Agricultural Diversity, Dietary Diversity, and Nutritional Outcomes in Central Asia: Empirical Evidence from Tajikistan

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Outline

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Background

- Long lasting developmental impacts of nutrition for human development (Hoddinott et al. 2011, Victora et al. 2010)
  - Investments in improving nutritional outcomes have substantial economic returns (Hoddinott et al. 2013)
- Various factors can impact nutritional outcomes
  - Parental (maternal) characteristics, socioeconomic status etc.
- There is broad literature which claims the importance of agricultural diversity for nutritional outcomes (Allen et al 2014, Fanzo et al, 2013, Haywood 2012, etc.)
- Dietary diversity is well established and widely recognized as important determinant of nutritional outcomes (WHO/FAO 2003, Arimond and Ruel 2004, etc.)

Motivation

- Despite recent improvements, malnutrition in Central Asian countries remain relatively high
  - Stunting among children under 5 varies between 13% in Kazakhstan to 30% in Tajikistan (WHO/UNICEF/World Bank database)
- The current strategy of the national governments and development partners is to promote agricultural growth and diversification to ensure food security and nutritional outcomes
- These interventions could be very beneficial given the fact that Central Asian countries have less diversified agricultural production systems
- However, there is little evidence regarding the linkages between agricultural diversity, dietary diversity and nutrition in Central Asian context

Objectives and research questions

- This study aims to provide empirical evidence on agriculture-nutrition linkages in Central Asia by investigating three interrelated questions
  - How is agricultural diversity associated with household dietary diversity?
  - Does allocation of more land to cotton and wheat affect dietary diversity?
  - How is dietary diversity correlated with nutritional outcomes?
- Assumption: Agricultural diversity influences nutritional outcomes mainly by improving dietary diversity of households and individuals
- What are the policy implications of main findings of the study?

Data and Methodology

- Data sources
  - Tajikistan Living Standards Survey (TLSS) 2007 and 2009
  - District level population and land allocation data (Regions of Tajikistan database, National Agency on Statistics, 2011)
- Methodology: Multilevel mixed effects, and combined mixed process models to examine relationships between agricultural diversity and dietary diversity and nutritional outcomes
  - Dependent variables: HH dietary diversity scores and child stunting, measuring chronic malnutrition
  - Key independent variables: agricultural diversity at HH and district levels and share of cotton and wheat in total land area; HH dietary diversity score, with a maximum of 12 food groups
  - Control variables: child, maternal, HH, and community characteristics, and region fixed effects
- Assumptions: interaction between child's age and dietary diversity
- Consistency check: we split the sample by rural-urban, and for nutritional outcomes, by children over age 24 months.

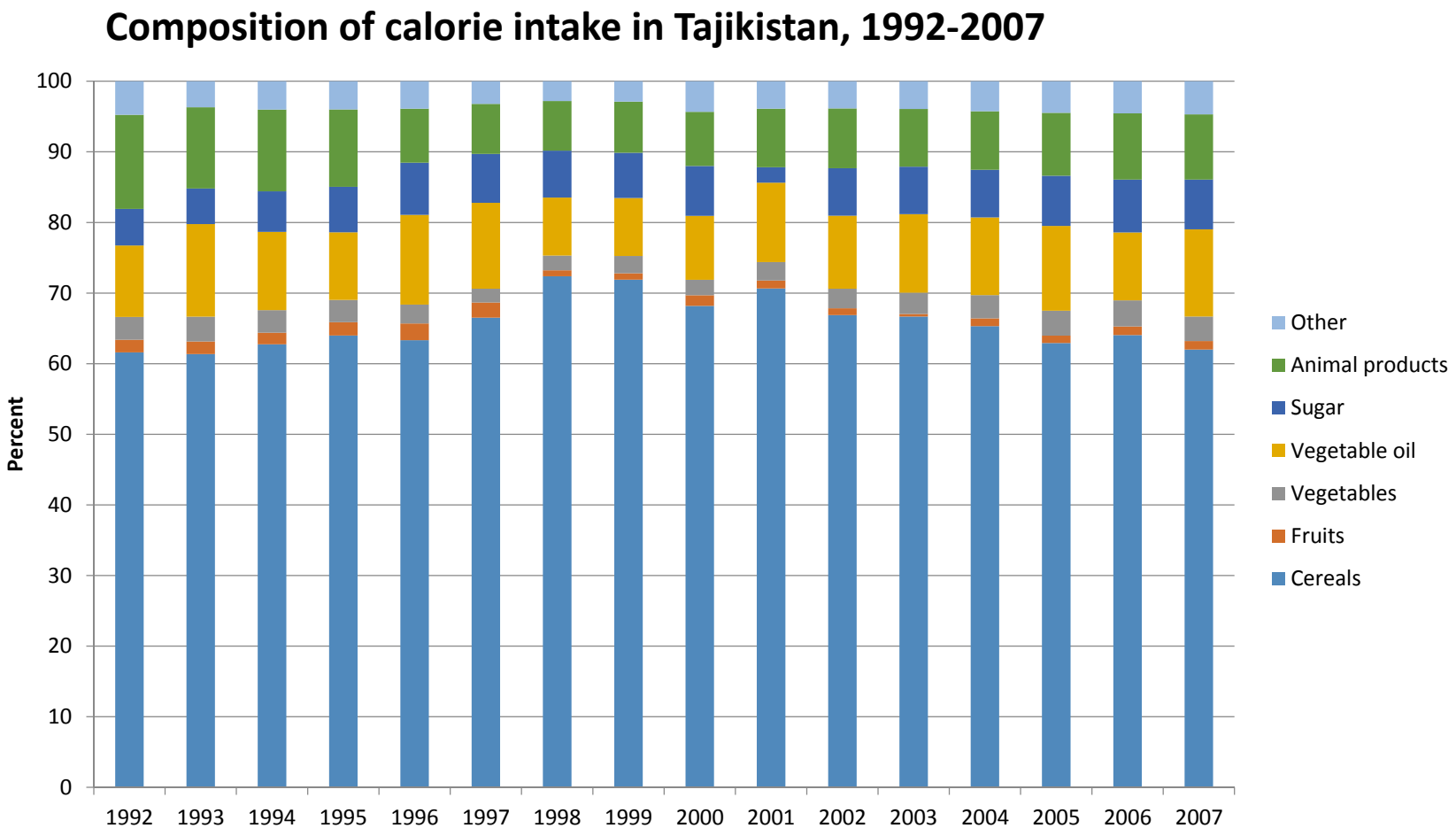
Measuring agricultural and dietary diversity

- Dietary diversity
  - Count based household DD score was developed using FAO's (2011) guidelines (12 food groups)
  - Calorie intake and food expenditure based indexes capture richness and evenness
  - Calorie intake and food expenditure based Log-abundance indexes captures richness and abundance
- Agricultural diversity
  - Count based household level agricultural diversity score
  - Land allocation based and population-weighted log abundance diversity scores were calculated at the district level

Descriptive Statistics

Variable	Mean	SD	Min	Max
Stunting	0.37	0.48	0	1
DD (count)	9.35	1.38	3	12
DD (evenness, cal, log)	1.59	0.25	0.40	2.23
DD (evenness, exp, log)	1.77	0.26	0.44	2.35
DD (abundance, cal, log)	3.28	0.68	0.89	6.13
DD (abundance, exp, log)	0.36	0.38	-0.72	2.35
Agric. Diversity (HH)	0.44	0.17	0.08	0.92
Agric. Diversity (District)	0.92	0.08	0.5	1
Cotton & wheat share	0.57	0.22	0	0.85
Distance to Urban Center (log)	3.74	1.49	-0.69	5.77
Per capita expenditures (log)	5.02	0.52	3.21	8.45

Household diets are dominated by cereals (wheat)



Source: FAOSTAT 2013

Regression Results: Dietary Diversity

	Dependent variable				
	Count-based DD	Calorie-weighted DD	Expenditure-weighted DD	Calorie-based log-abundance DD	Expen.-based log-abundance DD
Agricultural diversity (HH)	**0.0518*** **	**0.0486***	**0.0658****	**0.1753*** **	**-0.0150**
	(0.0118)	**(0.0281)**	**(0.0299)**	**(0.0583)**	**(0.0261)**
Agricultural diversity (district)	**0.0124****	**0.0487*** **	**0.0552*** **	**0.1113*** **	**0.0838*** **
	(0.0056)	**(0.0142)**	**(0.0154)**	**(0.0288)**	**(0.0136)**
HH expenditure (log)	0.0886***	0.1524***	0.1748***	0.7272***	0.3976***
	(0.0070)	(0.0160)	(0.0174)	(0.0476)	(0.0269)
Poor	-0.0200***	-0.0341**	-0.0417***	-0.1494***	-0.0753***
	(0.0057)	(0.0133)	(0.0142)	(0.0322)	(0.0167)
Location	0.0165***	0.0578***	0.0621***	0.0681**	-0.0020
	(0.0061)	(0.0130)	(0.0147)	(0.0293)	(0.0137)
HH size	0.0076***	0.0071***	0.0057**	0.0008	-0.0284***
	(0.0010)	(0.0024)	(0.0025)	(0.0049)	(0.0023)
No of children under 14	0.0032**	-0.0000	0.0036	0.0131*	0.0020
	(0.0015)	(0.0035)	(0.0037)	(0.0074)	(0.0033)
HH head's gender	0.0062	-0.0109	-0.0058	0.0120	-0.0230**
	(0.0057)	(0.0122)	(0.0135)	(0.0269)	(0.0109)
Distance to oblast center	-0.0066***	-0.0101***	-0.0211***	-0.0252***	-0.0002
	(0.0016)	(0.0034)	(0.0037)	(0.0076)	(0.0033)
Grain and Cotton share	**-0.0309****	**-0.0129**	**0.0232**	**-0.3142*** **	**-0.2134*** **
	(0.0152)	**(0.0331)**	**(0.0358)**	**(0.0768)**	**(0.0366)**
Constant	0.2891***	0.7286***	0.8661***	-0.3858	-1.4914***
	(0.0510)	(0.1210)	(0.1301)	(0.3062)	(0.1677)
Observations	3,062	3,062	3,062	3,062	3,062
F-test	42.49	22.36	27.66	94.67	190.45
R-squared	0.245	0.1578	0.1565	0.4228	0.6435
Note: Robust standard errors in parentheses; All specifications control for HH and community characteristics, region fixed effects					
*** p<0.01, ** p<0.05, * p<0.1					

Regression Results: Child Nutrition

	Key Independent variable				
	Count-based DD	Calorie-weighted DD	Expenditure-weighted DD	Calorie-based log-abundance DD	Expen.-based log-abundance DD
Dietary Diversity	-0.3238	0.2405	0.1692	-0.0536	0.0613
	(0.3153)	(0.1563)	(0.1573)	(0.0576)	(0.0542)
Child's age in months (log)	0.0555	0.2282***	0.2105**	0.0812	0.1115***
	(0.0786)	(0.0763)	(0.0857)	(0.0592)	(0.0215)
Interaction of DD with child's age	0.0423	-0.0878*	-0.0692	0.0026	-0.0122
	(0.0995)	(0.0486)	(0.0493)	(0.0184)	(0.0094)
Child's gender	0.0347*	0.0338*	0.0339*	0.0342*	0.0343*
	(0.0193)	(0.0194)	(0.0194)	(0.0193)	(0.0192)
Mother's height	**-0.6525*** **	**-0.6522*** **	**-0.6519*** **	**-0.6549*** **	**-0.6456*** **
	(0.1432)	**(0.1431)**	**(0.1432)**	**(0.1427)**	**(0.1441)**
HH expenditure (log)	0.0197	0.0036	0.0074	0.0355	-0.0065
	(0.0404)	(0.0401)	(0.0408)	(0.0438)	(0.0465)
Poor	0.0174	0.0168	0.0172	0.0137	0.0180
	(0.0335)	(0.0336)	(0.0336)	(0.0334)	(0.0334)
Location	-0.0450	-0.0452	-0.0432	-0.0446	-0.0465
	(0.0298)	(0.0292)	(0.0293)	(0.0297)	(0.0297)
Total livestock units	0.0044**	0.0040**	0.0040**	0.0043**	0.0045**
	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.0018)
Distance to nearest large urban center (log)	0.0193**	0.0189**	0.0188**	0.0192**	0.0191**
	(0.0091)	(0.0090)	(0.0091)	(0.0091)	(0.0091)
Chi-squared test for joint significance	**54.9462**	**59.6255**	**58.4859**	**55.1102**	**53.3205**
p-value	**0.0000**	**0.0000**	**0.0000**	**0.0000**	**0.0000**
Log Likelihood	-1549.4069	-1549.1685	-1549.3735	-1549.1225	-1550.0116
Wald test (full model)	118.77	131.86	125.42	118.42	119.12
p-value	0.0000	0.0000	0.0000	0.0000	0.0000
Observations	2,310	2,310	2,310	2,310	2,310
Note: Robust standard errors in parentheses; All specifications control for HH and community characteristics, region fixed effects					
Chi-squared tests for joint significance between dietary diversity score, age of child (log), and their interaction					
*** p<0.01, ** p<0.05, * p<0.1					

Summary of Findings

- Key empirical results suggest that
  - Agricultural diversity is positively associated with dietary diversity, and
  - Dietary diversity is in turn correlated with child nutritional outcomes and this relationship depends on child's age
- Findings also suggest that there is a negative association between household dietary diversity and share of land allocation to cotton and wheat at district level
- Households in communities located further away from urban centers tend to have lower dietary diversity
- These results are robust
  - Across alternative measures of household dietary diversity
  - Changes in estimation techniques
  - Controls for key child, maternal, household and community characteristics
  - Split sample: rural-urban, and children's age over 24 months

Conclusions and future research

- Further promotion of agricultural diversity may be necessary by allocating more land to horticulture and feed crops
  - In some districts up to 85% of arable land is still allocated to cotton and wheat
- Investment in infrastructure is important to promote market integration across different regions of the country
- Regional cooperation and trade is crucial to ensure food and nutritional security in the region

- Similar empirical research is being conducted using rich household survey data from Kyrgyzstan
  - Kyrgyzstan Integrated Household Survey (KIHS) with a sample size of 5000 hh
  - Rotated panel starting from 2003 to 2012

Thank you!