Effects of training duration and the role of gender on farm participation in water user associations in Southern Tajikistan: implications for irrigation management

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Summary

- Participatory irrigation in Tajikistan trained managers (male)
- Longer training increases farms’ likelihood of participating in WUAs
- With rapid male migration, untrained individuals (male and female) operate ~50% of farms
- Farms operated by untrained males don’t participate any less than farms operated by directly trained males
- Farms operated by females are less likely to pay dues, enter into water contracts, be represented at irrigation planning meetings (~30% of all farms)
- Sustaining participatory irrigation management in Tajikistan depends on directly investing in female human capital
Transformation in production systems

- From state collectives to dehkan (private) farms

  - Cotton/wheat systems
  - ~3 households associated with one farm
  - ~14% rural households have access to a farm
Transformation in institutions

- WUAs introduced for delivering irrigation water to dehkan farms
  - WUA Law (2006): membership only to dehkan farms
  - GoT requested international support to create WUAs
  - WUAs in gravity schemes (USAID + GoT)
  - WUAs in lift schemes (World Bank/GoT)

- Participatory institutions of collective action
- Member cooperation needed for successful functioning
WUAs in gravity schemes (Southern TJ)

• Some established by USAID; others by district irrigation departments

• Same training materials used (developed by USAID)

• But length of training is different
  – USAID WUAs: 20-24 months training during 2012-2013
  – Government WUAs: 3-6 months during 2013
Dehkan farm managers were trained

- Legal position; listed on title
- 98% managers male (FAO 2018)
- Male migration (~48% rural households; Buisson et al., 2016)
- Farms operated by non-trained members (Balasubramanya et al., 2018)
  - Non trained males: 30% of farms (in 2016)
  - Non-trained females: 25% of farms (in 2016)
Research questions

• Does length of training effect participation?
  – Yes; a positive effect

• Is participation affected when farm operated by non-trained member?
  – Not when male
  – Participation significantly lower when female

• Implications for WUA functioning
  – Potentially serious
Draws from (and contributes to)...

- **Social Sciences:**
  - Boundaries between consumer and service provider is blurred; ‘co-produce’ services (Beresford, 2010)
  - Longer training improves participation (Nagrah *et al.*, 2016)

- **Agricultural economics:**
  - Lead/male farmers have stronger networks to diffuse information (Anderson and Feder, 2007)
  - Improve cost-effectiveness of trainings (Feder *et al.*, 2004)

- **Development economics: diffusion depends on**
  - Complexity of information (e.g. Rola *et al.*, 2002); density of trained farmers (e.g. Tripp *et al.*, 2005)
  - Gender composition of trained and untrained (e.g. Kumar and Quisumbing 2011; Beaman and Dillon, 2018)
  - Farmer and farm characteristics (e.g. Fuglie and Kascak, 2001)
Confounders

- Assignment to length of training not random
- Gender of the operator when farm is managed by non-trained individual is also a choice (likely endogenous)
- This study controls for:
  - Observable and unobservable confounders at cluster level that determine assignment to training length (study design)
  - Observable and unobservable confounders at farm level that also affect participation (data and methods)
Identification strategy in summary

• Study design (matched clusters)
  – controls for selection on subdistrict observables

• The Modified DID with RHS covariates:
  – Eliminates time-invariant unobservable confounders
  – Controls time-varying unobservable confounders
  – Introduces a bias (underestimate) of treatment effects,

• In addition
  – All results also clustered at subdistrict level

https://doi.org/10.1142/S2382624X18500078.
Methods: reduced form

\[ Y_{jt} = \mu + \gamma S_j + \theta t + \omega (S_j \times t) + \beta X_{jt} + \nu_{jt} \]

- **Performance indicator**
- **Length of Training (dummy)**
- **Time trend**
- **Vector of farm-level co-variated (includes gender of person who runs the farm; dummy)**
- **Interaction term (causal effect of training)**

Source: Balasubramanya et al., 2018. *Water Economics and Policy*
Participation Indicators (LHS)

Irrigation Fees
Fees were paid for both irrigation seasons in the year

WUA membership fees
Membership fees were paid for the calendar year

Participation in pre-irrigation cleaning of canals
# of person-days supplied by farm towards cleaning

Legal relations
Farm signed a contract with the WUA
Farm member(s) attended WUA meetings
On the RHS

*Time-varying farm characteristics*

Farm operated by non-trained male
Farm operated by female
Number of members
Share of members that were female
Share of members that spent majority of time on farm
Number of households
Area with official title (ha)
Cultivated area (ha)
Irrigated area (ha)
Farm cultivated cotton
Area under cotton cultivation (ha)
Also on the RHS

<table>
<thead>
<tr>
<th>Time-invariant farm characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of the farm</td>
</tr>
<tr>
<td>Age of farm manager</td>
</tr>
<tr>
<td>Education of farm manager</td>
</tr>
<tr>
<td>Distance of farm from road</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Time-invariant subdistrict characteristics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dummy for subdistrict</td>
</tr>
</tbody>
</table>
## Results

<table>
<thead>
<tr>
<th></th>
<th>Irrigation fees</th>
<th>Membership fees</th>
<th># man-days</th>
<th>Farm signed a water contract</th>
<th>Farm attended WUA meetings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Longer training</td>
<td>-0.06 (0.05)</td>
<td>0.08 (0.05)*</td>
<td>7.10 (2.40)***</td>
<td>0.20 (0.05)***</td>
<td>0.09 (0.04)**</td>
</tr>
<tr>
<td>Farm operated by non-trained male</td>
<td>-0.02 (0.04)</td>
<td>-0.02 (0.02)</td>
<td>-2.43 (1.85)*</td>
<td>-0.02 (0.03)</td>
<td>-0.01 (0.02)</td>
</tr>
<tr>
<td>Farm operated by female</td>
<td>0.03 (0.05)</td>
<td>-0.09 (0.03)***</td>
<td>3.21 (1.94)</td>
<td>-0.11 (0.04)**</td>
<td>-0.03 (0.01)*</td>
</tr>
</tbody>
</table>

Number observations | 1753 | 1753 | 1561 | 1753 | 1753 |
Prob > F             | 0.28  | 0.57  | 0.01  | 0.00  | 0.09  |
R-squared            | 0.02  | 0.04  | 0.02  | 0.09  | 0.03  |
Implications for WUA functioning

- Non-payment of membership fees compromises financial health of WUA; affects operations
- Not signing contract: district irrigation department budgets less water for particular WUA than what is actually needed
- Not attending meetings: affects planning of irrigation schedule
Reasons for lower participation

- FGDs to understand female perspective (6 FGDs with female irrigators; 5 females per group)
  - Women believe only managers can attend meetings: non-managers are not allowed to attend
  - Irrigation scheduling at inconvenient times (midnight): less inclined to pay membership fees
  - Not clear about the purpose and frequency of contract
Role of policy and programming

• WUA Law: specify that any member can be nominated to represent a farm

• FTF Phase II:
  – Target female irrigators and train them on participation
  – Train WUAs to cope with changing demographics (hiring wage labor at WUA level to assist with irrigation)
  – Train district irrigation authorities (follow-ups with WUAs; capacity building activities)
Materials

  https://doi.org/10.1142/S2382624X18500078.


Media Coverage

- BBC Persian: زنان و آبیاری مشارکتی در تاجیکستان (Sep 6, 2018)
- BBP Persian: زنان و آبیاری مشارکتی در تاجیکستان (Sep 6, 2018)
- Farming First: Why Women are Key for Water Management in Tajikistan (July 5, 2018)
- Asia Times: Women will be key to tackling water worries in Central Asia (July 2, 2018)
- Agrilinks: Local Water Sharing in Tajikistan Requires Improved Coordination (June 28, 2018)
- World Bank Water Blog: Secrets to successful irrigation management from Central Asia (Jun 20, 2018)
- The Diplomat: The Impact of Migration on Water Scarcity in Central Asia (Jun 19, 2018)
- Agrilinks: Training Female Farmers is Essential to Sustain Participatory Irrigation in Tajikistan (May 25, 2018)
- Agrilinks (USAID): New Community Organizations Need Longer Training to Perform Effectively (May 11, 2018)
Thank you!
Determining sample size and design

- WUAs provide water to 1-2 sub-districts
  - Classify sub-districts on training length (treatment = longer training)
- Clustered sampling: first sub-districts, then farms
- Power calculations:
  - Indicators/measures of central tendency from T-LSMS 2003/2009
  - 2,000 farms from 40 treatment/40 control sub-districts; 25 farms per cluster
Selecting treatment and control subdistricts

- Implemented a census of all subdistricts (164) in all gravity schemes (10).

- Collected information on subdistrict covariates in 2014 (and historically)

- Calculated propensity scores; then matched treated and control subdistricts (1:1 without replacement)
  - Selected 40 treatment and 40 control subdistricts
<table>
<thead>
<tr>
<th></th>
<th>USAID treated jamaat</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Logit</td>
<td></td>
</tr>
<tr>
<td>Population of the jamaat in 2014</td>
<td>0.000</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Number of villages</td>
<td>0.033</td>
<td>(0.052)</td>
</tr>
<tr>
<td>Total area of the jamaat</td>
<td>0.000***</td>
<td>(0.000)</td>
</tr>
<tr>
<td>Majority of population Tajik (dummy)</td>
<td>-0.694</td>
<td>(0.541)</td>
</tr>
<tr>
<td>Number of secondary schools in jamaat</td>
<td>0.069</td>
<td>(0.080)</td>
</tr>
<tr>
<td>Number of rural health centers in the jamaat</td>
<td>-0.542***</td>
<td>(0.196)</td>
</tr>
<tr>
<td>Number of agricultural markets in the jamaat</td>
<td>0.400</td>
<td>(0.291)</td>
</tr>
<tr>
<td>Chairman born in the jamaat (Dummy)</td>
<td>0.162</td>
<td>(0.642)</td>
</tr>
<tr>
<td>Number of years of election of the chairman</td>
<td>-0.073</td>
<td>(0.070)</td>
</tr>
<tr>
<td>Elevation of the jamaat</td>
<td>0.000</td>
<td>(0.001)</td>
</tr>
<tr>
<td>Sandy soil (Dummy)</td>
<td>0.003</td>
<td>(0.554)</td>
</tr>
<tr>
<td>Low groundwater level (Dummy)</td>
<td>-0.809</td>
<td>(0.521)</td>
</tr>
<tr>
<td>Land reform completed (Dummy)</td>
<td>2.538***</td>
<td>(0.694)</td>
</tr>
<tr>
<td>Cotton main crop of the jamaat (Dummy)</td>
<td>2.838***</td>
<td>(0.658)</td>
</tr>
<tr>
<td>Gravity system (Dummy)</td>
<td>0.605</td>
<td>(0.670)</td>
</tr>
<tr>
<td>Constant</td>
<td>-3.892***</td>
<td>(1.498)</td>
</tr>
<tr>
<td>Pseudo R2</td>
<td>0.402</td>
<td></td>
</tr>
<tr>
<td>Sample</td>
<td>164,000</td>
<td></td>
</tr>
</tbody>
</table>
### PSM controls for selection on observable confounders at subdistrict

<table>
<thead>
<tr>
<th></th>
<th>Treatment-Control Unmatched</th>
<th>Treatment-Control Matched</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Std Dev</td>
</tr>
<tr>
<td>Population of the jamoat in 2014</td>
<td>797.18</td>
<td>1446.5</td>
</tr>
<tr>
<td>Number of villages</td>
<td>-1.34</td>
<td>1.08</td>
</tr>
<tr>
<td>Total area of the jamoat</td>
<td>2770.21</td>
<td>2888.16</td>
</tr>
<tr>
<td>Majority of population Tajik (dummy)</td>
<td>-0.13</td>
<td>0.07*</td>
</tr>
<tr>
<td>Number of secondary schools in jamoat</td>
<td>0.51</td>
<td>0.69</td>
</tr>
<tr>
<td>Number of rural health centers in the jamoat</td>
<td>-1.03</td>
<td>0.33***</td>
</tr>
<tr>
<td>Number of agricultural markets in the jamoat</td>
<td>0.09</td>
<td>0.15</td>
</tr>
<tr>
<td>Chairman born in the jamoat (Dummy)</td>
<td>0.05</td>
<td>0.07</td>
</tr>
<tr>
<td>Number of years of election of the chairman</td>
<td>0.12</td>
<td>0.62</td>
</tr>
<tr>
<td>Elevation of the jamoat</td>
<td>-178.22</td>
<td>56.08***</td>
</tr>
<tr>
<td>Sandy soil (Dummy)</td>
<td>0.04</td>
<td>0.07</td>
</tr>
<tr>
<td>Low groundwater level (Dummy)</td>
<td>-0.23</td>
<td>0.08***</td>
</tr>
<tr>
<td>Land reform completed (Dummy)</td>
<td>0.34</td>
<td>0.08***</td>
</tr>
<tr>
<td>Cotton main crop of the jamoat (Dummy)</td>
<td>0.48</td>
<td>0.08***</td>
</tr>
<tr>
<td>Gravity system (Dummy)</td>
<td>0.06</td>
<td>0.07</td>
</tr>
</tbody>
</table>
Study design and sampling

- Power calculations (40 subdistricts each of longer/shorter training; 25 farms per subdistrict)
- Propensity scores constructed for census of gravity subdistricts; matched pairs sampled (1:1)
- In selected subdistricts: census of farms to stratify on canal type; farm location
- Stratified random sample of farms in each subdistrict
Data: Panel

• Panel data by calendar-year
  – Survey 1: Data on 2014 (collected early 2015)
  – Survey 2: Data on 2016 (collected early 2017)

• Survey 1 answered by 1,956 farms; Survey 2 answered by 1,885 farms
  – 1,885 farms in 80 subdistricts
Methods: Standard DID estimator not sufficient to eliminate time-invariant unobservables
Methods: modified DID estimator

S. Balasubramanya, J. P. G. Price & T. M. Horbulyk

![Diagram showing modified DID technique](image)

**Figure 1.** The Standard and Modified DID Technique When the Treatment Unit Performs Better than the Control Unit

Source: Balasubramanya et al., 2018. *Water Economics and Policy*