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DROUGHT AND MIGRATION: EVIDENCE FROM THE KYRGYZ REPUBLIC

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Abstract

This study empirically examines the effect of the drought of 2021 on migration in the Kyrgyz Republic. A panel dataset was created using nationally representative household survey data for the period 2019–2022 with approximately 5,000 households in each year and integrated with the satellite data on precipitation at the community level to measure the drought. Empirical estimations based on the difference-in-differences method with fixed effects show that international migration of household members living in drought-affected locations increased during the post-shock year. Both urban and rural households demonstrated a positive migration trend. This finding suggests that policy aimed at creating resilience to the drought shock should be comprehensive and take into consideration its economy-wide effects.

Keywords: migration, climate change, drought, Central Asia, Kyrgyz Republic

JEL Classification: Q54, F22, O15

Contents

1. INTRODUCTION

There is growing evidence that climate change is the main concern for the livelihood of societies and that human activities will be severely impacted by unfavorable climate conditions. The mobility of people as one of the main potential actions of society in reacting to social and economic shocks is expected as a natural consequence of climate change (Boas et al. 2022; Myers 2002; Piguet 2022; Smirnov et al. 2023).

Among climate shocks, drought is the most frequent and has a significant influence on migration in most developing countries (Hoffmann et al. 2024). In the framework of economic theory, it is argued that negative climate shocks decrease productivity and induce migration away from these locations (Harris and Todaro 1970). Empirical literature confirms that drought decreases consumption and increases migration among households living in areas affected by the drought (Debnath and Nayak 2022; Kasie et al. 2020). Murray-Tortarolo and Salgado (2021), studying migration from Mexico to the United States, argue that drought alongside diminishing agricultural productivity increases migration from rural areas. Yoo and Agadjanian (2024) found in the case of rural Sub-Sahara an immediate increase in migration after a drought, but this decreased after a six-year period. Gröger and Zylberberg (2016), examining the impact of a typhoon in Viet Nam, stated that decreased income caused labor migration from rural to urban areas. In particular, this effect was evident for long-distance migration, and households with preexisting migration experience were found to be more resilient due to receiving more remittances, whereas local migration networks were not effective. Bohra-Mishra et al. (2017) analyzed the internal migration in the Philippines and stated that increased temperatures and typhoon activity raise migration, but precipitation does not have a strong effect. Overall, most studies show that in the face of weather extremes, including drought, low-income households are very vulnerable and may not be able to use the migration option (Debnath and Nayak 2022; Gray and Mueller 2012; Kasie et al. 2020).

However, empirical studies provide various results about the impact of climate shock on migration (Hermans and McLeman 2021; Hunter, Luna, and Norton 2015). Thus, some households may adopt an adaptation strategy under climate change and diversify income sources (Black et al. 2011; Vinke et al. 2020). Wealthier households may be able to adapt to climate change using new techniques for agriculture. Another part of the population may send labor migrants, while households left behind use remittances in their resilience to climate change (Zickgraf 2023). Moreover, some may just be negatively impacted by drought reducing consumption and due to a lack of financial resources may not be able to migrate. There may be evidence of both voluntary and involuntary immobility even in the wake of environmental shocks (Blondin 2022; Boas et al. 2022). Therefore, the net effect of climate shock remains vague and varies by country context, household characteristics, and migration experience.

On the other hand, literature provides some discussions about the duration of the effect of drought on migration, although conceptual discussions on the topic suggest that migration is a last-resort mechanism in dealing with climate shock as it implies financial costs and risks associated with employment (Kaczan and Orgill-Meyer 2020; Nawrotzki and DeWaard 2016). However, a preexisting migration network may facilitate migration even in the short-term post-shock period (Yoo and Agadjanian 2024).

One of the challenges in understanding the drought and migration nexus is the appropriate measurement of climate change and migration, and the availability of data (Hoffmann, Šedová, and Vinke 2021). Official statistics, particularly in developing countries, may not be sufficient to explore migration due to climate change. This is

partly due to the fact that climate change does not affect all households equally and the vulnerability of a population may vary by regions, communities, and households.

Labor migration in Central Asia has been a dynamic process since the beginning of the 1990s. The economic growth performance in the Russian Federation and Kazakhstan since the beginning of the 2000s has been associated with labor migration from three other Central Asian countries: the Kyrgyz Republic, Tajikistan, and Uzbekistan. Apart from the labor migration tendencies, the Central Asian region is not an exception from the climate change issues. Data on the weather since the beginning of the 20th century demonstrate an increasing trend in annual temperature, and projects predict further intensification of warming in the region (Peng et al. 2019; Reyer et al. 2017; Zhang et al. 2019). Along with this, the issue of water scarcity poses challenges for solving sustainable development issues (Guo et al. 2018; Huang, Duan, and Chen 2021; Wang et al. 2022). Also, a dynamic increase in the size of the population creates both pressure on the environment and a higher propensity for migration. For instance, according to the Groundswell report by the World Bank, there will be about 2.4 million climate migrants by 2050 in the region as a result of such a pessimistic scenario.

Despite the climate change challenges and migration dynamics in the region, only a limited number of studies have explored the relationship between migration and climate change in Central Asian countries (Blondin 2019, 2022). Some studies focus on country case studies in the Central Asian region and on the labor supply and different social and economic factors within the concept of climate change (Khaibullina et al. 2022; Otrachshenko, Popova, and Alimukhamedova 2023).

This study aims to empirically examine the effect of drought in 2021 on migration in the Kyrgyz Republic. Drought in 2021 was extreme in Central Asia, impacting negatively on agricultural productivity (Jiang and Zhou 2023). Taking this case into consideration, this study uses nationally representative household survey data for the period 2019–2022. A panel dataset at the household level was created and integrated with satellite data on precipitation at the community level to measure the drought. An empirical approach based on the difference-in-differences (DiD) method with household fixed effects is used to measure the effect of drought through a comparison of migration before and after the shock between those who were affected by drought and those who were not.

This study makes several contributions to the literature. First, it examines the short-term effect of drought. This contributes to the discussion on whether households can use migration as a means of coping with climate shock in the short term. Second, in focusing on the Kyrgyz Republic, it provides an interesting context representing a region with a high migration propensity and water scarcity issues. It enriches understanding of the climate-migration nexus and contributes to the scarce literature in the Central Asian context. Third, this study uses panel data, making it possible to observe changes over the stud period and compare the before- and after-shock behavior of households.

The remaining part of this paper is structured as follows. Section 2 provides data and descriptive statistics. Section 3 presents the methodology used. Section 4 provides results, and the final section concludes and makes policy recommendations.

2. DATA

Data Source

This study utilizes household-level panel data generated from the Kyrgyz Integrated Household Survey (KIHS) for the period 2019–2022. The KIHS, a nationally representative micro-level socioeconomic survey, has been conducted quarterly by the National Statistical Committee of the Kyrgyz Republic (NSC KR) since 2003. It is the primary source for national statistics on living standards, labor market indicators, and food security in the Kyrgyz Republic. The KIHS sample is drawn using stratified two-stage random sampling based on the population census results. The country is divided into 15 strata, encompassing urban and rural areas of the seven oblasts and the city of Bishkek. Each cross section is designed to be representative at the national, rural/urban, and regional (*oblast*) levels (Esenaliev et al. 2011).

Annually, the KIHS surveys approximately 5,000 households, focusing on the socioeconomic dimensions of living standards. It collects detailed information on household consumption, expenditure, migration, and income structure, allowing for the analysis of labor migration in relation to other socioeconomic characteristics of households. A household panel dataset was created by merging the KIHS data from 2019 to 2022 using a unique household identifier, resulting in a balanced panel dataset that includes 4,240 households per year from 226 locations.

However, the KIHS does not include data on drought conditions or their impact on households. Therefore, we use community-level satellite data on precipitation to measure drought in the locations where households surveyed in the KIHS reside. The precipitation data used in this study are sourced from the recent Modern-Era Retrospective analysis for Research and Applications, version 2 (MERRA-2) (Gelaro et al. 2017). The MERRA-2 dataset is produced by NASA's Global Modeling and Assimilation Office (GMAO) (Bosilovich et al. 2017). MERRA-2 was developed to replace and enhance the original MERRA dataset (Rienecker et al. 2011) and is available for the period from 1981 to 2022. The estimated drought dataset at the community level was merged with the KIHS household panel dataset using community identifiers.

Drought

The drought variable is constructed using community-level satellite data on precipitation sourced from the MERRA-2 dataset (Gelaro et al. 2017). The data provide the bias-corrected monthly totals of daily total precipitation at the surface of the earth (Reichle et al. 2017). Following the literature (Gray and Mueller 2012), we use the agricultural season for precipitation deviation estimations. Thus, for the southern regions of the Kyrgyz Republic, including Batken, Jalal-Abad, and Osh, we focus on cumulative precipitation from March to September. For the northern regions (Bishkek, Chui, Issyk-Kul, Talas, and Naryn), the period from May to September is considered.

For identification of the drought we follow previous literature (Burke, Gong, and Jones 2015; Epstein et al. 2022) and estimated total precipitation during the agricultural season for each community annually from 1982 to 2022. This total was ranked relative to historical observations from 1981 onward up to each year of our panel dataset (2019–2022), and the resulting rankings were converted into percentiles. We use the approach by Epstein et al. (2022) and classify drought if the community precipitation is below the 30th percentile, and no drought if it is above or equal to the 30th percentile.

Therefore, a binary variable is generated for the drought indicator and households are considered drought-affected if they live in locations experiencing precipitation below the 30th percentile.

Figure 1 represents the distribution of precipitation deviation percentiles during the vegetation period for the years 2019–2022. The horizontal axis shows the values of the precipitation deviation percentile, ranging from 0 to 100. Each year is represented by a violin plot, which visualizes the distribution of precipitation deviation percentiles across 4,640 households residing in 226 communities identified in the KIHS. The orange dots represent the median value for each year. As can be seen, the most drought cases occurred in 2021. Moreover, among 226 communities in the KIHS, 70 were affected by drought in 2021. These affected locations are in the Chui and Talas regions, including the capital city, Bishkek.

Figure 1: Precipitation Deviation Percentile

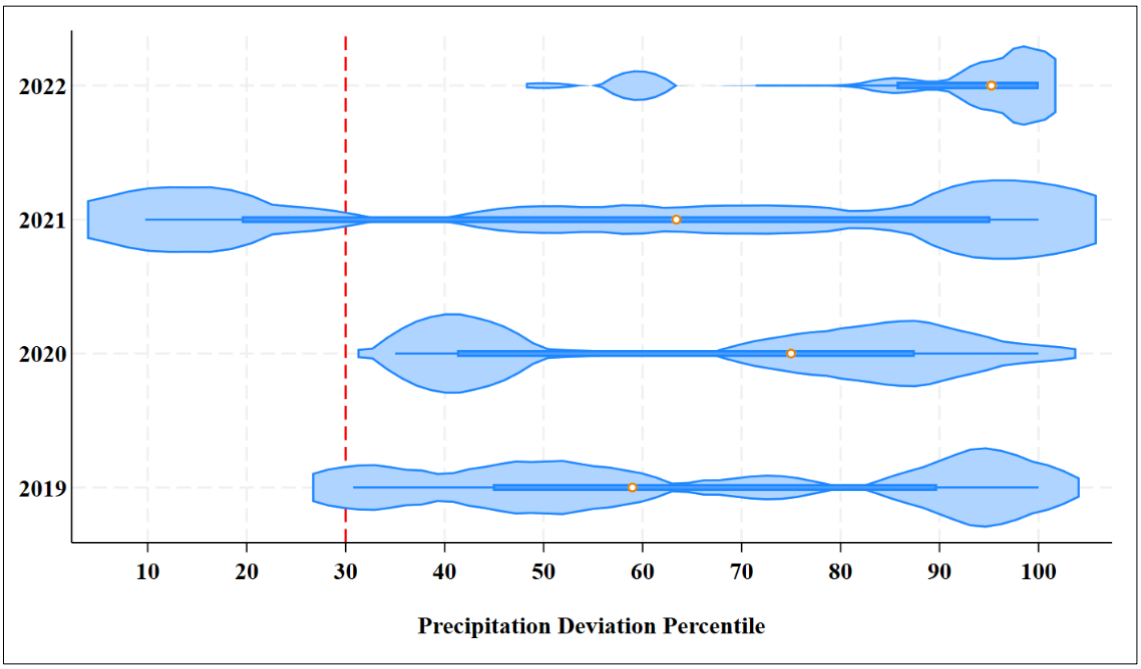

Table 1: Community Distributions by Drought in 2021

Region (Oblast)	No Drought	Drought-affected	Total
Batken	30	0	30
Bishkek	0	4	4
Chui	3	41	44
Issyk-Kul	30	0	30
Jalal-Abad	37	0	37
Naryn	26	0	26
Osh Oblast	29	0	29
Osh city	1	0	1
Talas	0	25	25
Total	**156**	**70**	**226**

Migration

We identify the migration status of households based on the household roster questions in the survey, which are asked during the first quarter of each year. In line with our objectives, we focused on households with temporarily absent individuals older than 15 who were working in another region of the Kyrgyz Republic or abroad. For migration, we used the number of temporarily absent household members. Migration of household members is measured both in total number and by destination as internal and international migration. Those who were reported as being abroad for labor purposes were considered international migrants, whereas those indicated as being absent, but not abroad, were classified as internal migrants.

Descriptive Statistics

Table 2 presents descriptive statistics for both the total sample and the subsamples of drought-affected and non-affected households. According to estimations, 1,471 households were identified as drought-affected (treatment group) in 2021. Households in the treatment group presented a lower number of migrants working both abroad and within the country than nonaffected households. The same trend is observed in the share of households with migrants. Though this can be noted as the evident difference between the treatment and control groups, it does not imply the causal effect of drought. However, the overall mean values of these variables over observed years indicate the growth of migrants in the post-treatment year 2022 (see Table 3).

Interestingly, drought-affected households tend to have a higher proportion of female-headed households, but be of a slightly lower age compared to the control group. On the other hand, the treatment group has a lower share of household heads who are married and a relatively higher proportion with vocational and tertiary education. Among other characteristics, drought-affected households were smaller on average, with fewer children and females. Also, most households that were affected by drought reside in an urban area and only a quarter of them have land for agricultural purposes. These features are expected given the fact that drought in 2021 was intensive in the central region of the country, including the capital city. On the other hand, one could argue that given the greater urban population with less agricultural land use, drought might have less of an impact on labor migration. But given the smaller number of children and females at home, they might be more inclined towards migration in general.

Table 2: Descriptive Statistics (Mean Values, Unless Otherwise Indicated)

	Total Sample		Drought-affected		No Drought	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Total number of observations	16,960		5,884		11,076	
Locations (N)	226		70		156	
Number of HHs	4,240		1,471		2,769	
Number of migrants in HH	0.17	0.48	0.08	0.327	0.23	0.536
Number of international migrants	0.12	0.41	0.05	0.26	0.16	0.47
Number of internal migrants	0.05	0.26	0.031	0.2	0.06	0.29
HHs with migrants (in %)	13.6	34.3	6.2	24.2	17.5	38.0
HHs with international migrants (in %)	9.7	29.6	3.6	18.7	12.9	33.5
HHs with internal migrants (in %)	4.2	20.0	2.7	16.3	4.9	21.6
Household head characteristics						
Female-headed HHs (in %)	39.1	48.8	44.5	49.7	36.2	48.1
Age	56.3	13.1	55.9	13.7	56.5	12.8
Married (in %)	63.0	48.3	57.9	49.4	65.7	47.5
Education (in %)						
Primary and below	*2.9*	16.8	1.9	13.5	3.5	18.3
Secondary	*54.2*	49.8	44.4	49.7	59.4	49.1
Vocational education	*25.1*	43.4	31.3	46.4	21.8	41.3
Tertiary education	*17.8*	38.2	22.4	41.7	15.3	36.0
Household characteristics						
HH size (number of people)	4.2	2.1	3.6	1.9	4.4	2.1
Number of children aged 0–5 years	0.45	0.77	0.31	0.63	0.52	0.83
Number of females in HH	2.2	1.3	1.9	1.1	2. 3	1.3
HHs living in an urban area (in %)	55.6	49.7	60.5	48.9	53.0	49.9
HHs with agricultural land (in %)	35.1	47.7	24.8	43.2	40.5	49.1

Source: Authors' calculations based on KIHS data.

Table 1: Drought and Migration over the Period

	2019	**2020**	**2021**	**2022**
Precipitation deviation percentile (in %)	65.40	66.94	57.34	88.19
Number of migrants in HH	0.17	0.18	0.16	0.18
Number of international migrants	0.15	0.16	0.09	0.10
Number of internal migrants	0.02	0.02	0.08	0.08

Source: Authors' calculations based on KIHS and NASA MERRA-2 data.

3. EMPIRICAL METHODOLOGY

This study examines the impact of drought on the migration status of households. For this purpose, the difference-in-differences (DiD) method with fixed effects is used. This approach enables us to estimate the effect of drought (treatment) through the comparison of outcomes before and after the treatment between those who were affected by drought (treatment group) and those who were not (control group). The following baseline model is estimated:

$$y_{jt} = \beta_0 + \beta_1 P_t + \beta_2 T_{jt} + \beta_3 (P_t * T_{jt}) + \beta_4 X_{jt} + \mu_j + \eta_t + \epsilon_{jt}, \quad (1)$$

where y_{jt} is the outcome variable of household j in year t. Outcome variables are measured by the migration status of households. Migration status is measured by the number of migrants, and a dummy variable if a household has at least one household member as a labor migrant. P_t shows the post-treatment period, which takes the value of 1 if the year is in the post-drought period.

As mentioned above, in this study the migration status of households is identified based on the household roster questions in the survey, which are asked during the first quarter of each year. On the other hand, drought is measured through precipitation data for the agricultural season that starts from the second quarter of each year. This means that in the KIHS survey of the particular year, the migration variable does not follow the drought data of that particular year. Therefore, for the model specification, the post-treatment period is taken as 2022.

T_{jt} represents the treatment status of households measured as a dummy variable being equal to 1 if a household lives in a community affected by drought. The vector X_{it} is the set of other covariates explaining outcome variables (see Table A.1.). It includes household head and household characteristics. Age, gender, marital status, and education level are typical variables included as household head characteristics. Household size, number of children aged up to six, number of females in the household, urban–rural location, and ownership of a land plot are among household characteristics that may affect the migration status of households. The household income level might be important for migration decision-making or in dealing with consequences of climate shocks. Thus, dummy variables for income quartile groups are included in the list of explanatory variables. μ_j and η_t refer to household and year fixed effects, respectively. In all estimations, standard errors are clustered at the community level. All estimations are estimated on the total sample and on urban–rural subsamples.

4. EMPIRICAL RESULTS

The outputs of regression models estimating the impact of drought on the migration status of households are presented in Tables 4–6. The results are given by international and internal migration. The main variable of interest to us is the interaction term for the year 2022 and whether the household resides in a drought-affected area. This shows the average difference in the effect of drought on migration between the treated and control groups.

This variable shows a statistically significant positive effect on the total number of migrants and international migrants, suggesting that households in communities where the drought was indicated had a higher number of labor migrants abroad in 2022 than in the pre-drought period. These results are in line with the general literature concluding that drought causes migration (Gray and Mueller 2012; Murray-Tortarolo and Salgado 2021). This indicates the importance of migration as a mechanism of coping with extreme weather events. However, on the other hand, decreasing internal migration in the post-drought period possibly explains the overall lower possibility of earning in other regions within a country. Indeed, this may be related to the fact that the particular drought season in this study was focused in the central and northern region of the country (Chui and Talas regions and the capital city, Bishkek), whereas traditionally migrant-sending regions are seen as not affected by severe drought. Therefore, when the central region, which is traditionally an area that attracts internal migrants from other regions, is affected by negative weather events, for households in this region, moving abroad is the most feasible approach to labor mobility.

Table 4: Drought Impact on Migration

	Number of Migrants	Number of International Migrants	Number of Internal Migrants
DiD coefficient (2022 year * Household lives in a location affected by drought)	0.0252**	0.0567***	–0.0316**
	(0.0123)	(0.0156)	(0.0127)
Household head characteristics			
Gender of household head (=1 if female)	0.308***	0.240***	0.0677***
	(0.0440)	(0.0439)	(0.0242)
Age	–0.00360***	–0.00328***	–0.000320
	(0.00109)	(0.00105)	(0.000655)
Marital status (=1 if married)	0.127***	0.0748**	0.0521**
	(0.0349)	(0.0328)	(0.0231)
Education (reference category – primary and below)			
Secondary education	0.00371	0.0275	–0.0238
	(0.0427)	(0.0489)	(0.0291)
Vocational education	0.0879	0.0933	–0.00537
	(0.0614)	(0.0625)	(0.0332)
Tertiary education	0.0493	0.0640	–0.0147
	(0.0823)	(0.0727)	(0.0462)
Household characteristics			
Household size (number of people)	0.113***	0.0793***	0.0333***
	(0.0122)	(0.0109)	(0.00666)
Number of children aged 0–5 years in HH	–0.0438***	–0.0283***	–0.0155**
	(0.0101)	(0.00933)	(0.00716)
Urban (=1 if HH lives in urban areas)	0.179**	0.164**	0.0149
	(0.0818)	(0.0827)	(0.0728)
Land (=1 if HH has agricultural land)	–0.0223	–0.0392	0.0169
	(0.0194)	(0.0250)	(0.0208)
Number of females in HH	–0.0542***	–0.0373***	–0.0168
	(0.0137)	(0.0143)	(0.0102)
Income group quartiles (reference category – first quartile)			
Second quartile	0.0678***	0.0560***	0.0118*
	(0.0109)	(0.0105)	(0.00601)
Third quartile	0.140***	0.111***	0.0296***
	(0.0200)	(0.0198)	(0.00982)
Fourth quartile	0.257***	0.187***	0.0694***
	(0.0328)	(0.0296)	(0.0157)
Constant	–0.392***	–0.255**	–0.137
	(0.128)	(0.113)	(0.0880)
Household FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Number of observations	16,960	16,960	16,960
R-Square	0.0840	0.0553	0.0290

Standard errors clustered at the community level.

* p < 0.1, ** p < 0.05, *** p < 0.01.

Source: Authors' calculations based on KIHS data.

Table 5: Drought Impact on Migration: Urban Sample

	Number of Migrants	Number of International Migrants	Number of Internal Migrants
DiD coefficient (2022 year * Household lives in a location affected by drought)	0.0170 (0.0136)	0.0500*** (0.0176)	–0.0329** (0.0147)
Household head characteristics			
Gender of household head (=1 if female)	0.349*** (0.0686)	0.269*** (0.0687)	0.0800*** (0.0278)
Age	–0.00348** (0.00171)	–0.00228 (0.00152)	–0.00120 (0.000719)
Marital status (=1 if married)	0.0922* (0.0517)	0.0792* (0.0460)	0.0130 (0.0245)
Education (reference category – primary and below)			
Secondary education	0.00606 (0.0628)	0.0399 (0.0614)	–0.0338* (0.0173)
Vocational education	0.155 (0.0925)	0.134 (0.0846)	0.0210 (0.0276)
Tertiary education	0.0815 (0.134)	0.0788 (0.106)	0.00275 (0.0425)
Household characteristics			
Household size (number of people)	0.112*** (0.0168)	0.0677*** (0.0135)	0.0447*** (0.00778)
Number of children aged 0–5 years in HH	–0.0441*** (0.0142)	–0.0220* (0.0115)	–0.0221** (0.00890)
Land (=1 if HH has agricultural land)	–0.0894** (0.0354)	–0.0595 (0.0751)	–0.0299 (0.0474)
Number of females in HH	–0.0564*** (0.0175)	–0.0213 (0.0199)	–0.0351*** (0.0114)
Income group quartiles (reference category – first quartile)			
Second quartile	0.0286** (0.0109)	0.0258* (0.0129)	0.00279 (0.00867)
Third quartile	0.0809*** (0.0244)	0.0637** (0.0266)	0.0171 (0.0125)
Fourth quartile	0.160*** (0.0410)	0.117*** (0.0396)	0.0427* (0.0213)
Constant	–0.301* (0.161)	–0.245* (0.133)	–0.0564 (0.0734)
Household FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Number of observations	9,426	9,426	9,426
R-Square	0.0846	0.0532	0.0271

Standard errors clustered at the community level.

* p < 0.1, ** p < 0.05, *** p < 0.01.

Source: Authors' calculations based on KIHS data.

Table 6: Drought Impact on Migration: Rural Sample

	Number of Migrants	Number of International Migrants	Number of Internal Migrants
DiD coefficient (2022 year * Household lives in a location affected by drought)	0.0407**	0.0676**	–0.0269
	(0.0205)	(0.0264)	(0.0210)
Household head characteristics			
Gender of household head (=1 if female)	0.253***	0.194***	0.0590
	(0.0432)	(0.0499)	(0.0429)
Age	–0.00377***	–0.00444***	0.000669
	(0.00139)	(0.00140)	(0.00111)
Marital status (=1 if married)	0.156***	0.0570	0.0989**
	(0.0437)	(0.0485)	(0.0436)
Education (reference category – primary and below)			
Secondary education	–0.00436	0.00484	–0.00919
	(0.0525)	(0.0738)	(0.0585)
Vocational education	–0.0227	0.00628	–0.0289
	(0.0708)	(0.0856)	(0.0674)
Tertiary education	0.0177	0.0429	–0.0252
	(0.0936)	(0.0975)	(0.0866)
Household characteristics			
Household size (number of people)	0.113***	0.0915***	0.0218**
	(0.0183)	(0.0168)	(0.0109)
Number of children aged 0–5 years in HH	–0.0440***	–0.0342**	–0.00975
	(0.0143)	(0.0144)	(0.0102)
Land (=1 if HH has agricultural land)	0.00270	–0.0275	0.0302*
	(0.0239)	(0.0251)	(0.0174)
Number of females in HH	–0.0538**	–0.0534***	–0.000458
	(0.0213)	(0.0205)	(0.0157)
Income group quartiles (reference category – first quartile)			
Second quartile	0.0968***	0.0808***	0.0160*
	(0.0159)	(0.0154)	(0.00888)
Third quartile	0.191***	0.154***	0.0367**
	(0.0253)	(0.0247)	(0.0168)
Fourth quartile	0.360***	0.261***	0.0992***
	(0.0353)	(0.0364)	(0.0227)
Constant	–0.257*	–0.0361	–0.221*
	(0.143)	(0.151)	(0.124)
Household FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Number of observations	7,534	7,534	7,534
R-Square	0.0957	0.0625	0.0352

Standard errors clustered at the community level.

* p < 0.1, ** p < 0.05, *** p < 0.01.

Source: Authors' calculations based on KIHS data.

Other explanatory variables showed some interesting results. The gender of the household head is important for migration. Thus, married and female-headed households are more likely to send household members as migrants, though households with an older head show a negative, but statistically not significant, impact. Moreover, in line with expectations, household size is positively associated with both migration types. A larger labor force within households presents a better opportunity to benefit from sending labor migrants. A higher number of children reduces the possibility of internal migration, possibly due to caregiving needs.

Interestingly, ownership of an agricultural land plot did not show a statistically significant effect on migration. As mentioned above, the drought season analyzed in this study affected mostly urban areas and a neutral effect of land can be considered an expected outcome. However, this finding indicates that the effect of drought on labor migration may not be linked directly to land owners, but rather, potential economy-wide conditions associated with other poor economic performance due to climate shocks are confirmed as important for migration.

Income level plays an important role in the migration potential of households as mobility requires financial resources. Income quartile dummies indicate that, compared to the lowest-income group, almost all other households have a statistically significant effect on both migration patterns. This finding reflects a potential vulnerability issue among households under climate shocks, as financial resources may not be as readily available for the lowest-income group households.

Results by urban and rural subsamples confirm findings from the total sample estimations, although estimations from the rural sample indicate a statistically significant effect only for international migration. However, one might expect that rural households affected by drought would resort to internal labor mobility first, and then international. But this finding suggests that a rural population affected by climate shock looks for options to migrate abroad, rather than within the country. This effect can be ascribed to the long-term migration trends in the Kyrgyz Republic and setting up of migration networks abroad, which facilitates labor mobility by reducing the cost of migration.

Robustness Analysis

For the robustness of findings, several alternative model specifications are estimated. First, along with the number of migrants, the outcome variable is specified as a dummy variable if households have labor migrants abroad or within the country (Model 1). For this, a logit model with fixed effects is estimated. One could argue that one of the challenges for migration analysis in the studied period is that mobility restrictions during the COVID-19 pandemic may have had an impact on lower migration trends, and eventually when restriction policies were lifted, the mobility number might have risen. Therefore, we estimated an alternative model excluding the 2020 and 2021 waves, thus comparing the 2022 and 2019 waves only (Model 2). The geographic distribution of the drought shock in this study was identified in two regions (Chui and Talas), including the capital city, Bishkek. As mentioned above, the capital city as the traditional dominant destination for internal migration may have an influence on estimation results. Because of this, another model estimated excluded Bishkek city households from the sample (Model 3).

One of the challenges in the DiD estimation technique is the violation of parallel trends of outcome variables between the treatment and control groups. In order to test whether locations exposed to different levels of drought have parallel trends during the pretreatment period, the placebo specification of the model was applied to the 2019 and 2020 waves only (Model 4) (Gröger and Zylberberg 2016; Roth et al. 2023).

Estimation results are presented in Table 7 and include DiD coefficients only. As can be seen, almost all results across models with alternative outcome variable measurement and samples confirm the main findings that drought increases international migration, while demonstrating a negative impact on domestic migration. Placebo tests show that the interaction term does not have a statistically significant impact on migration, suggesting that the difference in migration patterns between the treated and control groups in the studied period can be explained by the drought in 2021.

Table 7: Alternative Model Specification Results

	Model 1			Model 2		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
Total migration	1.072***	1.205***	0.859*	0.0408***	0.0306*	0.0589**
	(0.2540)	(0.4550)	(0.4400)	(0.0153)	(0.0175)	(0.0242)
International migration	1.086***	0.815*	1.114***	0.0849***	0.0757***	0.0957***
	(0.3010)	(0.4780)	(0.3670)	(0.0180)	(0.0227)	(0.0272)
Internal migration	–0.12	–0.0823	–0.181	–0.0442***	–0.0450**	–0.0368*
	(0.2600)	(0.4750)	(0.3550)	(0.0145)	(0.0185)	(0.0207)
	Model 3			**Model 4**		
	Total	**Urban**	**Rural**	**Total**	**Urban**	**Rural**
Total migration	0.0350**	0.0271	0.0407**	0.0149	0.00823	0.0219
	(0.0146)	(0.0174)	(0.0205)	(0.0103)	(0.0128)	(0.0165)
International migration	0.0636***	0.0609**	0.0676**	0.0112	0.0068	0.0169
	(0.0177)	(0.0226)	(0.0264)	(0.0096)	(0.0120)	(0.0149)
Internal migration	–0.0286**	–0.0338**	–0.0269	0.00368	0.00143	0.005
	(0.0134)	(0.0140)	(0.0210)	(0.0045)	(0.0033)	(0.0099)

Note: Estimation results include covariates used in the baseline model. Full estimation results are available upon request.

Standard errors clustered at the community level.

* p < 0.1, ** p < 0.05, *** p < 0.01.

Source: Authors' calculations based on KIHS data.

5. CONCLUSIONS AND POLICY RECOMMENDATIONS

This study examined the impact of drought on migration patterns using the nationally representative household survey panel dataset for the Kyrgyz Republic over the period 2019–2022. The empirical approach was based on the difference-in-differences technique with fixed effects. Alternative specifications of the baseline model confirmed the robustness of the estimation results.

Our findings suggest that households living in the location affected by drought in 2021 had more migrant household members in the subsequent year. Overall, this finding is in line with that in the relevant literature that drought induces migration. However, along with this, results showed a negative impact on internal migration, which is contradictory to other studies. However, this effect may explain the overall lower possibility of earning in other regions within a country, because the drought season studied in the

paper is focused in the central and northern region of the country, whereas most migration-sending regions are considered not to have experienced this effect. Therefore, when the central region, which is traditionally an area that attracts internal migrants from other regions, is affected by negative weather events, for households in this region, moving abroad is the most feasible approach to labor mobility. Moreover, even in the rural sample, drought had a significant impact on international migration only, though one would expect internal migration to be prioritized as the first migration option for rural households.

Overall, this study showed that even in the short term, immediately after a climate shock international migration is the primary option for sustaining the livelihood of households, both for urban and rural populations. This effect can be ascribed to the preexisting migration networks and long-term migration trends in the Kyrgyz Republic, where the main destination for migration is the Russian Federation. Therefore, migration to the Russian Federation might be less costly and more feasible given the existing network. However, even in this context, our study highlighted the potential inequality of households as low-income households had less potential for migration.

These findings have several policy implications. First, climate shocks create challenging issues for households even in urban areas and cause a higher migration propensity. From this standpoint, it is important to bear in mind that agricultural drought issues do not only have risk implications for rural landholders, but rather, their economy-wide effects and potential risks related to rising living costs are significant for predicting migration flows. Second, the use of migration in coping with the shock in the short term informs about the availability of such an option and migration networks abroad. However, restrictions in the traditional destination countries may limit the potential availability of migration for households affected by drought. Moreover, the vulnerability of low-income households and the more frequent occurrence of drought recently in the Central Asian region necessitate the development of policy tools not only to support agricultural support mechanisms but also to deal with the economywide effects of climate shocks, including drought.

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APPENDIX

Table A.1: Definition of Variables

Variable Name	
Dependent variables	
Number of migrants	Total number of HH members temporarily absent due to labor migration, either within the Kyrgyz Republic or abroad.
Number of international migrants	Number of HH members temporarily abroad for labor purposes.
Number of internal migrants	Number of HH members temporarily absent within the Kyrgyz Republic for labor purposes.
HH has migrants	Dummy variable: 1 if HH has at least one member temporarily absent for labor migration (internal or international), 0 otherwise.
HH has international migrants	Dummy variable: 1 if HH has at least one member temporarily abroad for labor purposes, 0 otherwise.
HH has internal migrants	Dummy variable: 1 if HH has at least one member temporarily absent within the Kyrgyz Republic for labor purposes, 0 otherwise.
Explanatory variables	
Household characteristics	
Gender of HH head	Dummy variable: 1 if HH head is female, 0 if male.
Marital status	Dummy variable: 1 if HH head is married (registered or unregistered), 0 otherwise.
Age	Age of HH head, measured in completed years at the time of the survey.
Education	
Primary and below	Dummy variable: 1 if HH head has incomplete primary education or is illiterate, 0 otherwise.
Secondary education	Dummy variable: 1 if HH head has completed or not completed general secondary education, 0 otherwise.
Vocational education	Dummy variable: 1 if HH head has incomplete higher or secondary vocational education, 0 otherwise.
Tertiary education	Dummy variable: 1 if HH head has completed a higher professional degree, 0 otherwise.
Household head characteristics	
HH size	Total number of members in the HH.
Number of children aged 0–5 years	Number of children aged 0 to 5 years living in the HH.
Number of females in HH	Total number of female members in the HH.
Urban	Dummy variable: 1 if the HH resides in an urban area, 0 if rural.
Land	Dummy variable: 1 if HH owns land, 0 otherwise.
Income group quartiles	HHs classified into four income groups (quartiles) based on per capita total income, adjusted by sampling weights.