The Policy of Agricultural Land Allotment to Households and its Impact on Household Welfare in Tajikistan

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Policy context

- Allocation of additional land for rural households – Presidential land
  - In 1995, 50,000 hectares of land were allocated for household subsidiary farming, without the right to build houses and other household facilities
  - In 1997, another 25,000 hectares were allocated to households

- This study provides evidence on the impact of this policy on household welfare, specifically dietary diversity

- Why dietary diversity?
  - It is strongly correlated with per capita calorie consumption, dietary energy adequacy and nutrition outcomes (Ruel 2003; Ruel et al. 2013)
  - It is also a strong predictor of diet quality in terms of micronutrient intake and adequacy (Ruel et al. 2013)

Research Question

- How does access to presidential land in Tajikistan affect crop diversity and dietary diversity?
  - Crop diversity: number of crops grown by a given household
  - Dietary diversity
    - Number of food groups consumed by a household member during last 24 hours, based on food groups identified in the survey (SDDS)
    - the same, but based on the FAO's 16 food groups (FDDS-16)
    - the same, but based on the FAO's 12 food groups (FDDS-12)
    - the same, but based on the FAO's 9 food groups (FDDS-9)

Preview of the results

- Household access to presidential land is associated with
  - Significantly higher crop diversity
  - Considerably higher dietary diversity
- Results hint that access to presidential land likely leads to higher dietary diversity through both higher crop diversity and yields
- Findings also suggest that households with higher female education, schooling access, assets, and migrants are likely to have higher dietary diversity

Motivation

- Land reform, farm reorganization, and individualization of agriculture played an important role in agricultural transformation in transition economies (Lerman et al. 2004; Rozelle and Swinnen 2004)

- Increased access to land led to higher productivity, food security, and household welfare (Fan 1991; Lerman et al. 2004; Lerman 2006; Tilt 2007; etc.)

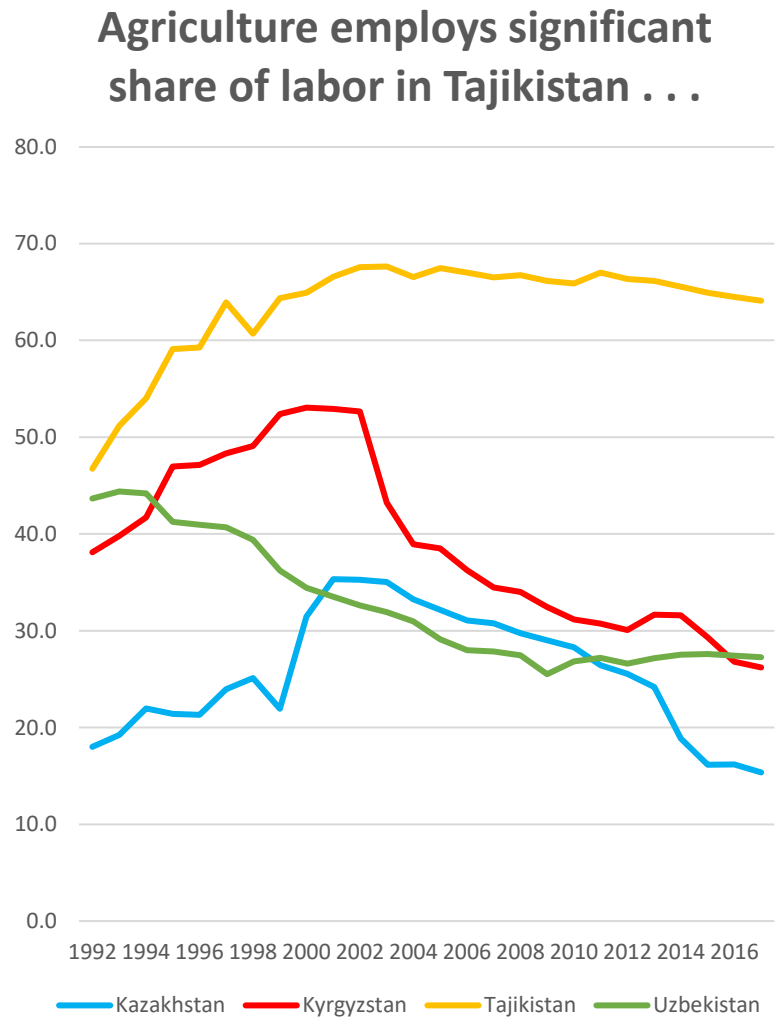
- Evidence also suggests smaller farms are more productive per unit of area than large farms (Rios & Shively 2005; Larson et al. 2013; Kagin et al. 2015)

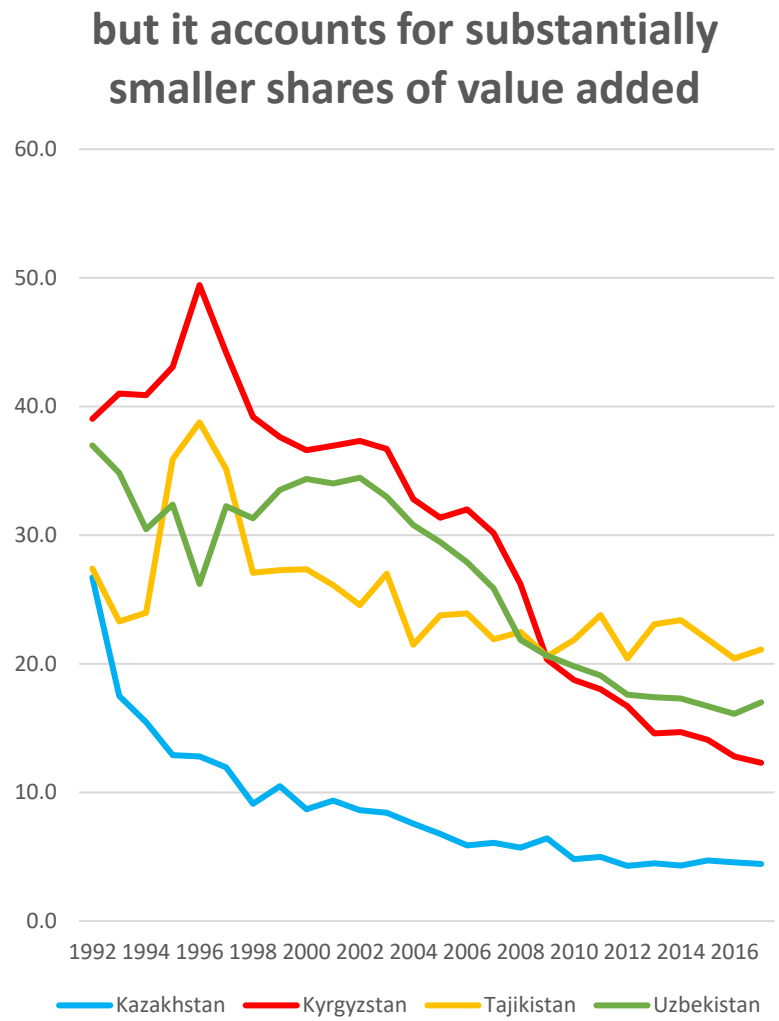
- However, some argue that land fragmentation may lead to misallocation of resources and duplication of tasks causing lower agricultural productivity (Hung et al. 2007; Rahman et al. 2009; Tan et al. 2010; Ali et al. 2018)

Motivation

- Mixed results of the reallocation of land to smallholders in terms of its impact on agricultural productivity (Adamopoulos and Restuccia 2020; Elahi et al. 2020)
- Causality challenges and external validity concerns
- Concerns about land fragmentation and productivity gaps in Central Asian countries (Akramov and Omuraliev 2009; Akramov and Shreedhar 2012)
- Raises an important question: What is the evidence on the relationship between improved household access to land and household welfare in Central Asia?

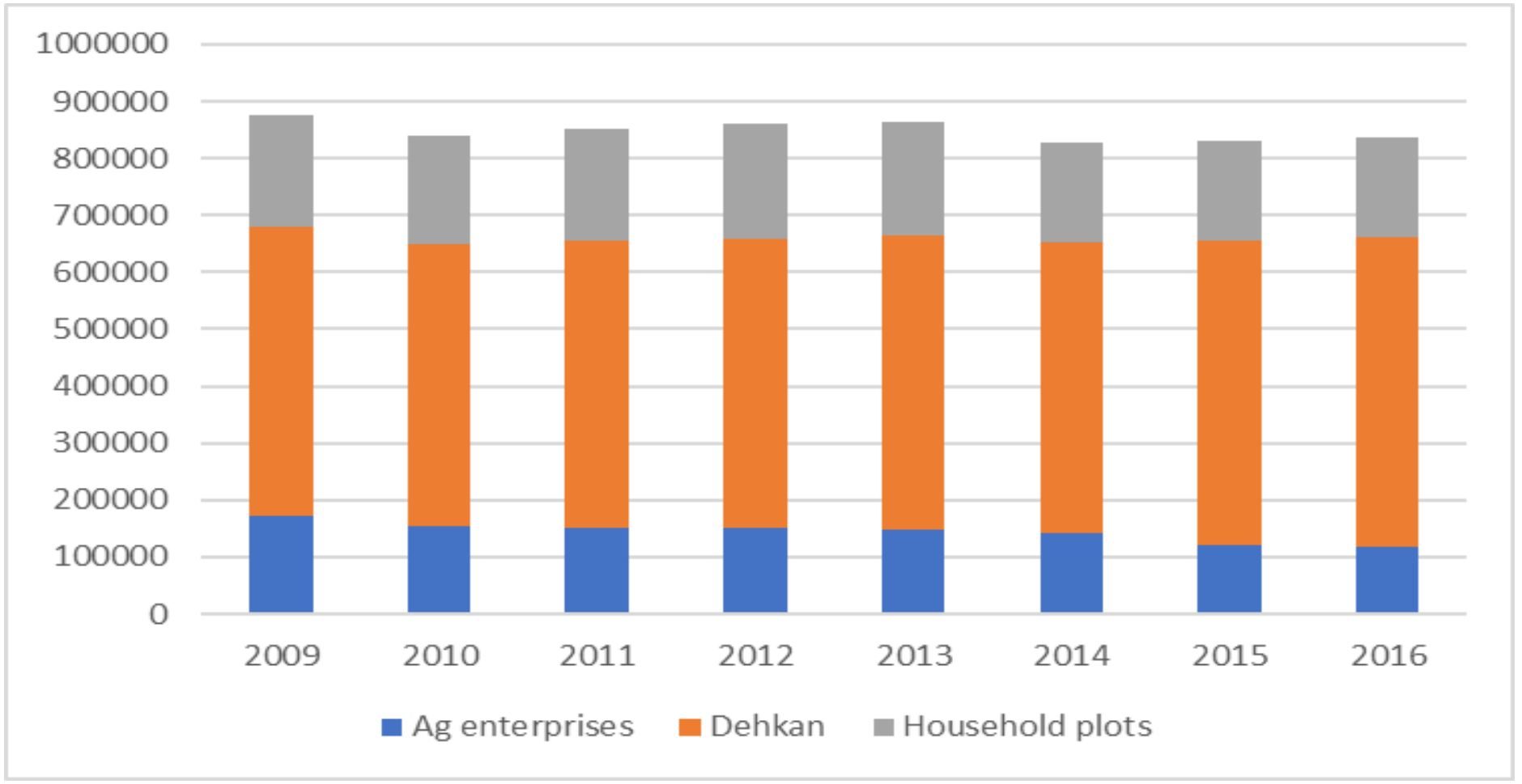
Study context: Agriculture in Tajikistan





Source: Akramov et al. 2019

Study context: Farm types in Tajikistan

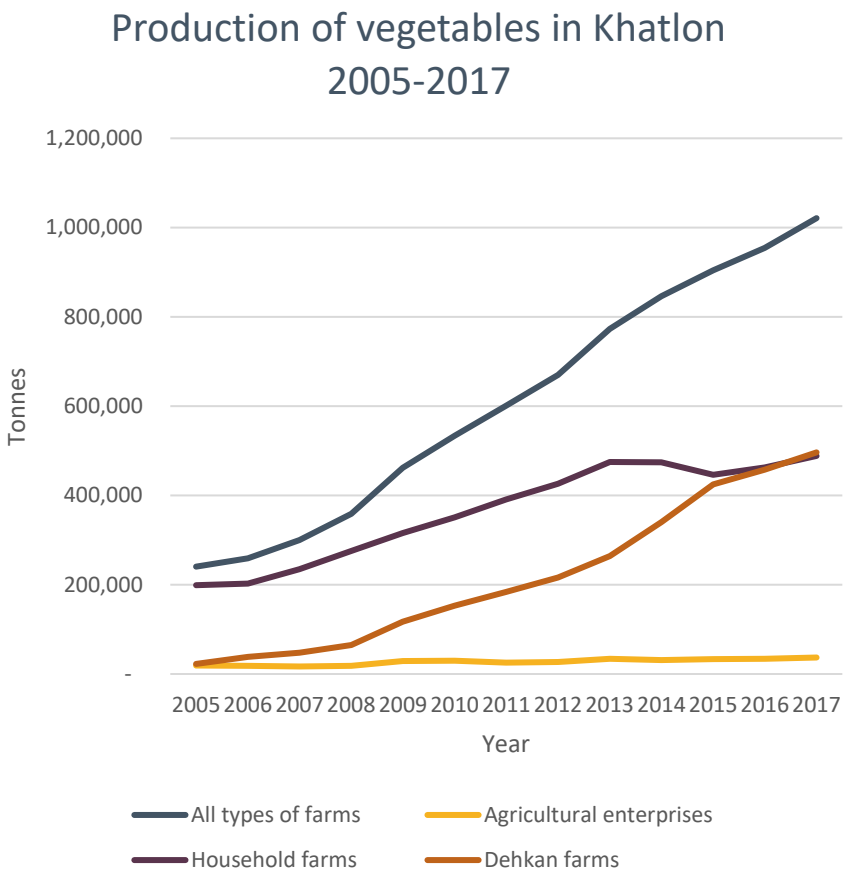


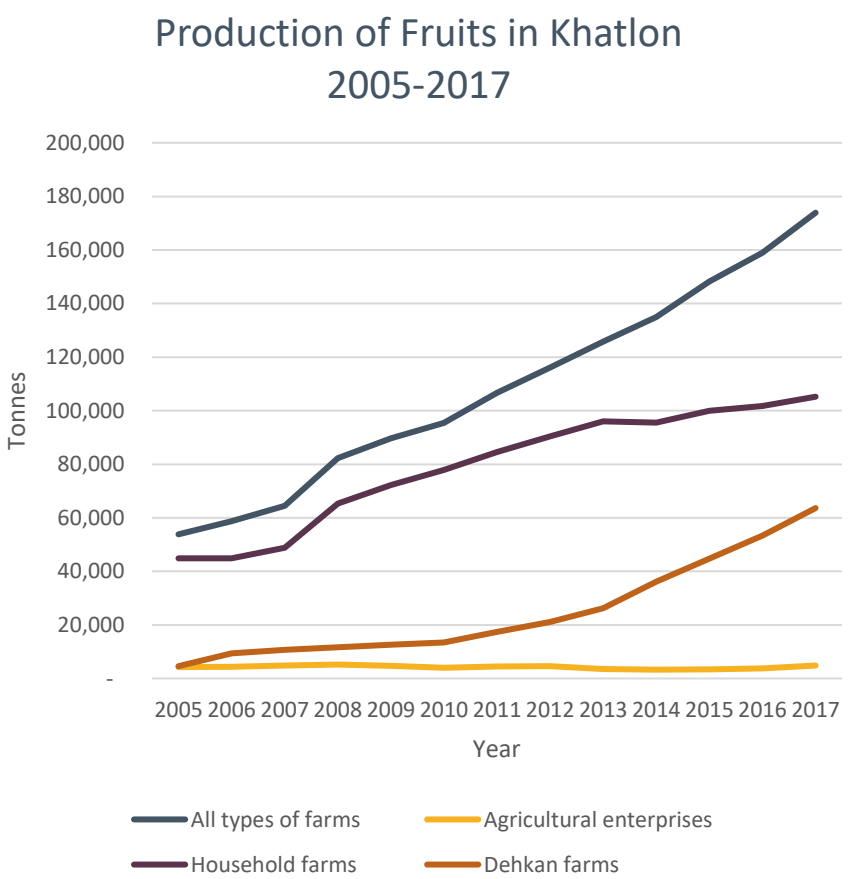
Source: Akramov et al. 2019

Study context: Agriculture in Khatlon

- While cotton and wheat remain major crops in Khatlon, horticulture cropland grew significantly faster during the last decade
- Allocation of more land for horticulture led to substantial growth of fruits and vegetables production
- Khatlon became the largest producer of fruits and vegetables in Tajikistan, producing 42% of fruits and 55% of vegetables
- Evidence suggests that horticulture production grew not only because of more land but also due to increasing yields

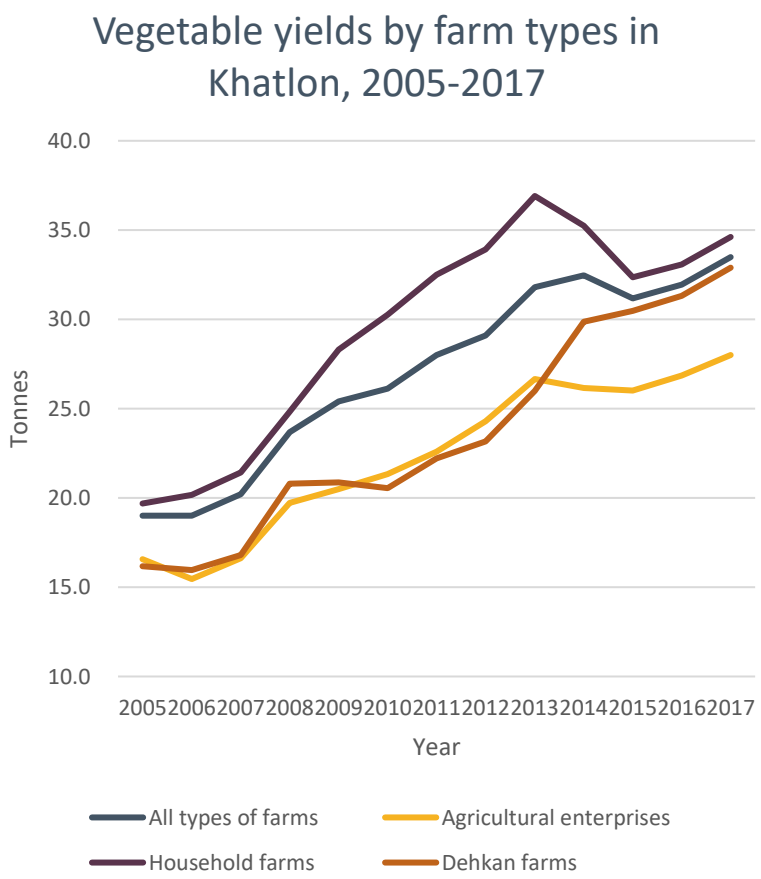
Growth of horticulture production is driven by household plots and dehkan farms

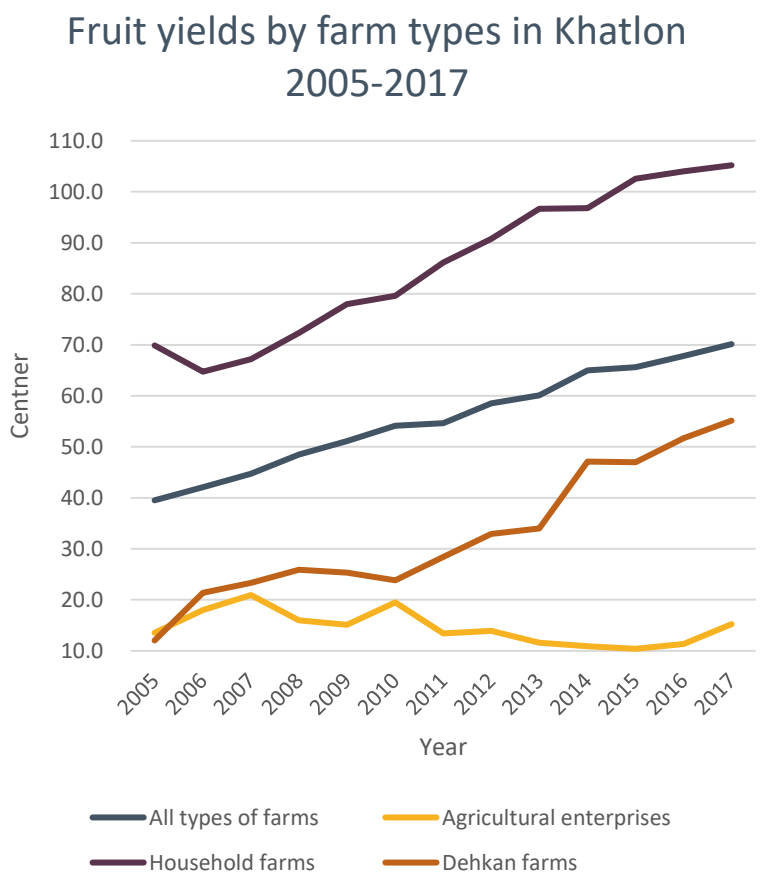




Source: Authors' estimates using data from Agency on Statistics under President of Tajikistan

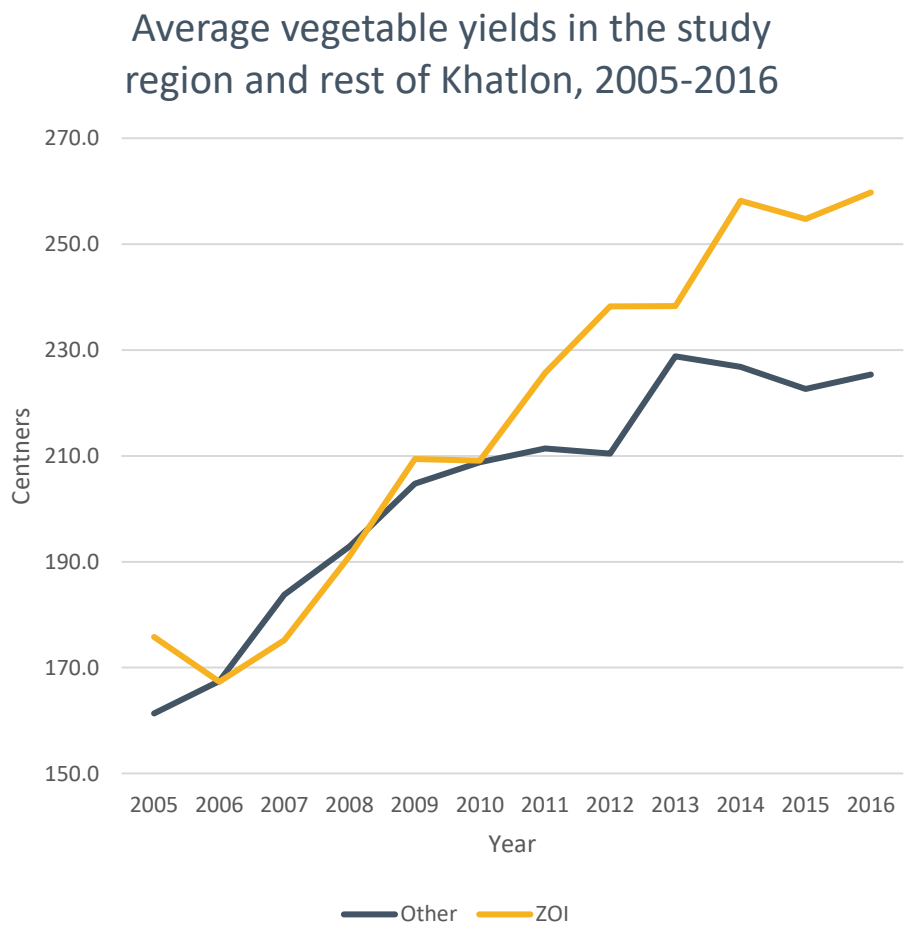
Significant yield gaps remain between household plots and other farms types

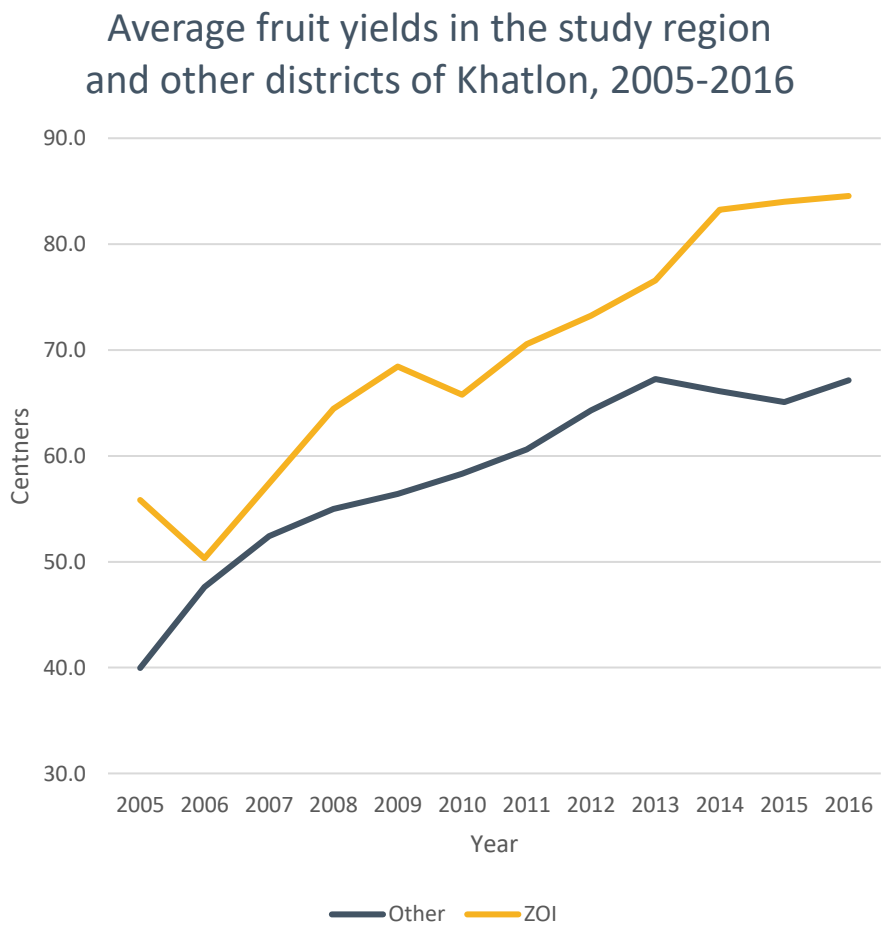




Source: Authors' estimates using data from Agency on Statistics under President of Tajikistan

Fruits and vegetable yields grew faster in the study region





Source: Authors' estimates using data from Agency on Statistics under President of Tajikistan

Household survey data

- Survey of households engaged in horticulture production and sales conducted in 2018 by IFPRI and Zerkalo Analytics (Tajikistan)

- Sample includes 1,200 households in 12 districts of the Khatlon province
  - 482 households have access to presidential land
  - 295 households engaged in individual dehkan farming

Agricultural land use in the study region

Basic plot characteristics from survey

Plot Type	Household plot	President. plot	Individual dehkan	Total
Plot size (in hectares)	0.15	0.11	2.48	
Possesses legal document (%)	96.8%	96.3%	95.3%	96.5%
Irrigated (%)	85.0%	77.6%	78.7%	82.3%
Good soil quality (%)	57.5%	54.6%	61.8%	57.6%
Low soil salinity (%)	40.5%	45.2%	40.2%	42.4%
N (households)	1197	482	295	

Source: Akramov et al. 2019

Many households farm two seasons

	Household plot	Presidential plot	Individual dehkan
Allocated land			
Grains	1.4%	36.4%	1.2%
Cotton and technical crops	3.4%	4.7%	93.6%
Horticultural crops	94.2%	49.2%	4.0%
Forage crops	0.8%	8.6%	1.1%
Other/unfarmed/unspecified	0.2%	1.1%	0.1%
Total plot size	0.16	0.12	2.66
N (primary season households)	1178	344	238

	Household plot	Presidential plot	Individual dehkan
Allocated land			
Grains	2.3%	50.9%	15.2%
Cotton and technical crops	0.2%	4.1%	43.1%
Horticultural crops	18.6%	22.6%	30.1%
Forage crops	78.3%	21.0%	11.5%
Other/unfarmed/unspecified	0.6%	1.3%	0.1%
Total plot size	0.16	0.15	2.68
N (secondary season households)	693	88	90

Commonly grown crops

- Among households surveyed the most commonly grown crops:
  - Potato (59.8% of hh); tomato (58.2%); cucumber (17.4%); sweet corn (17.3%); apricot (15.2%); onion (15.1%); grape (14.2%)

- The most commonly grown crops on…
  - Household plots: tomato, potato, cucumber, apricot, grape
  - Presidential plots: wheat, sweet corn, alfalfa, forage corn, potato
  - Dehkan farms: cotton, wheat, potato, onion, tomato

Input use

- Limited access to fertilizer and chemicals
- Most farmers have no access to improved seeds, seedlings, and saplings

Access to improved seed for selected crops

Crop	HH plot	President plot	Dehkan farm	Rented plot
Tomato	41.2	73.3	51.9	66.7
Potato	35.0	77.4	76.3	25.0
Onion & garlic	28.6	73.7	65.7	87.5
Cucumber	64.8	42.9	57.1	100
Pepper	42.9	33.3	100	-
Berries	33.3	50.0	62.5	100
Gourds	31.8	33.3	77.3	0.0

Machinery and hired labor use

- Nearly all farmers use machinery for plowing
- Limited use of machinery for other activities
- Most households relay on family labor
- Only small fraction of households' use hired labor, mainly in rented land and dehkan farms

Crops	All HHs that grow as a major crop (number)	HHs that use own or rented machinery (%)
Potatoes	492	26.6%
Tomatoes	366	26.8%
Onions	111	62.2%
Cucumbers	88	19.3%
Apricot	66	4.5%
Almond	65	1.5%
Grape	61	4.9%
Carrots	52	23.1%
Pepper (sweet)	46	41.3%
Peach/Nectarine	36	5.6%

Comparison of two groups diversity indicators

	Treated	Untreated	Difference	T-test
Crop diversity				
# of crops grown	4.53	3.10	1.43	9.75
Dietary diversity				
SDDS	9.14	8.23	0.91	4.23
FDDS-16	8.87	7.98	0.89	4.52
FDDS-12	7.42	6.74	0.68	4.62
FDDS-9	5.46	4.99	0.47	4.13

Note: Treated group: HHs with presidential land; Untreated group: HHs without presidential land
SDDS: Number of food groups consumed by a household member during last 24 hours, based on food groups identified in the survey; FDDS-16: DD based on the FAO's 16 food groups; FDDS-12: DD based on the FAO's 12 food groups; FDDS-9: DD based on the FAO's 9 food groups

Empirical strategy

- Allocation of presidential land was not random
- Observed differences in crop diversity and dietary diversity between households with and without presidential land could be due to selection and not due the access to presidential land itself
- Thus, while standard OLS may give a pretty good picture of the situation, it will badly over or underestimate the effect of access to presidential land
- We use PSM and IPW techniques to estimate the effect of access to presidential land on crop diversity and dietary diversity
  - PSM uses propensity score values as the conditional probability of receiving the access to presidential land given covariate values to create a counterfactual group
  - IPW uses propensity score values to weight outcome values (Abadie and Cattaneo 2018)

Empirical strategy: Setup

- *Treatment:* Access to presidential land
- Outcomes: Crop diversity and dietary diversity
- *Confounders:* Crop diversity (for DD), Poverty index, HH size, # of children, HH education, school score, female education, livestock, diary cow, HH assets, migration, ethnic background

Empirical strategy: Treatment effects

- Average treatment effect (ATE) is the difference between the outcomes of treated and control observations
  - It will be biased if treated and control observations are not similar
- Average treatment effect on treated (ATT) is the difference between the outcomes of treated and the outcomes of the counterfactual group
  - A counterfactual group is not observable and needs to be estimated
- We use the *psmatch2* and *teffects* commands to estimate ATE and ATT for various PSM and IPW estimators

Impact of access to presidential land on crop diversity: summary of OLS and matching estimator results

	OLS	PSM: nearest neighbor matching	k-Neighbors matching (k=3)	Kernel matching	Local linear regression matching (LLRM)	Inverse probability weighting (IPW)	Augmented Inverse probability weighting (AIPW)
ATE	1.1309*** (0.1462)	1.1248*** (0.1614)	NA	NA	NA	1.1418*** (0.1417)	1.1426*** (0.1418)
ATT		1.2004*** (0.2014)	1.1869*** (0.1788)	1.2272*** (0.1624)	1.2218*** (0.2101)	1.2137*** (0.1649)	NA
N	1170	1170	1170	1170	1170	1170	1170
Treated		469	469	469	469	469	469
Untreated		701	701	701	701	701	701

Treatment: Access to presidential land; Outcome: Number of crops grown by a given household
Confounders: Poverty index, HH size, # of children, HH education, female education, livestock, HH assets, migration, ethnic background

Impact of crop diversity on dietary diversity: summary of OLS results

	SDDS	FDDS (16)	HDDS (12)	WDDS
Crop diversity	**0.1551*** **	**0.1568*** **	**0.1401*** **	**0.0452** **
	(0.0434)	**(0.0396)**	**(0.0296)**	**(0.0231)**
Presidential land	**0.5778*** **	**0.5731*** **	**0.4039*** **	**0.3296*** **
	(0.2201)	**(0.2009)**	**(0.1502)**	**(0.1172)**
Poverty	0.0172	0.0135	0.0050	0.0105
	(0.0131)	(0.0120)	(0.0089)	(0.0070)
School score	0.5410***	0.4664***	0.3845***	0.2373**
	(0.2036)	(0.1858)	(0.1389)	(0.1084)
Female education	0.2439**	0.2206**	0.1821**	0.0913
	(0.1087)	(0.0992)	(0.0742)	(0.0579)
Migration	0.8614***	0.7277***	0.4501***	0.3378***
	(0.2576)	(0.2351)	(0.1758)	(0.1372)
Owen	0.2186***	0.2056***	0.1373***	0.0634
	(0.0758)	(0.0692)	(0.0517)	(0.0404)
R^2	0.090	0.093	0.096	0.075
N	1127	1127	1127	1127

Impact of access to presidential land on dietary diversity: summary of matching and weighting estimates

	SDDS	FDDS-16	FDDS-12	FDDS-9
Kernel matching	0.4735** (0.2387)	0.4736** (0.2180)	0.3245** (0.1629)	0.2703** (0.1260)
IPW	0.5860*** (0.2278)	0.5925*** (0.2088)	0.4028*** (0.1538)	0.3573*** (0.1258)
AIPW	0.5870*** (0.2286)	0.5939*** (0.2094)	0.4023*** (0.1540)	0.3597*** (0.1266)
N	1127	1127	1127	1127
Treated	459	459	459	459
Untreated	668	668	668	668

Treatment: Access to presidential land; Outcome: Dietary diversity; Confounders: Crop diversity, Poverty index, HH size, # of children, HH education, school score, female education, livestock, diary cow, HH assets, migration, ethnic background

Note: Kernel matching – the Epanechnikov Kernel Matching; IPW – Inverse Probability Weighting; AIPW – Augmented Inverse Probability Weighting.

Summary of key findings

- Household access to presidential land is associated with
  - Significantly higher crop diversity
  - Considerably higher dietary diversity
- Results hint that likely channels from access to presidential land to higher dietary diversity run through both higher crop diversity and yields
- Findings also suggest that households with higher female education, schooling access, assets, and migrants likely to have higher dietary diversity

Conclusions and policy implications

- Household survey and qualitative inquires within this study reveal serious failures in access to various inputs, development of value chains and markets
- Policies and public-private arrangements to address such constraints are vital to further promote crop diversification
- Need for more and better data and evidence

References

Abadie, A., & Cattaneo, M. (2018). Econometric Methods for Program Evaluation. *Annual Review of Economics, 10*, 465-503.

Adamopoulos, T., & Restuccia, D. (2020). Land Reform and Productivity: A Quantitative Analysis with Micro Data. *American Economic Journal: Macroeconomics*, *12*(3), 1-39.

Ali, D. et al. (2019). Costs and Benefits of Land Fragmentation: Evidence from Rwanda. *The World Bank Economic Review*, *33*(3), 750–771.

Akramov, K.T., & Omuraliev, N. (2009). Institutional change, rural services, and agricultural performance in Kyrgyzstan. IFPRI Discussion Paper 00904.

Akramov, K.T., & Shreedhar, G. (2012). Economic development, external shocks, and food security in Tajikistan. IFPRI Discussion Paper 01163

Elahi, E., Khalid, Z., Weijun, C., & Zhang, H. (2020). The public policy of agricultural land allotment to agrarians and its impact on crop productivity in Punjab province of Pakistan. *Land Use Policy*, *90*.

Fan, S. (1991). Effects of Technological Change and Institutional Reform on Production Growth in Chinese Agriculture. *American Journal of Agricultural Economics*, *73*(2), 266–275.

References continued…

Kagin, J., Taylor, J. E., & Yúnez-Naude, A. (2015). Inverse Productivity or Inverse Efficiency? Evidence from Mexico. *The Journal of Development Studies*, *52*(3), 396–411.

Hung, P. V., Macaulay, T. G., & Marsh, S. P. (2007). The economics of land fragmentation in the north of Vietnam. *The Australian Journal of Agricultural and Resource Economics*, *51*(2), 195–211.

Larson, D. F., Otsuka, K., Matsumoto, T., & Kilic, T. (2013). Should African rural development strategies depend on smallholder farms? An exploration of the inverse-productivity hypothesis. *Agricultural Economics*, *45*(3), 355–367.

Lerman, Z. et al. (2004). Agriculture in Transition: Land Policies and Evolving Farm Structures in Post-Soviet Countries.

Lerman, Z., & Stanchin, I. (2004). Institutional Changes in Turkmenistan's Agriculture: Impacts on Productivity and Rural Incomes. *Eurasian Geography and Economics*, *45*(1), 60–72.

Lerman, Z. (2006). The Impact of Land Reform on Rural Household Incomes in Transcaucasia. *Eurasian Geography and Economics*, *47*(1), 112–123.

Rios, Ana R. & Shively, Gerald E. (2005). Farm size and nonparametric efficiency measurements for coffee farms in Vietnam, 2005 Annual meeting, American Agricultural Economics Association

References continued…

Rahman, S., & Rahman, M. (2009). Impact of land fragmentation and resource ownership on productivity and efficiency: The case of rice producers in Bangladesh. *Land Use Policy*, *26*(1), 95–103.

Rozelle, S., & Swinnen, J. F. M. (2004). Success and Failure of Reform: Insights from the Transition of Agriculture. *Journal of Economic Literature*, *42*(2), 404–456.

Ruel, Marie T. (2003). Is Dietary Diversity an Indicator of Food Security or Dietary Quality? A Review of Measurement Issues and Research Needs. *Food and Nutrition Bulletin, 24*(2), 231-32.

Ruel, Marie T. et al. (2013) Nutrition-Sensitive Interventions and Programmes: How Can They Help to Accelerate Progress in Improving Maternal and Child Nutrition? *The Lancet, 382*(9891), 536–51.

Tan, S., Heerink, N., Kuyvenhoven, A., & Qu, F. (2010). Impact of land fragmentation on rice producers' technical efficiency in South-East China. *NJAS - Wageningen Journal of Life Sciences*, *57*(2), 117–123.

Tilt, B. (2007). Smallholders and the 'Household Responsibility System': Adapting to Institutional Change in Chinese Agriculture. *Human Ecology*, *36*(2), 189–199.