

CLIMATE CHANGE AND MIGRATION PATTERNS: FINDINGS AT THE COMMUNE LEVEL IN RURAL PROVINCES OF CAMBODIA

**Nong Monin, Sean Chanmony, Khan Donira, Nhong Sodavy,
Bunnath Zoe Sidana, So Lyhong and Ngin Chanrith**

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List of abbreviations

ADB	Asian Development Bank
CSO	Civil Society Organisations
GDP	Gross Domestic Product
GHG	Greenhouse Gases
IDMC	Internal Displacement Monitoring Centre
IPCC	Intergovernmental Panel on Climate Change
KII	Key Informant Interview
IOM	International Organization for Migration
MFI	Microfinance Institution
MoWRAM	Ministry of Water Resources and Meteorology,
NCDM	National Committee for Disaster Management
NGO	Non Governmental Organisation
NIS	National Institute of Statistics
PDoWRAM	Provincial Department of Water Resources and Meteorology
UN DESA	United Nations Department of Economic and Social Affairs
UNFCCC	United Nations Framework Convention on Climate Change
WBG	World Bank Group
WFP	World Food Programme

Executive summary

Migration forces rural people to find more and better jobs, which is key in generating incomes to sustain livelihoods and ensure food security in times of environmental change. In addition to agricultural production, climate change affects health, water, and energy resources and causes migration and conflict. The impacts of climate change on men and women can also differ in terms of employment, natural resource management, social norms, gender stereotypes, socio-economic opportunities, and adaptation to new technologies. Greenhouse gas emissions from production, transportation, and energy consumption will increase in urban areas due to various developments such as infrastructure. At the same time, agricultural land and corresponding activities in rural areas may be at risk of abandonment due to migration to cities or neighbouring countries. Moreover, falling into debt is one of the main reasons why remote villagers, both men and women, migrate to find work in the cities. The reasons behind these debts can be related to crop damage caused by natural disasters or other associated events. The migration burdens elderly mothers or grandmothers who take care of the children and grandchildren left behind, in addition to the uptake of many other household responsibilities.

Using a mixed-method approach, this study examined the association between climate change and migration in the three Cambodian communes of Kratie, Mondulkiri, and Steung Treng Provinces. Data was collected from 240 households with migrant members. The study aimed: (1) To understand trends of past and present weather and migrations patterns in rural communities of Cambodia, and (2) to analyse how climate change impacts migration patterns and suggest sustainable coping strategies appropriate for rural settings.

This study suggests that climate change and migration are linked. Temperatures have increased, and the rainy and dry seasons have become irregular. The income loss from damaged crops caused by extreme weather events is one of the causes of migration. Usually, villagers migrate short-term to ensure their family has enough money to survive; after earning enough money, they return to their farming activities. Most migrants are of working age and migrate to the capital city of their province or other provinces to work in garment factories, construction sites, or labouring work.

Political factors do not seem significant in influencing migration and its patterns. Furthermore, climate hazards, such as droughts, high temperatures, floods, and windstorms, were also not perceived as direct causes of migration. Some villagers faced family burdens, dependency, and health issues yet believed those factors were unlikely to contribute to the migration. This study finds that social and economic drivers were the key factors pushing people to migrate. These include poverty, indebtedness, transfer of workplace to another location, searching for the right jobs, food insecurity, unemployment, lost land or house, and decreased crop yields.

The study suggests that climate change-induced extreme events are the root causes of losses and damages, destroying properties or assets, crops, livestock, and poultries, leading to income loss and poverty. Poverty and indebtedness firmly push family members to migrate for better employment opportunities.

To improve local livelihoods and reduce migration, the following recommendations are suggested:

- (1) Provide training on agricultural practices that are resilient to climate change.
- (2) Provide irrigation systems and training on practical water usage to improve agricultural production and yields, diversify agrarian activities, and increase local farming jobs.
- (3) Enhance local participation and active engagement in community development planning and decision-making processes toward improving climate resiliency.

1. Introduction

1.1. Background

An Intergovernmental Panel on Climate Change (IPCC) Sixth Assessment report highlights migration as one of the most challenging issues. Climatic hazards, including high temperatures, changing rainfall patterns, more significant monsoon variability, rising sea levels, floods, droughts, and intense tropical cyclones, are increasing in frequency and extremity (Cruz et al., 2007). The hazards, as mentioned above, have affected current migration rates, among other socio-economic development trends, and increased the projections for the future. As a result, migration has been integrated into efforts to scale climate action in relation to response interventions and adaptation strategies (IPCC, 2023). In Southeast Asia, climate change is already wreaking damage and various parts of the region are more vulnerable to extreme climatic events, particularly droughts, landslides, floods, and cyclones (Yusuf and Francisco, 2009). Consequently, these hazardous events have negatively affected people's livelihoods and caused social issues, including loss of land, damage to/loss of housing and infrastructure, crops and livestock, and migration (Haque, 1997).

In recent years, migration has become one of the only options for local people to cope with the impact of environmental and climate change (Tacoli, 2009). A study by Édes (2012) revealed a close relationship between climate change and migration. It was shown that the flow of migration is frequently considered external to the will of the people where populations living in climatic-prone areas would be forced to relocate (Mastorillo et al., 2016). People are compelled to migrate in response to sudden disasters and extreme climatic hazards (Naik, 2009), and gradual/slow-onset environmental change (such as sea-level rise, soil erosion, deforestation and desertification) (Leighton, 2009). Migration occasioned by climate change occurs both temporarily (e.g., when people flee severe storms or droughts but return when the threat has subsided) or permanently (e.g., when the territory – a community, a city, or even a country – becomes uninhabitable) (Docherty and Giannini, 2009).

In Cambodia, climate change impacts have manifested as climatic hazards including floods and droughts that severely impact socio-economic development, primarily agricultural activities (Sok et al., 2021). Chihh et al. (2023) confirmed that the impacts of climate-induced droughts on rural populations have become more extreme, frequent, and severe. This may affect Cambodia's high internal and external migration rates. The Cambodian General Population Report 2019 showed that rural-urban migration (34.0 percent) is more significant than urban-urban (30.0 percent), rural-rural (29.0 percent), or urban-rural (30.0 percent) migration (NIS, 2020). In the report, the reasons for migration include mobility with families (44.9 percent), finding employment (19.4 percent), marriage (14.9 percent), job opportunities (9.1 percent), and education (2.3 percent). Indeed, some people migrate due to loss of land/home, natural disasters, becoming an orphan, and insecurity, but climate change was not specified as a reason for migration (NIS, 2020).

The International Organization for Migration (IOM) conducted a study in 2009 and found that environmental stressors and migration pressures force rural people to find alternative ways to diversify their income to sustain family livelihoods and food security in times of change (IOM, 2009). An extensive study by Goh (2012) indicated that climate change affects gender differently regarding assets - in relation to the disproportionate ownership and control of these assets – as well as differences in the level of well-being of men and women. Migration is one of the key impact areas along with agricultural production, food security, health, and water and energy resources. As a result of climate change impacts, more pressure is placed on the

inefficiency of urban infrastructure, and consequently, greenhouse gas (GHG) emissions from manufacturing, transportation, and energy use will increase in urban areas (Goh, 2012). At the same time, agricultural land and farming activities in rural areas may be being abandoned due to outmigration to cities.

A study by the Asian Development Bank (ADB) showed that falling into debt is one of the significant causes of migration for both men and women in remote regions who seek jobs in urban areas (ADB, 2018). The reasons behind the debt may have strong links to previously productive crops being destroyed by extreme weather events and micro-climates. The report adds that massive outmigration burdens older mothers or grandmothers more to look after children or grandchildren and take care of domestic and productive work simultaneously (ADB, 2018). Another study by Parsons and Nielsen (2020) found a robust correlation between climate change and migration patterns in remote households around the Tonle Sap Lake and the flood-prone areas of the Mekong River. Similarly, Nong (2021) found that the local population in Battambang province opts to work seasonally in other cities and on the border of Thailand when extreme drought and flood events occur. The primary purpose of migration is to earn and send remittances home to support families' living conditions (Sok and Yang, 2021). While migrants are confronted with unacceptable working and living conditions, Sok (2019) calls for appropriate mechanisms to improve these conditions because migration has become a family strategy to minimise risk and maximise income for rural youth in Cambodia (Sok and Yang, 2021).

Migration issues contextualise efforts to address climate change, migration, and food security in the policy priorities and negotiations under the United Nations Framework Convention on Climate Change (UNFCCC). Many factors drive people to migrate but scientists, policymakers, and researchers remain unclear about the relationship between migration and climate change due to a lack of empirical data and information (ADB, 2012).

In the context of migration, climate change has affected men and women in different ways in terms of shifts in employment, control over assets and resources, social norms, gender and stereotypes, socioeconomic development, and adoption of new technologies (Joarder and Miller, 2013; Kaczan and Orgill-Meyer, 2020; Brzoska and Fröhlich, 2016). Adaptation and resilience are the fundamental mechanisms to handle the adverse impacts of climate change, which affect rural poverty and food security (Sok and Yu, 2015; Sok et al., 2014). Communities with low adaptive capacity migrate to mitigate their vulnerability to climatic hazards.

1.2. Objectives

This study investigates if there is a relationship between the negative impacts of climate change and people's mobility in Cambodia. Two sub-objectives are further addressed hereunder:

1. To understand trends of past and present weather and migration patterns in rural communities of Cambodia
2. To analyse how climate change impacts migration patterns and suggest affordable coping strategies for rural settings.

2. Conceptualising impacts of climate change on migration

Climate change is a complex phenomenon affecting physical, social, and economic systems. Climate change can directly and indirectly impact human well-being, livelihoods, health, security, and development. Some of the effects and consequences include increasing temperatures and rising sea levels. The impact of climate change consists of an increase in rising temperatures and sea levels. Climatic hazards have increased in frequency and extremity

in terms of droughts, floods, windstorms, heat waves, wildfires, water scarcity, food insecurity and vector-borne diseases. The causes of climate change are attributed to human activities that alter the atmosphere's composition (Goh, 2012). Conceptually, migration is a multidimensional process involving people's movement from one place to another, within or across national borders. Migration can be voluntary or involuntary, temporary or permanent, circular or linear, regular or irregular, and influenced by various economic, social, political, cultural, environmental, and demographic (Castles et al., 2014). Migration can also have positive or negative impacts on the origin as well as the destination area, depending on the context and the characteristics of the migrants (Haan 1999; Agza, Alamirew, and Shibru 2023; Asfaw, Tolossa, and Zeleke 2010).

A displacement is a specific form of migration that occurs when people are forced to leave their habitual residence due to a threat or an actual hazard. Displacement can be internal or cross-border, sudden-onset or slow-onset, protracted or short-term, and individual or collective (IDMC, 2020). Displacement can also have significant humanitarian, human rights, development, and security implications for displaced persons and the host communities.

Studies have attempted to provide estimates or projections of current or future climate change-related migration or displacement at global, regional, or national levels. For example, a World Bank (2021) report projects that 216 million people, across six regions¹, could move from one country to another by 2050 due to slow-onset climate impacts such as water insecurity, crop damage, sea level rise, and storm surges. The report also estimates that early actions to slow down greenhouse gas emissions and guarantee inclusive and resilient development could reduce the incidence of internal migration caused by climate change at a remarkable rate (Clement et al., 2021).

Furthermore, the Internal Displacement Monitoring Centre (IDMC) (2020) reports that 24.9 million people were newly displaced by sudden-onset disasters in 140 countries and territories in 2019, of which 23.9 million were weather-related and 1 million were geo-physically caused. The report also notes slow-onset disasters such as droughts and rising sea levels, which will likely trigger or exacerbate future displacement. Still, there is a lack of data and analysis on this phenomenon (IDMC, 2020).

In the Asia- Pacific region, ADB (2012) estimates that by 2050 roughly 37 million people could be at risk of displacement as a result of rising sea levels, of which 12 million are in low-elevation coastal zones and 25 million are in atoll island states. The report also suggests that climate change could affect migration patterns in the region through various channels, such as changing agricultural productivity, water availability, natural disasters, health risks, urbanisation, and human security (ADB, 2012).

Cambodia may face challenges similar to those stated above, but the country has limited empirical evidence on the linkage between climate change and migration or displacement (Nguyen and Sean, 2021; Sigelmann, 2020). Maltoni (2010) found that migration has mainly touched upon remittance and socio-economic conditions. However, some studies have indicated that Cambodia is exceptionally susceptible to climate hazards due to its geographic location, adaptive capacity, and high dependence on natural resources. A variety of climate change impacts could affect migration or displacement in Cambodia, including (1) increased temperature and variability of rainfall, which could affect agricultural production, food security, water availability, and health outcomes; (2) increased intensity and frequency of floods and

1 The six regions comprise of Sub-Saharan Africa, East Asia and the Pacific, South Asia, North Africa, Latin America, and Eastern Europe and Central Asia.

droughts, which could destroy infrastructure, and livelihoods; and (3) sea level rise and saltwater intrusion which could threaten coastal areas, mangroves, fisheries, and freshwater resources.

It was found by Clement et al. (2021) that Cambodia is one of the countries in East Asia and the Pacific that is projected to experience the impact of climate migration due to slow-onset climate change impacts, including water scarcity, crop failure, rise in sea-level, and increased storm surges. If preparedness action is not taken, Cambodia could see up to 1.5 million people (or 9 percent of its national population) internally displaced by 2050, mostly from rural areas that depend on agriculture and natural resources (Clement et al., 2021). This report also identifies potential destination areas that could receive climate migrants, such as urban centres and higher-elevation regions that offer more economic opportunities and better access to services. Furthermore, Sigelmann (2020), who analysed the subnational climate vulnerabilities and the relationship between water availability and migration in Cambodia, found that precipitation is decreasing in northwest Cambodia, where people most heavily rely on rice agriculture.

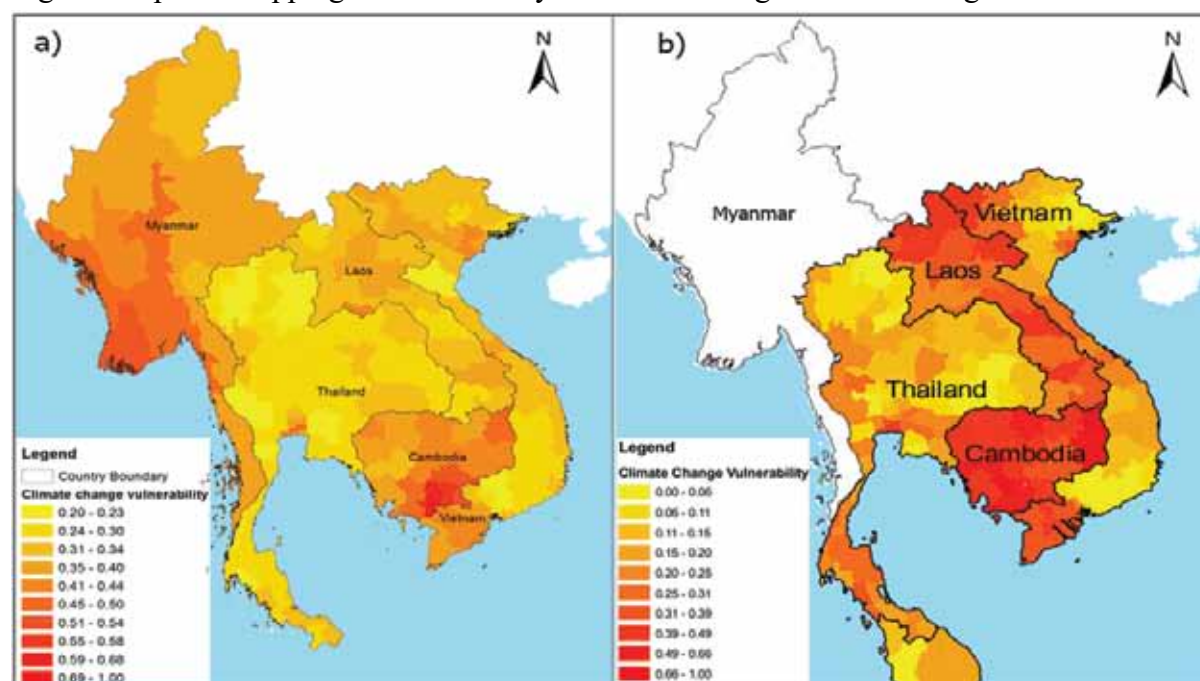
Jacobson et al. (2018), in cooperation with national and sub-national authorities and local Non-Governmental Organisations (NGOs) around the Tonle Sap Lake (Cambodia), found that up to 45 percent of households have at least one member migrating. Over half of these households stated that migration was due to climate stressors forcing them to move away from their communities. Moreover, it was shown that migration causes labour shortages and welfare issues in their home village and does not necessarily improve food security; migration may be one of the long-term coping strategies and climate change causes people to fall into the poverty trap (Jacobson, 2018).

To assess Cambodia's vulnerabilities and responses to environmental changes, Oudry et al. (2016) focussed on two provinces in the Tonle Sap Basin, where most people depend on fishing or agriculture for their livelihoods. The study found that environmental degradation and climate-related disasters are among the main drivers of migration in the Tonle Sap Lake. Migration operates as an adaptation strategy for many households but poses challenges such as social and economic integration, human rights protection, and environmental sustainability.

A recent IPCC report corroborated that Asia, including Cambodia, is at significant risk of climate change, with the severity depending on the extent of global warming (Chaturvedi et al., 2022). The region faces various hazards, including extreme heat, water scarcity, and heavy rainfall, all of which can harm human health, food production, and limited access to water. As global temperatures rise, the vulnerability to water-related issues will also increase. Central Asia, in particular, will encounter more severe droughts, further deteriorating water quality and exacerbating associated risks. South and East Asia have already witnessed an increase in flooding due to heavy precipitation, and this trend is predicted to intensify, while coastal countries are especially susceptible to rising sea levels, storm surges, and powerful waves (Chaturvedi et al., 2022).

Compared to other Southeast Asian countries, Cambodia stands out as particularly susceptible to climatic hazards and is highly vulnerable as coping capacities remain low for natural disasters (see Figure 1). Combined with the impact of man-made activities such as hydropower construction and deforestation, productivity in the Mekong River and the Tonle Sap Lake is being affected. This is deeply concerning for the impoverished, rural, and riverine communities that rely heavily upon these resources for their livelihoods and sustenance. Future climate change projections indicate that Cambodia will experience more frequent and severe floods and droughts, potentially leading to a substantial decline of nearly 10 percent in the country's gross domestic product (GDP) by 2050 (World Bank, 2021).

Figure 1: Spatial mapping of vulnerability to climate change in the Mekong countries



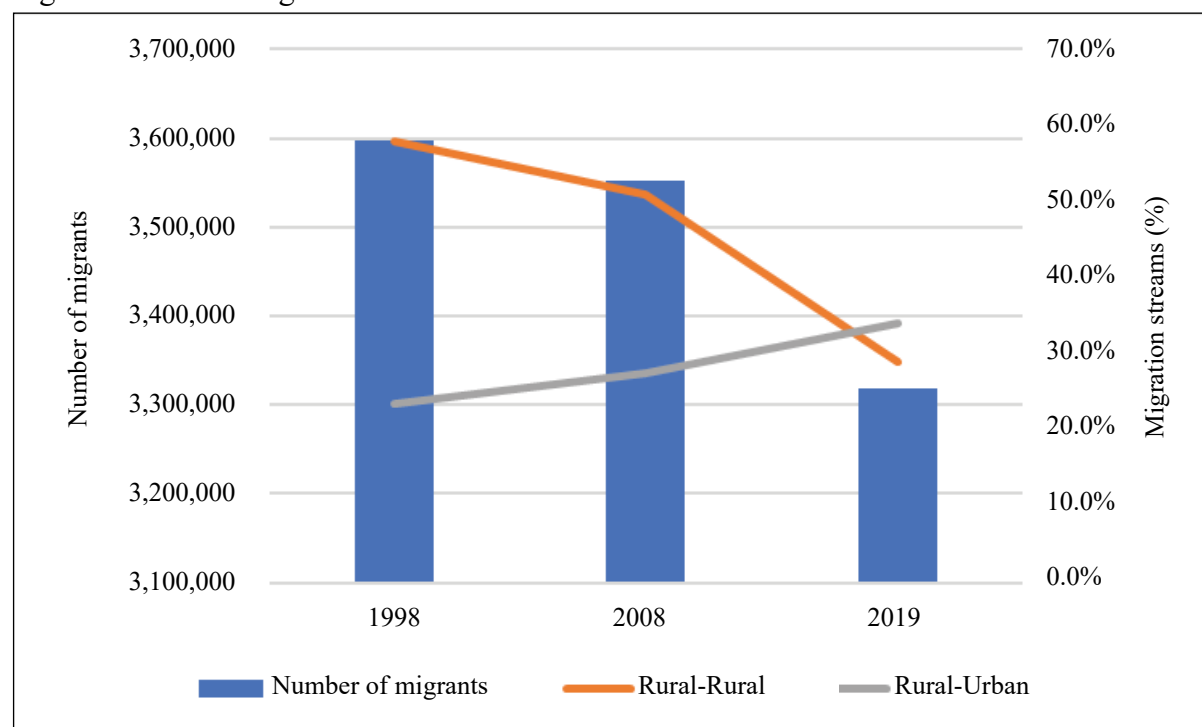
Source: (a) WREI (2015) and (b) Yusuf and Francisco (2009) (adopted from Kuntiyawichai et al. 2015)

Migration is crucial in shaping Cambodia's demographic and labour market dynamics. Rural households have come to rely on migration as one of the primary sources of their household income (Fitzgerald et al., 2007; Maltoni, 2010). It has brought about positive changes for these households, such as improved housing conditions, better access to higher quality food, increased opportunities for education, poverty reduction, and acting as a safety net during times of income fluctuations (Maltoni, 2006; Tong, 2011; Roth et al., 2015).

Cambodia's migration can be categorised into internal and cross-border migration based on the general population censuses. Internal migration, particularly rural-to-urban migration, has been a prominent trend since the 1990s, fuelled by limited economic prospects in rural areas and the allure of better opportunities in urban centres like Phnom Penh (UNESCO, 2016). According to the 2019 National Population Census, rural-urban migration constituted 34.0 percent of internal migration, surpassing the rate of rural-rural migration (29.0 percent) for the first time, as depicted in Figure 2. This migration pattern has driven rapid urbanisation in the country. As per the World Food Programme (2019) study, which involved surveying 2,341 rural households across 160 villages in 24 provinces of Cambodia, ~35.0 percent indicated that they had at least one household member involved in migration. Out of these migrants, approximately 43.0 percent were categorised as long-term migrants, with migration periods lasting from six months to three years. Additionally, ~33.0 percent of the migration cases were reported to be short-term or seasonal, lasting six months or less.

Cross-border migration is another significant trend in Cambodia, where people seek employment and livelihood opportunities in neighbouring countries. In 2020, an estimated 1.1 million Cambodian emigrants, making up approximately 6.74 percent of Cambodia's total population, ventured abroad in search of better prospects (see Table 1) (UN DESA, 2020). Thailand is a popular destination for Cambodian migrant workers due to its proximity and demand for labour across various sectors (OECD and CDRI, 2017). However, this form of migration also presents challenges, including issues related to human trafficking, exploitation, and violation (Lee, 2007; Sok, 2019).

Figure 2: Internal migration trend in Cambodia 1998-2019



Source: Cambodia General Population Census 2008 and 2019 (NIS, 2008; NIS, 2020 respectively)

Table 1: The trend of international migration in Cambodia

International migration	2000	2010	2015	2020
Total population (in thousands)	12,119	14,364	15,418	16,397
Stock of emigrants (in thousands)	460	953	1,075	1,105
Percent of emigrants to the total population	3.79 percent	6.64 percent	6.97 percent	6.74 percent
Destination countries (percent)				
Thailand (percent)	33 percent	64 percent	62 percent	63 percent
South Korea (percent)	0 percent	1 percent	4 percent	5 percent
Malaysia (percent)	1 percent	1 percent	1 percent	1 percent

Source: United Nations Department of Economic and Social Affairs, Population Division (2020)

The existing body of literature has well documented climate change adaptation (Bylander, 2015; Oudry et al., 2016; Tacoli, 2009). Climate change adaptation entails implementing strategies and measures to mitigate and adjust to adverse consequences, with the primary goal of safeguarding the wellbeing of individuals and communities. The abilities of individuals and groups to cope with climate stressors are determined by multiple factors, comprising their access to financial resources, information, education, healthcare, social support, infrastructure, and technology (Adger et al., 2007). If climate change exacerbates health issues and mortality rates, causes income declines, and restricts access to essential natural resources, individuals may consider migrating to regions they perceive as offering better opportunities and improved livelihoods. This raises concerns about potential increases in human mobility as a response to climate change (Warner et al., 2010).

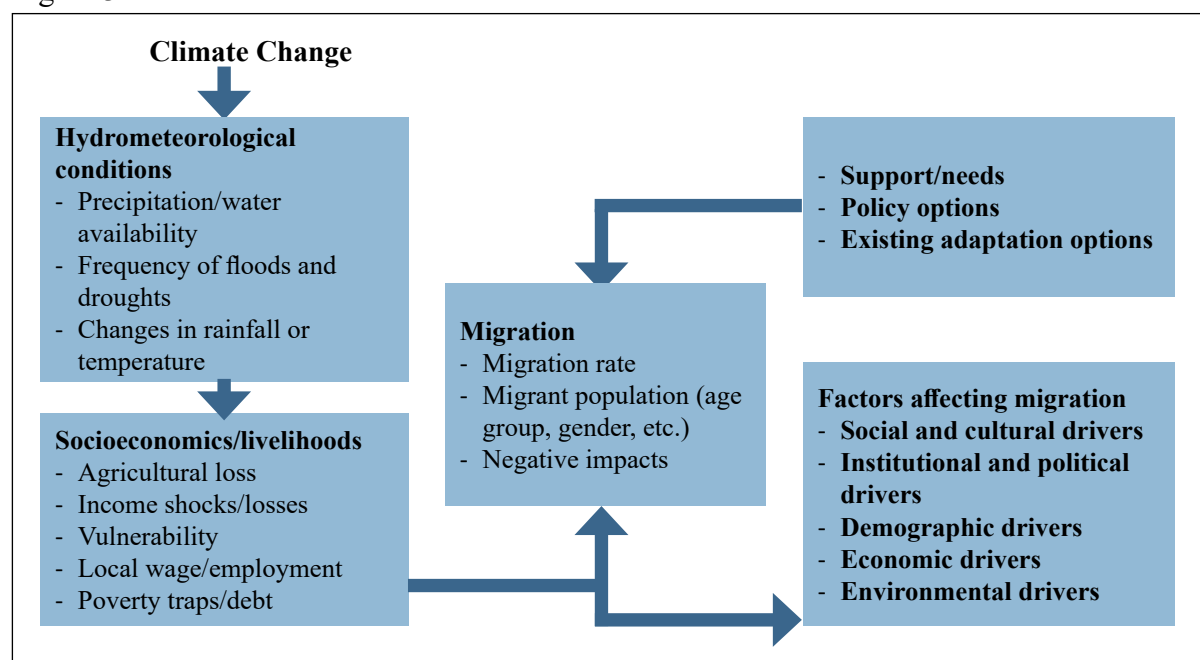
Several studies have explored the relationship between climate change and migration in Cambodia. Still, most of them have focused on specific regions while overlooking the country's northeast area. Jacobson et al. (2019) found that, in the northwestern regions, around 45 percent

of households had chosen to migrate, with over half of these migrations attributed to climate-related challenges. However, it remained unclear whether the migration was primarily internal or external. Parsons and Nielson (2021) investigated climate change perception and migration in the Tonle Sap and Mekong areas, establishing a solid link between climate change perception and household migration. Nguyen and Sean (2021) discovered an increased migration rate in Kampong Cham Province, particularly among small and medium-sized farmers facing more significant climate impacts. Sigelmann (2020) examined subnational climate vulnerabilities and the relationship between water availability and migration. The study found that households experiencing crop loss, drought, and poor rainfall were more likely to have migrating family members. If the northwest continues to dry, migration is expected to increase. Lastly, Oudry, Pak, and Chea (2016) assessed vulnerabilities and responses to environmental changes in the Tonle Sap Basin, their findings highlighted environmental degradation and climate-related disasters as key drivers of migration, posing challenges to social and economic integration, human rights protection, and ecological sustainability.

3. Research framework and methodology

This report's research applied a participatory approach that allowed the participants, ranging from policymakers and project implementers to local communities, to engage in the process. The method covered three steps: (i) desk review and consultative discussion, (ii) field observation, data collection, and analysis, and (iii) validation of the preliminary meeting and finalisation. The equal participation of both men and women was highly considered for an in-depth understanding of the gendered impacts of climate change. In the research process, multi-level government engagement was ensured, as well as local communities and NGO actors. Both qualitative and quantitative analyses were applied in this study.

Figure 3: Research framework



Source: Adopted from Parsons and Nielsen (2021); Sigelmann (2020); Bylander (2016)

To understand how climate change affects migration, we used a framework adopted by Parsons and Nielsen (2021), Sigelmann (2020), and Bylander (2016). We assumed that climate change affects migration through hydrometeorological conditions such as precipitation/

water availability, frequency of floods, droughts, and windstorms, and changes in rainfall or temperature (see Figure 3). The impact can also be felt in socioeconomic conditions and livelihoods regarding agricultural loss, income shocks, vulnerability, loss of local wage/employment, and poverty traps/debt. Migrants and mobile people are considered the groups most vulnerable to the adverse impacts of those climate variabilities.

Migration is a complex phenomenon which is influenced by multiple factors, including economic, social, environmental, political, and demographic conditions. In this section, we discuss factors that affect migration in Cambodia, focussing on the role of climate change.

Economic factors are often cited as the main drivers of migration, both domestically and internationally. Migration can be one of the livelihood strategies to eliminate poverty, unemployment, low wages, homelessness, indebtedness, and lack of opportunities in rural areas (Hunsberger et al., 2018; Jacobson et al., 2018; Sigelmann, 2020). Migration can also be motivated by the demand for labour in urban areas, industrial zones, and neighbouring countries, especially Thailand and Vietnam, where migrants can earn higher incomes and remittances (Hunsberger et al., 2018; Jacobson et al., 2018; Sigelmann 2020). However, economic factors alone cannot fully explain migration patterns, as they are often intertwined with other factors, such as social networks, cultural norms, personal preferences, and environmental conditions (Jacobson et al., 2018; Sigelmann, 2020). Moreover, migration is not always beneficial for migrants and their families, as it can entail risks and costs, such as exploitation, abuse, trafficking, discrimination, health problems, and social isolation (Hunsberger et al., 2018; Jacobson et al., 2018; Sigelmann, 2020).

Social factors shape migration decisions and outcomes. Social networks, such as family ties, kinship groups, friends, and neighbours can facilitate or constrain migration by providing information, assistance, support, and influence (Jacobson et al., 2019; Sigelmann, 2020). Social networks can also create a chain migration effect, where previous migrants encourage or sponsor new migrants to follow them (Jacobson et al., 2018; Sigelmann, 2020).

Social norms and values can also affect migration behaviour, especially regarding gender roles and expectations. In Cambodia, migration is often gendered, with more women than men migrating internally and more men than women migrating internationally (Hunsberger et al., 2018; Jacobson et al., 2018; Sigelmann, 2020). Women migrate to work in garment factories, domestic service, or entertainment sectors in urban areas or neighbouring countries, while men tend to migrate to work in construction, agriculture, or fisheries sectors in rural areas or neighbouring countries (Hunsberger et al., 2018; Jacobson et al., 2018; Sigelmann, 2020). Thus, migration can impact women and men differently regarding empowerment, vulnerability, and well-being (Hunsberger et al., 2018; Jacobson et al., 2018; Sigelmann, 2020).

Political factors can influence migration dynamics in Cambodia. Political stability, governance quality, human rights protection, and the rule of law can affect security, freedom, and opportunities in the origin and destination areas (Hunsberger et al., 2018; Sigelmann, 2020). Political factors can also shape the legal and institutional frameworks that regulate migration flows, rights, and services (Hunsberger et al., 2018; Sigelmann, 2020). Further, political aspects can interact with other factors to affect migration outcomes. For instance, political factors can mediate the impacts of environmental factors by enhancing or undermining the resilience, adaptation, and mitigation capacities of communities and individuals (Hunsberger et al., 2018; Sigelmann, 2020). Also, political factors can exacerbate or alleviate the conflicts and tensions arising from migration processes, such as land disputes, ethnic clashes, or social unrest (Hunsberger et al., 2018; Sigelmann, 2020).

Demographic factors can also explain migration patterns in Cambodia. Population size, growth rate, age structure, and spatial distribution can affect labour, resources, and services supply and demand in different areas (Sigelmann, 2020). Moreover, demographic factors can reflect the historical and cultural influences that shape migration trends and preferences (Sigelmann, 2020).

Specifically, demographic factors can have implications for migration and its challenges. For instance, a young and growing population can increase the potential for migration as a source of income diversification and social mobility (Sigelmann, 2020). However, a growing young population can also challenge education, health, employment, and social protection systems in the origin and destination areas (Sigelmann, 2020).

This study examined various climate change variables, including temperature, rainfall, natural disaster events, water resources, meteorology, disasters, and climate and weather information collected from relevant ministries and provincial departments. The collected climate variables, temperature and precipitation deviations from climate literature (Marchiori et al., 2011; Parsons, 2015) were examined to see the differences between the study areas' decadal averages and their long-running averages. The intensity and severity of natural disasters, such as floods and droughts, in the study areas are also presented.

Key-informant interviews (KIIs) were conducted with stakeholders, including government officials (especially at the subnational level), NGOs, and other knowledgeable persons, to validate results and gain a deeper understanding of the local context. Qualitative data from KIIs were compiled and summarised immediately after returning from the field. Data and information collected for each area were stored in separate files with a code number and then compiled according to the nature, type, and characteristics of the data. Table 2 below shows the number of study participants.

Table 2: Sampling and sample sizes

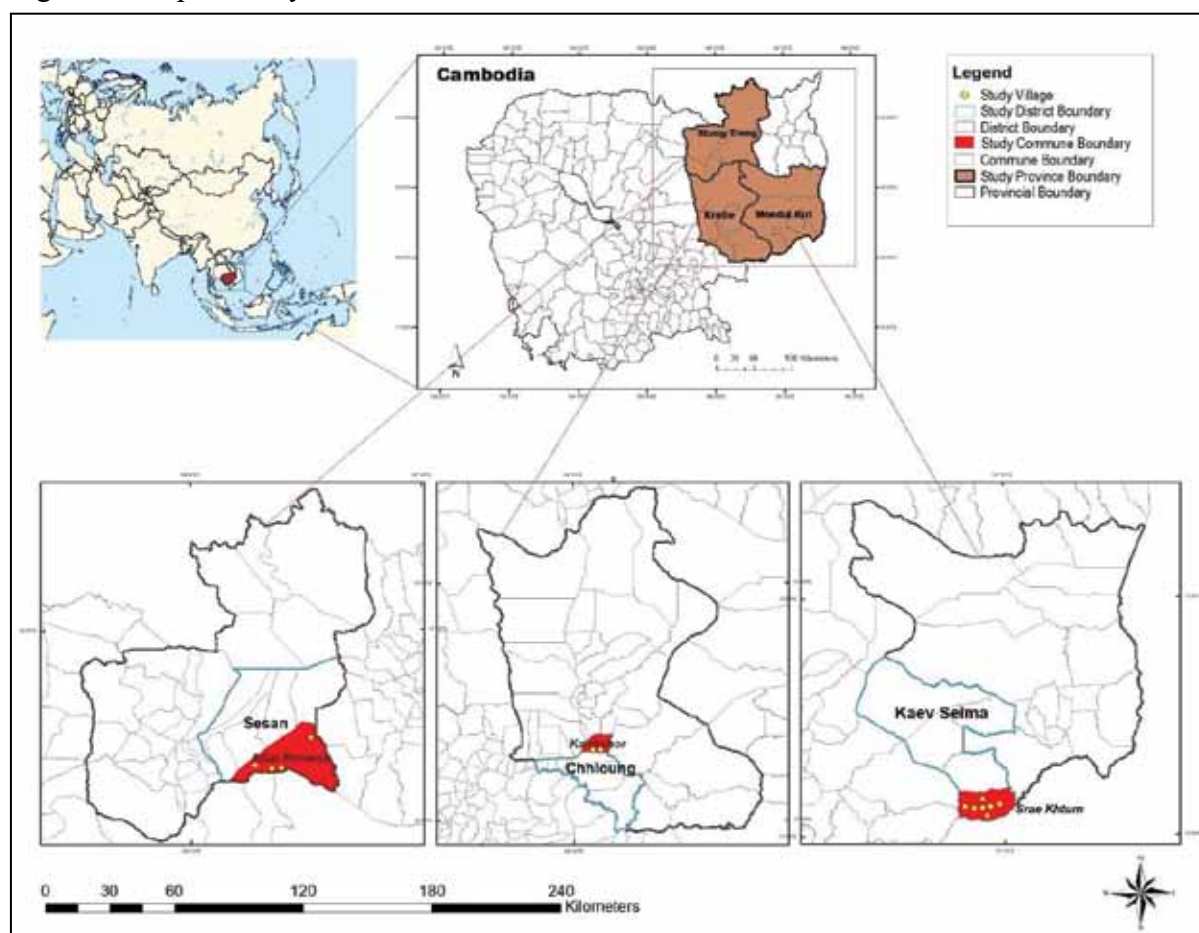
Data collection tools	No. of participants
Key informant interviews (local authorities in Steung Treng, Mondulkiri, and Kratie and NGOs/CBOs)	15
Survey with households who have migrant members	240

This study extensively employed primary data collection methods to investigate the relationship between climate change and migration. Surveys of 240 households with migrant members were conducted. The survey questionnaire was constructed and piloted to check whether the questions fit the local context and to see if there was any need for further revision. The interview was conducted with migrants themselves or household heads to substitute for migrants working away during the data collection period. Three types of questionnaires were designed for household respondents, migrant members, and key informants. The questionnaire specifically aimed to gain the following information: 1) household socioeconomic situation; 2) information about each household member regarding their backgrounds (i.e. age, education level, marital status) as well as migration-related information; and 3) their experiences of climatic events and the impacts on their livelihoods. Data obtained from the survey was analysed through specific data analysis methods such as descriptive data analysis (cross-tabulation, percentage, mean value, etc.) and analytical statistics, employing t-tests and ANOVAs to illustrate how climate change and migration interact.

Table 3: Distribution of total samples by commune

Provinces		Sre Ktum	Kbal Romeas	Kanhchor	Total
Households	Female head	5	12	15	32
	ID Poor	36	17	17	70
	General	39	51	48	138
Migrant members	Male	66	71	91	228
	Female	79	72	65	216
Local authorities	Male	6	5	1	12
	Female	0	0	2	2
Local NGOs	Male	1	0	0	1
Total		232	228	239	699

Figure 4: Map of study sites



Source: Authors (2023)

Training on how to conduct the questionnaire was provided for 15 enumerators at CDRI from 26th – 27th June 2023. Following this, the questionnaires' pilot test and final revisions took place on 28th June in Chheu Teal Phluoh Kraom Village of Kanhchor Commune in Kratie Province. After completing the pilot and revision, two groups of enumerators (five members in each) departed for Steung Treng Province and Monduliri Province, while one team stayed

in the Kratie Province. Surveying households and key informant interviews commenced from 29th June and until 4th July 2023. Notably, July 1st fell on the general election campaign, and the local authorities advised us not to interview the respondents. In total, 80 household surveys were collected in each province, comprising 240 interviews. A total of 444 migrant samples were collected by using separate survey questionnaires. Of all interviewed households, 32 women-headed households, 70 poor households, and 138 general families were interviewed; 228 migrants were male and 216 were female. We completed 15 interviews with key informants (12 males and two females of communes and village authorities and one NGO representative) (see Table 3 below). Finally, the national validation workshop was held with 45 representatives from relevant stakeholder groups, such as district and commune level, government officials, NGOs, researchers, academia, development partners, policymakers and practitioners on August 31st, 2023.

4. Results and findings

In this section, extracting from the primary quantitative and qualitative data, we provide (1) demographic, social, and economic information on households and characteristics of migrant members, (2) the past and current trends of climate hazards that the local people have encountered over in the past ten years, their perception of the impact severity on their livelihoods, and (3) various factors influencing migration coupled with the coping capacities.

4.1. Characteristics of migrant respondents

4.1.1. Profile of migrants

Table 4 below describes the overall demographic characteristics of migrants from three different study sites: Kanhchor in Kratie Province, Sre Ktum in Mondulkiri Province, and Kbal Romeas in Steung Treng Province. The table organises the data into several categories, such as gender, relation to household head, age, and marital status. The table allows for a comparative analysis of the population characteristics and migration patterns across the three communes and the aggregate data for all the migrants. Kbal Romeas has more male migrants (59.1 percent) compared to female migrants (40.9 percent), while Kanhchor and Sre Ktum have more female migrants (54.5 percent and 51.0 percent) than males (45.5 percent and 49.0 percent). Overall, slightly more males (51.4 percent) are present. Most of the individuals who migrate are the sons or daughters of the household heads (80.7 percent in Kanhchor, 53.8 percent in Sre Ktum, and 53.9 percent in Kbal Romeas), followed by heads of households themselves (4.8 percent, 16.6 percent, and 15.6 percent), son in law or daughter in-law (6.9 percent, 13.8 percent, and 8.3 percent) and husband or wife (4.8 percent, 16.6 percent, and 15.6 percent, respectively). Other relationships with the household head (less than 4 percent) are less common among migrants. On average, the majority of migrants are around 25.7 years old, with Sre Ktum having the most senior migrants (27.8 years) and Kanhchor having the youngest migrants (24.1 years). The average age at migration is around 20 years old, with Sre Ktum having the highest age of migration (23.9 years) and Kbal Romeas the lowest (19.1 years). Regarding marital status, Kanhchor has mostly single migrants (71.6 percent), while the majority in the two other provinces are married (56.7 percent in Sre Ktum and 51.4 percent in Kbal Romeas). Different marital status categories are uncommon. Most migrants have a whole-year migration (48.3 percent in Kanhchor, 55.2 percent in Sre Ktum, and 35.1 percent in Kbal Romeas), followed by seasonal (9.7 percent, 29.7 percent, and 43.5 percent, respectively). Permanent migration is more prevalent in Kanhchor (37.2 percent) than in Sre Ktum (10.3 percent) and Kbal Romeas

(11.0 percent). Accompanying parents account for 3.5 percent in Kanhchor, 4.8 percent in Sre Ktum and 10.4 percent in Kbal Romeas and other migration types (1.4 percent) in Kanhchor.

Table 4: Profiles of migrant members by commune (percent)

Demographic information	Kanhchor (N=145)	Sre Ktum (N=145)	Kbal Romeas (N=154)	Overall (N=444)
Gender				
Male	45.5	49.0	59.1	51.4
Female	54.5	51.0	40.9	48.7
Relation to the household head				
Head of household	4.8	16.6	15.6	12.4
Husband or wife	2.8	9.7	11.0	7.9
Sister or brother-in-law	0.0	3.5	2.6	2.0
Son or daughter	80.7	53.8	53.9	62.6
Son-in-law or daughter-in-law	6.9	13.8	8.4	9.7
Grandchild	3.5	2.1	5.8	3.8
Stepchild	1.4	0.0	0.0	0.5
Parents or parent-in-law	0.0	0.0	1.3	0.5
Niece or nephew	0.0	0.7	1.3	0.7
Age of migrant members (averaged year)	24.1	27.8	25.1	25.7
Age when they migrated (averaged year)	19.7	23.9	19.1	20.9
Marital status				
Married	24.1	56.7	51.4	44.1
Single	71.6	35.5	42.1	49.8
Divorced	0.7	2.1	4.3	2.4
Widow	3.6	5.7	2.1	3.8

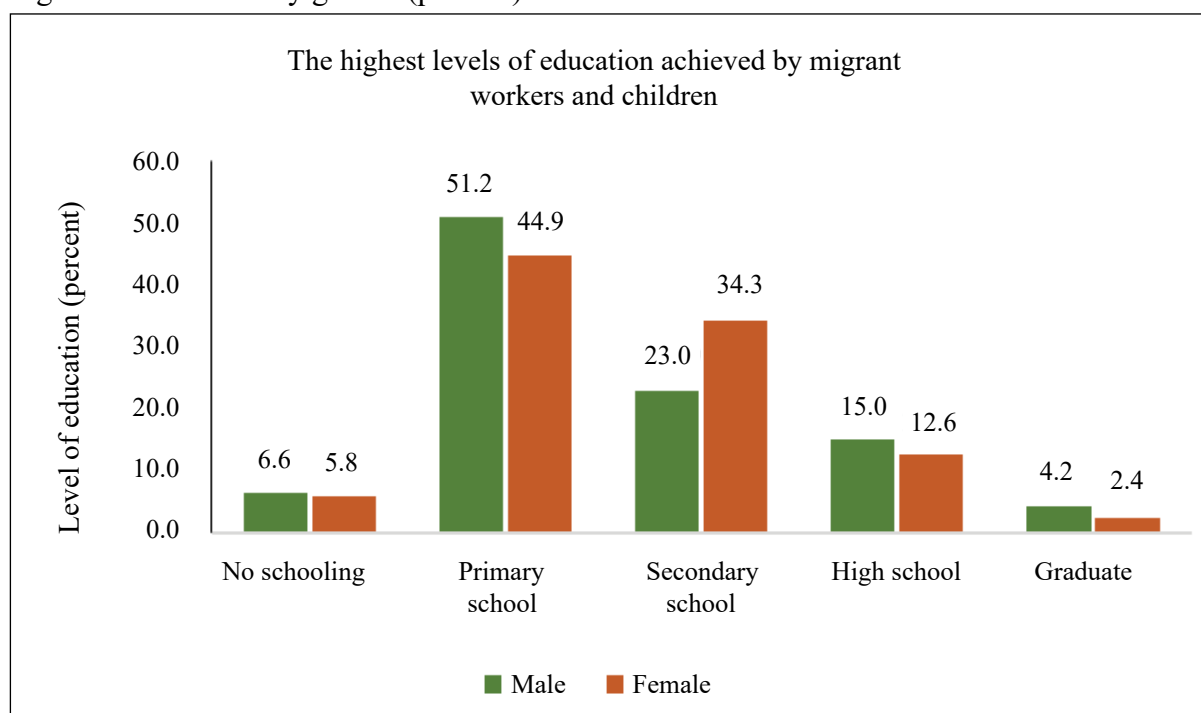
Source: Survey, July 2023

4.1.2. Education

Half of the workers migrate for the whole year, while some migrate seasonally and bring their young children with them. More female than male migrants are likely to drop out of school at primary school age, while more males complete secondary school. Figure 5 depicts disparities in educational achievement based on gender among migrant children in the study sites, offering a visual overview of academic levels attained. Beginning at the primary school level, males (51.2 percent) surpass females (44.9 percent).

Conversely, a larger proportion of females (34.3 percent) completed the secondary level than males (23.0 percent). At high school and university levels, lower percentages of females (12.6 percent and 2.4 percent, respectively) completing these levels than males (15.0 percent and 4.2 percent, respectively) underline potential hurdles or limited opportunities for advanced education among females. Moreover, the illiteracy rates among males and females are similar (6.6 percent and 5.8 percent, respectively).

Figure 5: Education by gender (percent)

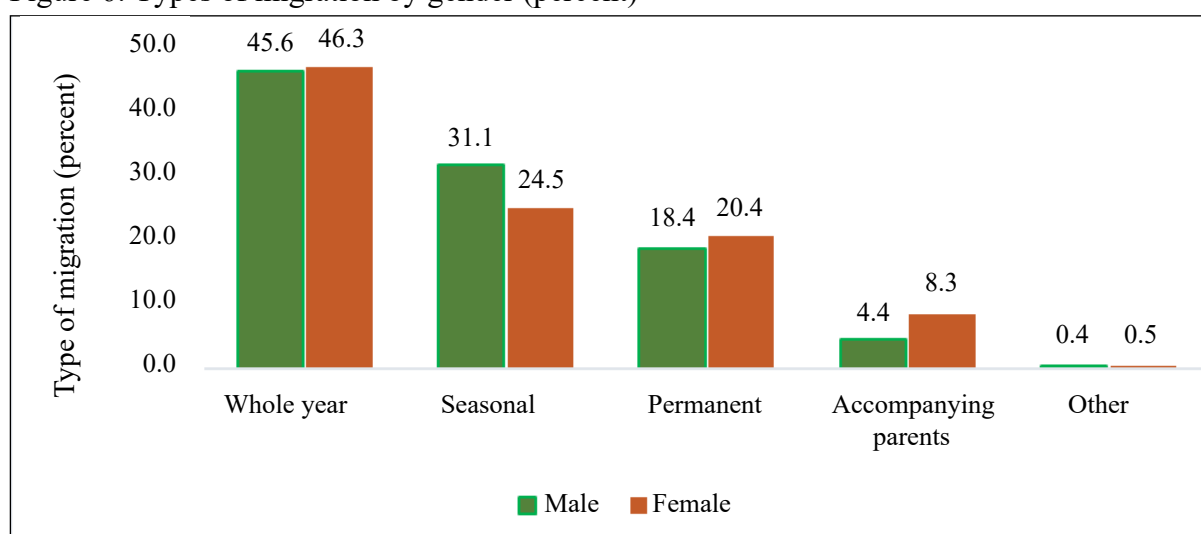


Source: Survey, July 2023

4.1.3. Types of migration

Most migrants are married or single sons and daughters of the family head. Both males and females in the target study sites proportionally move out to find jobs, showing the gender roles of young women (on average 24 years old) accessing job opportunities who are less likely to rely on unpaid jobs or stay at home. In Cambodia, children help parents by earning income, which is a great responsibility and culturally crucial for families.

Figure 6: Types of migration by gender (percent)



Source: Survey, July 2023

Illustrated in Figure 6 are the patterns of migration categorised by gender. The analysis reveals that the predominant migration pattern, regardless of gender, is pursuing year-round employment opportunities. This is succeeded by seasonal migration, with a higher percentage

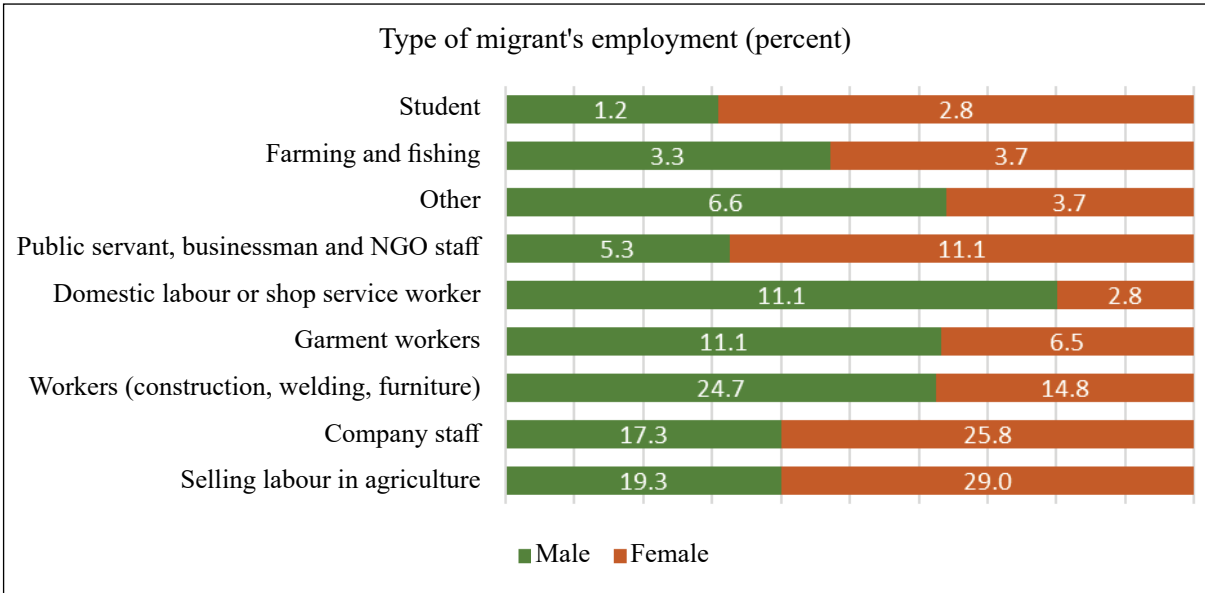
of male migrants (31.1 percent) engaging in such endeavours than their female counterparts (24.5 percent). Permanent migration, a significant phenomenon within the study areas, showcases a unique trend where more females (20.4 percent) opt for this approach than males (18.4 percent). Notably, a distinctive insight surfaces: a greater percentage of females (8.3 percent) than males (4.4 percent) are identified as migrating in the company of their parents.

4.1.4. Types of employment and migration destinations

Both male and female migrants have access to diverse jobs, depending on their experiences, skills, education, and networking. Figure 7 shows the unique employment patterns observed within the migrant population, delineated by gender-based classification. The information reveals that a substantial portion of males is primarily occupied as casual labourers for difficult and dangerous jobs, particularly in domains associated with construction and welding, accounting for a significant proportion of 24.7 percent. Furthermore, an interesting trend emerges among female migrants, with a noteworthy proportion finding employment as company staff, surpassing their male counterparts at 17.3 percent. Migrants are also engaged in various other occupations, albeit to a lesser extent, including roles like garment workers, domestic labourers, and public servants.

The NGO representative mentioned that some migrants moved to the Puchri Commune of the Pichda District in Mondulkiri Province to work full-time in pepper plantations owned by a Korean private company, a gold mining company, or other rubber farms owned by a French private company. Some migrants move short-term during the non-harvesting season to do construction work [Key informant interview with Program Coordinator, My Village Organisation, Mondulkiri Province on June 30th, 2023]. Some villagers in Kbal Romeas Village migrate seasonally to find available jobs as labour sellers at commercial farms or private companies near the village within the commune area. Lay Company mainly harvests palm oils, bananas, cashew nuts, and rubber plants [Key informant interview with Head of Kbal Romeas Village, Stung Treng province on July 2nd, 2023]. More jobs are available in urban areas because local residents do not accept dangerous labour jobs and are mainly involved in the service industry.

Figure 7: Types of employment by gender (percent)

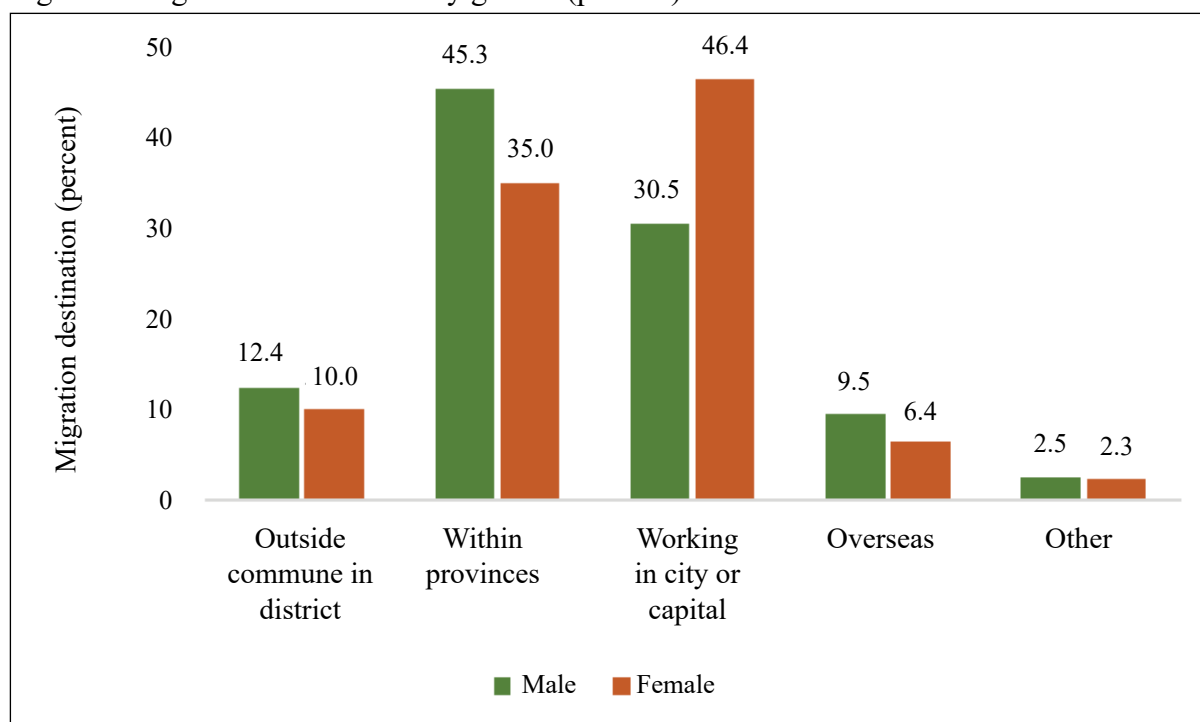


Source: Survey, July 2023

While there are job opportunities in the local areas where men and women can work in provincial towns, Phnom Penh capital city, other major cities, and special economic zones like Sihanouk Ville and Bavet City, few locals have access to overseas jobs. Most rural villagers find it costly and cannot afford to travel abroad to find employment or there is not much information surrounding it.

Figure 8 illustrates the distribution of males and females across various migration destination categories within the study areas. Migration within and outside the provinces are prevalent patterns among migrants of both genders. Women are more inclined to migrate to cities (46.4 percent) than men (30.5 percent). Conversely, men have a more pronounced tendency to migrate within the province (45.3 percent) than females (35.0 percent). The proportion of male and female migrants engaged in work outside the commune and overseas is both minimal and alike. Migrants most likely consider going as individuals and rarely go as a family when seeking a job in the cities. It has also been noticed that there have been immigrants coming to the communes to work for cassava farms or agricultural labour [Key informant interview with commune council, Kanhchor commune, Kratie province on July 2nd 2023]. While most migrants work for factories, within the garment industry, and in construction in major cities such as Phnom Penh and Kampong Som, a few migrants prefer to work overseas, in Japan or South Korea [Key informant interview with Head of Prek Chom Lak Village, Kanhchor Commune, Kratie province on July 4th 2023].

Figure 8: Migration destinations by gender (percent)



Source: Survey, July 2023

4.1.5. Incomes by migration destination

Overseas employment offers higher incomes than domestic jobs and even higher than in the local villages. Although some female migrant workers served at private companies, government, or NGOs, the average incomes earned by women are lower than men in all types of migration destinations, except for provincial work.

Table 5 delivers an overview of the average monthly earnings of migrants, taking into account their gender and the places they have migrated to. In a general sense, male migrants tend to secure higher incomes compared to their female counterparts. The data indicates that the average monthly incomes for males is USD 218.13, while for females, it is slightly lower at USD 185.85. However, women’s earnings are lower than the minimum wage of 2023 (US\$200 per month) set by the government.

When examining the influence of migration destination on earnings, it becomes evident that overseas migration holds the potential for greater financial gain. This is true across both genders. Male migrants who have chosen overseas destinations report an average monthly income of USD 611.25, whereas female migrants in the same category earn around USD 294.10 per month. By focusing on migrants within urban areas, regardless of gender, the data shows they can anticipate relatively similar earnings, averaging around USD 200 per month. This suggests that urban migration doesn’t necessarily lead to substantial gender-based income disparities.

In contrast, migrants working within the same district as their point of origin tend to earn comparatively lower incomes. This translates to an average of approximately USD 132 per month for males and USD 69 per month for females under similar circumstances.

Table 5: Total incomes by migration destination and gender (in USD per month)

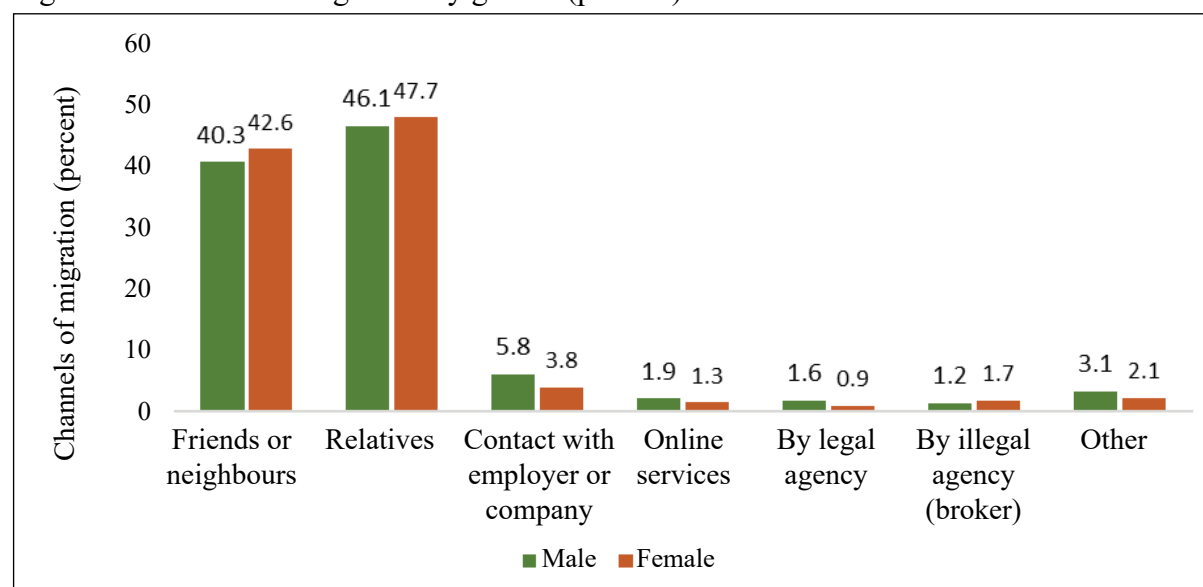
Migration destinations	Male	Female	Total
Outside commune in the district	132.63	69.24	101.19
Within provinces	178.52	184.85	181.32
Working in a city or capital	201.13	197.40	198.92
Overseas	611.25	294.10	484.39
Averaged incomes	218.13	185.85	202.32

Source: Survey, July 2023

4.1.6. Channels of migration

Social connections are crucial in migrating channels through friends, neighbours, and relatives. This happens when people migrate to seek job opportunities in the cities or neighbouring cities such as Thailand, while access through formal processes remains rare.

Figure 9: Channels of migration by gender (percent)



Source: Survey, July 2023

Figure 9 displays different approaches to how individuals of different genders secure employment. Nearly half of the participants (both males and females) depend on their social connections, such as friends, neighbours, and relatives, to discover job prospects. The second most prevalent method involves directly communicating with employers or companies, closely followed by online services. Comparatively fewer standard methods include legal or illegal agencies and other avenues. The graph also highlights intriguing disparities between males and females. For instance, females tend to rely more on relatives and friends, while males slightly favour online services and direct communication with employers or companies.

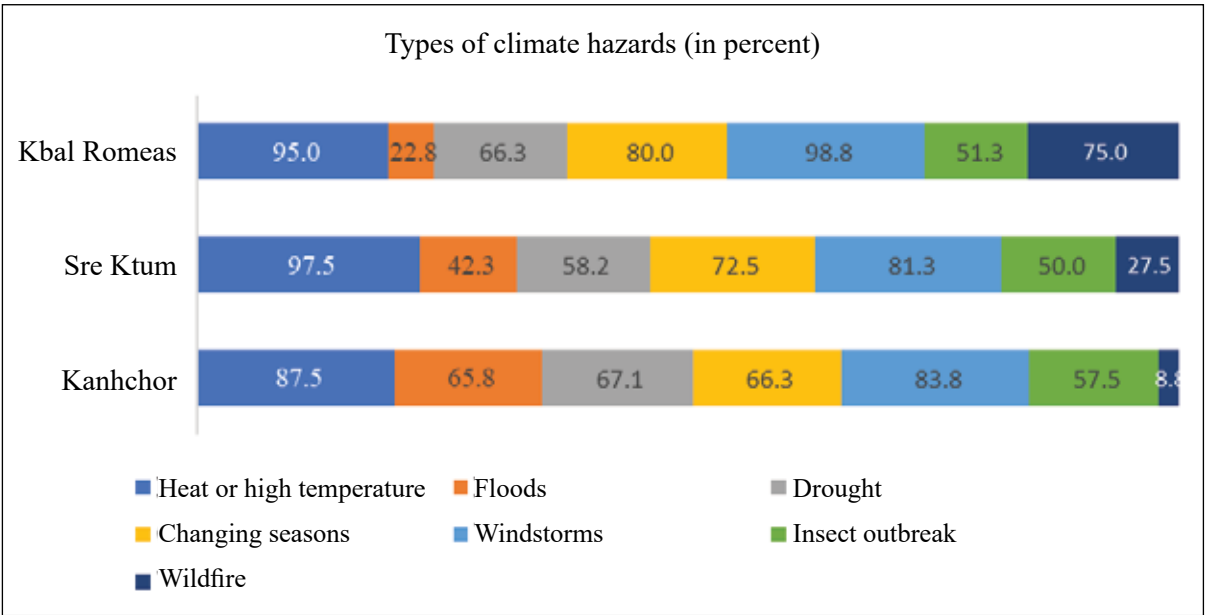
4.2. Exposure to climate hazards

The following section describes the level of exposure to climate hazards, the effects local people have experienced in the past ten years, and different coping strategies in each of the study sites.

4.2.1. Types of climate hazards

The local communities' vulnerability level depends on the degree of exposure and adaptive capacity of people confronted by the climate hazard. Different communes are exposed to and impacted differently by different types of environmental threats.

Figure 10: Types of climate hazards the locals have experienced in the past ten years by commune (in percent)



Source: Survey, July 2023

Figure 10 illustrates the varying types of climatic hazards on populations residing in the regions. Overall, participants in the study communes have encountered a range of climatic hazards including heatwaves, floods, and droughts, within the past decades. However, each locality grapples with distinct challenges and susceptibilities due to geographical characteristics and related factors. For instance, the local community Kanhchor reported higher rates of droughts (67.1 percent), flooding (65.8 percent), and insect outbreaks (51.3 percent) but experiences lower susceptibility to wildfires (8.8 percent). In contrast, the surveys revealed that the people in Sre Ktum experienced a higher proportion of heatwaves (97.5 percent), windstorms (81.3 percent), changing seasons (72.5 percent), and droughts (58.3 percent), and, yet relatively

lower susceptibility to floods (42.3 percent) and wildfires (27.5 percent). The villagers in Kbal Romeas noted more frequencies of windstorms (98.8 percent), high temperature (95.0 percent), changing seasons (80.0 percent), wildfires (75 percent), droughts (66.3 percent), and insect outbreaks (51.3 percent) while rates of flooding are low (22.8 percent).

4.2.2. Locals' perceptions of climate hazard impacts

Table 6 analyses how climate change affects multiple areas and the ANOVA test was used to explore significant differences among the study communes. The table covers seven climatic hazards: heatwaves or abnormally high temperatures, floods, droughts, changing seasons, windstorms, insect outbreaks, and wildfires. The table also shows the impact levels of these hazards, where the overall assessment indicates the impacts range from 'very low,' 'low,' and 'moderate.' The 'high temperatures' and 'windstorms' categories mark the most severe hazards at 'moderate' impact levels. Less severe hazards at 'low' impact include 'droughts', and 'insect outbreaks'. The statistical tests for the drought and change in rainfall are also significant, while the test for insect outbreaks is not statistically significant. Finally, wildfires appear to have a 'very low' impact severity with statistical significance.

Table 6: The extent to which local people perceived being impacted by climate hazards over the past ten years

Climate hazards	Kanhchor (N=80)		Sre Ktum (N=80)		Kbal Romeas (N=80)		Overall (N=240)	
	WAI	OA	WAI	OA	WAI	OA	WAI	OA
High temperatures	0.45	moderate	0.63	high	0.63	high	0.57***	moderate
Floods	0.32	low	0.21	low	0.16	very low	0.23***	very low
Drought	0.33	low	0.30	low	0.42	moderate	0.35**	low
Changing seasons	0.29	low	0.41	moderate	0.45	moderate	0.38***	low
Windstorms	0.35	low	0.41	moderate	0.74	high	0.50***	moderate
Insect outbreaks	0.27	very low	0.30	low	0.36	low	0.31	low
Wildfires	0.03	very low	0.12	very low	0.45	moderate	0.20***	very low

Remarks: WAI indicates the weight average index measured on a 5-point scale at very low (0.00-0.20), low (0.21-0.40), moderate (0.41-0.60), high (0.61-0.80), and very high (0.81-1.00). OA indicates overall assessment. Asterisks (*, **, and ***) denote significant at 0.10, 0.05 and 0.01, respectively.

Source: Survey, July 2023

Heatwaves or high temperatures at Kanhchor were most frequently reported in the 'moderate' impact level (WAI=0.45). However, Sre Ktum and Kbal Romeas are more sensitive to heatwaves as they reported more in the 'high' level (WAI=0.63 and WAI=0.64). Floods at Kanhchor and Sre Ktum have a balanced distribution of responses across the 'low' level of impact (WAI=0.32 and WAI=0.21). At the same time, Kbal Romeas is even less vulnerable to flooding as it has a proportion of responses in the 'very low' impact category (WAI=0.16). Kanhchor and Sre Ktum have less experience with droughts at 'low' levels (WAI=0.33 and WAI=0.30), while Kbal Romeas are more affected at 'moderate' levels (WAI=0.42). Changing seasons at Kanhchor had an even distribution of responses at the 'low' impact level (0.29), while Sre Ktum and Kbal Romeas had more responses in 'moderate' (WAI=0.41 and WAI=0.45). Windstorms at Kanhchor have a large portion of responses in the 'low' level (WAI=0.35), while Sre Ktum has a

more uniform distribution of responses at the ‘moderate’ level (WAI=0.41). Kbal Romeas has a remarkable number of responses at a ‘high’ level (WAI=0.74) for windstorms. Kanhchor is less susceptible to insect outbreaks than other hazards at ‘very low’ (WAI=0.27). They more critically impact Sre Ktum and Kbal Romeas, who are affected at ‘low’ (WAI=0.30 and 0.36). Sre Ktum and Kbal Romeas are less prone to wildfires at ‘very low’ levels (WAI=0.03 and WAI=0.12), while Kanhchor has a substantial proportion of responses at ‘moderate’ levels (WAI=0.45).

The vice head of the O’Rona Village in Mondulkiri province emphasised that the loss of forest was one of the major causes of the changing weather in the region, particularly leading to the gradual increase in temperature. At the same time, rainy and dry seasons have become unpredictable. Drought historically occurred between January and April and affected common crops in the village, such as cashews, cassava, rubber, rice, beans, and corn. The farmers who plant cassava were heavily impacted by drought since this crop cannot survive in high temperatures, causing them to replant their failed crops multiple times. After April, heavy rain also severely damaged cassava, and more pests emerged. Growing crops in the past using traditional agricultural practices, in which climate and natural conditions played a prominent supporting part is now impossible. The soil used to be highly fertile but has now become infertile.

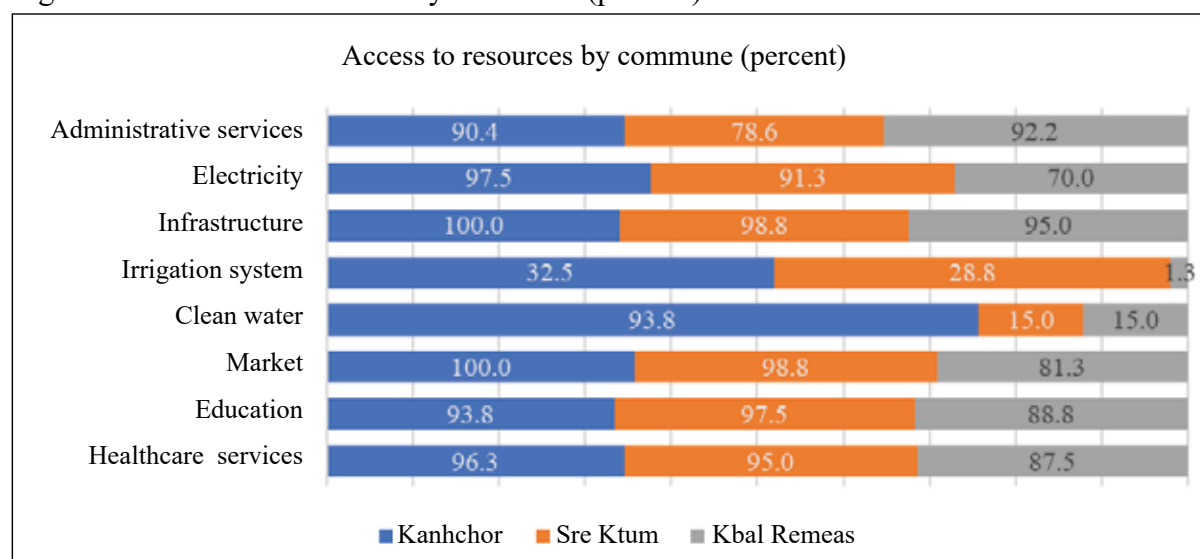
4.3. Adaptive capacity

The communities’ vulnerability depends on the degree of exposure and their ability to offset impacts with their coping capacity. Coping strategies comprise access to community resources or public services, dealing with the consequences, engagement in commune development and planning, and support and access to weather and climate information.

4.3.1. Communes’ access to resources

Figure 11 shows the accessibility levels to various essential resources across the three surveyed communes. The data illustrates that participants in these communes can support themselves through specific services crucial to their well-being and development. The analysis reveals a promising trend, wherein a significant proportion of respondents in each commune enjoy access to service benefits within their localities. These indispensable services encompass administrative facilities, electricity supply, local markets, educational institutions, and healthcare facilities.

Figure 11: Access to resources by commune (percent)



Source: Survey, July 2023

Nonetheless, the data also uncovers persistent disparities in resource accessibility. Despite the positive outlook, specific resources remain less accessible. Notably, the figure indicates that a relatively lower percentage of respondents across all three communes have access to irrigation systems. The accessibility rates are 32.5 percent for Kanhchor, 28.8 percent for Sre Ktum, and only 1.3 percent for Kbal Romeas. Further investigation into the data reveals another critical concern – the limited accessibility to clean water. While the participants in each commune have access to clean water, the figures expose a shortfall for Sre Ktum and Kbal Romeas. Only 15 percent of the participants in these communes can access clean water.

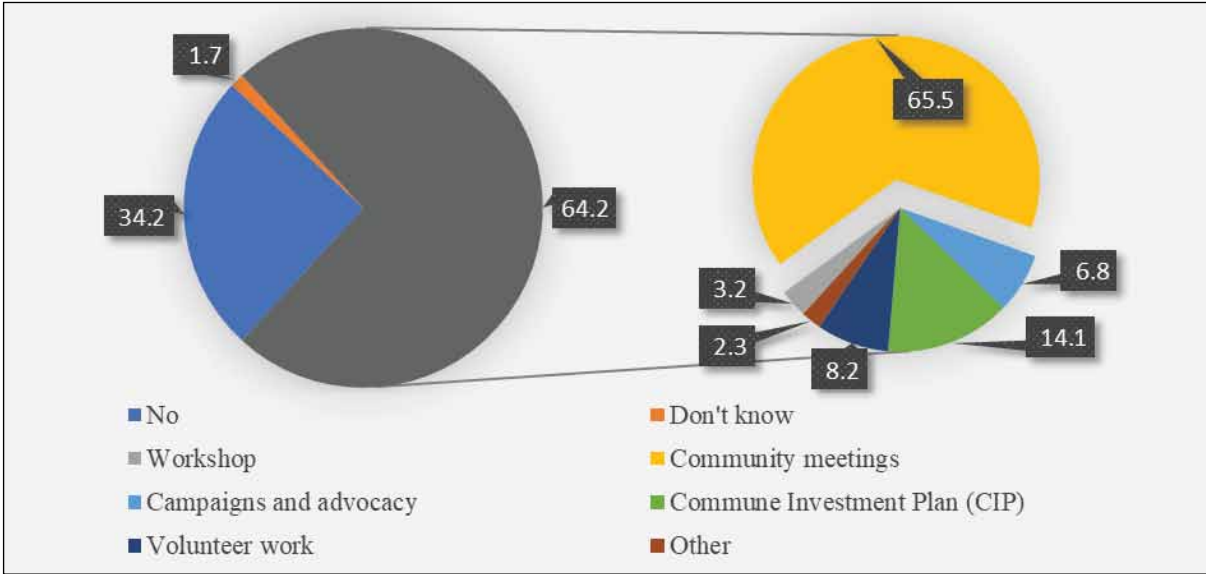
The NGO representative suggested that support in terms of financial and technical elements is necessary for local farmers, and an effective irrigation system, which requires efficient water supply for agricultural activities and electricity, is needed to supply each household with water.

Another challenge to be tackled is the market. The villagers produce and supply organic vegetables in the local market through the Kor Prey Community Initiatives. Farmers are also mobilising resources in Mondulkiri to develop an avocado community, considering the abundance of avocados from the local farms. Those income-generation activities are essential for the local villagers to produce specific crops. The villagers can also work on providing premium-quality produce for the local market and then eventually reach out to cross-border suppliers for international markets. However, infrastructure and transportation are the main barriers to local farmers promoting local products.

4.3.2. Participatory engagement in the commune development

Out of all the survey participants, more than half (64.2 percent) participated in multiple activities to improve their local community; see Figure 12. Sixty-five percent of participants attended the meetings organised by the commune, while a smaller group (14.1 percent) contributed to the commune’s investment plan. A few others did voluntary work, participated in campaigns and advocacy, or engaged in other activities.

Figure 12: Participatory engagement in the commune development (percent)



Source: Survey, July 2023

Agriculture in Sre Ktum commune has shifted from traditional to technical farming practices because the people received support, training and material from WWF Cambodia. The

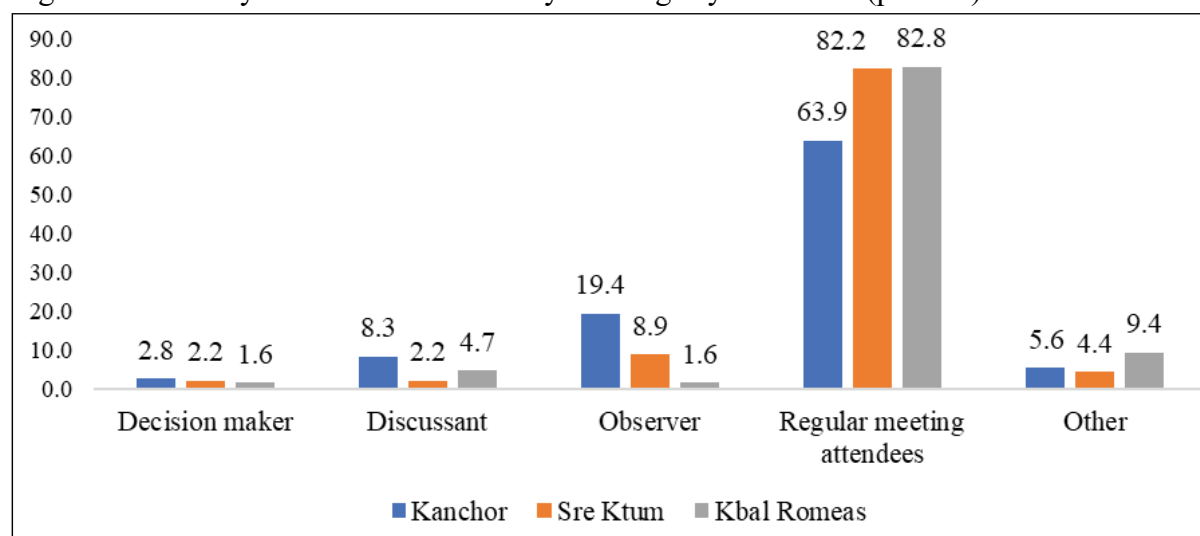
community condition is much improving when compared to before the REDD+ project. REDD+ and WWF Cambodia have funded roads, schools, toilets, and infrastructure. The commune partners with the Wildlife Conservation Society (WCS) Cambodia to implement the REDD+ project, which aims to promote community development to reduce the migration rate. O Am, O'Rora, and Srae Lavy in Mondulkiri province are the villages that benefit from the REDD+ project. WCS also provided a budget to support community development and similar awareness-raising activities to tackle land encroachment. These illegal logging issues could lead to deforestation and climate change. The REDD+ community could gain between USD 10,000 to 50,000 annually for protecting their forest. In 2023, the commune obtained over USD 70,000 from the REDD+ project implemented in the three villages that have been classified as Community Protected Areas (CPA). WCS, WWF and the commune have been discussing how the money obtained from the project can be used to improve the villagers' livelihood through livelihood diversification and household farming.

The village chief of Sre Ktum expects to reduce migration by increasing local job opportunities and income generation activities. If the villagers can earn money from their community, they will not need to migrate to find an income in the future. The village chief expects that the REDD+ project, provincial environmental department, and WWF will continue to support the village. The Provincial Department and District Office of Environment have also raised awareness of climate change and are working with the supporting NGOs. Indeed, the commune councils are working to mobilise resources and support and the Provincial Department and District Office are working with the Commune Councils to carry out some activities to reduce the impact of climate change on migration. For example, the Provincial Department of Agriculture manages the proposed agricultural projects [Key informant interview with Chief of Sre Ktum commune, Mondulkiri province on July 3rd, 2023].

4.3.3. Key roles and responsibilities in community development

The survey participants were also asked about their participation in community meetings, as depicted in Figure 13. A significant majority of the participants were identified as consistent attendees of these meetings; 63.8 percent in Kanhchor, 82.2 percent in Sre Ktum, and 82.8 percent in Kbal Romeas. In contrast, a smaller fraction, approximately 2.0 percent in each of the surveyed communes, assumed a decision-making role during these meetings.

Figure 13: The key roles in the community meetings by commune (percent)



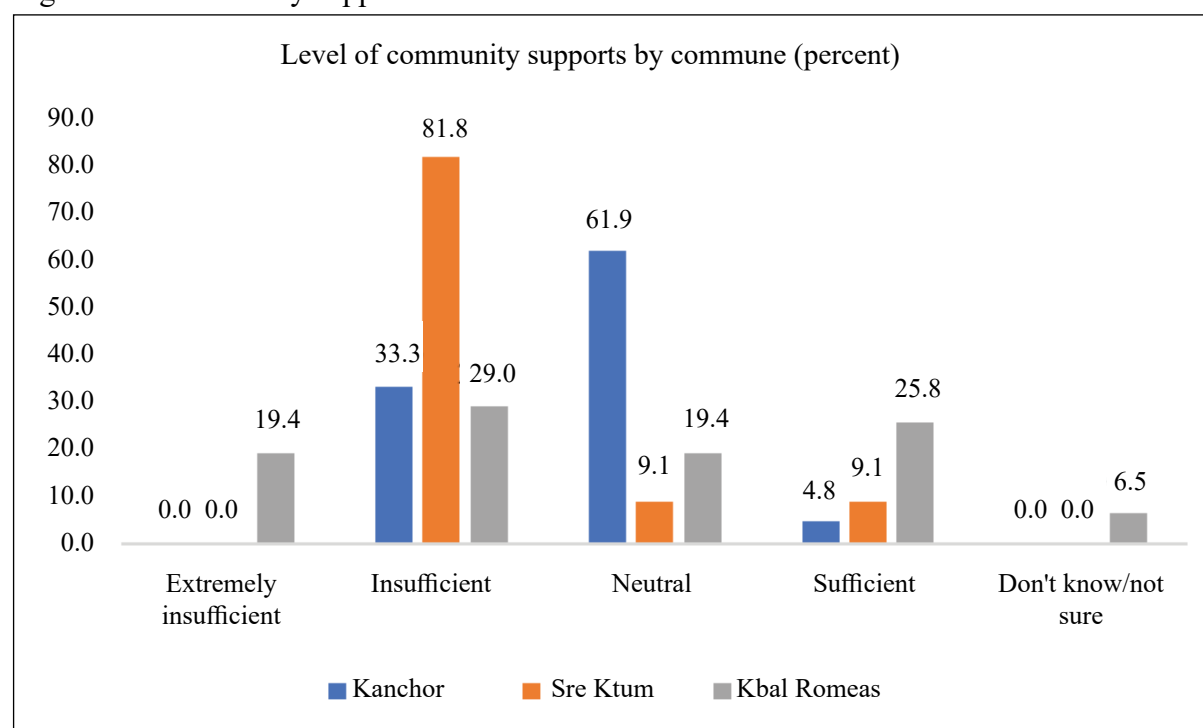
Source: Survey, July 2023

4.3.4. Access to local support

Participants from the study communes were also queried about the adequacy of the assistance they received from the community, as described in Figure 14. Overall, the majority of the participants, irrespective of their geographical locations, indicated that the aid they had been provided fell short. To delve into the specifics, in the Kanhchor area approximately one-third (33.3 percent) of the participants conveyed that the support they received was lacking. A larger portion (61.9 percent) expressed a neutral stance, and a minor fraction (4.7 percent) considered the assistance satisfactory.

Conversely, in the Sre Ktum region, a significant proportion (approximately 81.8 percent) of the participants expressed dissatisfaction with the support level, while only 9.0 percent acknowledged its sufficiency. Shifting focus to Kbal Romeas, it was observed that 19.3 percent of the participants found the assistance significantly inadequate, and an additional 29.0 percent of the participants considered it lacking. Within this region, 25.8 percent of respondents stated that they were happy with the support they received.

Figure 14: Community supports



Source: Survey, July 2023

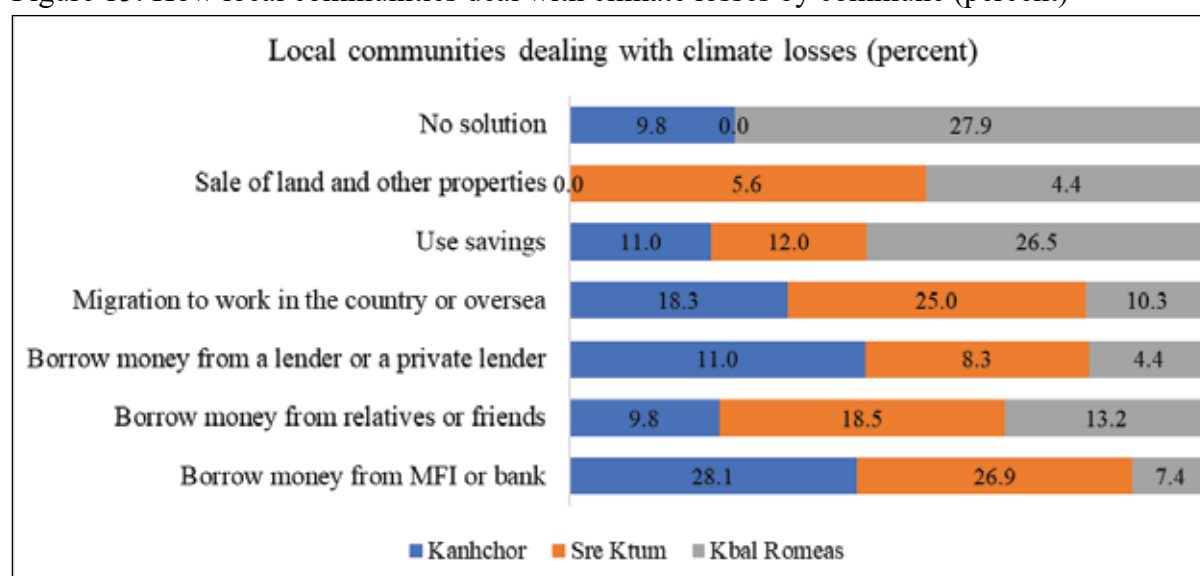
4.3.5. Local adaptive capacity and coping strategies

Figure 15 illustrates the local community's diverse strategies to address climate-induced losses within their regions. Each commune exhibits distinctive patterns of solutions in response to the challenges they face. In Kanhchor commune, the participants commonly borrowed money when experiencing financial difficulty. In Kanhchor, out of the total, 28.1 percent of the participants opted to borrow money from MFI or banks. In comparison, 11.0 percent sought financial assistance from lenders or private individuals. Furthermore, around 9.8 percent of the participants resorted to borrowing money from friends or family. A tactic the community embraces is migration, with approximately 18.3 percent of the participants experiencing this option as a way to cope in the past.

Similarly, in the Sre Ktum commune borrowing money emerged as a prevalent approach. Roughly 26.8 percent of the surveyed participants in this area acquired loans from MFIs or banks, while 18.5 percent sought financial support from relatives or friends. Additionally, migration was identified as a significant strategy, with around 25 percent of the participants in this commune opting for this course of action.

Contrastingly, the Kbal Romeas commune seems to lack concrete solutions for addressing losses caused by climate impacts, with a notable proportion (27.9 percent) reporting that they do not possess any distinct approach. In this context, approximately 26.5 percent of the participants resorted to using their savings to mitigate losses. In comparison, 10.3 percent chose migration as their strategy to cope.

Figure 15: How local communities deal with climate losses by commune (percent)



Source: Survey, July 2023

According to a KII in July 2023 with the head of Sre Ktum village, Mondulkiri Province, it was emphasised that “the village has been affected by dry and hot weather. The village has no climate change resiliency or related technical coping strategy yet. At the same time, some locals keep believing and praying for rain when it is dried out, having no water for farming”. The head of O’Rona village in Mondulkiri Province also mentioned that the commune’s fund has only been used to support the development of infrastructure (a road and bridge) in the village, not for development-related activities such as migration. The district development fund and the Provincial Department of Agriculture’s annual budget have been allocated to their office agenda and should support agricultural-related matters. This village is one of the CPAs involved in the REDD+ project as stated before, the sub-village chief said that this has played a major role in limiting migration. However, the reduction of migration, climate resilience, and extensive rural pastoral agricultural use have not been integrated into the village development plan.

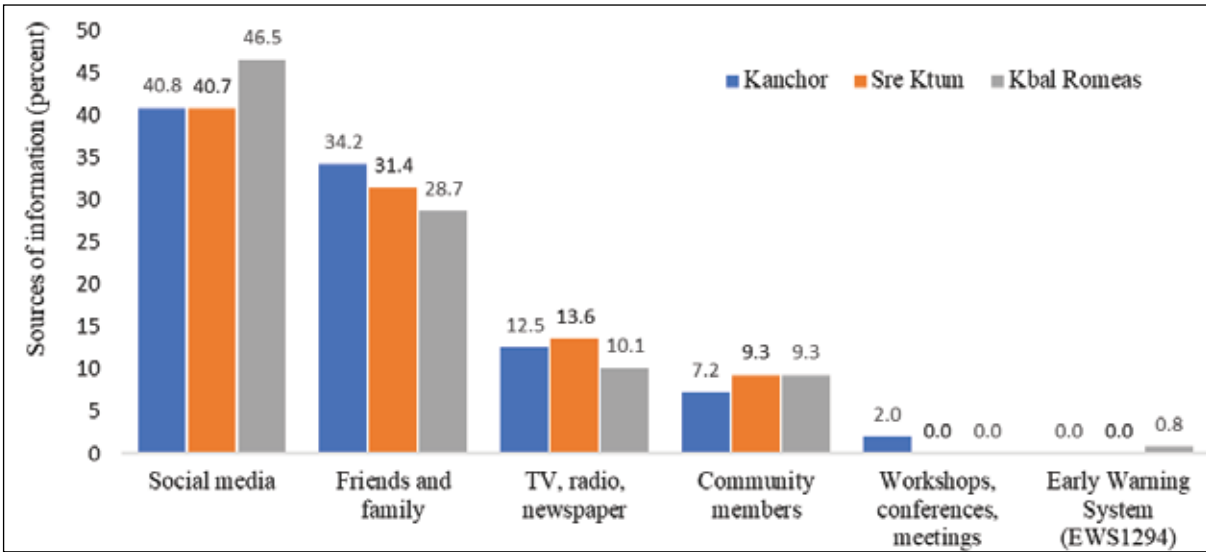
4.3.6. Sources of information about climate change

Figure 16 illustrates different sources of information through which the participants from the three study communes obtained climate-related information. The survey confirms that social media, including Facebook and Telegram, is the primary source used by 40.0 percent of the participants. The second most utilised source revolves around friends and family, with 34.0

percent of the participants in Kanhchor Commune and roughly 28.0 percent of those from Kbal Romeas and Sre Ktum relying on this network. The third and fourth sources are closely behind, encompassing mass media (including TV, radio, and newspapers) at about 10.0 percent and community gatherings at 9.0 percent, contributing significantly across the study sites. Intriguingly, other sources like NGOs and early warning systems appear relatively uncommon to most participants.

Between 2021 and 2022, nine houses in the Chnaeng village, Sre Ktum commune were damaged by windstorms and lightening. The villagers in the communities mainly received news about natural disasters from the radio. People in the village have not yet been informed about natural disaster events or have not been taught how to prepare for or respond to hazardous events that will likely occur in the future.

Figure 16: Sources of information about climate change by commune (percent)



Source: Survey, July 2023

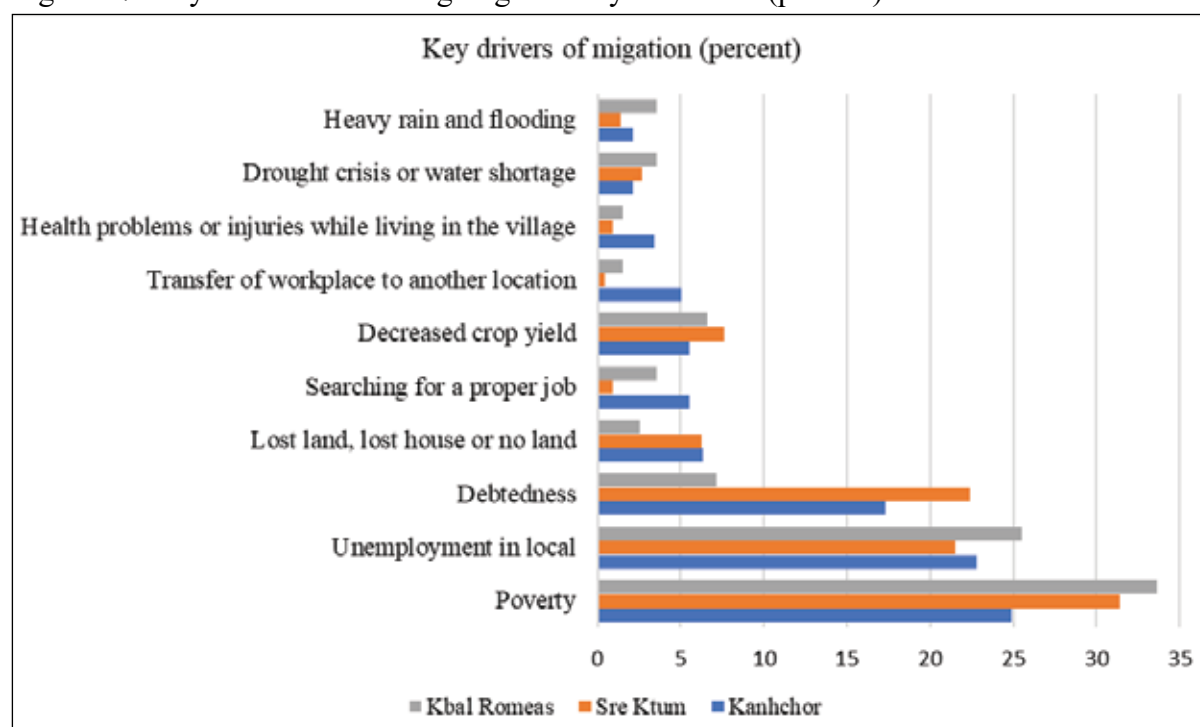
4.4. Key factors influencing migration

The survey also inquired about the main reasons that cause people to migrate, as illustrated in Figure 17. The primary factors across the three different areas studied are centred around poverty, with over 30.0 percent of the participants giving this response. Other notable aspects include being unable to find a job locally and having debt. The study also observed reasons linked to changes in the climate. These reasons consist of reduced crop harvests; the figure is 6.6 percent in Kbal Romeas; 7.6 percent in Sre Ktum; and 5.5 percent in Kanhchor. The participants also reported the reasons for drought and insufficient water (3.6 percent in Kbal Romeas, 2.7 percent in Sre Ktum, and 2.1 percent in Kanhchor) and excessive rainfall leading to flooding (3.6 percent in Kbal Romeas, 1.4 percent in Sre Ktum and 2.2 percent in Kanhchor).

There are five main factors influencing the migration patterns perceived by the participants. Figure 18 denotes that economic drivers contribute the highest proportion to migration (Kanhchor at 59.9 percent, Sre Ktum at 63.2 percent, and Kbal Romeas at 52.5 percent), followed by the social and cultural drivers at 29.1 percent, 27.8 percent, and 28.1 percent for Kanhchor, Sre Ktum and Kbal Romeas respectively. The survey also reveals that environmental factors contribute less to migration, accounting for 5.1 percent, 4.0 percent, and 7.1 percent for Kanhchor, Sre Ktum, and Kbal Romeas, respectively.

The economic loss and agriculture crop-related damages caused by climate change are significant causes of migration. The interviews with local authorities revealed that the lack of technical support in agriculture, low yield and increasing debt make people decide to migrate to earn better incomes. This is especially true for migrants who are able to find work overseas, earn higher salaries, and send money back home. The head of O'Am village, Mondulkiri Province, mentioned that compared to other villages in the region there are fewer migrants, 5 percent of the total 802 families in O'Am because the villagers have a better livelihood and are knowledgeable on climate change impacts and the consequences of the migration. Economic issues and lack of agricultural land mainly drive the migrants who leave for work. Usually, the villagers migrate on a short-term basis to earn enough for their family's survival. Most of those migrants take part in seasonal migrations when the harvesting period is finished. Extreme weather, like flooding in the village, adversely impacts rubber trees and cassava crops [Key informant interview with Head of O'Am village, Sre Ktum Commune, Mondulkiri province on July 2nd 2023].

Figure 17: Key factors influencing migration by commune (percent)

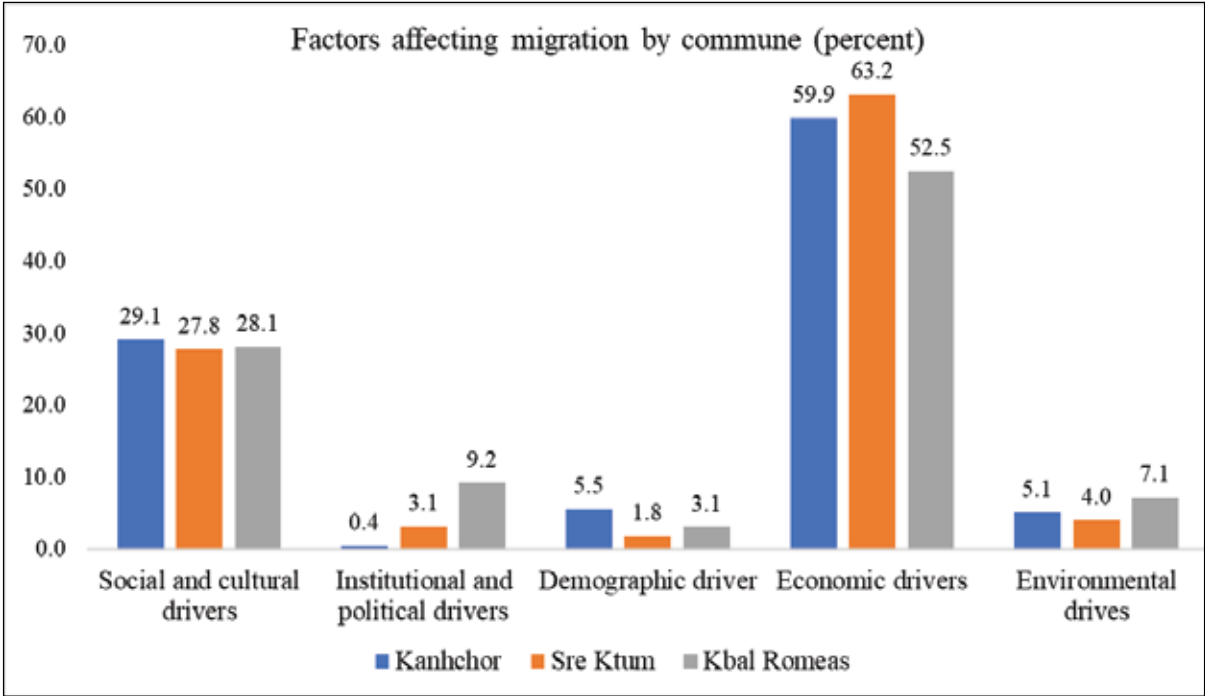


Source: Survey, July 2023

Similarly, the commune chief of Sre Ktum, Mondulkiri Province, perceived that the reasons for migration include the low agricultural yield and debt. The low yield occurs due to climate-related reasons since farmers in the commune depend on rain-fed agriculture. In particular, unseasonal rain damages cashews' flowering, while drought damages rubber. For this reason, the farmers need to spend more capital replanting those crops [Key informant interview with Chief of Sre Ktum commune, Mondulkiri province on July 3rd 2023]. Further corroborating this finding, Lapakhe village viewed financial lag, insufficient irrigation for farming, and landlessness as the major causes of migration. The main reason for migration is financial issues ... villagers rely on rain for cultivation because there is no irrigation system ... a migrant does not own any land for far mining ... migrants seek to work in Phnom Penh and other cities [Key informant interview with Head of Lapakhe village, Sre Ktum commune, Mondulkiri province on July 4th 2023].

An NGO representative revealed that most households in Mondulkiri Province have at least one person in their household of working age who are likely to migrate for employment. The representative perceived the cause of migration to be strongly linked to climate change, causing low soil fertility, which in turn causes agricultural loss.

Figure 18: Factors affecting migration by commune (percent)

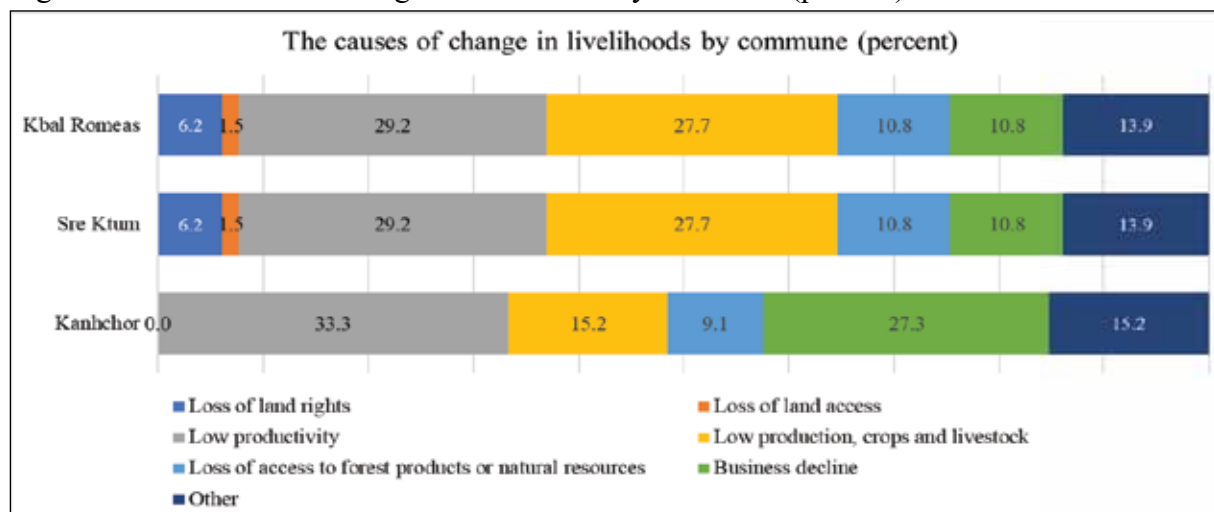


Source: Survey, July (2023)

4.5. Changes in livelihood patterns and their causes

The majority (67.1 percent) of participants in the study communes confirmed that their family members were affected by severe weather events destroying properties or assets, crops, and livestock resulting in a loss of profit and spending on more healthcare. Figure 19 provides insight into the factors contributing to the deterioration of the participants’ means of living. The primary causes across various research locations stem from reduced productivity from decreased available work. In Sre Ktum and Kbal Romeas, insufficient output, coupled with the loss of crops and livestock because of climatic stressors, especially extreme rainfalls, high temperature, drought, windstorms, or pest outbreaks, constitute additional factors that contribute to the decline in the community’s sustenance. Meanwhile, in Kanhchor, a trend in the local area is the reduction of businesses, which significantly impacts local overall livelihoods—a quarter of the participants in the three communes perceived other factors, including a lack of job opportunities, indebtedness, high-cost agricultural inputs, low price or no market for agricultural produce, the consequences of hydropower dam development, health problems, and family burdens. Since 2020, the agricultural productivity of crops like cashew, cassava, and rubber has been relatively low due to the unseasonal droughts in June-July. This heavily impacted the livelihoods of the farmers.

Figure 19: The causes of change in livelihoods by commune (percent)



Source: Survey, July 2023

5. Discussion

5.1. Long-term effects of climate change

Local people experienced extreme weather events such as high temperatures, floods, droughts, seasonal changes, windstorms, insect outbreaks, and wildfires. The perceived levels of impact ranged from moderate to high. Kbal Romeas Commune in Steung Treng Province seems to be highly exposed to extreme weather events, especially windstorms, floods, insect outbreaks, high temperatures, and wildfires. Sre Ktum Commune in Mondulkiri Province is highly exposed to insect outbreaks and high temperatures, while Kanhchor Commune in Kratie Province seems less exposed to extreme events.

In this study, local villagers emphasised their experience with high temperatures as one of the climate variabilities that more often occur during the end of February to May in Kanhchor and Sre Ktum communes and from March to May in Kbal Romeas Commune. This is consistent with Heng (2015), who found that temperatures in Cambodia have risen since 1950 by 0.8 °C, at a rate of 0.023 °C per year. Similarly, Lonn et al. (2021) found that extreme heat is increasingly prevalent (between 33 °C and 42 °C in 2019), especially in the dry season between March and April, which is higher than in the 1990s (33 °C and 38 °C). Coupled with delayed rainfalls, extreme heat burdens vulnerable families, forcing them to abandon farming practices and climate-smart agriculture techniques provided by program interventions (Lonn et al., 2021).

This study also reveals that river floods occur more frequently from July to October in Kanhchor Commune, and flash flooding often happens in Sre Ktum commune from early June to the end of September in Kbal Romeas Commune. This finding aligns with other studies (e.g., Rom et al., 2022; Try et al., 2023) that indicate flooding has become more severe and frequent. The major causes of flooding have been identified as climate change, river infrastructure development, and land-use change, especially for agricultural production (Rom et al., 2022).

In the study communes, droughts often occur throughout the year, from January to December. However, severe droughts happen from March to May in Kanhchor and Kbal Romeas Communes and from March to June in Sre Ktum Commune. Farmers in all study sites experienced low agricultural productivity, particularly cashew, cassava and rubber, caused by unseasonal droughts. Along with heat stress, Cambodia's Lower Mekong Basin regions are prone to droughts, which heavily affect water, farming, and domestic consumption (Sithirith, 2021; Miyan, 2015).

Further to floods and droughts, participants in the study communes experience other extreme weather events at different times of the year. They recognised that seasonal rainfall patterns change from April to July. Villagers in Kanhchor Commune experience windstorms from April to July and from May to August in Sre Ktum Commune, while Kbal Romeas Commune faces this event in April and May. Insect outbreaks occur in June and July in Kanhchor Commune and occasionally in June in Sre Ktum Commune, but they happen more often from May to August in Kbal Romeas Commune. Finally, forest fires usually occur in all study communes from January to April.

5.2. Impacts of climate change on rural livelihoods

This study finds that climate change adversely affects villagers' income sources and livelihoods. In Kanhchor and Kbal Romeas Communes, the impacts of climate change are unpredictable as the weather continues to change, resulting in less water for local agriculture compared to the past ten years. Droughts have caused animal deaths, while floods (the most severe destruction occurred in 2018-2019) have caused damage to households who live alongside the river and destroyed the irrigation systems in the riverine areas for a whole year.

With the shifting weather patterns, locals in the study communes are confronted with many challenges to their living and livelihoods. The changes and damages have caused lower crop yields, fish stock decline, and reduced incomes.

Notably, severe droughts have reduced the productivity of cashews, cassavas, rubber, rice, beans, and corn. Farmers who cultivate cassavas have been heavily impacted by these weather events as cassava cannot survive during the dry conditions, causing farmers to replant the crop multiple times. Also, cassava has become severely damaged by over-watering or flooding, making farmers reluctant to grow this previously relied upon crop. Some farmers have applied new agricultural techniques to deal with the changes, but these techniques seem to provide drawbacks because of the overuse of chemical fertilisers, pesticides, and herbicides, causing high production costs and health problems. Another impact of climate change was on fishing households. A few natural lakes in the villages have dried out, causing fish stocks to decline in the communes between 2005 and 2010; consequently, fishermen cannot earn enough income.

These findings are consistent with what is known in Cambodia - climate change has affected agricultural productivity and rural livelihoods due to low coping strategies, natural resource dependency, limited institutions and governance, and a lack of robust physical infrastructure (Lonn et al., 2021; Sam and Pech, 2015; Mendoza et al., 2014; Nuorteva et al., 2010). Increases in poverty could be influenced by the loss of income for those who rely on natural resources due to the aforementioned extreme weather events (Tong and Sry, 2013). This is because marginalised rural populations with multi-dimensional poverty have limited alternative livelihoods and receive insufficient local government attention to reduce disaster risk (Tong and Sry, 2013).

5.3. Characteristics and the situation of migration

Migrants chose different destinations to travel to for work: in the village or commune, outside the province, in the capital city, or overseas (especially in Japan and Korea). Approximately 30 percent of the participants migrated to Cambodia's capital city of Phnom Penh to work in the garment industry, while around 5 percent went abroad. Most migrants are young adults aged under 30 years old. Half of the migrants moved to Preah Sihanouk, Phnom Penh, and Bavet city (Svay Rieng Province), where commercial and business activities are concentrated. Some migrated to work in banana farms in nearby rural provinces. Most young adults above 18 years migrated to work at garment factories or as domestic labourers (for women) and at construction

sites (for men). Some migrants worked seasonally as labourers at private companies near the villages within the commune areas, such as in palm oil, banana, cashew nut, and rubber plantations. Adult workers earn an average daily wage of 25,000 riels (6 USD) from these jobs. Most migrants participated in long-term migration and returned home only during public holidays such as the Khmer New Year and the Pchum Ben festival.

5.4. Links between climate change and migration

This study finds that social and economic drivers directly influenced migration. Poverty, indebtedness, transfer of workplace to another location, searching for the right jobs, food insecurity, unemployment, loss of land or houses, and decreased crop yields are the factors that drove migration. These findings echo previous studies (Hunsberger et al., 2018; Jacobson et al., 2018; and Sigelmann, 2020) that found rural people tend to move out for employment opportunities to improve their livelihoods and deal with poverty, unemployment, indebtedness, and low wages.

Environmental, demographic, and political factors seemed unlikely to influence migration and its patterns. Compared to other main drivers, the locals perceived that extreme weather events, such as droughts, high temperatures, floods, and windstorms, were not the direct contributors to migration. Also, although some villagers were confronted with family burdens, dependency, and health issues, they believed those factors were unlikely to contribute towards migration. This finding differs from those of Sigelmann (2020) and Jacobson et al. (2018), who found that environmental stressors are one of the push factors influencing the decision to migrate. It also contrasts with Hunsberger et al. (2018) and Sigelmann (2020), who argued that political aspects influence migration and its outcomes.

However, climate change seemed to influence migration indirectly. Higher temperatures have increasingly become more obvious in the study communes. At the same time, rainy and dry seasons have become unseasonal and floods have destroyed houses and crops in the communes. People in Kbal Romeas commune have resettle since 2017 in their current villages, making them more exposed to floods than in the old villages where droughts used to happen. Ways of adapting to two different climate hazards of villagers remain low.

This study's findings confirm the published literature about the indirect relationships between climate change and migration. Migration is influenced by factors such as poverty, population growth, and security (Laczko and Aghazarm, 2009). Yet, climate change is expected to exacerbate the challenges stemming from underlying environmental, economic, social, and governance issues, reducing resilience and increasing the vulnerability of people who migrate (United Nations of Economic and Social Commission for Asia and the Pacific, 2017). While sudden environmental events can hinder a households' ability to engage in costly migration (Robalino, Jimenez, and Chacón, 2015), numerous studies confirm that gradual ecological changes such as droughts (Baez et al., 2017), land degradation due to droughts (Makondo and Thomas, 2020), and changes in soil salinity (Chen and Mueller, 2018) have prompted people to migrate. This migration pattern highlights the susceptibility of remote areas where local livelihoods depend highly on natural resources.

6. Conclusion and policy implications

Local people in the study sites have experienced extreme climate hazards including heat stress, seasonal floods, droughts, seasonal changes, windstorms, insect outbreaks, and wildfires. These hazards have become more frequent, severe and unpredictable over the last decade.

Consequently, these extreme events have caused an increased risk of loss of life, insufficient water supply for local communities, and reduced agricultural productivity. Consequently, this has resulted in decreased income for rural farmers, destruction of livelihoods, particularly for those depending on water-intensive agriculture, and the risk of food insecurity. The surveyed communities were shown to be susceptible to these climate hazards because they lack access to early warnings, have limited preparedness (because of poverty and lack of social support), have inadequate climate-proof facilities and infrastructure, and have few sources of alternative livelihoods or incomes. Therefore, the local people's adaptive capacity to respond to and recover from these extreme events is low, resulting in low yields, lack of crop water, declines in fish stocks, and lower incomes.

This study suggests that social and economic drivers are the key factors pushing people to migrate. Yet, this study indicates that climate change-induced extreme events are the root causes of losses and damages that destroy properties or assets, crops, livestock, and poultry, leading to loss of income and increased spending on health care.

Based on the results of this study, the following recommendations are suggested to improve local livelihoods and adaptive capacity and reduce migration:

(1) Extreme climate events have damaged agricultural production in the study communes. Training on resilient farming practices to climate change will benefit farmers and help them increase their cultivation, improve their livelihoods, and reduce migration.

(2) Agricultural farming is the main income generation activity in the study villages, followed by local labour and migration. Yet, farmers do not have enough water sources to ensure effective and productive farming and lack of job opportunities and low incomes from agricultural farming encourage local people to migrate in order to find better work. If enough water sources exist and farmers are trained to use water effectively, agrarian activities will be diversified, farmers will have better incomes, and people will have more local farming jobs, hence reducing their migration. By having a well-connected irrigation system, farmers will be able to grow rice for two seasons and increase their yield. With enough water, farmers may switch from traditional to modern farming practices that are climate-resilient and produce higher yields, thus enhancing food security.

(3) People in the communities obtain insufficient support from the local authorities. At the same time, their engagement in commune development and decision-making processes remains very low. Enhancing local participation and actively involving them in community development planning and decision-making processes on climate change adaptation and disaster risk reduction can improve access to commune resources, knowledge, and information and enhance preparedness.

Limitations and areas for further research

This study was exploratory and provides findings related to the selected communes in the target provinces. Further investigation of motivating factors and drivers related to climate change and migration in other agroecological regions is needed. Understanding why people migrate in response to climate change in different contexts is crucial for developing effective geography-specific policies and interventions. Also, further research is needed to explore intertwined factors that influence migration decisions, such as economic opportunities, environmental conditions, and social networks. Other areas for additional examination should include the impacts of climate-

induced migration on food security and the role of social protection. Climate change significantly affects agricultural productivity, food availability, and the livelihoods of people dependent on farming. Understanding these impacts is vital for developing strategies to ensure food security in changing climatic conditions. Social protection mechanisms must also be examined to determine how well they support vulnerable populations affected by climate change. Empirical evidence from vulnerable groups, such as women, youth, the elderly, people with disabilities, and indigenous peoples, is essential for understanding local dynamics and disproportionate impacts. This evidence is crucial for designing inclusive and equitable policies and interventions that address the needs of all affected populations.

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