Impact of Multiple Shocks on Agricultural Income in Kyrgyzstan

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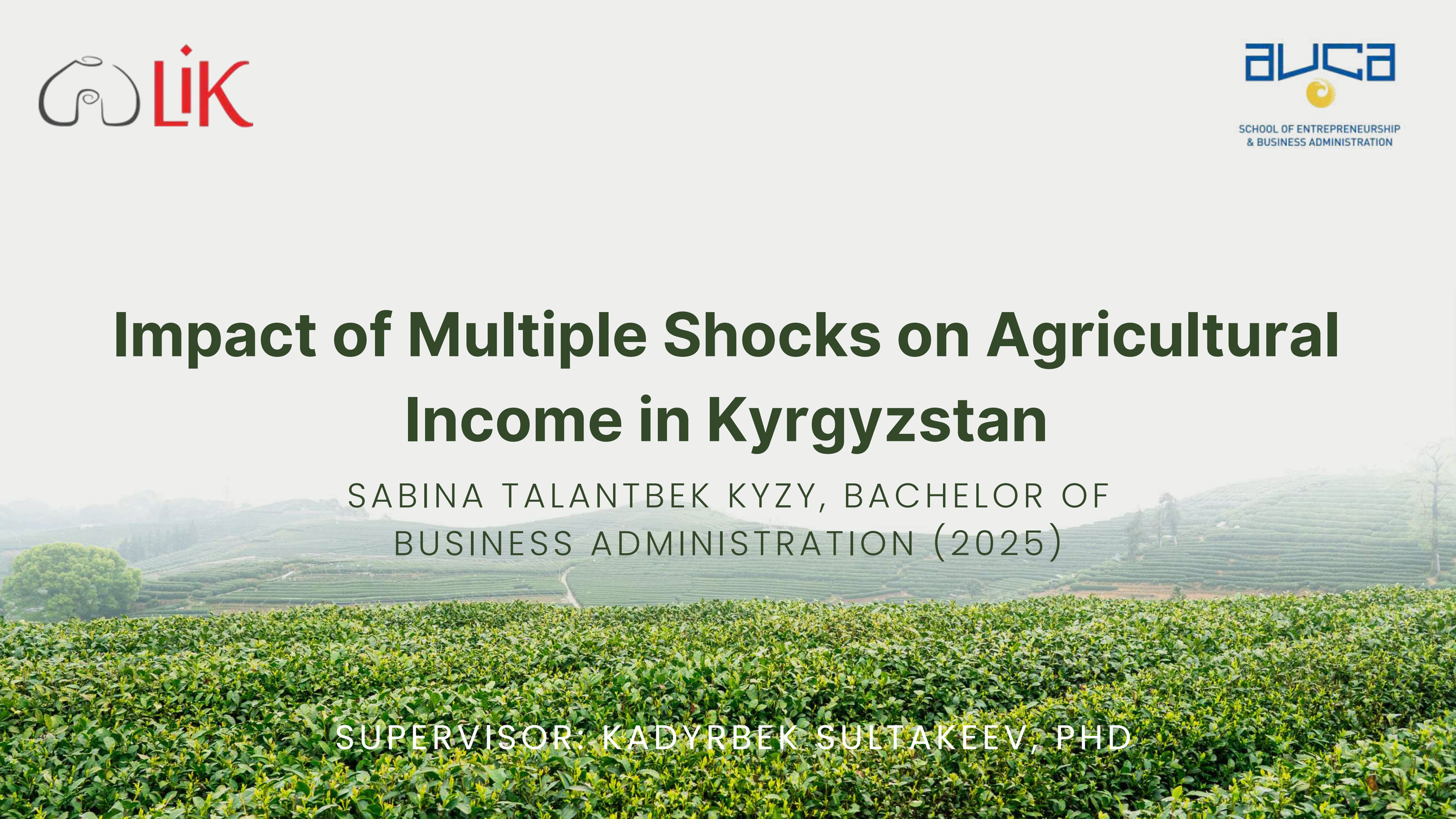

For Kyrgyzstan,

Agricultural income is a lifeline for many households - understanding how it's affected by multiple shocks is key to building effective policies.

Importance: 40% of population depend on agriculture (World Bank, 2021). The sector is second biggest component of GDP

Vulnerability: Income at risk from frequent shocks

Research Questions

1) How Multiple Shocks Impact Agricultural Income in Kyrgyzstan?

2) What Coping Strategies Households Use To Resist Shocks?

Literature Review

Environmental and social shocks (drought, illness, death) reduce agricultural income in LMICs (Bandara, Dehejia, & Lavie-Rouse, 2015; Carter et al., 2007; Khan, Bedi, & Sparrow, 2015).

Health shocks especially affect labor supply and household productivity (Alam and Mahal 2014).

Rural households frequently rely on insufficient or ineffective strategies to cope with multiple shocks, which can result in lasting negative consequences (Mehar et al., 2016; Dabla-Norris & Gündüz, 2014).

Gaps: Limited studies in Kyrgyzstan and Central Asia on this topic.

Most studies examine the relationship between shocks and household consumption, few focus on their direct impact on income.

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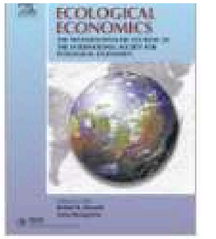

Analysis

Multiple shocks and households' choice of coping strategies in rural Cambodia

Thanh-Tung Nguyen [a b], Trung Thanh Nguyen [a], Ulrike Grote [a]

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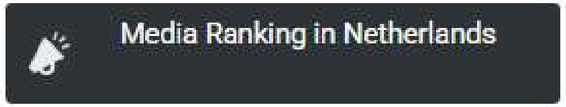

SUBJECT AREA AND CATEGORY

Economics, Econometrics and Finance
└ Economics and Econometrics

Environmental Science
└ Environmental Science (miscellaneous)

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Theoretical Background

Permanent Income Hypothesis (Friedman)

People don’t base their spending only on their current income, but on what they expect their long-term (permanent) income to be.

Sustainable Livelihoods Framework (Chambers & Conway)

When formal support is weak or missing (like insurance or state aid), people turn to informal coping strategies — like borrowing from relatives, selling livestock, or reducing consumption. Over time, this weakens their resilience and makes them more vulnerable to future shocks.

Hypotheses

H1: Multiple shocks (e.g., natural disasters, economic crises, health shocks) significantly reduce agricultural income in Kyrgyzstan (Permanent Income Hypothesis).

H2: Households employ coping strategies as borrowing from relatives, selling assets, working more which are informal (Sustainable Livelihoods Framework).

Data Usage

The dependent variable, agricultural income, was constructed using data from the Household Income Sources section of the Life in Kyrgyzstan (LiK) dataset (2019-2020).

Table 1 Multiple Shocks

Variable	Obs	Mean	Std. Dev.	Min	Max
Drought	1231	.457	.498	0	1
Insufficient water	1231	.226	.418	0	1
Divorce	1231	.077	.267	0	1
Frost	1231	.106	.308	0	1
Illness	1231	.108	.311	0	1
Death	1231	.086	.281	0	1

Table 2. Coping Strategies

Variable	Obs	Mean	Std. Dev.	Min	Max
Worked more	1231	.217	.412	0	1
Borrowed money	1231	.077	.267	0	1
Did nothing	1231	.331	.471	0	1
Sold assets	1231	.105	.306	0	1
Migration	1231	.016	.126	0	1

source: author's calculations using LiK by stata

Data Usage

Life in Kyrgyzstan survey for the period 2019-2020

Table 3. Control Variables

Variable	Obs	Mean	Std. Dev.	Min	Max
Gender	1231	1.5	.5	1	2
Age	1231	27.373	19.853	0	91
Ethnicity	1231	1.177	.382	1	2
Household size	1231	7.4	2.518	1	16
Child ratio	1231	.319	.183	0	.714
Female ratio	1231	.313	.12	0	1
Male ratio	1231	.314	.145	0	1
Old person ratio	1231	.023	.062	0	.5
Distance to main road (km)	1231	.814	1.012	.01	6
Distance to agricultural market (km)	1231	11.13	12.606	.15	60
Marital status	1231	1.595	.491	1	2
Oblast	1231	4.802	2.121	2	8
Residence	1231	1.959	.199	1	2

source: author’s calculations using LiK by stata

Methodology

OLS regression

$$AgrIncome_{ij} = \beta_1 S_{ij} + \beta_2 X_{ij} + e_{ij}$$

Where:

- $AgrIncome_{ij}$: Annual agricultural income of household i at village j

- $\beta_1 S_{ij}$: A vector of binary variables indicating whether the household experienced specific shocks (e.g., drought, insufficient water, frost, illness, death, divorce)

- $\beta_2 X_{ij}$: A vector of household-level control variables (e.g., age, gender, household size, child ratio, male ratio, old person ratio, distances to roads and markets, and residence type)

- e_{ij}: Error term

Methodology

Probit models are estimated for five binary outcomes, To interpret the probit coefficients more intuitively, average marginal effects (AMEs) are computed post-estimation

$$P(Y_{ij} = 1) = \Phi(\alpha_0 + \alpha_1 \times Shock_{ij} + \alpha_2 \times X_{ij})$$

Where:

- Y_{ij}: Binary indicator equal to 1 if household i adopted strategy at village j, 0 otherwise.

Dependent variables are divided as follows: worked more, borrowed money, sold assets, did nothing, migrated

- $\Phi(.)$: Standard normal cumulative distribution function

- $Shock_{ij}$: Vector of shocks (drought, insufficient water, frost, illness, death, divorce)

- X_{ij}: Vector of controls (age, gender, household size, child ratio, male ratio, old person ratio, distances to roads and markets, and residence type)

$$AME = \frac{\partial \Phi(X_{ij}\beta)}{\partial X_{ij}}$$

Results

1st RQ

Table 4. Impact of Multiple Shocks on Agricultural Income through OLS Regression

	(1) Agricultural Income
Drought	16060.251
	(0.723)
Insufficient water	-1.63e+04
	(0.732)
Divorce	-2.59e+05***
	(0.000)
Frost	-2.12e+04
	(0.717)
Illness of a household member	-1.15e+05***
	(0.001)
Death of a household member	-2.39e+05***
	(0.000)
N	1231

**** p<.01, ** p<.05, * p<.1*

Source: author's estimations

Shock Type	Impact on agricultural income	Likely reasons
Divorce	negative	Labor Fragmentation and Loss of Cooperation
		Increased Care Burden on Single Parents
		Economic Disruption and Asset Division
Illness	negative	Increased Caregiving Burden
		Medical Costs Divert Resources
		Direct Loss of Labor During Critical Periods
Death	negative	Financial Strain from Funeral and Aftercare Costs
		Disruption of Knowledge and Management Roles
		Emotional and Physical Strain on the Household

Analysis of control variables

- **Old Person Ratio**: Households with more elderly members have lower labor capacity
- **Distance to Main Road**: Remote households face higher transport costs, poor input access, & limited market reach (Wudad et al., 2021)
- **Distance to Agricultural Market**: May reflect access to larger, better-paying markets by more commercially-oriented or well-equipped households (Buckmaster, 2012)

Table 4. Impact of Multiple Shocks on Agricultural Income through OLS Regression

	(1) Agricultural Income
	(0.000)
Gender	3935.982
	(0.936)
Age	642.491
	(0.628)
Household size	-1.34e+04
	(0.133)
Child ratio	-2.48e+05
	(0.284)
Male ratio	3.43e+05
	(0.198)
Old person ratio	-9.33e+05***
	(0.000)
Distance to main road	-9.89e+04***
	(0.000)
Distance to agr. market	19813.606***
	(0.000)
Residence	1.06e+05
	(0.162)
_cons	1.15e+05
	(0.590)
N	1231

*** p<.01, ** p<.05, * p<.1

Results

2nd RQ

Probit Model's Results

Table 6. Coping Strategies Against Multiple Shocks through Probit Model Regression

	(1) Worked more	(2) Borrowed money	(3) Did nothing	(4) Sold assets	(5) Migration
Drought	0.577***	0.050	0.829***	-0.153	-0.830**
	(0.000)	(0.711)	(0.000)	(0.232)	(0.016)
Insufficient water	0.900***	0.840***	0.460***	-0.093	0.000
	(0.000)	(0.000)	(0.000)	(0.542)	(.)
Divorce	0.191	0.000	0.388**	0.000	0.000
	(0.353)	(.)	(0.015)	(.)	(.)
Frost	-1.105***	0.000	2.222***	0.286	0.000
	(0.000)	(.)	(0.000)	(0.142)	(.)
Illness of household member	1.126***	0.690***	-0.531***	1.273***	0.933***
	(0.000)	(0.000)	(0.002)	(0.000)	(0.003)
Death of household member	-0.589***	0.468**	-0.436**	0.000	0.000
	(0.009)	(0.012)	(0.013)	(.)	(.)
Gender	0.104	-0.042	0.043	0.026	-0.104
	(0.279)	(0.730)	(0.625)	(0.825)	(0.656)
Age	-0.001	-0.001	-0.001	0.001	-0.004
	(0.771)	(0.732)	(0.616)	(0.829)	(0.684)
Household size	-0.017	0.044*	-0.107***	0.116***	-0.105*
	(0.414)	(0.083)	(0.000)	(0.000)	(0.058)
Child ratio	1.037***	-1.074*	-0.770**	0.191	0.983
	(0.007)	(0.054)	(0.036)	(0.736)	(0.259)
Male ratio	0.604	0.139	-1.035**	2.016***	-0.529
	(0.191)	(0.830)	(0.015)	(0.002)	(0.675)
Old person ratio	-7.212***	-2.281**	0.349	3.895***	0.000
	(0.000)	(0.048)	(0.633)	(0.000)	(.)
Distance to main road	0.358***	-0.320***	-0.313***	-0.083	0.139
	(0.000)	(0.002)	(0.000)	(0.243)	(0.128)
Distance to agr. market	0.003	0.001	-0.000	0.004	0.009
	(0.369)	(0.907)	(0.954)	(0.402)	(0.351)
Residence	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
N	1180	972	1180	983	460

**** p<.01, ** p<.05, * p<.1*

Results

2nd RQ

Marginal Effect's Results

Table 7. Coping Strategies Against Multiple Shocks through Marginal Effects

	(1) Worked more	(2) Borrowed money	(3) Did nothing	(4) Sold assets	(5) Migration
Drought	0.577***	0.008	0.213***	-0.025	-0.104***
	(0.000)	(0.711)	(0.000)	(0.232)	(0.001)
Insufficient water	0.900***	0.126***	0.118***	-0.015	0.000
	(0.000)	(0.000)	(0.000)	(0.542)	(.)
Divorce	0.191	0.000	0.100**	0.000	0.000
	(0.353)	(.)	(0.015)	(.)	(.)
Frost	-1.105***	0.000	0.570***	0.047	0.000
	(0.000)	(.)	(0.000)	(0.142)	(.)
Illness of a household member	1.126***	0.103***	-0.136***	0.210***	0.054***
	(0.000)	(0.000)	(0.002)	(0.000)	(0.007)
Death of a household member	-0.589***	0.070**	-0.112**	0.000	0.000
	(0.009)	(0.012)	(0.013)	(.)	(.)
Gender	0.104	-0.006	0.011	0.004	-0.013
	(0.279)	(0.730)	(0.625)	(0.825)	(0.383)
Age	-0.001	-0.000	-0.000	0.000	-0.000
	(0.771)	(0.732)	(0.616)	(0.829)	(0.597)
Household size	-0.017	0.007*	-0.027***	0.019***	-0.012***
	(0.414)	(0.083)	(0.000)	(0.000)	(0.002)
Child ratio	1.037***	-0.161*	-0.197**	0.032	1.792
	(0.007)	(0.054)	(0.035)	(0.736)	(0.984)
Male ratio	0.604	0.021	-0.265**	0.332***	1.602
	(0.191)	(0.830)	(0.014)	(0.002)	(0.986)
Old person ratio	-7.212***	-0.342**	0.090	0.642***	0.000
	(0.000)	(0.048)	(0.633)	(0.000)	(.)
Distance to main road	0.358***	-0.048***	-0.080***	-0.014	0.011*
	(0.000)	(0.003)	(0.000)	(0.244)	(0.070)
Distance to agr. market	0.003	0.000	-0.000	0.001	0.002***
	(0.369)	(0.907)	(0.954)	(0.403)	(0.005)
Residence	0.000	0.000	0.000	0.000	0.000
	(.)	(.)	(.)	(.)	(.)
N	1180	972	1180	983	574

*** p<.01, ** p<.05, * p<.1

Interpretation of Probit Model's and its Marginal Effect's results

Coping Strategy 1: Working More

- This strategy is significantly more likely in response to illness, insufficient water, and drought.
- Marginal effects: illness (+11.3 pp), insufficient water (+9.0 pp), drought (+5.8 pp).
- Households increase labor supply by reallocating members, extending work hours, or involving women and children.
- While common, repeated reliance may have long-term costs such as school dropout and physical overwork.

Coping Strategy 2: Borrowing Money

- Borrowing is more likely in response to insufficient water (+12.6 pp), illness (+10.3 pp), and death (+7.0 pp).
- Reflects urgent liquidity needs, often for medical or funeral expenses.
- Borrowing depends on access to social capital or informal lenders.

Coping Strategy 3: Doing Nothing

- This response is significantly more likely in the face of frost (+57.0 pp), drought (+21.3 pp), insufficient water (+11.8 pp), and divorce (+8.0 pp).
- Illness and death significantly reduce the probability of inaction, suggesting these shocks require immediate response.
- Inaction often reflects a lack of resources or options, rather than resilience.

Interpretation of Probit Model's and its Marginal Effect's results

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Coping Strategy 4: Selling Assets

- Only illness is significantly associated with asset sales, increasing the likelihood by 21.0 percentage points.
- This indicates a last-resort coping response to health-related financial stress.
- Environmental shocks did not lead to significant asset sales, possibly due to limited asset ownership or a desire to preserve productive capacity.

Coping Strategy 5: Migration

- Migration is the least used strategy overall.
- Illness increases the probability of migration by 5.4 percentage points, likely as a means of generating income through external labor.
- Drought, conversely, reduces the likelihood of migration (−10.4 pp), possibly due to the cost and risk of moving during widespread hardship.

Conclusion on the analysis of the LiK survey

1. Rural households in Kyrgyzstan face both environmental (drought, frost, water scarcity) and social shocks (illness, death, divorce) that significantly disrupt agricultural income.

2. Health shocks (especially illness and death) have the most damaging effects on income due to labor loss and medical expenses.

3. Coping strategies vary by shock type:
Environmental → labor intensification or inaction
Health-related → borrowing and asset sales

4. Migration is rarely used, likely due to financial and logistical barriers.

5. Inaction often reflects constraint, not choice, especially among poorer households.

Policy Implications

This research highlights the need for targeted, shock-sensitive policies that strengthen rural resilience and reduce inequality:

- Expand rural health protection
- Invest in climate adaptation
- Improve rural infrastructure and inclusion
- Enable accessible financial tools

STUDY CONTRIBUTIONS

01

First empirical analysis of how multiple shocks affect agricultural income in Kyrgyzstan.

02

Identifies the most severe shocks impacting household income.

03

Analyzes coping strategies and highlights the need for targeted social protection.

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Study Limitations

There is no panel data for conducting this study.

This study is based on subjective approach due to the self response data.

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thank you

For comments, feedback, and questions regarding the presentation,
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