Climate Change and Migration Intentions: The Role of short-term climate shocks and long-term climate trends

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Summary

Between 2015 and 2020, emigration from Western Balkan countries increased by nearly half a million people, driven by economic hardship, political instability, and conflict. Recently, environmental factors, particularly climate change, have emerged as significant migration drivers, especially in rural agricultural areas. Rising temperatures, shifting precipitation patterns, and extreme weather events negatively impact livelihoods. However, individuals' perceptions of climate change vary based on socio-economic and cultural contexts, influencing migration decisions differently than objective climate data.

Despite growing research on climate-induced migration, Southeast Europe remains underexplored, with limited studies utilizing remote sensing data to assess climate shocks' effects. This study addresses gaps in understanding whether cumulative climate shocks and long-term trends impact migration intentions differently than isolated climate events. It also examines discrepancies between subjective climate perceptions and objective climate measures in shaping migration decisions.

Using a probit model, the study analyzes data from the RuWell (Rural Well-being in Transition: Multidimensional Drivers and Effects on (Im)Mobility) project, a 2024 household survey in Albania, Kosovo, Moldova, and Romania. The individual-level data was complemented with current and historical precipitation and temperature data (~10km spatial resolution) from the ERA5-Land product. Based on this data, also SPEI values were calculated along the Hargreaves method. Additionally, night-time lights were added to approximate economic development in the respective regions. This data was obtained from the Annual Global VIIRS Nighttime Lights dataset offering a spatial resolution of 465 meters per pixel.

Findings indicate that cumulative climate stress over five years has a stronger association with migration intentions than recent extreme events, while perceived climate trends show no significant correlation. These insights are crucial for designing adaptive policies that mitigate migration pressures and enhance rural resilience.

1 Problem background

Between 2015 and 2020, the emigration rate from Western Balkan Countries increased by nearly half a million or 10%. By 2020, approximately one-fifth of these countries' combined population was residing abroad, mostly in other OECD countries (OECD, 2025). Migration from the Balkans is driven by economic hardship, political instability, and conflict (Daoust & Selby, 2024). While socio-economic factors remain paramount, recent research has highlighted the increasing importance of environmental factors for explaining migration patterns (Parsons & Nielsen, 2020). In particular, climate change is increasingly recognized as a significant cause of rural migration, also on a political level (FAO, 2017). Rising temperatures, changing precipitation patterns, and the increasing frequency of extreme weather events such as floods and droughts can impact livelihoods, especially in rural and agricultural communities (Mertz et al., 2009).

In recent years, increasing attention has also been paid to the role of subjective climate perceptions in shaping migration intentions. Individuals' responses to objective climate change can differ based on their interpretation and perception within their specific socio-economic and cultural contexts (De Longueville et al., 2019; Van Praag et al., 2021).

Despite a growing body of literature on climate-induced migration, Southeast Europe remains largely unexplored in this context (UNESCO, 2023). Another significant gap in the literature is the limited use of remote sensing data to compare the effects of climate shocks on migration (Khavarian-Garmsir et al., 2024). Remote-sensing information offers insights into long-term influences on socioeconomic drivers that may shape migration patterns over time (Daoust & Selby, 2024). Such data can reveal

underlying long-onset climate risks (drought, desertification, and temperature increase) often overlooked due to recall and perception biases in individual risk assessments (Bazerman, 2006; Luo & Zhao, 2021). Both long-onset and fast-onset climate events (hurricanes, torrential rains, floods, landslides) affect agricultural productivity and rural livelihoods. At the same time, both long-onset and short-onset climate shocks can have cumulative effects that exceed single-shock events, depending on the individual's perception and 'ecological memory' (Hughes et al., 2019).

2 Research questions

Against this background, we answer the following research questions:

(1) Do isolated climate shocks or cumulative shocks and climate trends play a different role in explaining the intention to migrate from rural areas?
(2) In how far does subjective perception of cumulative climate shocks and climate trends differ from objective measures with respect to their migration impacts?

With our research, we close an important research gap in the field. While there is research on the difference between fast-onset climate events (hurricanes, torrential rains, floods, landslides) and long-onset (drought, desertification, and temperature increase) with respect to migration (Cattaneo et al., 2019), there has been only few research on the difference between sudden short-term shocks and long-term trends/ cumulative shocks in their effect on migration (Helbling & Meierrieks, 2021; Locke, 2009). The produced insights are essential for designing adaptive policies that account for the varying vulnerabilities and responses of rural populations, particularly in regions where agriculture is central to socio-economic stability.

3 Data and methods

Given that the migration intention is a binary outcome, we employ a probit model to estimate the likelihood of migration intention *mi* of individual *i*. We use the following regression equation:

$$P(mi_i = 1) = \Phi(\alpha + \beta' \mathbf{climate}_i + \gamma' \mathbf{x_i}),$$

where *mi* is a binary variable, which takes the value of 0 for no migration intention and 1 for migration intention. $P(mi_i = 1)$ indicates the probability that individual *i* has migration intention. The vector **climate** contains our variables of interest, including the five-year means trend with respect to SPEI and average summer temperature, as well as SPEI and summer temperature means for 2025. Furthermore, we test the effect of perceived risk for agricultural drought and heat waves within the past years.

The vector **x** represents the socio-demographic and socio-economic characteristics of an individual. We control for a set of standard characteristics, such as the respondent's age in years (also squared), gender, education, financial status, health status, existence of migration experience within the household, regional nighttime lights, and if the respondent lives in a farm household. The parameter Φ represents the cumulative distribution function (CDF) of the standard normal distribution, which transforms the linear prediction into a probability between 0 and 1, and β and γ are the parameters to be estimated.

For our analysis, we use data collected within the framework of the RuWell project.[1] The RuWell data is a cross-sectional household survey conducted between June and September 2024 based on a proportional random sample in rural areas in the Republic of Albania, the Republic of Kosovo, the Republic of Moldova, and Romania, to reflect the considerable regional and demographic diversity in each country. This strategy provided data that allows statistical inferences to be made for the rural populations in each of the sampled countries. The RuWell net sample comprised around 2,405

1 "Rural well-being in transition: multidimensional drivers and effects on (im)mobility" (RuWell) is a Leibniz Best Minds project funded by the Leibniz Association.

observations with individuals older than 18. The individual-level data was complemented with current and historical precipitation and temperature data (~10km spatial resolution) from the ERA5-Land product (Muñoz Sabater, 2019). Based on this data, also SPEI values were calculated along the Hargreaves method (Hargreaves & Samani, 1985).
Additionally, night-time lights were added to approximate economic development in the respective regions. This data was obtained from the Annual Global VIIRS Nighttime Lights dataset (Elvidge, 2021) offering a spatial resolution of 465 meters per pixel.

4 Preliminary results

Our results first of all confirm a stronger impact of climate stress building over a five-year horizon (column 3) as compared to more recent, isolated climate extremes (column 2). Furthermore, subjectively perceived climate trends (column 1) had no statistically significant association with migration, implying that climate shocks rather have an indirect, systemic effect on migration over people's livelihoods. These results point out the need to further research into the influence of climate change on socioeconomic drivers of migration in the region, helping to anticipate migration movements as well as mitigating their roots in a timely fashion for sustainable rural development.

Table 1: Probit regression output

Variable	perception	current	trends
Perceived heat waves	0.023		
Perceived agricultural drought	0.017		
student			
Yes	0.072	0.052	0.057
Gender			
Female	-0.018	-0.038	-0.019
age	-0.009**	-0.010*	-0.010***
age2	0.000	0.000	0.000
family ever migrated y/n			
No	-0.087***	-0.108***	-0.073***
sufficiency: income			
insufficient problems	-0.057*	-0.106**	-0.029
just sufficient no problems	-0.132***	-0.137***	-0.048
sufficient can save	-0.168***	-0.145**	-0.081*
nighttime light mean 2024	-0.024	-0.035	0.031
Farm household (0/1)	-0.068***	-0.093**	-0.065***
overall health	-0.000***	-0.000***	-0.000***
SPEI2024_drier		-0.045	
Degrees above sample summer average		-0.015	
SPEInegative_absolute			-0.001***
Average summer temperatures, % chan			-1.444***

Legend: * p<0.05; ** p<0.01; *** p<0.001

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