

IAMO

Leibniz Institute of Agricultural Development
in Transition Economies



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SUSADICA

Doctoral Programme on Sustainable
Agricultural Development in Central Asia

Participation in informal cooperation and adoption of sustainable agricultural practices

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SUSADICA Symposium

TIAME, TASHKENT | 12-14 October 2023



Sustainable agricultural practices (SAPs) adoption

- SAPs demonstrated economic feasibility at the field level for various crops in Central Asia (CA) (Pender et al. 2009)
- Implementing SAPs helps to minimize land degradation's impact on farming profits (Mirzabaev et al. 2023).
- However, CA farmers use only few practices (i.e., crop rotation/biological pest control methods)
 - SAP adoption level among farmers is still low (Kurbanov et al. 2022)



Cooperation among farmers and SAP adoption

- Information access and exchange are as pivotal for the adoption of agricultural technologies (Dessart et al. 2019)
- Engagement in group activities serves as a platform for enhancing capacity and facilitating the exchange of valuable information related to SAP (Olawuyi and Mushunje 2020)
- Participation in collective action can increase the exposure of farmers to knowledge about the use and benefits of SAPs (Takeda et al. 2015, Xue et al. 2022)
 - Farmers who participate in collective action are likely to adopt SAPs such as no-till (Xue et al. 2022)

Does this hold true for rural Uzbekistan?

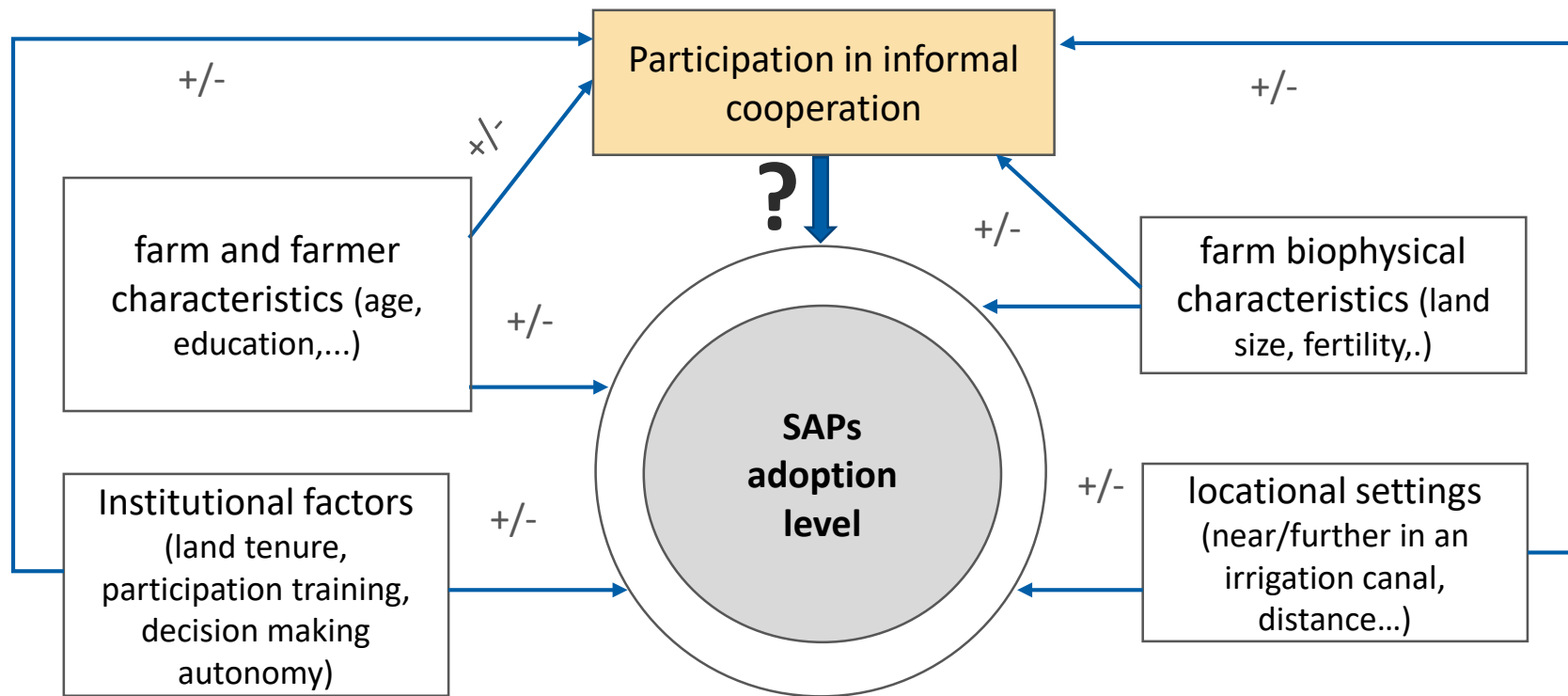
1. What are the primary drivers that encourage farmers to participate in informal cooperation?
2. Does farmer's participation in informal cooperation result in greater SAPs adoption?

- ‘*Hashar*’ plays crucial role in agriculture and water management:
 - Voluntary non-compensated labor contribution to neighborhood or *mahalla* as a whole (Rasanayagam 2002)
 - Farmers are placed in a specific set of social expectations (obligations) from neighbors and other farmers (Liu 2017)
 - Social norms creating order & group solidarity ensure cooperative behavior (Sievers 2002)
 - Tradition of self-help determine local informal cooperation in water resource management (Troschke 2011)
- Participation in *informal cooperation* strengthens social ties via:
 - self-organization to conduct works on maintenance of canal infrastructure such as pumps and irrigation and drainage canals (O’Hara 2000)
 - sharing the agricultural knowledge and information



Does participation in informal cooperation in water management increase the adoption of SAP among farmers in Uzbekistan?

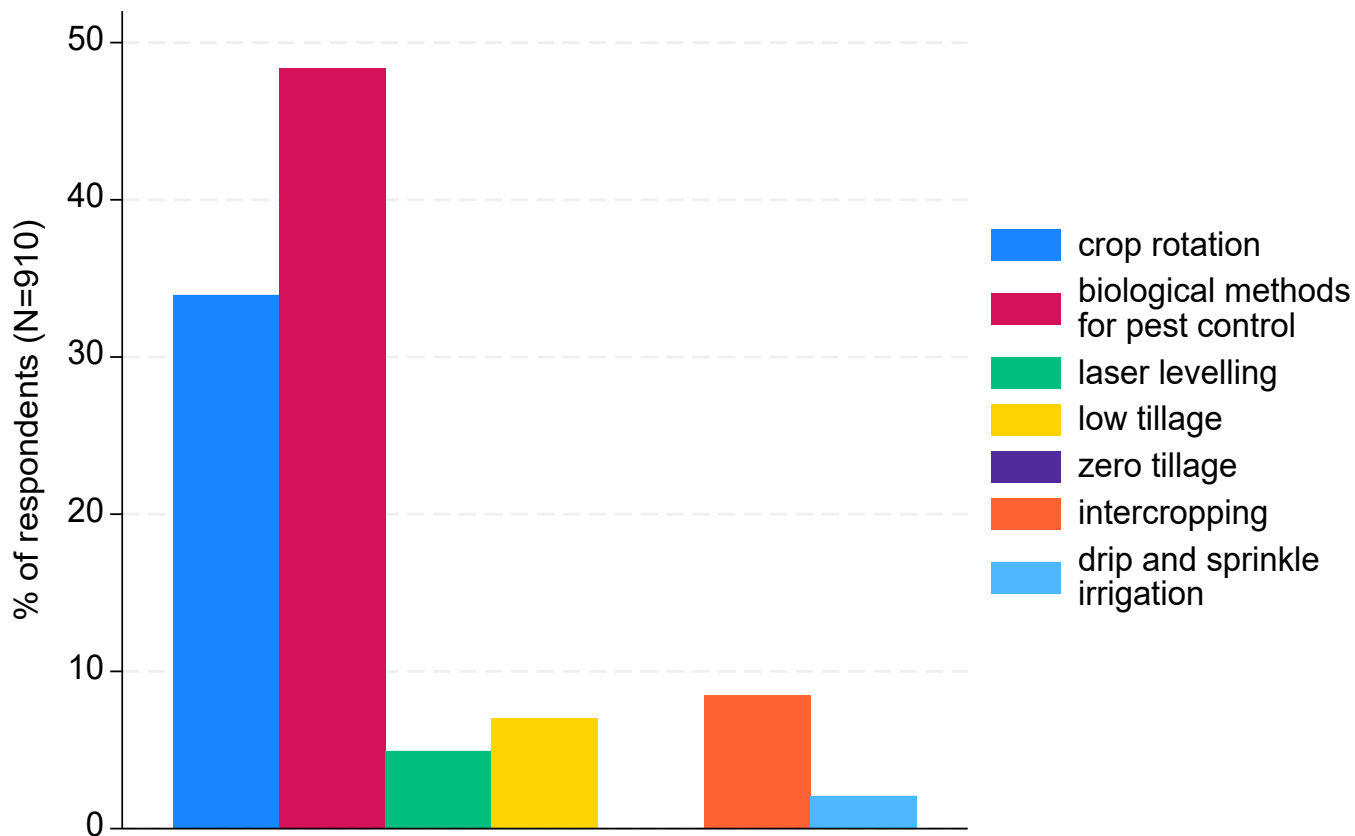
$$Y_i = f(k, ic) \rightarrow Y_i - \text{outcome variable}, ic - \text{informal cooperation}, k - \text{vector of other observable variables}$$



Sources: Based on Feder et al. (1985), Foster and Rosenzweig (2010), Kienzler et al. (2012), Kurbanov et al. (2022), Ruzzante et al. (2021), Willy and Holm-Müller (2013), Zhang et al. (2019)

AGRICHANGE II / SUSADICA farm survey data

SAPs adoption level in Samarkand region in 2019 and 2022



AGRICHANGE II in 2019
SUSADICA in 2022

| No. interviewed farmers | |
|-------------------------|------------|
| 2019 | 460 |
| 2022 | 450 |
| Total | 910 |

Source: AGRICHANGE II and SUSADICA farm survey data (2019 and 2022)

Farmers' participation in informal cooperation in water management

M1 What formal or informal form of cooperation did you choose?

Activities

1. Irrigation of fields and control of water distribution
2. Repair and cleaning of irrigation and drainage canals
3. Joint maintenance, utilization, construction and repair of irrigation equipment and infrastructure
4. Cooperation in input supply (seeds, fertilizers, fuel, fodder, etc.)
5. Land preparation for sowing
6. Harvesting
7. Sale of products
8. Joint use of machinery and equipment

Form of cooperation

Informal cooperation

- Informal agreement with farmers
- Hashar (voluntary-free labor mobilization with farmers and households)

Formal cooperation

- Formal contract
- Via Farm association/union
- Via Cooperative

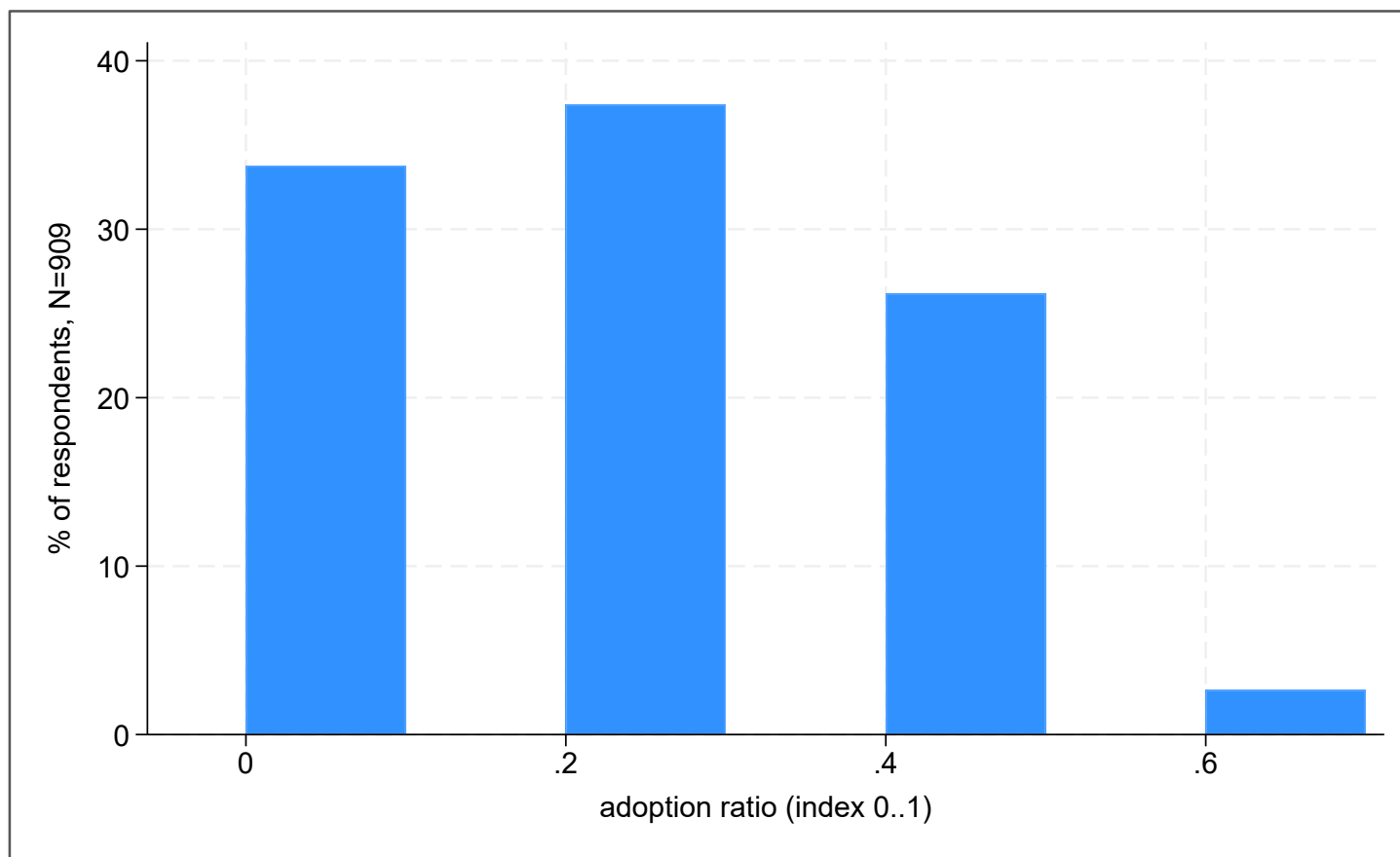


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farms who don't participate in any form of cooperation in irrigation activities

Adoption ratio = number of used SAPs by a farmer / number of all SAPs



- 1 - Crop rotation
- 2 - Biological pest control methods
- 3 - Low tillage of land
- 4 - Direct planting without tillage
- 5 - Intercropping

Source: AGRICHANGE II and SUSADICA farm survey data (2019 and 2022)

Marginal treatment effect model

Probit model

$$IC_i = \beta_{IC}(Z) - V_i$$

where $IC_i = 1$ if a farm participates in informal cooperation, and 0 otherwise.

Z -> vector of observable variables

β_{IC} -> a vector of parameters to be estimated

V_i -> the unobserved resistance to treatment (or participation in informal cooperation) (i.e., the error term).

The relationship between SAP use and participation in informal cooperation can be modelled as

$$S_{ji} = \beta_j X_i + U_{ji} \quad j = 0, 1$$

where, S_{ji} -> farmer i 's SAPs use

X_i -> again vector of observable variables

U_{ji} -> error term representing unobserved characteristics that effect SAPs

j -> denotes the participation status, where $j=1$ participants, $j=0$ non-participant farmers

Marginal treatment effect

$$\begin{aligned} MTE(x, u_{ic}) &= E(S_1 - S_0 | X_i = x, U_{IC} = u_{ic}) \\ &= x(\beta_1 - \beta_0) + E(U_1 - U_0 | U_{IC} = u_{ic}) \end{aligned}$$

Factors influencing participation in informal cooperation

| Participation in informal cooperation in water management | dx/dy | Std.err |
|--|-----------|---------|
| Farm has own knowledge on agronomy (1/0) | 0.068** | 0.032 |
| Participation in trainings related to SAPs (1/0) | 0.074* | 0.038 |
| Free to decide crop cultivation and selling (index 1 ...5, 5=free) | 0.048*** | 0.018 |
| Land tenure security (1/0, 1=secure) | -0.145*** | 0.032 |
| Good soil fertility index (0...1) | 0.092** | 0.040 |
| Condition of irrigation and drainage, dummy (1/0, 1=good) | 0.169*** | 0.047 |
| Distance to the main road (km) | -0.026*** | 0.006 |
| Survey year (1/0, 1=2022) | 0.167*** | 0.044 |
| Pseudo R2 | 0.117 | |
| N 858 | | |

Participation in cooperation is positively associated with:

- Knowledge on agronomy
- Participation in trainings
- Decision-making autonomy
- Good soil fertility and irrigation infrastructure

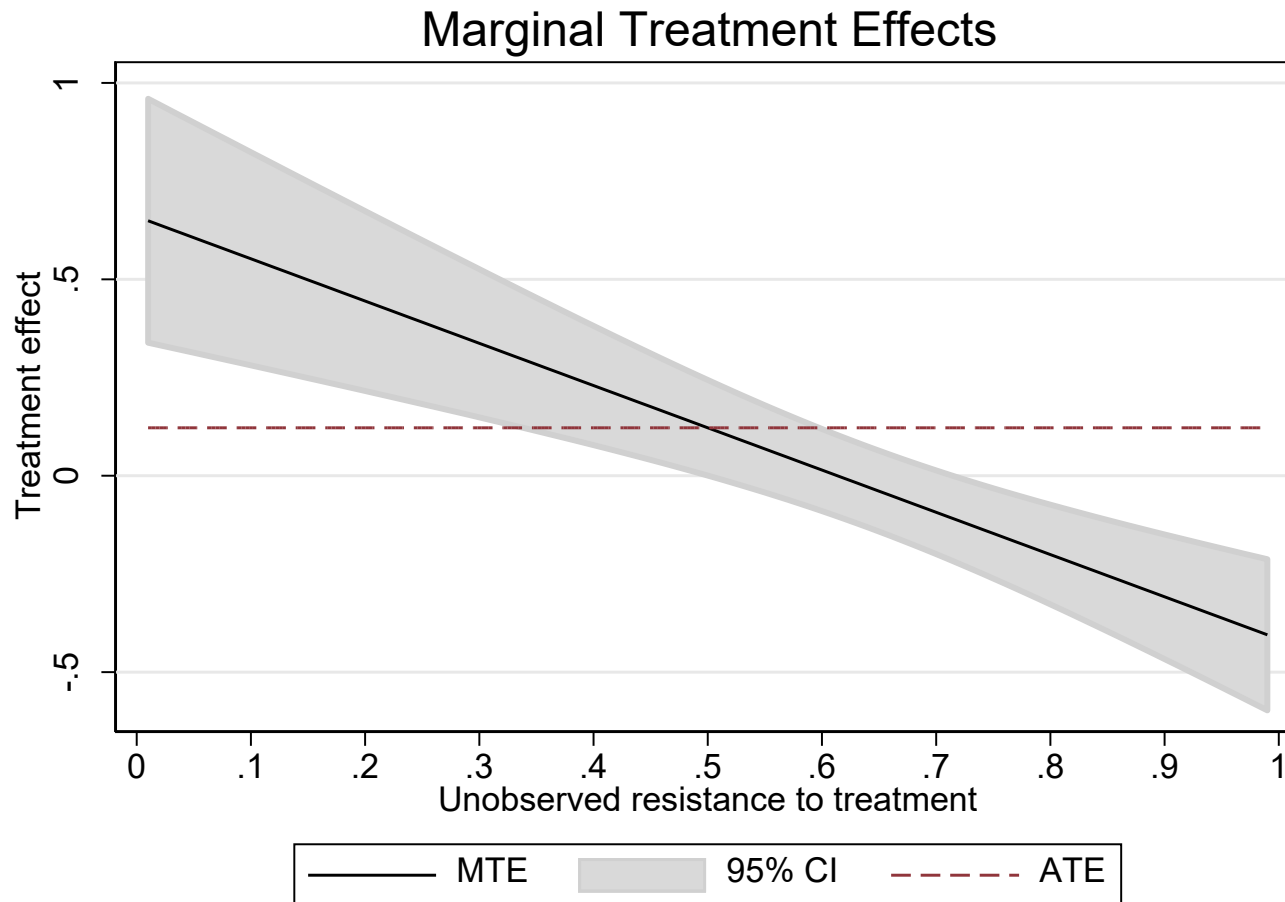
Negatively associated with:

- Land tenure security
- Distance to main road

Note: ***, ** and * are significant at 1%, 5% and 10% level, respectively

Marginal Treatment Effect (MTE) curve

Farmers with lower resistance to participate in informal cooperation in water management (i.e. with higher inclination to cooperate) adopt more SAPs



Treatment effects

| effects | coeff | |
|-------------|----------------------|--|
| ate | 0.122** (0.062) | participation in informal cooperation increases SAPs adoption by 12% for an average farmer |
| att | 0.334*** (0.096) | if a cooperating farmer decides leave informal cooperation its SAPs adoption level would drop by 33% |
| atut | -0.182*** (0.062) | for non-cooperating farmers, participation in informal cooperation would decrease SAPs adoption by 18% |

Note: ***, ** and * are significant at 1%, 5% and 10% level, respectively
Standard error in parentheses

ATT > ATE > ATUT → This position of three effect measurements indicates a positive selection on gains from informal cooperation




- Farmer's with agronomic knowledge, training, greater decision-making autonomy and with good conditions of irrigation canals & soil fertility are likely to participate in informal cooperation
- Farmers with higher tenure security and located further away from main road are less likely to participate in informal cooperation, but manage water issues individually
- Participation in informal cooperation significantly increases SAP adoption level of an average farmer
- If cooperating farmer decides to leave informal cooperation, the SAP adoption will be severely affected (drop by 33%)
- For non-cooperating farmers, informal cooperation can reduce SAP adoption level as these farmers might have already self-selected themselves as non-adopters



- **Encouraging farmers to cooperate** can contribute to wider adoption of SAPs:
 - Keep promoting community-based self-organized initiatives, e.g. where farmers collectively manage irrigation water resources & infrastructure
- Efforts to **boost farm training & extension services** can indirectly increase the chances of SAP adoption by contributing to farmers' participation in informal cooperation in water management:
 - Keep investing in farm training & extension services
 - Pay attention to those farmers who do not participate in informal cooperation in water management (they might lose in SAP adoption levels)

Thank you for your attention!

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Descriptive statistics of explanatory variables (selected)

| farm and farmer characteristics farm biophysical characteristics Institutional factors locational settings | Participant (N=507) (mean) | Non- participant (N=351) (mean) | mean diff. |
|---|----------------------------------|--|------------|
| Farmer's age | 44.846 | 44.934 | -0.088 |
| Special education in agriculture of farm manager, (1/0) | 0.444 | 0.387 | 0.056 |
| Total currently available land of farm (ha) | 73.760 | 79.998 | -6.238* |
| Farm has own knowledge on agronomy, (1/0) | 0.462 | 0.416 | 0.046 |
| Participation in trainings related to SAPs, (1/0) | 0.359 | 0.262 | 0.097*** |
| Free to decide crop cultivation and selling (average b17 and b21) (index 1 ...5, 5=free) | 2.398 | 1.870 | 0.528*** |
| Land tenure security (1/0, 1=secure) | 0.469 | 0.595 | -0.126*** |
| Good soil fertility index (0..1) | 0.669 | 0.615 | 0.054* |
| Condition of irrigation and drainage, dummy (1=satisfying, good, excellent) | 0.921 | 0.806 | 0.115*** |
| Location of plots to water resources, dummy (1=head of the water source) | 0.233 | 0.182 | 0.050* |
| Using electric/motor pumps for irrigation of fields (1/0) | 0.276 | 0.296 | -0.020 |
| Distance to the main road from farm (km) | 2.922 | 3.713 | -0.792*** |

Note: ***, ** and * are significant at 1%, 5% and 10% level, respectively

Factors influencing participation in informal cooperation

| Participation in informal cooperation in irrigation activities | dx/dy | Std.err |
|---|------------|---------|
| Farmer's age | -0.0018 | 0.0016 |
| Special education in agriculture of farm manager, dummy (1=yes) | 0.0147 | 0.0332 |
| Total currently available land of farm (ha) | -0.0003 | 0.0003 |
| Farm has own knowledge on agronomy, (dummy 1=Yes) | 0.0681** | 0.0322 |
| Farm has nonfarm income, dummy (1=yes) | 0.0309 | 0.0374 |
| Farm has own tractor, dummy (1=yes) | 0.0703 | 0.0446 |
| Caring opinion of neighbors, relatives, and farm colleagues (average e20_2 and e20_5) (index 1..5, 5 =care) | 0.018 | 0.0209 |
| Participation in trainings related to SAPs (dummy, 1=yes, participate) | 0.0741* | 0.0384 |
| Free to decide crop cultivation and selling (average b17 and b21) (index 1 ...5, 5=free) | 0.0481*** | 0.0176 |
| Land tenure security (dummy, 1=don't lose land ownership) | -0.1449*** | 0.0322 |
| Good soil fertility index (0..1) | 0.0916** | 0.0398 |
| Condition of irrigation and drainage, dummy (1=satisfying, good, excellent) | 0.1691*** | 0.0471 |
| Location of plots to water resources, dummy (1=head of the water source) | 0.0381 | 0.0405 |
| Using electric/motor pumps for irrigation of fields (dummy, 1=yes) | -0.0455 | 0.0356 |
| Distance to the house from farm (km) | 0.002 | 0.0037 |
| Distance to the main road from farm (km) | -0.026*** | 0.0059 |
| year | | |
| 2022 | 0.167*** | 0.044 |
| Baseline B2 | 0.117 | |