



Impact of climate change on migration trends in rural Central Asia

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ABSTRACT

Central Asia is considered a region highly vulnerable to climate change impact and susceptible to climate-induced migration. Rural populations throughout the region are particularly at risk of experiencing adverse effects of climate variability and (im) mobility due to increased exposure to environmental hazards and distress that can severely affect agricultural productivity. This paper explores how climate change impacts migration trends in rural areas of Central Asia with an aim to contribute to the research on climate mobility in the region focusing on most vulnerable inhabitants. By examining the ongoing region's environmental degradation with increased aridity and retreating glaciers that affect local agriculture, water and food security, this paper suggests possible outcomes of such effects on rural mobility trends across five Central Asian countries.

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climate change, climate-induced migration, rural (im)mobility, Central Asia, rural migration

1. Introduction

Although the amount and scope of studies examining climate change impact on Central Asian societies are limited (Vakulchuk et al., 2022), this region has become increasingly important for researching the link between environmental degradation and human (im)mobility (Blondin, 2018; 2022). In general, studies on climate change impact for Central Asia are still limited and inadequate (Hijioka et al., 2014) and require more comprehensive analysis on how the variability in global climate affects different sectors across the region. The percentage of scholarly articles that are focused on climate change in Central Asia is significantly low compared to other topics concerning the region in the last decade. In a timeframe between 1991 and 2021 and a sample of a total 13,488 journal articles in eight key journals for Central Asia research, researchers detected only 33 articles (0.24%) discussing climate change or a related topic. (Vakulchuk et al., 2022). Such scarce academic scope and interest in the topic of climate change in Central Asia leads to unjustified neglect of a very important realm of research that otherwise could reveal multifaceted analysis of intertwined climate factors that affect different areas of study, ranging from socio-economic, political, security and migration studies. Moreover, the significant gap in research on the human dimensions of climate change, including impacts on humans and climate adaptation further prevents a deeper comprehension of climate change - human migration nexus in the Central Asia region.

Central Asia, a landlocked region, consisting of five countries - Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan, and Uzbekistan- is considered a climate “hot spot” prone to negative consequences of global warming that range from natural disasters, food scarcity, landslides, floods to climate migration and even immobility of people trapped in hazardous areas that are usually located in already impoverished, rural areas. In most of the region semi-arid to arid climate is present while there are also parts with a mountainous climate, which makes Central Asia susceptible to extreme weather events such as droughts, melting glaciers, and other natural disasters. Insufficient research on the impact of climate change in the Central Asia region is surprising especially taking into consideration the conclusions that this region is highly vulnerable to the changing nature of global climate and heavily exposed to various environmental hazards (Lukyanets et al., 2020). Due to observed increase in average annual temperature across the region (Clement et al., 2021), combined with the climate characteristics that vary from arid and semi-arid to mountainous climate, many natural disasters, including droughts, glacier melting and floods (Hu and Han, 2022), might become inevitable, more frequent and devastating.

In Central Asia, more than a half the population resides in rural regions whereas agriculture represents an important part of rural livelihoods. However, due to rather

gloomy predictions that the Central Asia region will be severely affected by climate change (Reyer et al., 2015), these rural areas and agricultural productivity might be under serious pressure and threat (Liu et al., 2020). Consequently, such tendencies can lead to increased mobility of people from rural to urban areas and abroad, but at the same time impoverish further already poor rural households and restrict their movements to more friendly environments. Mobility and migration are very common in Central Asian societies, including internal and migration across the borders. Labor migration is also notable within the rural population and many find Kazakhstan and Russia as a major job opportunity hub for acquiring enough means to send home their earnings (Clement et al., 2021). Climate change can intensify migratory flows within and across countries in Central Asia by provoking an environmental crisis and forcing local populations to migrate.

According to the World Bank's report, the number of climate migrants could reach 216.1 million by 2050 globally. Concerning the Central Asia subregion, the report suggests that in every of three projected scenarios, the region will experience an increase in climate migration to a varying degree. Thus, in the pessimistic scenario, the region is expected to record 2.4 million (3.4 percent of the total population) climate migrants, while in the more inclusive development scenario, that number would be 1.9 million (2.5 percent of the total population), and in the more climate-friendly scenario, 1.7 million (2.4 percent of the total population) (Clement et al., 2021). It is expected that climate change will increase migration, usually within the countries and rural to urban migration. For that reason, it is important to assess all possible aspects of the climate variability-migration nexus in order to draw conclusions on more comprehensive predictions and solutions.

The objective of this paper is to examine how climate warming affects concurrently human mobility and immobility in rural areas of the Central Asia region and thus contribute to scarce research on the nature of the relationship between rising temperatures and human migration as well as inability to move in the case of a particularly vulnerable subregion.

2. Central Asia as a Climate Change “Hotspot”

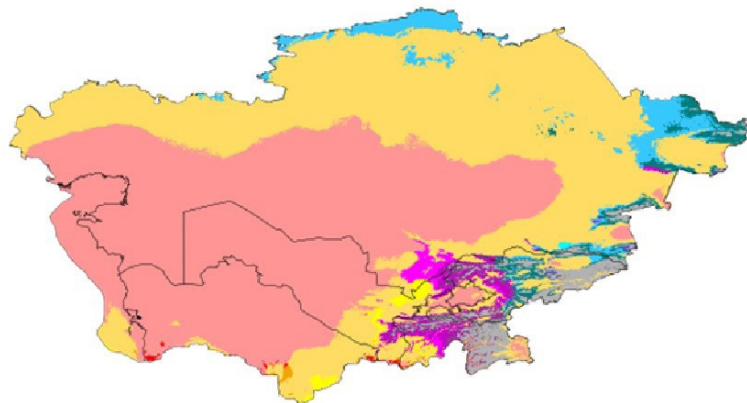
Central Asia is among hotspot regions that are highly susceptible to the adverse effects of rising temperatures (Haag et al., 2019). Due to the region's vast dry and semi dry areas with some mountainous parts, “the natural ecosystems of Central Asia are very sensitive and vulnerable to climate variability” (Zhou et al., 2015). It is estimated that out of 400 million hectares in Central Asia, two-thirds represent drylands where even the slightest climate pressures can cause significant negative consequences to the environment and local populations (Quillerou et al.,

2016). According to the 2022 IPCC report, Central Asia has already experienced large increases in temperature extremes while decreased precipitation and increased evapotranspiration observed in the region have contributed to drought conditions (Shaw et al., 2022). The IPCC report (Shaw et al., 2022) also mentions that the glaciers in Central Asia have been decreasing and additionally worsening the water scarcity and supply issues.

Studies suggest that the Central Asia region will experience raising temperatures significantly above the global average due to its arid and semi-arid climate that creates highly drought-prone conditions in vast areas of the region (Liu et al., 2020; Reyer et al., 2017). Although it is projected that the rise of annual mean temperature will vary across the region, the expected warming will be significant in each Central Asian country. According to the Representative Concentration Pathways (RCP) 8.5 group, annual temperature between 2040 and 2059 will increase by 2.75°C in Kazakhstan, 2.55°C in Kyrgyzstan, 2.65°C in Tajikistan, 2.27°C in Turkmenistan, and 2.37°C in Uzbekistan (Clement et al., 2021 in ICRC, 2021). Regional warming might put an additional stress on agricultural communities and further impoverish already affected rural areas in the region.

Climate map of the region shows a diversity of climate characteristics ranging from cold desert to temperate continental climate (Figure 1). Climate across Central Asia includes moderate to cool winters, with mean temperatures ranging from -3°C to 20°C and warm and hot summers with average temperatures differing from 20°C to 40°C (ICRC, 2021). Present variety in climate throughout the region makes regional trends at the level of districts and valleys to differ greatly (Haag et al., 2019). However, meteorological data collected since the end of the 19th century reveal a constant raising of annual and winter temperatures in this region (Lioubimtseva and Henebry, 2009). Other studies suggest that this trend will continue in the 21st century at a rate which is above the global mean increase (Mannig et al., 2013; Hu et al., 2014), which can lead to a series of environmental risks and adverse consequences in agricultural areas.

Köppen-Geiger climate classification map for Central Asia (1980-2016)



■ Arid, Desert, hot (BWh) ■ Arid, desert, cold (BWk) ■ Arid, steppe, hot (BSh) ■ Arid, steppe, cold (BSk) ■ Temperature, dry summer, hot summer (Csa) ■ Cold, dry summer, hot summer (Dsa) ■ Cold, dry summer, warm summer (Dsb) ■ Cold, dry summer, cold summer (Dsc) ■ Cold, dry winter, hot summer (Dwa) ■ Cold, dry winter, warm summer (Dwb) ■ Cold, dry winter, cold summer (Dwc) ■ Cold, no dry season, hot summer (Dfa) ■ Cold, no dry season, warm summer (Dfb) ■ Cold, no dry season, cold summer (Dfc) ■ Polar, tundra (ET) ■ Polar, frost (EF)

Figure 1. Köppen - Geiger climate classification map for Central Asia (1980-2016) (Beck et al., 2018)

It is predicted that the warming trend will consequently result in a higher evaporation in the basin oases causing growing aridity and a notable retreat of glaciers in the mountainous areas resulting in floods (Yu et al., 2019). There are already negative signs of increased temperatures that cause growing aridity in the region. In 2021, Central Asia experienced an extreme agricultural drought that damaged many crops and caused a deadly effect on livestock. Jiang and Zhou (2023) argue that this episode of serious drought is not an isolated or independent event but a consequence of a dryer trend over the past half century in the region. Melting glaciers, as one of the outcomes of increasing mean temperature, lead to changing water cycles across Central Asian countries. Important mountain ranges of the region such as the Pamir, Altai and Tian Shan Ranges have already recorded alarming decreases of glaciers (Glantz, 2005; Hijioka et al., 2014). Central Asia's glaciers are under significant pressure because they are melting faster than the global average. According to Rounce and others (2023), the region's glaciers could shrink considerably and experience a loss of 75 percent of their 2015 mass by the year 2100. Predictions suggest that Central Asia will become drier and hotter that will cause changing climate configuration of the region and bring serious environmental challenges to the

most affected areas. Beck et al. (2018) predict that in the period from 2071 to 2100 arid hot areas will significantly increase and affect southern countries of Central Asia, especially Turkmenistan and Uzbekistan, while polar tundra and polar frost areas in the south east will almost disappear suggesting dramatic glacier shrinkages and consequently issues with water supplies in the affected regions (Figure 2).

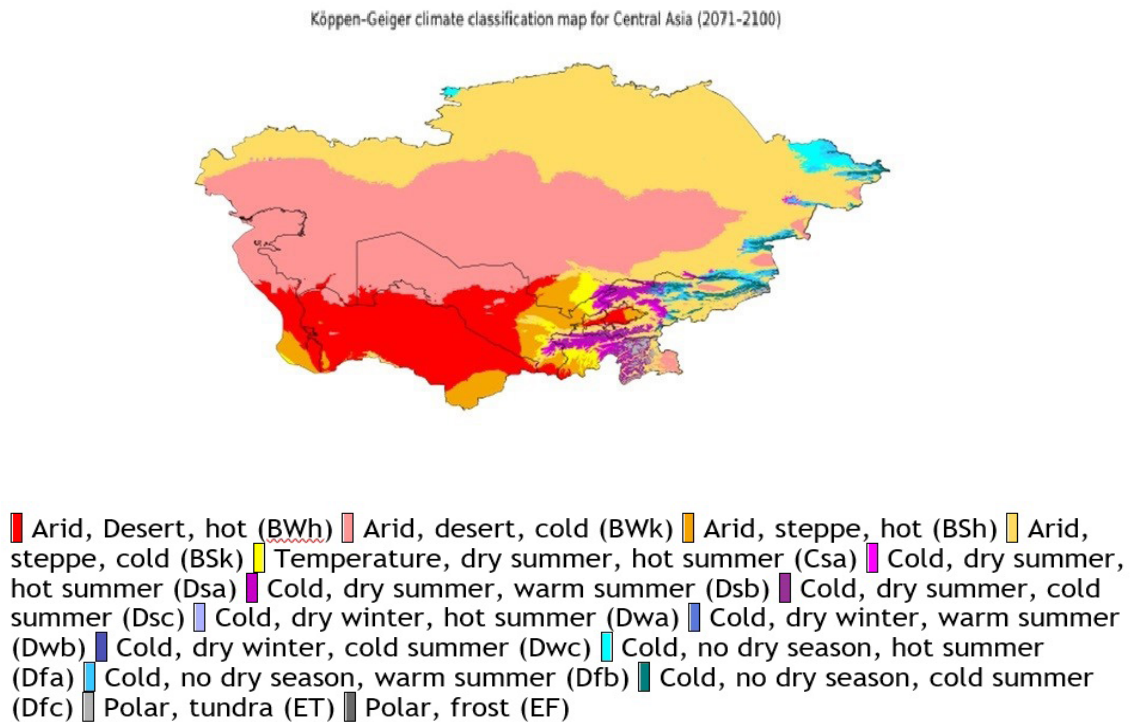


Figure 2. Köppen - Geiger climate classification map for Central Asia (2071-2100) (Beck et al., 2018)

Retreating of glaciers might be also responsible for triggering serious floods and landslides in the region, affecting road infrastructure, livelihood of densely populated areas and migration from affected parts. Some studies suggest that a considerable number of internal migrants migrate for environmental reasons, including mudslides and landslides, floods, hazardous waste and desertification (Jaeger et al., 2009). For instance, the heavily populated and fertile Fergana Valley region is in particular risk of experiencing grave natural disasters such as floods and mudslides, since glaciers surround the valley to the south, the east and the north, which can intensify out-migration from the region (Reyer et al., 2015). Although the melting of glaciers in the short run can bring greater water availability for some communities, in the long run and particularly in the lowlands, with expected increasing aridity, there will be more frequent and more damaging floods and mudflows, as well as increase in water pollution (Kull et al., 2022).

Water availability plays a significantly important role in agricultural areas. Land productivity depends on irrigation and any disturbance including climate change can decrease agricultural output and force affected populations to migrate to more secure areas. The arid and semi-arid parts of Central Asia heavily depend on water supply. However, in the past three decades, this region has suffered from uneven distribution, over consumption, and pollution of water resources causing serious water supply issues and hindering regional sustainability and growth (Yu et al., 2019). With accelerated effects of climate change, water management will probably encounter more issues due to the need for intensified cross-border cooperation and rational usage of remaining water resources.

Most of the major Central Asian rivers and lakes represent trans-border water bodies. Currently, the mountainous regions in Tajikistan and Kyrgyzstan, as places where many regional rivers originate, have enough water for domestic use, however, countries such as Uzbekistan, Turkmenistan and Kazakhstan suffer from water scarcity (Yu et al., 2019) Due to uneven distribution of water resources in the region, trans-border water management cooperation is crucial. However, political rivalries and conflicting economic interests among five Central Asia countries continue to maintain a harmful practice of regional water mismanagement (Howard and Howard, 2016). Dramatic shrinkage of the Aral Sea over the years is an example of how irresponsible irrigation practices and poor water management between countries in the region can harm the local environment (Yu et al., 2019). It is less likely that the countries of Central Asia will start putting more effort in trans-national water cooperation, especially considering their history of water mismanagement. Prolonged water crises can lead to increased out-migration because of its deteriorating effects on local livelihoods, development and security.

Researchers predict that the population living in hotspots that will be particularly affected by climate change will increase for Tajikistan, 55.4 % in Uzbekistan, 41.3 % for Turkmenistan and 31.3 % for the Kyrgyz Republic (Reyer et al., 2017). Rising temperature combined with projected increase of population exposed to climate change will probably increase incidents of drought, prolonged dry periods and poverty rates, which consequently might reduce agricultural productivity and put many rural households in a very vulnerable position.

3. Methodology and Data

This research relies on a non-systematic literature review incorporating assessment of available, although scarce, academic and research studies and reports discussing the topic of climate mobility in Central Asia. A great source of information and data, especially in terms of migration and remittances-related statistics, poverty

data and agricultural productivity information, has been collected from World Bank development indicators databases (World Development Indicators, 2019, 2021). Reports of international and development organizations and agencies, such as IPCC (Hijioka et al., 2014, Shaw et al., 2022), World Bank (Clement et al., 2021), and Asian Development Bank (Chapman et al., 2021), also contributed as a valuable source of information on current climate change impact and migratory trends across the region. Process of collecting information mostly relied on excessive online search concerning climate change, environmental degradation, rural migration and climate justice in Central Asia and beyond. Most commonly used key search words and phrases were “climate change”, “rural migration”, “climate -induced migration”, “(im)mobility”, “Central Asia”, etc.

Several extensive studies on climate change impact and environmentally-induced migration in Central Asia (Reyer et al., 2017; Blondin, 2018, 2021) have been a great source of information that were available online and in English language at the time of writing this research paper. Such studies also helped in discovering more valuable articles and research through following their referencing work ranging from general studies on climate change impact to case studies focusing on the climate risk and tendencies assessments reports of a single or group of countries. However, even after extensive research and search for articles and reports lack of scholarly attention and research on climate-induced mobility in Central Asia has remained evident. As Hermans (2024) concludes that even though in the past two decades, research on climate change and migration has been widely conducted, but limited to Africa, South Asia, and the United States, Central Asia continues to be “a major blind spot in climate-migration studies”, thus, leaving “critical knowledge gaps”. Although some research limitations related to language and only desk-based research might have affected the paper`s overall comprehensives, still the issue of knowledge gap in the field of climate change impact on migration in Central Asia remains problematic.

4. Lack of Research on Climate-Induced Migration in Central Asia: Overview and Reasons

The Central Asian countries have already experienced serious environmental-induced migration issues. In Kyrgyzstan, between 1992 and 1997, at least 17,000 people had to move from their place of residence because of landslides, mudflows, floods and earthquakes (Sulaimanova, 2004). In 1996, about 100,000 people were forced to resettle due to a severe environmental crisis in the Aral Sea region alone (Small et al., 2001 in ADB, 2012). Furthermore, during the drought period between 1999 and 2001, that is deemed to be responsible for a regional widespread unemployment, about 273,000 people from Karakalpakstan, an autonomous region in Uzbekistan

(about 20% of the region's total population), migrated to Kazakhstan and to the Russian Federation in search of more prosperous economic and job opportunities (Glantz, 2005 in ADB, 2012).

Central Asia has been traditionally sending region and rural to urban migration has been a common trend for a long time. The region represents a strong source for one of the most steady and large-scale external migration outflows in the world, only in 2021 it accumulated around US\$ 15 billion in remittances (Figure 3). Many Central Asian countries perceive remittances as a necessary financial lifeline and migration as an effective strategy for alleviating countries' poverty. For instance, remittances in 2020 accounted for around a third of GDP in the Kyrgyz Republic and Tajikistan (Ratha and Ju Kim, 2022).

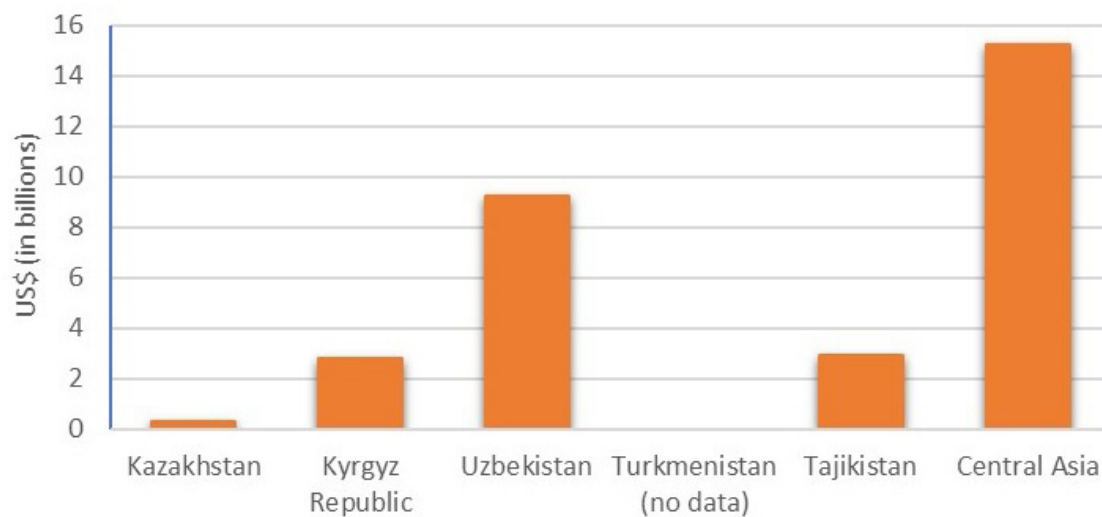


Figure 3. Personal remittances, received (current US\$) in 2021
(World Bank, World Development Indicators, 2021)

It is difficult to assess the number of labor migrants from Central Asia, many work illegally or cross the borders multiple times for the purpose of conducting seasonal jobs or do not report migration within the country. As a result, labor migration from Central Asian countries remains typically undetected in both home countries and in the main destination country - Russia. Moreover, to identify the number of rural migrants is even more challenging due to the lack of data and the aforementioned reasons. There are only estimations that most Central Asian migrant workers are from poorer rural areas who are under greater pressure to obtain necessary means for living due to impoverished economic situation and unstable land productivity in the rural environment (Jung and Newson, 2022).

Both internal and migration across the borders in Central Asia are perceived mostly as economically driven necessity. Poverty, lack of job opportunity, low income and limited access to agricultural land are usually identified as major factors for out-migration, whereas climate change is largely neglected and overlooked. However, all of these factors can be repercussions of climate variability (Blondin, 2018). Environmental change inevitably interacts with a range of economic, social, demographic and even political factors, making assessing its effect on migration flows more arduous.

Moreover, absence of information and knowledge on climate change effects among the local population represents a significant challenge for researchers to conduct surveys and interviews concerning climate-induced mobility in rural Central Asia. Even though in some cases, the local population might be aware of environmental issues in their places of residence, connecting such issues with the decision to migrate remains complex and unclear. The 2016 IOM study on environment, climate change and migration in the Kyrgyz Republic questioned 500 households about the reasons motivating people from their village to migrate. While 27% selected unemployment as a main reason for mobility, some chose environmental reasons such as landslides (12%), drought (11%), floods (9%), land degradation (4%) and climate change (3%) (Chandonnet et al., 2016). Local populations in rural areas often recognize social and economic factors as responsible for migratory dynamics in the area of their residence while perceiving environmental factors as mostly a contributing reason for mobility.

The chronic underinvestment in research and lack of financial support, especially to young scientists and researchers in the Central Asian countries also impose constraints on conducting and developing more comprehensive research on climate change-migration nexus in Central Asia (Suleimenov, 2021). Xenarios et al., (2019) draw attention to the negative effects of the scientific and infrastructural vacuum created after the end of the Soviet-era that contribute to knowledge gaps in climate-glacier-water and hazard interactions especially in the Pamir and Tien Shan mountains areas prone to climate-induced distress.

5. Rural Migration and Climate Change in Central Asian Countries

More than half of the population in Central Asia resides in rural areas (Figure 5). Majority of rural inhabitants work in the agricultural sector and depend on its productivity. With growing risk of droughts and other natural disasters caused by climate change, agriculture is under serious threat of decreased output, food scarcity and poverty directly affecting rural residents in the region. Climate variability can intensify migration within a country, especially rural-urban mobility that plays an important role in overcoming the burden of poverty in rural areas of Central Asia.

World Bank (Clement et al., 2021) reports that climate change mostly affects and intensifies internal movements and that, in the best-case scenario, Central Asia will still have 1.7 million climate migrants by 2050.

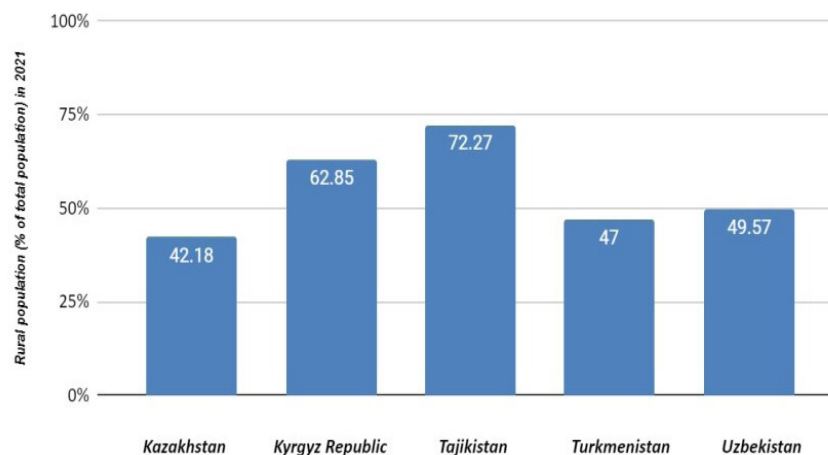


Figure 4. Share of rural population in the Central Asia region in 2021, by country (*World Bank, World Development Indicators, 2021*)

Although scarce data concerning the share of people migrating from and within Central Asia hinder research on regional migration trends, tracking remittances and exploring independent research efforts about migration flows in particular Central Asian countries, can help mapping some common mobility trends and their causes. According to the World Bank (Clement et al., 2021) remittances play a significant part in some of Central Asian countries` GDP, helping impoverished households to meet their basic needs. Sending money from abroad by migrant workers, employed mainly in Russia, contributes to the livelihoods of poor communities in rural areas, (Clement et al., 2021). Many Central Asian countries perceive remittances as a necessary financial lifeline and migration as an effective strategy for alleviating countries` poverty. For instance, remittances in 2020 accounted for around 30 % of GDP in the Kyrgyz Republic and Tajikistan (Ratha and Ju Kim, 2022).

It is difficult to assess the number of labor migrants from Central Asia, many work illegally or cross the borders multiple times for the purpose of conducting seasonal jobs or do not report migration within the country. As a result, labor migration from Central Asian countries remains typically undetected in both home countries and in the main destination country - Russia. Moreover, to identify the number of rural migrants is even more challenging due to the lack of data and the aforementioned reasons. There are only estimations that most Central Asian migrant workers are from poorer rural areas who are under greater pressure to obtain necessary means for living due to impoverished economic situation and unstable land productivity in the rural environment (Jung and Newson, 2022).

A significant share of Central Asians lives in poverty and in rural areas that often lack proper infrastructure, resources and power to resolve many vulnerabilities, inter alia, environmental degradation and ongoing adverse climate change effects. According to Asian Development Bank Data (2021), 25.3% of the total population in Kyrgyzstan still lives below the poverty line. In Kyrgyzstan, labor migration is notable, particularly in rural regions where poverty is especially persistent (Khashimov et al., 2020). Being one of the most remittance-dependent nations in the world, Kyrgyzstan heavily relies on its labor out-migration that represents an important and usually a major source of income for rural households in particular. Environmentally-related hazards such as drought, land and mudslides, flash floods, and glacier lake outburst floods are very common in the country, which increases vulnerabilities and risk exposure for many rural households (Chapman et al., 2021). The Third National Communication of the Kyrgyz Republic report (2016), identifies the agriculture, water management, and energy sectors as most exposed to harmful effects of climate change, while women, children, rural and poorest communities remain the most vulnerable parts of population to climate variability in the country. Considering current migration trends, slow development process and anticipated climate-driven increase of floods and landslides, it is expected to witness an increase in rural-urban as well as external migration in Kyrgyzstan.

Similar to Kyrgyzstan, Tajikistan suffers from a high rate of poverty and unemployment. Although Tajikistan has experienced significant reduction in poverty and improvement of economic conditions in the past decade, yet more than quarter of the total country's population lives below the poverty line and the economy cannot cope with the growing population in terms of job creation and more stable economic environment (World Bank, 2022). This mountainous Central Asian country is highly vulnerable to climate change and environmental disasters, which can exacerbate already serious economic challenges and encourage migration especially from rural areas. The World Bank (2022) estimated that in the period from 1992 to 2016, natural and climate-related calamities inflicted GDP losses of around US\$ 1.8 billion, affecting almost 7 million people in Tajikistan. In the country, the rural population represents a highly significant percentage of the total population (72.27%), while agriculture remains a main sector for employment in rural areas (Chapman et al., 2021). Hofman (2021) argues that a high level of external migration in Tajikistan is predominantly a consequence of the lack of meaningful domestic employment opportunities and a response to hardships in rural areas of the country. Moreover, Hofman adds that rural-urban migration is less common due to lack of substantial employment opportunities across the country. It is estimated that the increased drought periods caused by climate change will have indirect impacts on agriculture and direct effects on potable water supply that will consequently negatively affect

some of Tajikistan's poorest communities (Chapman et al., 2021). Even though the poverty rate in Uzbekistan (11.5%) is lower compared to Kyrgyzstan and Tajikistan, this country suffers from water scarcity and population growth that in the near future can represent a serious challenge and cause increased eco-migration. It is one of the most populous country in Central Asia (Khashimov, 2020) with the population of the republic increasing an average of 650 - 700 thousand people annually; following the current trend, it is estimated that Uzbekistan's population will reach 39 million by 2030 (Eureporter.org, 2021). However, experts suggest that such population increase will also raise water demands by 18-20% and add additional pressure to the already scarce water supply in the country (Eureporter.org, 2021). Another factor that makes Uzbekistan highly vulnerable to climate change impact is that 78% of the country's total area is desert, which increases risks of prolonged periods of droughts and water scarcity (Climateadaptationplatform.org, 2021). Rural to urban migration will probably increase in the foreseeable future, especially due to estimations that the Ferghana Valley in Uzbekistan and Tajikistan, as well as southern Uzbekistan along the Amu Darya will become hot spot pockets reflecting projected reductions in water availability and agricultural productivity (Clement et al., 2021).

Despite being one of the most developed country in the Central Asia region, Kazakhstan suffers from a negative net migration (Khashimov, 2020) and is also susceptible to adverse climate change impacts. Kazakhstan's Seventh National Communication and Third Biennial Update Report (2017) recognizes the agricultural sector, water resource and human health as most vulnerable to climate change in the country. The joint report of World Bank and Asian Development Bank on climate risk in Kazakhstan (Chapman et al., 2021) expects that increased droughts in the country might reduce crop yields, cause death of livestock, endanger drinking water supplies, and accelerate the process of soil degradation. Considering current migration trends and expected adverse climate change impact, it is highly likely that Kazakhstan's rural areas will be the most affected and prone to internal as well as external migration.

Due to the tight state control over media and information services in Turkmenistan, it is very difficult to acquire any official data including the country's migration statistics. However, this Central Asian country, similar to other countries in the region, has experienced a negative migration net ever since the collapse of the Soviet Union (Khashimov, 2020). Turkmenistan, as most of the region, is highly dependent on water supply because of its arid climate. Land scarcity is another serious issue that affects Turkmenistan since about 80% of the country is covered by desert (Duan et al., 2019). Even though this country is rich in oil and gas resources, it remains an underdeveloped, primarily rural country with the majority of population depending on agriculture whose livelihoods are especially vulnerable to climate change (Lioubimtseva et al., 2014).

Reyer and others (2017) argue that climate change might intensify internal mobility of people in Central Asia as well as from the region to the Russian Federation. The rural-urban migration research has received little attention in the region; few infrequent scholarly work reveal connection between migration and environmental degradation, which can be considered as an important breakthrough in eco-migration studies in Central Asia. These rare studies on climate mobility in rural parts of Central Asia suggest that internal migration can be intensified with deteriorating irrigation and water supply scarcity (Bekchanov and Lamers, 2016), as a repercussion of food scarcity (Aleksandrova et al., 2014), or by the subsequent adverse change of decreased agricultural labor productivity (Reyer et al., 2017). These worsening environmental processes can all be attributed to climate change to various extent. Agriculture, as one of the important sectors of the economy across the region, is highly exposed and vulnerable to the adverse effects of climate change. According to World Bank data in 2019, the share of agriculture in the GDP of the countries in the region accounted from 4.5% to 25% (Figure 4), exposing a rich diversity of agricultural production in Central Asia.

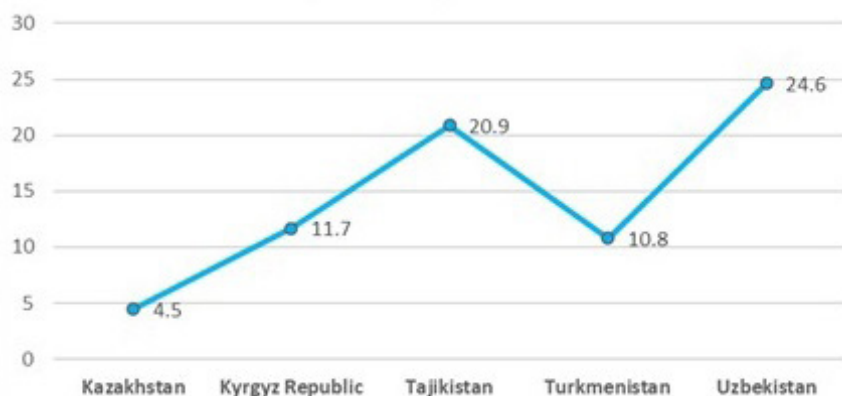


Figure 5. Agriculture, forestry, and fishing, value added (% of GDP) in 2019 (World Bank, World Development Indicators, 2021)

Rural population is directly affected by changes in agricultural productivity and they are first in line to experience any repercussions of changing land cultivation, such as reduced income or food shortages. Decreased agricultural yield usually causes income reduction in agricultural areas that consequently leads to increased rural poverty, and eventually to intensified rural migration (Christmann et al., 2019). However, the effect of climate change for agriculture does not necessarily have to be negative. Some estimations suggest that rising temperature could have a positive impact on cooler and northern areas of the region including extended growing season, expansion of the land available for agricultural production and

higher agricultural output (Liu et al., 2020). In such an optimistic scenario, areas with increased agricultural productivity might increase in-migration and reduce local mobility by providing better and more secure livelihoods with enhanced land outputs (Blondin, 2018). Nonetheless it is not possible to assess with certainty to what extent such changes may contribute to rural-rural movements or rural-urban mobility to the northern parts of the region (Reyer et al., 2017). Agriculture in Central Asia will be exposed to various challenges as well as opportunities due to climate variability, including changes in migration trends within the region.

6. Rural Immobility

Even though adverse effects of climate change can increase out-migration, especially internal migration, there are concerns that the most vulnerable will stay put, suffering the most due to lack of resources to move or simply because they feel attached to the land and communities of their residence (Blondin, 2018). Involuntary as well as voluntary immobility in the context of climate change deserves greater attention especially in studies concerning eco-migration in Central Asia.

Lack of mobility in the region is particularly evident in the poorest rural areas, which are most affected by natural disasters and changing climate. Some research suggests that the poorest who are highly exposed to food insecurity, water deficit and thus most vulnerable to adverse effects of climate change, usually are more likely to remain trapped than to migrate to more prosperous environments (Zaveri et al., 2021; Zickgraf, 2019). In Central Asia, women and children in rural areas are especially vulnerable to climate variability due to increased male-migration and greater exposure to hazard-prone areas. For instance, women residing in rural areas of Kyrgyzstan with frequent floods and landslides incidents are forced to be more involved in agriculture and livestock activities because of considerable male migration, which places them in more unsafe situations (Kelly et al., 2013). The poorest rural dwellers in Central Asian countries, besides being among the most exposed to negative consequences of ongoing climate change, are also more susceptible to the risk of involuntary immobility due to lack of means to migrate or absence of information on mobility options and the possible risks they are faced with.

Voluntary immobility phenomenon has recently acquired more scholarly attention, especially in the context of ongoing debate regarding negative consequences of climate change on rural communities in Central Asia (Blondin, 2018; 2021). The variety of cultural, emotional, spiritual, and social bonds can form a strong feeling of place attachment (Blondin, 2021) that often plays a critical role in the decision to remain rather than move to less affected areas. Blondin (2021; 2022). Many locals are not keen to migrate because they develop a strong bond to their place

of residence and local communities. The notion of the watan (homeland) for some Tajik local population is highly significant that migration is perceived as the ultimate, unfavorable solution, exercised only in cases of extreme environmental incidents. Some households, if they are eventually forced to move, decide to relocate closest to their previous place of residence in order to maintain the social and emotional ties to their villages (Blondin, 2018).

Several studies suggest that gender can have a significant influence on immobility (Schewel, 2019), especially in the context of climate risks (Tripathy Furlong et al., 2022), emphasizing separated gender roles that perceive women as those who stay behind being responsible for maintaining households and taking care of children and elderly members of their families, while men migrate in search for better economic opportunities. Although some countries of Central Asia have experienced increased feminization of migration (Asel, 2020), mobility is still male dominated across the region. Through the prism of the immobility dimension, women, children, elderly and poorest rural dwellers remain the most vulnerable category to climate risks across the region, regardless if staying put is reality based on a voluntary or involuntary reasoning.

7. Concluding remarks

Adverse changes in the habitual human environment provoked by global warming that range from abrupt and disastrous to long-term and gradually deteriorating ones, can exacerbate rural economic and security situations, prompting affected populations to migrate or at least consider moving to a more bearable environment (Lukyanets et al., 2020; Jäger et al., 2009). Although some studies suggest that the evidence for a connection between migration and climate change is largely frail mostly due to gap in the knowledge base and the complexity and abundance of other push and pull factors that dictate migration flows alongside environmental change (Reyer et al., 2015; Asian Development Bank (ADB), 2012), there are still strong conclusions that environmentally-induced migration will become more prominent and that many countries, including Central Asian countries, have already been affected by this phenomena

Due to its geographical position and climate configuration, Central Asia is significantly prone to the climate crisis consequences. In addition, this region is susceptible to both internal and external migration that may intensify in the future because of deteriorating environmental conditions especially in rural areas. Researching climate migration has become a significantly important area of study because of its global reach and effect. However, studying the climate change-mobility nexus in Central Asia represents a great challenge for various reasons. First of all,

lack of data and research on the impact of climate change in the region, which might be contributed to the general lack of interest due to more pressing socio-economic and political issues affecting Central Asian countries. Furthermore, finding a solid proof for a connection between migration and climate change is a challenging matter not only due to gaps in the knowledge base but also because of the complexity and abundance of other push and pull factors that dictate migration flows alongside climate variability.

Recent research study on eco-migration predicts that Central Asia, even in the most optimistic scenario, will experience intensified climate migration in the foreseeable future (World Bank, 2021). Moreover, the region is already considered a climate hotspot with rising temperatures considerably above the global mean. Rural areas and populations in particular are expected to bear the majority of negative consequences of climate change because of their dependency on agricultural productivity that can be affected the most by the ongoing climate crisis with more frequent and devastating natural disasters. Since more than a half of the Central Asian population resides in rural parts who are highly exposed to intensified environmental degradation, the volume of rural out-migration will probably increase. Across the region, climate change will bring increased aridity and intensified melting glaciers that can force many households to consider moving to more bearable environments.

While researching the climate mobility trends in Central Asia, it is important to include situations where impoverishment or other social and emotional bonds prevent people from migrating despite apparent environmental risks and hazards. Often the most vulnerable parts of the population such as women, children and elderly in affected rural areas are faced with lack of mobility either due to gender or poverty reasons. Migration in Central Asia is still male dominated while women usually stay behind to tend the households in environmentally insecure areas. Involuntary immobility in the context of ongoing climate crisis should therefore be equally considered when drafting development and adaptation climate agendas. However, voluntary immobility, based on a feeling of attachment to the place of residence or origin, is also present in some remote rural areas in the region and important for further research.

Climate change does not affect everyone equally and not everyone is equally responsible for the climate crisis. However, often the poorest, rural inhabitants who are more exposed to devastating natural disasters and at risk of being forced to migrate or trapped in their place of residence, unjustifiably suffer more from negative consequences of climate variability. Being highly susceptible and vulnerable to climate change impact as well as to climate (im)mobility trends and climate injustice, the rural population in Central Asia should receive greater scholarly attention in climate change and eco-migration research.

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