changing roles in irrigation in dekhan *farms*

While the majority were not involved, some women did water their *dekhan* farm plots themselves, including slightly more than half the women from Namuna, Obshoron, and Sayfuddinov. In describing their participation, most women referenced the absence of a qualified male family member, indicating that they would still prefer or are accustomed to men applying water to the *dekhan* farm plot. Shirinbonu in Obshoron stated, "if men are home they [apply water], if not I do… For men [it is easier than it is for women], but when they are not home we have to do it" – referencing the fact that men in rural areas are often away for months or years at a time working as laborers in Russia or in another city in Tajikistan. Women working on their own plots performed this task if there were no men at home and also if the male members of their household did not have enough knowledge to properly water the crops. For example, a farm manager from Zarbdor stated that even though her husband and adult son live at home, she is primarily responsible for watering her *dekhan* farm because she has more experience.

If there are no male family members at home, some women prefer to hire wage laborers to irrigate their *dekhan* plots rather than take on the task themselves. One woman in Sayfuddinov

explained that most women would first choose to hire a laborer to apply water, but if they do not have the financial means then they are compelled to learn how to apply water and do it themselves. With her husband and son in Russia, Jamila in Sayfuddinov recruits and negotiates the payment of a hired laborer to water her crops. Fereshta in Iftikhor also hires a male wage laborer to apply water to her plot, but says her son negotiates the wage laborer's payment if he is at home. Sometimes she finds it difficult to pay the laborer his full wage at once and has to pay him in installments.

With high rates of male out-migration in many villages, female wage laborers in some areas have also begun to irrigate plots. In Ziraki, half the participating wage laborers had been engaged in assisting or leading crop irrigation for the past several years, as very few men in their *jamoat* are still working in agriculture. They explained that, while their work in this area was once looked down upon, their skills are now in demand and they are working towards teaching other women how to irrigate crops effectively.

> "Before, we would apply water and get all dirty and the village women would laugh at us. Now they don't, because they do it themselves and complain that it's hard work. These women used to call us names…and laugh at us for the amount of money we worked for. But now they can't apply water properly…it has its own technique."

6.3.2 Receipt of Timely and Adequate Irrigation Water

Regardless of their level of involvement in irrigation, all the participants were aware of issues related to water availability on the farms on which they worked. Their interest in this topic is understandable, as the timely receipt of adequate irrigation water and management services are crucial to the ability of any woman working in agriculture to retain her position, livelihood, and provide for her family. Reports of water availability varied within and across *jamoats*, though positive reviews were limited to one woman in Namuna and some women in Sayfuddinov, who said that their village usually had enough water. Overall, women were unhappy with the quantity and timing of the water they received, not only in terms of a lack of water, but also with the saturation of their soil with water. Dissatisfaction with water availability was present in every *jamoat*, regardless of the irrigation service provider or the location of the *jamoat* along a canal.

6.3.2.1 Lack of irrigation water

At least one woman in every *jamoat* had experienced a lack of water on plots owned by their household or those on which they worked. These shortages meant that crops were not properly irrigated, resulting in poor yields. Women in Zarbdor said that, while they have adequate water for their kitchen and presidential plots, they do not have enough water for their *dekhan* farm plots. One farm in their area by the name of 'Sabz' did not receive water when needed and lost an entire harvest. 'Sabz' was a major employer of female wage laborers and many are now seeking employment on other farms, as the wages paid by this farm are comparatively low, perhaps in part due to poor harvests. Women in Namuna, Iftikhor, Obshoron, and Ziraki also experienced irrigation water shortages and consequent impacts on their harvests. Shirinbonu, the manager of a four-hectare farm in Obshoron, stated "water comes to this small canal very late, so all the crops die. I spend money and work hard to plant cotton, but it dies because it does not receive water on time. Once, I harvested my cotton and only got two bags. The rest just died." In Iftikhor, some women tried to grow tomatoes in their kitchen gardens, but the plants died due to a lack of water. These women expressed frustration that they could not grow a greater diversity of crops. They stated:

> "There is no water, otherwise we could grow everything! Crops like wheat, cotton, pumpkin. We have women [in our *jamoat*] with 40-70 years of experience [in agriculture]. Before, our *jamoat* grew [the most] onions in the district, but now since we don't have water, we can't grow all these things. Day by day the situation is getting worse."

Women in Iftikhor noted that a lack of water and lost harvests translate into negative profits, which means less money to pay off the credit taken on agricultural inputs and less money to invest in the next cultivation cycle.

While some women suffered from a lack of water year round, others noted that their water shortages primarily occurred during a specific season. In Obshoron, women only receive water from May to October – the cotton growing season. There is no water in the canals during winter and spring, not even for drinking. Women in downstream Iftikhor stated they suffer from the same seasonal shortages, though the timing varied slightly as they receive water only from May

to September. Seasonal variations in irrigation water were also mentioned by women in other *jamoats*. In Sayfuddinov, women stated that they receive slightly less water in the fall, whereas a woman in downstream Namuna stated she has difficulty getting water for her crops at the beginning of spring, with the worst shortages in June and July while cotton is growing.

Most women sourced their water problems back to the location of their farm along a canal system or infrastructure that was in need of repair. A woman in Sayfuddinov stated that she experienced a lack of water because her farm was far from the canal. Women from Namuna, Iftikhor, and Zarbdor, and one woman from Obshoron noted that, by the time irrigation water is taken by farms upstream, there is not enough water left for them. In Iftikhor, women complained that not only did they lack water because of overuse by upstream farms, but also that the *district* ahead of them on the canal system, Yovon, intentionally stops the flow of all water down their canals during the winter and spring because of a debt owed by their *jamoat* to Yovon for the provision of water. Women in Obshoron, in Yovon, explained their seasonal shortage differently. They said that, according to the WUA, the canal leading to their *jamoat* must be shut to prevent flooding caused by build-ups of snow and water during the winter. Under the Soviet Union, water came during these months via pipes, which are now broken.

6.3.2.2 Waterlogging

Some women, including those from *jamoats* where water shortages were experienced, also reported waterlogged fields, some with high levels of salinity. Wage laborers in Zarbdor complained that they would like to grow peppers and carrots on their presidential plot, but cannot do so because the lands are flooded. In Iftikhor, one wage laborer said that 30 to 40 meters of her land is waterlogged, which she believes is partly responsible for her household's inability to grow profitable wheat, alfalfa, mung bean or corn crops for the past two years. Other women in the group stated that they are experiencing a similar phenomenon: "we…don't get profit because the lands became waterlogged...we work hard and use many crop chemicals but there are no results." Another woman in Iftikhor stated that her fields are so full of water that, "I jump from stone to a stone to check my cotton. Nobody does their duties well, nobody cares." Her statement implies that she believes the roots of her problem lie in the poor maintenance of water infrastructure. In Iftikhor, waterlogged fields were believed to be caused by both blocked canals

that overflowed and seeped into the ground, and old leaking wells that were located on farmers' land.

6.3.3 Maintenance of Irrigation Water Infrastructure

The maintenance of irrigation water infrastructure is essential to ensure that farmers receive adequate amounts of water and prevent flooding. In particular, the canals running to farmers' plots become blocked by debris or plant growth over the year and require periodic clearing.

6.3.3.1 Small canals

Few women who worked on their household plots were involved in cleaning the canals leading to their plots, with most of them stating that male family members took on the task because of its physical difficulty. Women in Zarbdor, Namuna, and one woman in Iftikhor said that the canals leading to their kitchen garden were cleaned by their sons and husbands, often in the spring.

While participants agreed that cleaning canals was a job traditionally completed by men, they acknowledged that some women have become involved in this, working alone or alongside other family members or neighbors to clean smaller canals due to male out-migration. For example, in Iftikhor, women said that the ditches near their kitchen gardens are mainly cleaned by women in November and December because their sons are not at home. Some women in Sayfuddiov and Obshoron also cleaned the canals around their plots.

Female wage laborers in Ziraki, Obshoron and Sayfuddinov said that they have never been hired to clean canals; however, in some areas, female wage laborers have been hired to do this job. This is a low paying job in comparison to weeding or watering the fields, and they earn just 3 TJS for every meter they clear. Despite poor wages, almost all participating wage laborers in Iftikhor accepted these jobs when offered. All participating wage laborers from Zarbdor also said that they have been hired to clean small canals. According to these women, this activity begins in February or March and is physically difficult, as they have to stand in the cold canal water and work to clear the canals by hand. In Namuna, participants mentioned that, in their *jamoat*, an NGO hired several women and their families to clean canals.

6.3.3.2 Larger canals

Some canals are too large to be cleaned by hand, and in such cases an excavator is needed to fully clear the blockage. Few households own such machinery and generally need to hire the equipment and a driver, who is almost always a man. In Zarbdor, women noted that their community self-organizes to ensure that larger canals get cleaned, with village leaders collecting money for diesel fuel and the hiring of an excavator. In Sayfuddinov, the women said that they received external assistance from an NGO that cleaned the canals leading to the presidential plots and *dekhan* farm plots.

Without collective organization, the costs and logistics of renting this piece of heavy machinery can be difficult for farmers to manage. Fereshta in Iftikhor believes that women experience these challenges more acutely than men, stating:

> "Men can go out, bring the equipment and clean [the canals]. Men are men, they are able to arrange such things, but who can women talk with?...Women are too busy, we have work coming from all directions, from the household and the *dekhan* farm…I do want [to clean the canal near our plot] but I don't know where to go and who to speak with in order to solve this issue."

Fereshta was told that it was her responsibility as a *dekhan* farm owner to pay for the maintenance and cleaning of her nearby canal. With a big family to support, she is unable to afford such a cost. Another woman in Iftikhor also noted the difficulty of paying the high cost of excavators on top of other expenses. She states, "With [only] 600-1,000 TJS, tractor operators won't even talk to you! They will simply ask for more money."

6.3.4 Interacting with Irrigation Service Providers

Interacting with the local institutions responsible for water distribution and management is an important part of ensuring access to irrigation water and services. *Dekhan* farmers may come into contact with their irrigation service provider in various ways depending on the structure of the institution and the needs of the individual, such as through fee payment, meetings, or in seeking assistance to a water-related problem. The following section examines the circumstances under which female farm managers commonly interact with their irrigation service provider,

their experiences in those interactions, and obstacles to the development of a positive, productive relationship between the farmer and irrigation service provider.

6.3.4.1 Irrigation service fees

Women across the *jamoats* pay irrigation service fees that are collected at their homes by either WUA or *Vodkhoz* representatives, but beyond this core similarity the specifics of fee payment, including the individual responsible for making the actual payment, the basis for payment, and the repercussions for late payment, differed among female-headed farms in Khatlon Province.

The actual payment of the fee was done by both men and women, depending on the *jamoat* and the household. In Zarbdor, irrigation service fees were said to be paid only by men. Similarly, in Iftikhor, Fereshta said that her husband pays the water fees, despite the fact that he is in Russia for the majority of the year. If the WUA comes to collect money before her husband arrives home, she has to ask them to return later, hoping they do not turn off her water in the meantime. Another woman in Iftikhor said that she pays her fees herself each year on January 15th, and if the WUA staff do not come that day she will seek them out and pay them to avoid any trouble. The majority of women in Obshoron also paid fees themselves.

Women in *jamoats* with WUAs all said that they pay fees for each one of their plots separately on an annual basis, with the exception of one woman who paid her fees quarterly. In Zarbdor, which does not have any WUA structure and is served only by a *Vodkhoz*, women said that they only paid fees for the water provided to their *dekhan* farm and not for irrigation of their kitchen garden or presidential plots.

Several groups mentioned that the amount they owe the service provider is based on the area of their land, with a set price per *sotikh* (one-tenth of a hectare) or hectare of land. Payment amounts varied, with women in Namuna and Zarbdor stating that they pay TJS 15 and TJS 40 per hectare, respectively.

Women in Zarbdor, Iftikhor, and Obshoron expressed frustration with this method for calculating their payment, as the amount they pay is not reflective of the amount of water they receive. In Zarbdor, women noted that they pay the same amount of money as farm managers upstream, but get less water. Women in Iftikhor and Obshoron also indicated that they felt cheated, as they pay

for water for a full 12 months, but do not receive water during the winter and spring. For these women, the burden of paying for water they did not receive is intensified by new financial burdens resulting from a lack of water, including the costs of trucking drinking water from another village and lost income from unproductive crops. One woman in Iftikhor stated "They tell us to pay. How can we pay if we can't sell anything? We don't have any profit. It is such a torture."

Across all *jamoats*, women maintained that paying fees to their irrigation service provider is an ongoing challenge, in part due to a lack of readily available cash. They explained that they face greater difficulty in paying the WUA or *Vodkhoz* staff, if fees are collected before the sale of a major crop harvest, because they tend to have little cash at that time. Furthermore, some participants said that they face difficulty even after the harvest. Shirinbonu in Obshoron said that because she does not earn any profit from her cotton, she consistently struggles to pay fees and at times feels as though she has been taken advantage of by her WUA. She stated:

> "They give water just before they come to collect money, and by then it is too late to help the crops. They collect TJS 200, give us a receipt, and [simply] leave. We are naive people, so we don't complain anywhere, but that's why they use us. People in other parts of the world would sue them for this."

Rohila, another participant in Namuna, stated, "We don't always have money to pay and it's embarrassing."

When women did not have enough means to pay their fees, they employed different coping strategies to cover costs. For example, participants said that they often borrow money. Nodira, a 25 year old head of a farm in Obshoron said that, if you do not have enough cash when the WUA staff come to collect fees, the representative will wait at your house, drinking tea while you run to borrow money from someone else. Women in Iftikhor stated that they are obligated to sell the majority of the produce from their presidential and *dekhan* plots to "cover expenses such as taxes and water fees."

If they are not able to pay the fee in full, some participants in Sayfuddinov, Namuna, and Iftikhor stated that the representatives were willing to come back another day. However, there were also

women, including one in Iftikhor, who said that WUA staff have threatened legal action or fines, if they are unable to pay. As one woman put it, "they come to our door and demand water fees. We tell them, how can we pay if we don't have any profit? But in response, they tell us that if we don't pay they will sue us. I get scared and I pay." Women in Obshoron said that they are threatened with fines equal to the amount owed for their irrigation water, if they cannot pay on the day the WUA representative comes. This is despite the fact that they said there is no mention of a fine for late payment in their contracts with the WUA. Shirinbonu, in Obsohron, reported that, when she was one day late with her payment, she was told to pay a 200 TJS fine to the bank on top of her 200 TJS irrigation water bill. In this case, Shirinbonu reported that she was a member of a WUA and it was the WUA who had come to collect her fees and charged her the fine, but upon speaking with the WUA representative in her area later, he said that her neighborhood is not under his jurisdiction and that she is served by the *Vodkhoz.* Her lack of clarity regarding who is coming to collect her fees and who is charging her fines may be experienced by others as well. The origins of the fines discussed are also not clear, as many WUAs collect water fees which are passed onto the *Vodkhoz* and so it is possible the fines were levied by the *Vodkhoz.* However, fines were not explicitly mentioned in connection with the *Vodkhoz* by any participants.

6.3.4.2 Meetings

In Namuna, Sayfuddinov, Iftikhor, and Obshoron, most female farm managers said that, if they have the time, they will attend WUA meetings. Although, women in Iftikhor did say that occasionally male members of their household will not let them attend. In Obshoron and Iftikhor, women expressed the opinion that the WUA does not always invite all the female farm managers to all the meetings. One woman in Obshoron stated "They are afraid we will complain and talk about our problems. That's why they don't call us." In Zarbdor, no women had been invited to a meeting with the *Vodkhoz*.

In Namuna, women said they feel comfortable sharing their thoughts during meetings and one woman stated "I speak very freely. I am proud of being a woman, and taking care of my work and responsibilities." Some female farm managers in Iftikhor also said that they talk openly about their problems at WUA meetings which are held every three to four months. However, other women in Iftikhor and other *jamoats* noted more reservation about participating in WUA

meetings. Fereshta in Iftikhor said she has never been invited to a WUA meeting and that she is not interested in going, "because they are men and I am a woman. I am not used to being around men so often." Shirinbonu from Obshoron also hesitates to speak openly at meetings, if there are many men in attendance. She says while there are two or three other female WUA members, they usually send their sons in their place. Jamila in Sayfuddinov had a different reason for not actively participating in the meetings. If called, she will go and sit quietly through the meeting unless she was asked a direct question. She says she is not interested in becoming more active in the WUA as "it is not profitable. There is no benefit at all, so why would I? I pay for all my expenses. I do everything by myself on my farm. The WUA doesn't help me."

6.3.4.3 Trainings or special events

Very few women had participated in trainings or events organized by their irrigation service provider. In Zarbdor, women said that no events had ever been organized by the *Vodkhoz*. In areas with WUAs, such as Sayfuddinov, most women agreed that trainings had occurred in the past, but that none of them have attended them because they do not have time. In Namuna, women also said that the WUA has organized trainings and that some of them did attend a special meeting with women about water distribution. They viewed this special session as unproductive, as no changes occurred following the meeting.

When asked what skills or information they would be interested in learning, only one group specifically mentioned water management. Wage laborers in Zarbdor stated "we want to know more about irrigation, when and how we should apply water to crops." Along with most women in Namuna, Sayfuddinov, Iftikhor, and Obsohron, women in Zarbdor were also interested in learning more about agriculture generally, and specifically about seed selection for different soil types and the use of crop chemicals.

Many women also noted a strong interest in trainings about health. Wage laborers in Zarbdor stated "It would be good to conduct trainings about health, so we would know how to take care of ourselves and our children." They emphasized that good health is essential to their ability to work in agriculture and provide for their families. All groups noted negative health impacts as a result of their agricultural labor, including back, leg, and head pain, allergic reactions from weeds and chemicals, and sickness from drinking contaminated canal water while working.

6.3.4.4 Leadership positions

None of the women in these groups held leadership positions with their irrigation service providers, and there was little interest expressed in taking on such roles. One woman, who was the head of a farm in Namuna, was offered a position with her local WUA, but she turned it down as the majority of her co-workers would have been men, implying that she felt uncomfortable working in an environment that was mostly male. Other women said they were not interested in leadership positions because of the time commitment required.

6.3.4.5 Resolution of water challenges

Beyond routine interactions through the payment of fees or attending meetings, farmers often rely on their irrigation service provider for assistance with water-related challenges. While many female farmers said they do or would work directly with their irrigation service provider when the need arises, some women also said that they would send someone in their place because of their age or due to time constraints. In Zarbdor, Saida said that, in the past, she went personally to talk with the *Vodkhoz* in the event of a water shortage, but now she usually sends her son as she is older and uses groundwater to satisfy her primary needs. One woman in Iftikhor said that male family members usually contact the irrigation service providers for assistance to resolve any issues, as women are occupied with housework during the day.

Very few women were satisfied with the ability of their local WUA or *Vodkhoz* to resolve their problems. Only in Namuna and Sayfuddinov, *jamoats* that are primarily served by WUAs constructed by the ADB, did one or two women indicate that they were generally happy with the services provided to them year round. A few women in Iftikhor and Obshoron, which are primarily served by WUAs supported by USAID, said they are satisfied with the WUA in the summer, but they didn't receive water during the rest of the year. In Iftikhor, they stressed that they did not blame the WUA for the existence of their seasonal water shortages, but were still unhappy that the WUA had not been able to effect positive change in this area.

Overall, most women who worked on their own plots expressed frustration and dissatisfaction with the services provided by both WUAs and *Vodkhozes*. Key obstacles that female farmers faced in working effectively with their irrigation service provider included: a) a lack of knowledge about who to approach to resolve water problems; b) a lack of trust in the irrigation

service provider due to failures to resolve past water challenges; and c) a perception that women are treated differently because of their gender.

Lack of knowledge

Several women noted that they had not sought out assistance or contacted anyone regarding water problems, as they did not know who to approach. Fereshta in Iftikhor stated, "I haven't gone [to talk to about our lack of water in the winter] because I don't know who I should talk to... There were times when we were out of water for so long that we had to drink bitter [stagnant] water and got sick." Other women in Iftikhor stated, "If there was a leader to tell us what to do, we would go. *Dekhan* farmers don't know and don't understand these things." Wage laborers in the same *jamoat* also voiced a fear that even if they did know where to go, their concerns would either be dismissed immediately because of their low status and level of education or they may even be arrested for stating their complaints.

Other women said they waste precious time going to different offices because they do not know where to seek out help. In Obshoron, Shirinbonu said she took her problems to several different levels of the government to try to get assistance. She states:

> "First, I went to *jamoat* [to tell them about my water problems], but when they didn't help I went to the district authority, where they called WUA representatives to resolve the issue. The WUA representatives informed me that the pump was broken and they shall fix it. But, the WUA representatives never fixed the pump."

Due to the delay and inadequate water for irrigation, her crops were destroyed. Shirinbonu said that when she talked with the district authority they told her to bring the WUA to court for not providing water, indicating antagonisms or confusion between different water management and public service institutions may play a role in intensifying this challenge for women.

Lack of trust

The consistent failure of both WUAs and *Vodkhozes* to resolve water challenges brought before them has led many women to view these institutions as ineffective, and has left them with little faith in their ability or desire to resolve future issues.

Women in Obsohron said "we brought this issue [that the pipes are broken] to the attention of the WUA, but they said they don't have money to repair them…They say 'Pray to God about it.' They always make promises, but never follow-through." Broken promises were also mentioned by women in Zarbdor with reference to the *Vodkhoz*.

Women in Iftikhor felt that even when the WUA did take action, it was poorly executed. One woman explained that when the ADB came to repair broken wells that were flooding farmers' lands, the WUA provided them with a map of well placements that was nearly four decades old, as opposed to collecting current data on where the broken wells were located. As a result, a few problematic wells were fixed and farmers had to bear the cost of fixing the others themselves. With regards to their seasonal water problems, women in Iftikhor felt the WUA was powerless, stating, "This man can't do anything regarding our water issues. It's not his fault. It's [the upstream district]…that causes us problems. What can he do? Nobody listens to him."

Gender discrimination

Women from Obsohron, Ifitikhor, and Sayfuddinov did not feel that their gender impacted their access to water and, in general, their right to water was respected by both the WUA and other farm managers. Shirinbonu felt differently regarding her interactions with *jamoat*, district authority, and WUA officials:

> "I feel [that I face difficulty getting water because I am a woman]. When I go there, they say why I am bothering myself, I should tell my husband to deal with this. But my husband doesn't have time for all of this. I may be a woman, but I can take care of all of the [farm activities] if there would just be water. I am a strong mother and a pensioner… I am not a weak woman, I know my rights and I am the head of the *dekhan* farm. I am not afraid of stating my problems and they should listen to me. My farm is legal, I have all the papers and I have the receipts from paying fees."

She went on to explain that she feels these institutions may solve more of the problems brought to them by men than by women, because "they are afraid of men."

6.3.5 Responses to Water Challenges

Besides working with their irrigation service provider, participants highlighted three other ways they cope with water challenges: collective organization or negotiating with neighboring farms; relying on alternative sources of water; and growing crops which are less water dependent.

6.3.5.1 Collective organization/negotiating with neighbors

In several *jamoats*, women worked alongside their neighbors to develop strategies to share irrigation water. In Zarbdor, Zarina partnered with five neighboring farms to clean a canal and take turns using the water. Zarina said that male members of their households cleaned the canals and negotiated the arrangement. In Obshoron, one woman pooled money with five other farms to purchase hydrants for use when there is no water in the canals.

6.3.5.2 Relying on other sources of water

In response to a lack of water flowing from on-farm canals, several women sought out alternative sources, namely from groundwater, re-routing water from other canals, and rainwater. In Zarbdor, an NGO installed a groundwater pump in Saida's yard to improve her family's access to drinking water, but she has re-installed the pump next to her field, outfitting it with a new motor and pipes. This decision highlights the importance of irrigation water for her livelihood, as it took precedence over improved drinking water. She said that prior to this action her neighbors used to complain about the water she took from the canal and sometimes she stole water from other farms. Now, she has better relations with her neighbors, and they have followed her example and installed pumps to tap into groundwater on their land. Women in this *jamoat* also dig wells to irrigate kitchen gardens. In Ifitikhor, Oisha dug a 25-meter deep well on her land to ensure that she gets water, and neighbors have followed her example.

Other women in Zarbdor and Namuna, said they have stolen water to irrigate their crops – breaking down upstream dams put in place by their neighbors to re-route water and building their own.

When they have no water in the winter and spring, women in Obshoron and Iftikhor rely on rainwater to grow their crops. Wage laborers in Iftikhor said "When there is no water, we pray to

God to send rain so we would have at least one liter of water." Fereshta in Iftikhor felt that, while relying on rainwater is risky, they have no other choice.

6.3.5.3 Growing less water-dependent crops

Women tried to maximize their potential for a good harvest by choosing crops with lower water dependency. This strategy appears to have been most frequently employed in kitchen and presidential plots. In Zarbdor, one woman said that she is growing *jurbi* (bush used to make brooms) on her kitchen plot, as they have poor access to water. In Obshoron, women said they choose crops that can survive solely on rainwater, such as potatoes and onions. In Sayfuddinov, Ifikhor, and Obshoron, women expressed a desire to diversify their crops to include wheat, tomatoes, herbs, and pumpkin, but because of a lack of water they can only grow crops such as alfalfa and corn. Shirinbonu in Obshoron says that her soil is good and she would like to grow other crops, but the water she receives is not even enough for her primary crop, cotton. She stated, "Every year, I swear that I will never plant anything else again, but when the time comes I forget about my words and cultivate again."

6.3.6 Conclusions

From the qualitative research performed, it appears that women's overall involvement in water management is significant and may be increasing despite a prevailing perception that water management is primarily a job for men. Beyond the irrigation of crops on kitchen and presidential plots, women now apply water to *dekhan* farm plots, are more concerned with water availability, assist in the cleaning of canals, work actively with irrigation service providers, and develop solutions to overcome water challenges.

This being said, women's participation in water management still varied depending on a number of factors, including the absence or presence of male family members, and challenges such as a lack of capital, knowledge, physical ability, and age. It should also be noted that this chapter was limited to reviewing direct challenges to irrigation, and women face a number of more general difficulties working in agriculture, such as negative impacts on their health, a lack of child care, and the need to complete housework.

In general, women working on their own plots had a higher degree of participation in irrigation water management within their role than women working as wage laborers. Women working as wage laborers may be involved in water management to a greater degree than reflected by the discussions held, as they may also tend kitchen gardens or presidential plots at home.

Overall women's participation in water management tasks and the challenges related to water management outlined by participants did not appear to clearly diverge between women in upstream and downstream *jamoats* and in different irrigation service provider contexts. However, more research is needed before any clear conclusions can be made as the information collected through the qualitative survey was limited and there are no data for women working on their own plots from Ziraki due to a lack of participant availability.

6.4 Insights and Further Research

The qualitative research presented above provides a snapshot of the economic opportunities and challenges in water management experienced by women in six *jamoats* of Khatlon. As highlighted by these women, the challenges they face in irrigation water management impact their household's food security by negatively affecting their ability to cultivate a profitable harvest and grow diverse crops for household consumption on kitchen, presidential, and *dekhan* farm plots.

These challenges and opportunities could differ in intensity and expression, if the nature of water delivery, governance, maintenance, fee payments, and conflict resolution vary by the type of WUA, as is suggested in chapters 4 and 5. At the same time, different types of WUAs may also affect crop choice and yield, as suggested in chapter 5. In order to gain a fuller understanding of this connection and issues regarding household-level access to irrigation water and management services in FTF Zones of Influence, more research is needed.

In pursuit of this understanding, two surveys targeting households will be conducted. The first survey will be conducted in March 2016 and the second survey in 2017. The second survey will follow-up on key areas of interest identified through the first survey. The objective of this study component is explore trends in the participation of different household members, including women, in various agricultural tasks across different farm plots and their engagement with

irrigation service providers, including WUAs. It also aims to identify current practices and obstacles regarding crop cultivation and the securing of agricultural inputs and services at the household level, as well as how these impact experiences of food insecurity. Data will be analyzed using descriptive statistics and econometric methods. The data from this survey will contribute towards a larger understanding of the context in which WUAs were established and the potential effects of WUAs beyond *dekhan* farms.

Similar to the qualitative research completed in August 2015, women will be the respondents in the household survey. Considering the significance of their role in agriculture, and particularly in the cultivation of kitchen gardens, it is important their voices be represented in research related to household cultivation and the division of labor on *dekhan* farms, and on presidential and kitchen plots. As they are primarily responsible for food preparation, women are also likely to have special insight onto issues relating to food security. Without a targeted approach to data collection, it is likely that the views of male respondents would dominate, as was the case with the *dekhan* farm survey. This survey will also target areas within the three contexts presented above, wherein USAID initiated WUAs are present, WUAs initiated by other donors are present, and no WUAs are present, to allow for comparison across irrigation service providers.

Based, in part, on the issues identified through this research, the household survey will explore the following key topics, among others.

- *Use of farmland area* – Background information on the type, location, and area of farm plots, as well as estimated size of cultivated land and reasons behind non-cultivation will be collected to provide insight into patterns of land use.

- *Division of agricultural labor and decision making* –This survey component will identify which family member is the primary actor and decision maker in completing farm duties on the three plots. Understanding who is responsible for different tasks and gendered divisions of labor has important implications for the design of trainings and targeted interventions.

- *Crop cultivation, yields, and consumption* –With the goal of better understanding the connection between access to water and crop diversity, as well as the role kitchen and

presidential plots play in household nutrition, the household study will note the specific types of crops grown on different plots, how much of the harvest is kept for self-consumption and the constraints faced in cultivating this plot.

- *Securing agricultural inputs and services* – The household survey will explore how and where agricultural inputs such as seeds, fertilizer, machinery, and irrigation water are accessed for different plots, as well as the challenges faced during these processes. Households will also be questioned about the time of day in which irrigation water is released and the seasons when it is available, as these were both noted by women to be significant challenges.

- *Payment of water fees and receipt of infrastructure maintenance services* – Further research will be conducted to understand on which plots water fees are charged, to whom the fees are paid, and the average amount charged per plot annually. The household survey will also investigate respondent satisfaction with the condition of their irrigation infrastructure and whether maintenance has occurred.

- *Participation in trainings and community groups* – The household survey will investigate which family members, if any, have participated in trainings or community groups to understand household and gendered access to new information or social support.

- *Engagement with irrigation service provider* –With male out-migration, it is thought that the active participation of female farmer may be important for the organization's sustainability; however, preliminary research indicated that women have little interest in becoming more engaged. The household study will investigate the contexts in which women interact with their irrigation service provider (if at all), including if they participate in meetings, and if applicable, the reasons behind women's lack of engagement.

- *Household food security* - Food insecurity is a challenge for many families in Khatlon and in the focus groups, women mentioned that they often had to ask for food on credit from local stores. The household survey will collect data on this and on other strategies

employed by families to cope with food shortage as well as the months when food shortages occur.

- *Migration of household members* – All focus groups acknowledged a connection between migration and the changing roles and experiences of women in agriculture. The data collected at household level will be useful to understand the current migration from different locations and farming contexts, as well as the use of remittances to fund agricultural inputs and—if male-out migration has increased—the burden of work for women in the home or on farming plots.

Issues beyond the scope of the household survey, but which may be interesting to explore nevertheless are also listed below.

- *Contracts between WUA members and WUAs* – Several women in the focus groups mentioned the existence of a contract between themselves and their WUAs. It may be worthwhile to explore the text of these contracts and how they differ between WUAs initiated by different donors, as well as how perceptions of WUA responsibilities by farmers and the WUAs themselves differ from what is detailed in the contracts.

- *Communication and coordination between WUAs and Vodkhozes* – The primary functions of WUAs include collecting water fees to be passed onto the district water authorities (*Vodkhozes*), mediating conflicts, working towards the improvement of irrigation water supply and infrastructure maintenance, and in some cases, detailing water schedules. The success of these activities is likely to be impacted by, if not dependent on, effective communication and coordination with the *Vodkhoz,* who maintains primary responsibility for the provision of irrigation water at the local level. An investigation may look into the relationship between WUAs and *Vodkhozes,* and especially if any memorandum of understanding, contract or verbal agreement exists to facilitate the division of service provision and cooperation between these two bodies.

- *Value and utility of dried cotton stalks (guzapoya)* – Focus group respondents highlighted the value and crucial role of *guzapoya* (dried cotton stalks) as a source of fuel for heating and cooking. For farmers, *guzapoya* may also be used as form of payment for labor or

income if the stalks are sold in mass to non-cotton growing neighbors who need fuel. The significance of this crop by-product may be researched, particularly whether it plays a role in farmers' decisions to continue growing cotton and what sustainable fuel sources exist to replace *guzapoya* if farmers transition away from cotton production.

- *Overlap between drinking water and irrigation water management* – Women indicated that they drink water from irrigation canals during their labor in the fields and at home if an alternative source does not exist, leading to illness. It may be important to research the extent to which this occurs and how WUAs may play a role in identifying or organizing collective action to provide other sources drinking water and educating members about the dangers of drinking polluted canal water.

- *Childcare in the fields* – During the Soviet Union era, childcare was provided for parents who worked in the fields. As these institutions no longer exist, women noted that they are now forced to leave their children at home, where they may not be adequately supervised or take them to the fields, where they risk exposure to extreme elements and pollutants. Some women also work until their eighth month of pregnancy and may be unable to nurse if they have to travel for wage labor far from their home. Childcare practices and the impact of field labor on mother and child health may be researched further.

7 Conclusion

Many WUAs have been created in the last 5 years in Tajikistan. Interviews conducted by the research team with donors suggest that almost all gravity irrigation schemes in Tajikistan are now linked with associations—most of them registered—that organize farmers to manage irrigation water for *dekhan* plots within delineated command areas. The creation of many of these organizations has been led by international donors and, in some cases, by the local government. Most of these WUAs are young, being in existence for around 2-3 years.

The preliminary findings from this baseline report suggest that WUAs created by USAID allow for more water applications per hectare of cropped area than WUAs created by other donors and the government. The findings also suggest that the differences could be systematic, in that the farms at the tail end of canals in USAID WUAs are likely have more water applications than their counterparts in non-USAID WUAs. Whether this is a sustained impact of USAID WUAs on on-farm water availability remains to be examined, and will be pursued through the course of this evaluation. Similarly, the baseline report suggests that farms served by USAID WUAs are systematically likely to grow a greater variety of crops, and also likely to have a greater surplus for sale than their counterparts served by non-USAID WUAs. Whether this is an impact of USAID WUAs will be analyzed in this research project, which examines these dynamics after USAID withdrew active support from its WUAs. These effects can thus be interpreted as a measure of the resilience of WUAs.

If different WUAs have different impacts on access to on-farm water, which in turn affect production decisions, they are also likely to affect differentially livelihood opportunities for smallholder farmers. For example, if increased access to on-farm water translated into increases in areas that are irrigated then more individuals may find work on the farm. Either surplus labor in the family may be employed in the fields or wage labor could be hired, depending on the supply of labor. If crop choices are affected due to water availability then the time needed for different components of production (tilling, weeding, sowing, harvesting) are likely to change. Male and female workers are usually responsible for different components of the production process, thus changes in crop choices could lead to different opportunities for male and female wage labor. Whether economic activities of males and females, and opportunities for the

immediate future are different between areas served by USAID WUAs and those that are not, will also be examined over the next two years.

The preliminary findings from the baseline report identify a few factors that could compromise the ability of WUAs to deliver water to the farm, most of which are young organizations. The sources of revenue for these WUAs, especially those developed and created by USAID, will change as donor support is phased out. The baseline report suggests that WUAs and farmers have a different understanding of fee structures, and that there are differences among the WUAs' responses as well. The cost structures of these WUAs could also change, especially if each WUA plans to adjust its activities and operations to match its revenues. The financial health of the WUA would likely determine its ability to provide on-farm water in a timely manner. With the division of repair and maintenance responsibilities between the WUA and the local government often not clear, it is unclear to what extent repairs and maintenance would be affected when the financial status of WUAs change. These factors merit further study over the next few years to understand the gravity of threats that may compromise increases in on-farm water access, crop diversity, and marketed surplus associated with improved functioning of USAID WUAs.

In conclusion, this study will shed light on the persistence of impact on on-farm water availability, crop choice, and marketed surplus; the changes in the types of economic opportunities and challenges created for male and female agricultural workers; and factors that may compromise the functioning of the WUAs to sustain such effects over time.

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