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OXFAM

RESEARCH REPORT

IMPACTS OF CLIMATE CHANGE AND DISASTERS ON MULTIDIMENSIONAL INEQUALITY IN VIET NAM

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IN COOPERATION WITH
OXFAM IN VIET NAM

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ACRONYMS AND ABBREVIATIONS

ADB	Asian Development Bank
AFD	Agence Francaise de Développement
BIDV	Bank of Investment and Development of Viet Nam
CCA	Climate change adaptation
CEP	Capital Aid for Employment of The Poor Microfinance Institution
CSO	Civil society oganization
DARD	Provincial Department of Agriculture and Rural Development
DOLISA	Provincial Department of Labour, War Invalids and Social Affairs
DONRE	Provincial Department of Natural Resources and Environment
EM	Ethnic minority
ENSO	El Nino - Southern Oscillation
FAO	Food and Agriculture Organization
FDI	Foreign direct investment
FGD	Focus group discussion
GCF	Green Climate Fund
GDP	Gross domestic product
GESI	Gender equality and social inclusion
GRAISEA	Gender Transformative and Responsible Agribusiness Investments in Southeast Asia
HDI	Human Development Indicators
IDI	In-depth interview
IMHEN	Vietnam Institute of Meteorology, Hydrology and Climate Change
IPCC	Intergovernmental Panel on Climate Change
LGBT	Lesbian, gay, bisexual and transgender
LSE	London School of Economics
MARD	Ministry of Agriculture and Rural Development
MIF	Multidimensional Inequality Framework
MOLISA	Ministry of Labour, War Invalids and Social Affairs
MONRE	Ministry of Natural Resources and Environment

NCD	Non-communicable diseases
NDC	Nationally Determined Contribution
NGO	Non-governmental organization
NOAA	National Oceanic and Atmospheric Administration
NSCC	National Strategy on Climate Change
NTP	National Target Programme
NTP NRD	National Target Programme on New Rural Development
NTP SPR	National Target Programme on Sustainable Poverty Reduction
PCF	People's Credit Funds
PWD	People with disability
PWU	Provincial Women's Union
RCP	Representative Concentration Pathway
SLR	Sea level rise
SOAS	School of Oriental and African Studies of University of London
TDS	Total dissolved solids
TYM	Tinh Thuong Microfinance Institution
UN	United Nations
UN WOMEN	United Nations Entity for Gender Equality and the Empowerment of Women
UNDP	United Nations Development Programme
UNFCCC	United Nation Framework Convention for Climate Change
UNICEF	United Nations Children's Fund
USD	US dollar
VBSP	Viet Nam Bank for Social Policies
VHLSS	Viet Nam Household Living Standards Survey
VND	Vietnamese dong
VNDMA	Viet Nam Disaster Management Authority
VNGO	Viet Nam non-governmental organization
VWU	Viet Nam Women's Union

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EXECUTIVE SUMMARY

Vietnam is highly vulnerable to climate change and disasters as it ranks sixth among countries and territories hit hardest by extreme weather events by Germanwatch. It has been noted that impacts of climate change and extreme climate events are uneven across different populations and regions, meanwhile, research in this area is still at an early stage. This report, "Impacts of Climate Change and Disasters on Multidimensional Inequality in Viet Nam" is part of an ongoing effort to widen the evidence base on climate change-induced impacts. It is a product of a mixed-method study implemented by the Mekong Development Research Institute and Oxfam in Viet Nam. This study aims at partly applying the Multidimensional Inequality Framework to: i) analyse how climate change and disasters/shocks may deepen inequality in human's capabilities and wellbeing in Viet Nam, particularly in five selected areas of research priorities including health and life, education and learning, dignified work, the households' financial security, and adequate living conditions; ii) identify coping strategies from affected people and assess these strategies' impacts on their wellbeing; iii) propose policy implications/recommendations to better implement climate change adaptation and coping strategies to ensure multidimensional equality.

The methodology applied included both quantitative and qualitative approaches, and a desk review of existing literature. The quantitative component was primarily drawn on the available secondary data including the Viet Nam Household Living Standards Surveys from 2010-2018, the climate data for precipitation and temperature at the district level from 1981 to present (extracted from the Climate Hazards Group InfraRed Precipitation with Station) and the temperature frequency data from 1979 to 2018 processed by the Climate Prediction Center of the Earth System Research Laboratory of the U.S. National Oceanic and Atmospheric Administration (NOAA ESRL) Physical Sciences Division. The quantitative analysis sought to measure the effects of climate extremes and disasters on individual-level outcomes (health, education, and employment) and household-level outcomes (household income, expenditure, and housing conditions), using three regression models. With respect to the qualitative component, stakeholder consultations were materialized through key informant interviews with representatives of government agencies, mass organizations, and development organizations at the national level (Ha Noi) and provincial level from Thua Thien Hue and Ca Mau between November 2021 and January 2022. Multiple focus group discussions and in-depth interviews were undertaken with the commune-level duty bearers and local residents during a field study in selected areas of Thua Thien Hue and Ca Mau in mid-January 2022.

Impacts of Climate Change and Disasters on Multidimensional Inequality in Life and Health

With respect to life and health, the quantitative analysis indicates that the adverse effect of low temperature extremes appears to be statistically significant for children and adults of poor households and those living in households with lower-education head. Furthermore, people in Southeast region, urban areas and those in non-farm and poor households are more likely affected by temperature extremes. Qualitative findings demonstrate that inequality increases the exposure of the disadvantaged groups to the adverse health effects of climate hazards.

Given the exposure level, inequality increases the disadvantaged groups' susceptibility to health problems caused by climate hazards. Limited access to transportation during a flood has been shown to cause missed or delayed medical care appointments, and more, generally, to limit access to health care for especially the elderly, children, people with disabilities, and pregnant women. Moreover, crop losses following prolonged droughts have implications for food shortages, hunger and especially childhood stunting associated with poor maternal health and nutrition, inadequate infant and young child feeding practices among low-income households of studied ethnic minorities.

From perspectives of coping abilities, people in the studied sites are likely to limit their exposure to the extreme weather to avoid its negative health

impacts, however, this measure does not apply to all people as some poor and outdoor labour still have to work even in bad weather conditions. In the case of sickness due to weather changes, local people usually look for primary healthcare at the commune health centres. Thus, investments in those grassroots health services will bring great benefits to those people living in remote areas. The study shows that climate-related safe water scarcity affects all social groups, but it affects them differently, depending on the resources they have and the alternate opportunities available. The ones most affected are the low-income households, especially the elderly and women heads of household because they have no large reservoirs for storage and sedimentation, resulting in a remarkably high risk to waterborne diseases. Furthermore, often health hazards are exacerbated by the conditions at the temporary shelters which are the medium-high public buildings, posing extreme challenges without adequate sanitation facilities as well the potential risk of sexual harassment, intimidation and violence against women, girls, and boy due to overcrowding in evacuation sites.

Impacts of Climate Change and Disasters on Multidimensional Inequality in Education and Learning

Speaking of the education sector, the impacts of climate change are primarily discussed in terms of two aspects, namely school attendance and learning capacity. According to the quantitative results, extreme weather, especially low temperature extremes, is inversely proportional to school attendance. High temperature extremes or extensive droughts, on the other hand, are also posing additional challenges for children's commutes to school, as agreed by most interviewed stakeholders. Under the influence of climate change, the hot and dry southwest wind arrives earlier, resulting in hotter and longer summers than in the past. Adverse weather events and natural disasters are detrimental to children's education because they disrupt studies and trigger other negative indirect consequences such as the loss of motivation to teach tin disaster-prone areas.

The findings, both quantitative and qualitative, further revealed that climate change impacts are not uniform between population groups, in which inequality is a key driver. Children from low-income families and/or living in rural settings are more likely to be severely impacted by climate change impacts on education than their non-poor and urban counterparts. For example, poor children and children whose families' livelihoods are primarily dependent on environment may experience school breaks or dropout as a result of income impoverishment caused by climate change. In both study locations which are resided by a large number of poor households, the local residents have been seen to have no other choices but to cut back on educational expenses during difficult periods pertaining to climates (crop failure due to weather extremes or natural disasters). Climate change-induced migration also put children's education at jeopardy, whether the child moves or stays. Academic disruption owing to school transfer, limited learning opportunities due to policy/social constraints at the host destination, and otherwise poor study accomplishment as well as underdeveloped socio-emotional skills in the absence of parental engagement are some of the noteworthy consequences. Last but not least, in the face of climate change, nutrition related issues such as food scarcity, hunger, and childhood stunting following catastrophic crop losses and livestock deaths are projected to increase absenteeism and impede children's educational outcomes.

Through the lens of coping strategy, climate change adaptation and mitigation require a radical shift in education and training for different population, both in terms of approach and accessibility. There is a necessity to educate people on the effects of the climate issue while also providing them with the necessary knowledge, skills, values, and attitudes to respond to the climate crisis. However, disadvantaged populations (the poor, the ethnic minority, residents of rural, remote areas), who already have poorer access to education than usual, will find it difficult to realise and leverage the potential of education in adapting to climate change.

Impacts of Climate Change and Disasters on Multidimensional Inequality in Dignified Work

As regards employment, qualitative results suggest a link between the rising temperatures and labour productivity, indicating combinations of risks, vulnerabilities and hazards facing the workers of low-income ethnic minority households. High temperature extremes decrease wages of farm people, ethnic minorities and people with less

than primary education. Similarly, the effect of low temperature extreme is significant and negative for ethnic minority and poor people but not for Kinh and non-poor people. In view of the growing hardship of fishing workers against the backdrop of increasing weather extremes, it has been noted that many young fishermen have quitted their job, seeking alternative livelihoods in off-farm domains. This mechanism of labour mobility cause manpower shortage in the local fishing sector, posing serious difficulties for offshore vessel owners to retain and recruit needed labourers for fishing trips. In order to pay off the additional cost of employee pay and benefits, local vessel owners had to intensify capture fisheries, causing a decline of fish stock. At the same time, a large proportion of local farmers who suffered from climate change-induced crop yield loss turned to shore fishing for a living. Facing constantly decline in fish outputs, some of fishermen are very likely to invest more capital in the purchase of fishing equipment and for offshore fishing vessels. A combination of poverty, limited access to capital, a lack of experience in offshore fishing as well a lack of awareness on sustainable fishery creates the vicious cycle of resource dependence and economic stagnation among fishing workers in the study communes of Ca Mau.

From an employment creation perspective, existing provisions on urgent support for job and production development in the wake of natural disasters address the vulnerability of households whose primary income earner was found dead or missing or production means were lost/damaged in the disaster. Nevertheless, there is no explicit regulation on support scheme for these vulnerable people, particular women to acquire the skills and resources to engage in income generation activities, such as employment and entrepreneurship. Women with disabilities already face additional barriers in the employment and income generating activities as a result of stigmatisation and discrimination and accessibility of workplaces which might be also exacerbated by climate change and can be heightened by other intersecting factors such as age, displacement, or ethnicity.

Impacts of Climate Change and Disasters on Multidimensional Inequality in Adequate Living Conditions

Qualitative findings suggest that climate change and natural disasters cause damages and negative impacts to housing conditions of the affected households, for example, floods and storms can lead to leaking roof, blow the roof away, or even destroy the houses. While temporary houses and semi-permanent houses are more prone to disasters than permanent houses, low-income households in the areas mostly affected by natural disasters, i.e., mountainous areas, coastal areas, tend to own temporary and semi-permanent houses, thus, they are likely to suffer more severe impacts and damages from the disasters. Moreover, the poor tend to live in the locations of high susceptibility to disasters, i.e., on the hillside in the mountainous areas or in the low-lying land in the coastal areas, while non-poor households can choose a better place to build their houses. On the other hand, low-income level is a big barrier preventing poor households improve their housing conditions to better cope with climate change and disasters.

Regarding clean water, people in the rural or remote areas are reported to have low access to tap water and tend to depend heavily on rainwater and groundwater, making them likely to be affected by the weather and environment changes. In the climate changes scenarios, some regions like Mekong Delta, Northern Mountains, Central Coast, and Central Highlands are expected to suffer water scarcity in the dry season. Water shortage also leave more financial burdens on poor households than the non-poor as it raises the costs of purchasing drinking water and using electric water pump to get groundwater. In some cases, the high costs for clean water may force the poor households to use unhygienic water sources for drinking and cooking, which possibly causing health problems for them.

When it comes to sanitation, the study results suggest that most households currently have access to hygienic latrines, i.e., flush latrines, thus, they did not report many impacts of climate events and disasters such as floods and storms on their sanitary conditions. Nevertheless, poor households are unable to afford flush latrines and tend to face inconvenient use of unhygienic latrines in case of long rains, floods, and storms. In addition, heavy precipitation and sea level rise pose a threat of water pollution in the riverine and coastal areas, as they increase flooding that wash untreated garbage into the rivers and sea gates, polluting the coastal water and causing negative impacts to the ecological health of nearby population, who are mostly the poor.

Extreme weather and disasters also create more need for electric equipment and energy for cooling and heating. The quantitative results suggest that natural disasters such as floods, storms and droughts tend to decrease the ownership of most home appliances such as fridge, water heater, and air conditioner, while households who experience high temperature extremes and droughts are more likely to own electric fan. However, there is a big gap in terms of ownership of electric devices between the poor and non-poor households, as well as between the EM and the Kinh subgroups, making poor households and EM households have lower abilities to cope with the extreme weather and suffer more negative health impacts than their counterparts. Poor households are also less likely to have telecommunication devices for accessing live weather forecast information, thus, they have limited abilities to adjust their activities to the climate change and become more vulnerable to emergency cases such as natural disasters.

Impacts of Climate Change and Disasters on Multidimensional Inequality in Financial Security

In views of the linkages between climate change and financial security at the household level, results of the quantitative analysis of this study show negative effects of disasters on households' income. In particular, an additional flood, storm, and drought in the past 12 months can decrease per capita income of the households. Furthermore, exposure to storms increases the probability of being poor. While the effect of storms on per capita income is negative and significant for most demographic subgroups, the effects of storms and droughts vary between geographical areas.

The study results also reveal that in times of shocks brought about by natural disasters, loans are often sought from both formal and informal credit. For formal finance, the provision of many credit lines at favourable terms particularly provided by policy bank such as the Viet Nam Bank for Social Policies (VBSP) makes the Bank lending products attractive to low-income borrowers. Besides, obtaining credit from family members and close relatives is the most and the first source of informal finance among local borrowers. It has been observed that in some cases borrowers have to rely on moneylenders or traders for their emergency loans, varying in credit power dynamics between the lenders and the borrowers in agriculture production.

Cross-cutting themes

Within the scope of this qualitative study component, there are a number of cross-cutting aspects. First, there are differences among the household participants in the studied sites in terms of climate change awareness. This may be partly due to the climate-change risk message incongruence coupled with existing language barriers among ethnic minorities given the inherently uncertain and abstract nature of climate change. Second, at the national level, it has been also observed that stakeholders, both male and female, especially those who are neither working on climate issues nor from areas that are vulnerable to climate change are very likely to perceive it as a distant phenomenon. This reflects underexplored individual differences or contextual variables as drivers for climate change perception and behavioural change. These findings have meaningful implications for climate change communication strategies.

From policy perspectives, the relevance of social inequality in the context of climate change has been a persistent issue in climate change related policies of Viet Nam. In general, it has been part of the discussion on especially "vulnerability" and gender equality issues. Despite the progress, the discussion of the interlinkages between climate change and inequality has been rather limited. The existing climate related provisions have generally addressed the direct effects of climate change on the affected people, especially the vulnerable groups, with relatively less effort devoted to responding to the prospective long-term effects of climate change on human welfare. For development sector, CSOs within multi-stakeholder partnerships have an active role to play in advocating for considerations of social inequality in climate change impacts and response over the past decade.

Conclusion and Recommendations

The study findings help illustrate that climate change and natural disasters have aggravated multidimensional inequality through three channels including a rise in the exposure of the disadvantaged social groups to the adverse effects of climate change, an increase of the disadvantaged groups' susceptibility to problems caused by climate change, and a decline in these groups' relative ability to cope with and recover from damages and losses they suffer in five selected areas of research priorities.

The following presents a number of suggested recommendations for formulating policies and programmes that can address these different inequality-enhancing effects of climate change and disasters.

On measuring and monitoring climate change impacts on multidimensional inequality:

- Elaborate a thorough monitoring system and database of climate change and natural disasters at the district level to support the evaluation and forecast of the different impacts of climate change-induced hazards to different areas and population subgroups. Those data should be collected officially and periodically, and should be widely disseminated to relevant line ministries, agencies, and researcher;

- Ensure a systemic collection of sex, age, ethnicity and disability disaggregated data, development of inclusive and gender sensitive indicators in design, planning, implementation, monitoring and evaluation of climate policy and action in all sectors and at all levels;

- Conduct and expand rigorous research in both qualitative and quantitative approaches on the inequality-enhancing effects of climate change by sector and region to build an evidence base for climate change-related policies in the future. Besides, there is a need for policy discussions on the correlation between climate change and multidimensional inequality, and on the linkage between climate change adaptation and mitigation interventions and poverty and inequality reduction programmes.

On capacity building for climate change adaptation and mitigation:

- Enhance institutional capacity building, including short-term and long-term training on inclusive and gender-responsive climate action in ministries, institutions, agencies, organizations with a mandate to tackle climate change and promote social inclusion and gender equality including for both male and female leaders;

- Empower and train women, ethnic minorities and other vulnerable groups such as the elderly, people with disability, etc. to act as change agents in climate change action at community level, building on the existing dialogue platforms, participatory, leadership trainings of development organizations and other agencies.

On support provision to vulnerable groups:

- Evaluate the needs and provide necessary support to the poor, EM groups, and those living in the areas susceptible to climate change and disasters (i.e., the mountainous and coastal areas). The support can focus on some key domains of life such as improving housing conditions, improving access to clean water, sanitation, quality healthcare services, and weather forecast information, as well as building sustainable livelihoods to adapt to and mitigate climate change.

1

INTRODUCTION

1. INTRODUCTION

1.1 Background

Vietnam is highly vulnerable to climate change and disasters as it ranks sixth among countries and territories hit hardest by extreme weather events by Germanwatch[1].The impacts of climate change in Vietnam, especially in the scenario of 1-metre sea level rise, are projected to be enormous, including 5% land losses, 7% agricultural activities impacted, 11% population affected, and 10% GDP reduced.[2]

However, those impacts are uneven across different populations and regions. Specifically, World Bank observes that the Mekong Delta and Central Coast suffer the highest exposure while Central Highlands and Northern Mountains obtain the most sensitivity to climate change. Besides, farmers and smallholders, the poor, and women are most mentioned by current researches as those negatively affected by environmental changes.[3] In fact, climate events can reduce 65-70% income from crops and livestock in poor households, while this reduction is estimated about only about 33-35% in rich households.[4] Similarly, poor, rural, agricultural and most marginalized households are shown to bear a bigger burden of rising temperature, leading to an increase of income inequality.[5] While focusing on income inequality, those studies show a significant lacuna on assessing impacts of climate change on opportunity inequality in key domains of life such as health, education and living conditions.

To overcome climatic disasters, most affected households implement short-term responses rather than long-term coping strategies to climate events. One of the common responses is to use transfers and remittances which have positive impacts in short-term.[6] Migration is widely seen as an option; however, it creates potential risks and vulnerabilities such as food and water insecurity, and high living costs when moving to urban areas.[7] These issues pose a need of analysis of coping strategies of each affected population group to propose appropriate policies for individual and community levels to ensure households' wellbeing.

This study partly applies the Multidimensional Inequality Framework (MIF), an inequality assessment tool, to assess the effects of climate changes and disasters on inequality in different domains of life and identify the different coping strategy levels of affected people in Viet Nam. The research will contribute to provide evidence of the climate change impacts on gaps between population subgroups, not only in income but also in some essential domains of life such as life and health, education and learning, employment, financial security and living conditions. Along with that, the research assesses the impacts of coping strategies on the affected population groups' wellbeing and proposes policy implications to support communities and households in designing appropriate adaptation strategies to reduce inequality and build resilience.

Via these two academic contributions, the research will inform and contribute to (i) ongoing debates on working towards a Human Economy[8] in Viet Nam which Oxfam in Viet Nam has been engaging in the development of Vietnamese 10-year socio-economic development strategy for 2021-2030, and (ii) development partners' ongoing debates on emerging topics related to climate change and inequality, sustainable and inclusive development, green deal etc. The research will also enrich the MIF when climate events are seen as a driver of inequalities and adequate coping strategies for climate events are solutions to reduce inequalities.

(1) Germanwatch (2020). Global Climate Risk Index 2020.

(2) World Bank (2007). Sea Level Rise from Global Warming: Potential Impacts on Developing Countries, DECRG Working Paper.

(3) Huynh, T.P.L. et al. (2020). Inequalities and Environmental Changes in Cambodia, Laos, Myanmar, Thailand, and Vietnam: Scoping and Systematic Reviews

(4) World Bank (2010). The Social Dimensions of Adaptation to Climate Change in Vietnam.

(5) Pacillo, G. et al. (2020). Who bears the burden of climate variability? A comparative analysis of the impact of weather conditions on inequality in Vietnam and Indonesia. AFD Research Papers.

(6) Pacillo, G. et al. (2020). Ibid.

(7) UN (2014). Migration, Resettlement and Climate Change in Viet Nam: Reducing exposure and vulnerabilities to climatic extremes and stresses through spontaneous and guided migration.

(8) Human Economy is a socio-economic model in which people and planet are put before profits, people are at the centre of economic thinking, and the economy works to benefit the majority, not simply a rich few. More information of this model can be found at https://vietnam.oxfam.org/latest/policy-paper/magazine-inequality-matters-03.

This study report consists of four main parts. Part 1 introduces the study background, research approach and methodology. Part 2 offers an overview of climate change and natural disaster impacts in Viet Nam. Part 3 then explores the linkages between climate change, disasters, and multidimensional inequality regarding five priority areas of life and health, education and learning, dignified work, the households' financial security, and adequate living conditions. This part also discusses different groups' strategies and capacities to cope with climate change and their hindering factors. Finally, Part 4 highlights the key results and suggests some recommendations to tackle multidimensional inequality in the climate change-related policies and actions.

1.2 Multidimensional Inequality Framework and Research Objectives

Multidimensional Inequality Framework (MIF),[9] co-developed by London School of Economics and Political Science (LSE), School of Oriental and African Studies (SOAS) of University of London and Oxfam in 2018, is a guiding tool for the evaluation of inequality in the essential domains of life. The MIF draws on the capability approach of Amartya Sen, a 1998's Nobel Prize winner-economist, in order to provide a method to assess inequalities in individual well-being.

The approach focuses on capability deprivation (measuring differences in rates of deprivation between groups) and calls for a multidimensional approach to understand individual and collective well-being. This approach has been widely used in research relating to poverty reduction and Human Development Indicators (HDI) yet has not been applied in inequality analysis. A key challenge in measuring multidimensional inequality through the capability approach is that there is not a definitive list of capabilities. Amartya Sen offered some guidance on how to compile such list and suggested a number of key capabilities which are considered vital for human well-being (being well-nourished, physical secure, mobility, etc). From his work, MIF proposed 7 key domains covering the core capabilities to analyse inequality as represented in Table 1.

TABLE 1. INEQUALITY DOMAINS OF THE MIF

Domain	Short title	Sub-title
Domain 1	Life and health	Inequality in the capability to be alive and to live a healthy life
Domain 2	Physical and legal security	Inequality in the capability to live in physical safety and legal security
Domain 3	Education and learning	Inequality in the capability to be knowledgeable, to understand and reason, and to have the skills to participate in society
Domain 4	Financial security and dignified work	Inequality in the capability to achieve financial independence and security, enjoy dignified and fair work, and recognition of unpaid work and care
Domain 5	Comfortable, independent and secure living conditions	Inequality in the capability to enjoy comfortable, independent and secure living conditions
Domain 6	Participation, influence and voice	Inequality in the capability to participate in decision-making, have a voice and influence
Domain 7	Individual, family and social life	Inequality in the capability to enjoy individual, family and social life, to express yourself and to have self-respect

Source: LSE, SOAS and Oxfam

(9) Further information can be obtained from the MIF website at https://sticerd.lse.ac.uk/inequality/default.asp.

MIF was first piloted in Spain and Guatemala between 2017 and 2019 before being introduced in Burkina Faso and Viet Nam for stage 2 in 2020. The application of MIF in Viet Nam was a pioneering effort in assessing multidimensional inequalities in lesser-known areas like inequality in voice and opportunity, with an aim to enhance in-depth understanding of inequality and identify concrete policy gaps to tackle inequality in Viet Nam.[10]

Following the success of MIF in Viet Nam, this study is another attempt to utilise this framework in looking into the linkage between climate change and multidimensional inequality. The research will therefore contribute to the evidence on impacts of climate change on disparities not only in income but also in different critical domains, such as life and health, education and learning, dignified work, financial security, and living conditions. These MIF domains are considered as those directly affected by climate change and natural disasters; thus, they are selected for this study with an expectation of providing practical evidence to shed a light on the correlation between climate change and inequality in Viet Nam. In addition, the study evaluates the various consequences of climate coping techniques on the well-being of the impacted population groups and proposes policy implications to assist communities and households in developing appropriate adaptation strategies to reduce inequality and build resilience.

In particular, the study aims to particularly explore the following objectives.

- Analyse how climate change and disasters/ shocks (i.e., extensive droughts, typhoon and floods) deepen inequality in human's capabilities and wellbeing in Viet Nam, particularly in four key domains: (1) life and health, (2) education and learning, (3) financial security and dignified work, and (4) adequate living conditions;
- Identify coping strategies from affected people and assess these strategies' impacts on their wellbeing;
- Propose policy implications/recommendations to better implement climate change adaptation and coping strategies to ensure multidimensional equality.

1.3 Research Methodology

This study was conducted based on an analytical framework developed by the research team to clearly identify the research subjects. Specifically, the framework displayed the population subgroups which can be disaggregated from the household data, the common signs of climate change and their potential effects on key domains of life, and the climate change coping strategies of the households (Figure 1).

On the research methods, this study started with a literature review to develop theoretical foundations, then employed a mixed approach of quantitative and qualitative methods to obtain and analyze information for its findings and recommendations. The quantitative research was firstly conducted and relied on secondary data to seek for possible impacts of climate change and natural disasters on the four studied domains of the MIF. Based on those results, the research team had developed a qualitative tool kit and later implemented qualitative interviews and field study to complement the research findings with the stakeholders' opinions and factual evidence from the locations experiencing climate change and natural disasters. In addition, a desk review of relevant documents was conducted throughout the study to enrich the findings.

1.3.1 Desk Review

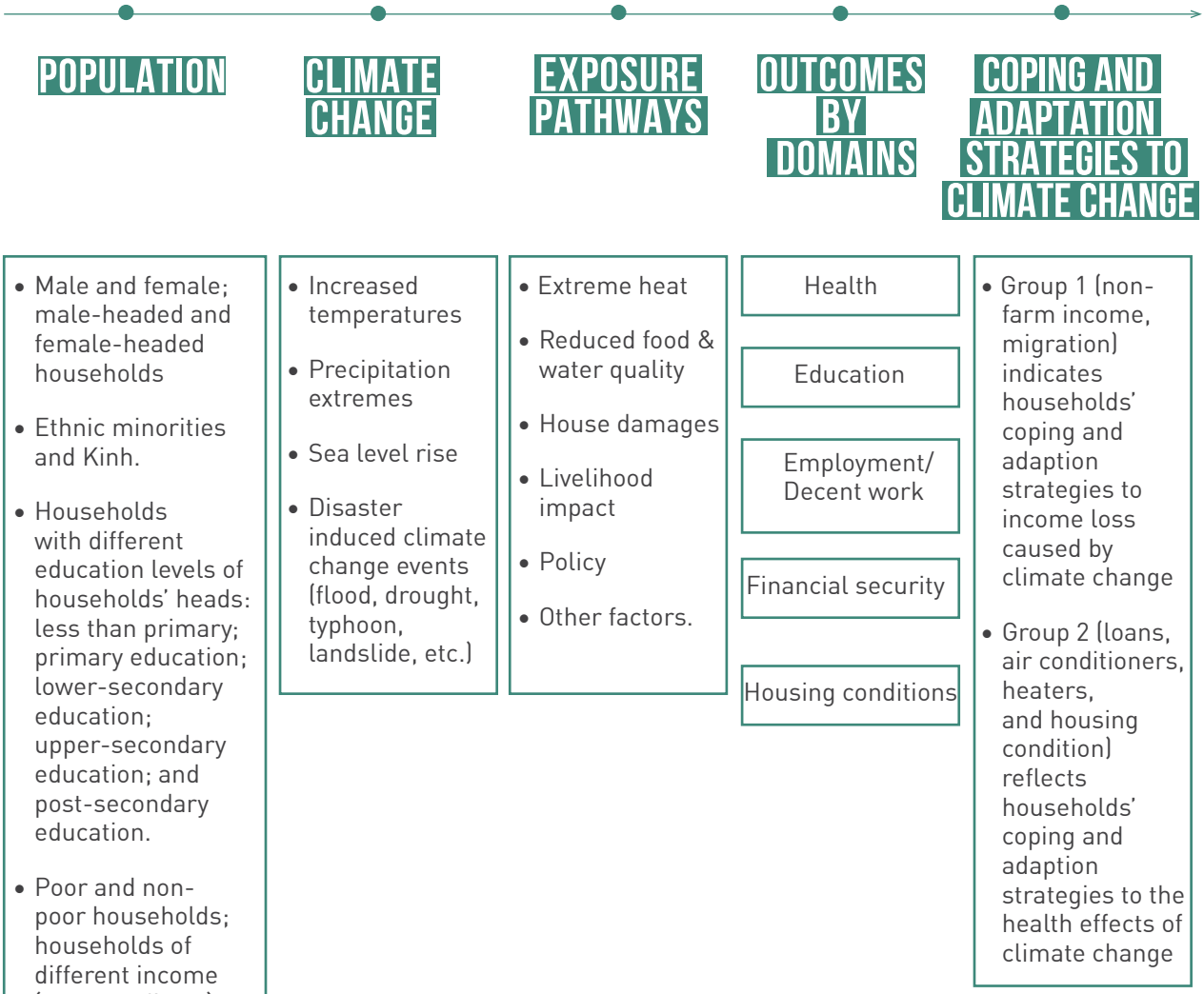
In this study, the desk review gathers information on climate change and its impacts from relevant documents. The research team firstly began with a literature review of most updated research and assessment reports on climate change to form an overall understanding of the climate change scenarios in Viet Nam and its socio-economic impacts. That understanding was presented later in this report in an overview section of climate change in Viet Nam to summarize key points of this topic to readers. Besides, based on that understanding, the research team was able to identify some key impacts of climate change on the four studied domains of the MIF and develop the analytical framework to guide the study.

Throughout the study, the research team also conducted desk review of legal documents, reports, and articles from online resources that related to climate change to support the findings when needed. Information from the desk review were

(10) The MIF was piloted in Vietnam by Mekong Development Research Institute (MDRI) and Oxfam in Viet Nam with the financial support of the European Union and the Agence Francaise de Développement (AFD), and technical support of Oxfam Intemón. This pilot screens income inequality in the domain "financial security and dignified work" and looks closely into three key domains: (i) life and health, (ii) education and learning, and (iii) participation, influence and voice.

combined with the quantitative and qualitative findings to provide a thorough picture of climate change impacts on different population subgroups, thus, they helped clarify climate change impacts on inequality in Viet Nam and lead to appropriate conclusions and policy implications.

FIGURE 1. ANALYTICAL FRAMEWORK



1.3.2 Quantitative Component

The quantitative study aims to measure the climate change impacts on multidimensional inequality through an analysis of nationally representative data to find the correlation between climate events and the socio-economic conditions of different household groups. Thus, it requires the use of data from periodic climate and household surveys in Viet Nam, which are, in fact, not numerous at the study time. After a careful consideration of the available data, two secondary datasets were selected for the quantitative analysis as follows.

The first dataset used in this study is the Viet Nam Household Living Standards Surveys (VHLSS) from 2010 to 2018,[11] which collects extensive data on demographics, education, health, employment, income and living conditions of roughly 45,000 households nationwide. The survey was conducted every two years and its sample is representative at the provincial level. Therefore, the VHLSSs reflect well the socio-economic changes of the population in both urban and rural settings and in six geographical regions of Viet Nam. This dataset also provided the number of natural disasters in each rural communes of Viet Nam during the above period.

The second source of data was obtained from the research paper of Pacillo et al., which provided climate data including precipitation and temperature at the district level.[12] The original rainfall frequency data were retrieved from the Climate Hazards Group InfraRed Precipitation with Station (CHIRPS) and were collected at a very high resolution (5 km) from 1981 to the present time. Meanwhile, the temperature data were processed from Climate Prediction Center (CPC) of the NOAA ESRL Physical Sciences Division (PSD), which provides temperature frequency data since 1979 to 2018.

In this study, the research team ran three regression models to measure the effects of climate extremes and disasters on individual-level outcomes (health, education, and employment) and household-level outcomes (household income, expenditure, and housing conditions). Specifically, the district-level climate data was connected with the VHLSS household and individual data of the corresponding districts to estimate the correlation between the climate change and the changes of those socio-economic outcomes over time. In the first model (model 1), daily mean temperatures were classified in different bins, i.e., 0-15 degree Celsius, 15-18, 18-21, etc. and the annual number of days of each temperature bin were used to estimate the effects on the individual and household outcomes. The second model (model 2) was similar, but it used the annual number of days with temperature and rainfall extremes (those among the 5-percent lowest or highest temperature and precipitation of the local districts over the past 20 years) as the inputs instead. Meanwhile, the third model (model 3) examined the effect of natural disasters in the rural areas, using the annual number of floods, storms, and drought in each commune.

In each model, the climate change and natural disasters impacts were firstly estimated on the outcomes of the four studied domains of the MIF. Then the estimates were disaggregated for different population subgroups, including gender, ethnicity, education level, poor status, livelihood and living areas. By comparing the discrepancies between those subgroups, the research team would figure out and estimate the impacts of climate change on the inequality. For example, temperature extremes would increase inequality if they had higher (negative) effects on more disadvantaged people than those who are less disadvantaged.

A detailed description of the estimation methods can be found in Appendix 1.

1.3.3 Qualitative Component

While the quantitative analysis is powerful in estimating major socio-economic changes induced by climate change, it relies on the qualitative study to capture small changes in some specific areas, as well as to collect in-depth information from key stakeholders to elucidate the linkage between climate change and the multidimensional inequality. As such, the qualitative study was designed including consultations with climate change experts, mass organizations leaders (i.e., Women's Union) and line ministries representatives of relevant sectors like natural resources and environment, agriculture, and social affairs, as well as field observations and qualitative interviews with local authorities and residents of some communes significantly affected by the climate change and natural disasters. The content of the qualitative study targeted three main themes as follows.

- Climate change impacts on different population subgroups and potential linkage with inequality;
- Different climate change coping strategies among those population subgroups;

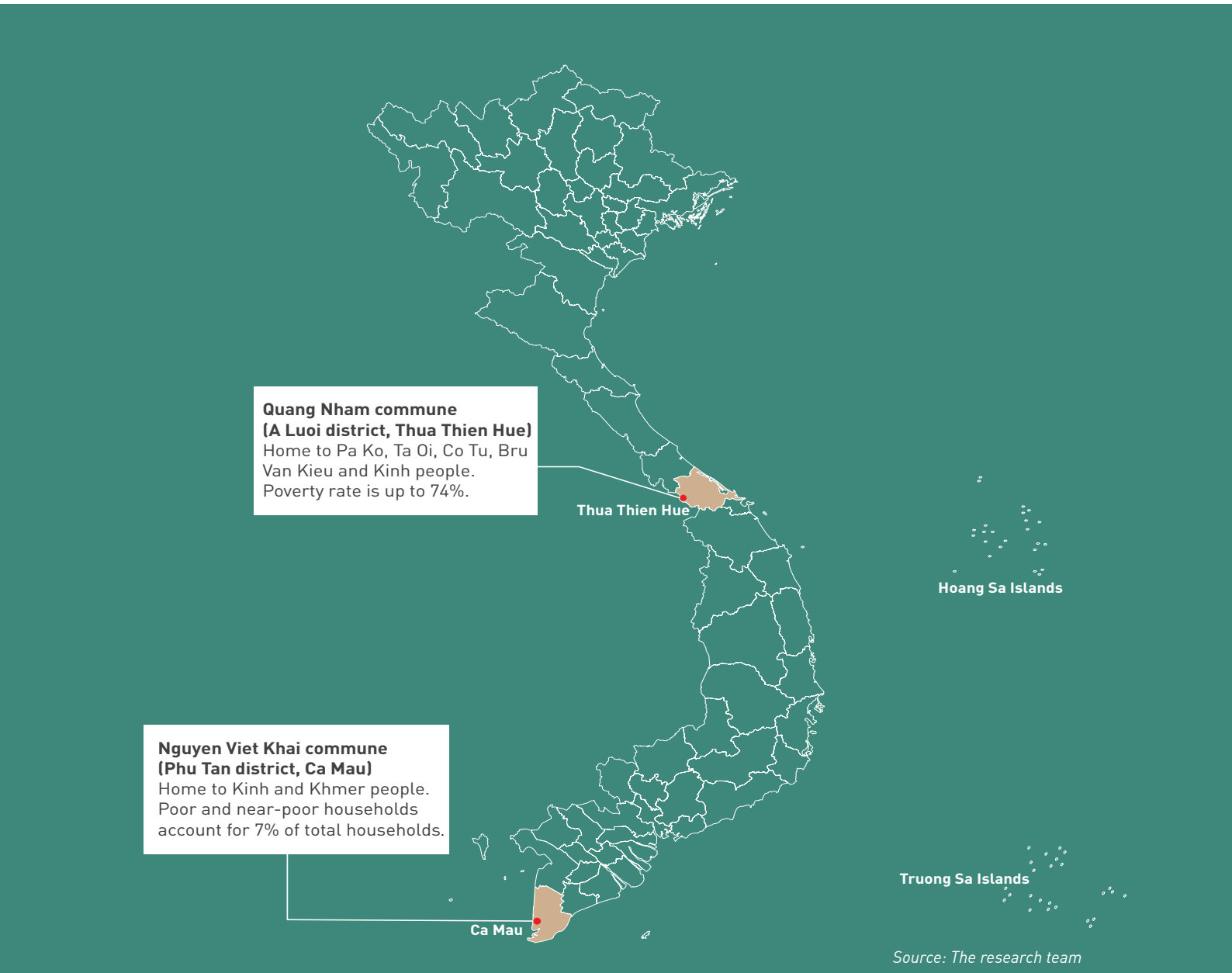
(11) While the latest VHLSS took place in 2020, their results have yet to be released, thus, the 2018 VHLSS data is used for this study instead.

(12) Pacillo et al. (2020). Ibid.

- Current gaps in climate change policies toward vulnerable groups (the poor, ethnic minorities, people in need) and recommendations.

Regarding the research locations, the qualitative study was implemented in two provinces of Thua Thien Hue (in the Central Coast) and Ca Mau (in the Mekong Delta), which were identified among the regions having the highest exposure to climate change and disasters in Viet Nam.[13] In addition to the consultations with provincial officials of relevant sectors as mentioned, the research team conducted field research in Quang Nham commune (A Luoi district, Thua Thien Hue) and online qualitative interviews in Nguyen Viet Khai commune [14] (Phu Tan district, Ca Mau) with a hope to bring diverse findings to the study. Those communes were suggested by the local government as where different population subgroups (the Kinh, ethnic minorities, the poor/near poor/not poor) resided and most importantly, as clearly affected by different types of climate change and extreme weather events such as typhoon, flash flood, landslides in A Luoi's mountainous area and drought, flood, and sea level rise in Ca Mau's coastal area.

FIGURE 2. MAP OF THE QUALITATIVE RESEARCH AREA



Source: The research team

(13) World Bank (2010). The Social Dimensions of Adaptation to Climate Change in Vietnam. World Bank Discussion Paper.

(14) Due to the outbreak of COVID-19 and as requested by the provincial authorities, the field research in Nguyen Viet Khai commune was changed from offline to online mode.

The qualitative study employed two main methods including In-depth Interview (IDI) and Focus Group Discussion (FGD), complemented by field observations in order to bring variety to the findings. The IDIs were conducted with key informants at the national level, provincial level, commune level and grass-roots level, involving climate change experts, representatives of line ministries and mass organizations, local authorities, village leaders, and disadvantaged households in the study sites. In each studied commune, two additional FGDs, each group included 8 to 10 participants, were conducted with male and female representatives of households, including diverse subgroups such as the poor, near poor, non-poor, and ethnic minorities, to obtain common opinion of the local communities on the climate change and its different impacts to the local areas. Besides, direct and indirect field observations were taken by the research team with support from local guides to enrich the findings with illustrative pictures from reality.

A detailed list of organizations and stakeholders consulted is provided in Appendix 3 of this report.

FIGURE 3. FGDS WITH FEMALE AND MALE RESIDENTS IN QUANG NHAM COMMUNE, THUA THIEN HUE

Source: The research team

1.4 Limitations and Mitigation Measures

This study was overall executed in an even manner, however, like all studies, it encountered several challenges in the implementation process. The research team had anticipated those challenges and took the best effort to minimize their effects on the quality of the study. Following is a summary of those limitations and their respective mitigation measures during the study implementation.

- ***Outbreak of COVID-19 pandemic in Viet Nam***. The 4th wave of COVID-19 hit almost all provinces of Viet Nam in the latter half of 2021, leading to a period of lockdowns and travel restrictions in several cities and provinces. This difficult situation affected the fieldwork plan and required most of the qualitative interviews to be conducted online. While the research team succeeded in making the field trip to Thua Thien Hue when the number of COVID-19 cases declined, the initial plan to visit Ca Mau was dropped at the last minute and switched to online mode (via video calls, phone calls) due to the prevalence of infected cases in the local area. With the support of the key informants and the local coordinators, all interviews were conducted smoothly and photos of the commune in Ca Mau were provided to the research team as an alternative to field observation.

- ***Field sites cannot be fully representative.*** Due to financial limitations, only a limited number of field sites were included in the qualitative study and could not be representative to all regions of Viet Nam. Thus, the research team took careful consideration and selected two provinces among the most affected areas by climate change and natural disasters for the qualitative study. Two communes chosen for the field research also had different background as one from the mountainous area (Quang Nham commune) and one from the coastal area (Nguyen Viet Khai commune) to bring variety to the findings.

- ***Limited quantitative data to measure climate change impacts in Viet Nam.*** While climate change is not a new challenge to Viet Nam, climate change monitoring data of the country remain limited. In fact, most data on temperature, precipitation change, natural disasters and their damages are counted for the national and regional levels, while it lacks a comprehensive monitoring system and database at the grass-roots level. This issue limited the outcomes to be measured and the ability to find latent impacts of climate change by the quantitative assessment. Some data, i.e., number of natural disasters at a specific commune, were collected from the estimation of local respondents during the employed surveys and thus, may lead to underestimation the climate change impacts. Regarding that issue, regression models of this study were constructed with a set of control variables to mitigate biases. Besides, the mix-method approach of this study helped mitigate the limitations and cover all impacts of climate change. The quantitative method provided the overall picture and representativeness of the impacts at the national level while the qualitative study detailed and nuanced the impacts at the local level. The quantitative results and qualitative findings were also presented in an intertwining manner in this report so as to complement each other and provide significant and comprehensive evidence on the impacts of climate change and natural disasters.

2

OVERVIEW OF CLIMATE CHANGE AND DISASTER IMPACTS IN VIET NAM

2. OVERVIEW OF CLIMATE CHANGE AND DISASTER IMPACTS IN VIET NAM

2.1 Climate Change and Disasters in Viet Nam: Scenarios, Facts and Figures

Climate change has been widely observed in the past two decades and has become an urgent problem of the world. This change mainly comes from the global warming, which is reported by the Intergovernmental Panel on Climate Change (IPCC) to intensify at a rate that is unprecedented in at least the last 2,000 years due to the emission of greenhouse gases (i.e., carbon dioxide, methane) from human activities.[15] While greenhouse gases in the nature work as the main factor to warm the Earth and create a comfortable environment for life, the enormous greenhouse gas emission from industries over decades has contributed to the prevention of aerosol cooling, causing the global surface temperature to increase rapidly. For instance, the global temperature in the period 2001–2020 was 0.99 degrees Celsius higher than the pre-industrial era (1850–1900) and this temperature increase is expected to be over 2 degrees Celsius during the 21st century. The temperature increase also leads to unprecedented sea ice melting in the Arctic and Antarctica and glaciers retreat over the world, raising global sea level and atmosphere humidity. Those temperature and humidity changes intensify the degrees of drought and rainfall in different regions of the world, as well as increase the number and power of storms. Besides, in the short-term, the evolution of warm air disrupts the polar vortex, making polar cold air to move further into the south than average, leading to abnormal periods of extreme cold in some regions.[16]

The climate change has led to multiple extreme weather-related events and natural disasters around the world in the recent years. Some notable examples of the temperature increase include extreme heatwaves hitting Europe, North America, and Australia in the 2020 and 2021 summers, causing several wildfires across those regions. While some countries in Europe and Asia are reported to suffer from increasing droughts, some others like Germany, China, India were hit by unusual heavy rainfalls and floods in 2021. Meanwhile, the disrupted Arctic cold air are believed to cause extreme cold waves in the United States in the 2021 and 2022 winters. While it might take time to examine if each of those events is attributable to climate change, such series of extreme weather and disasters is clear evidence that the global climate is changing.

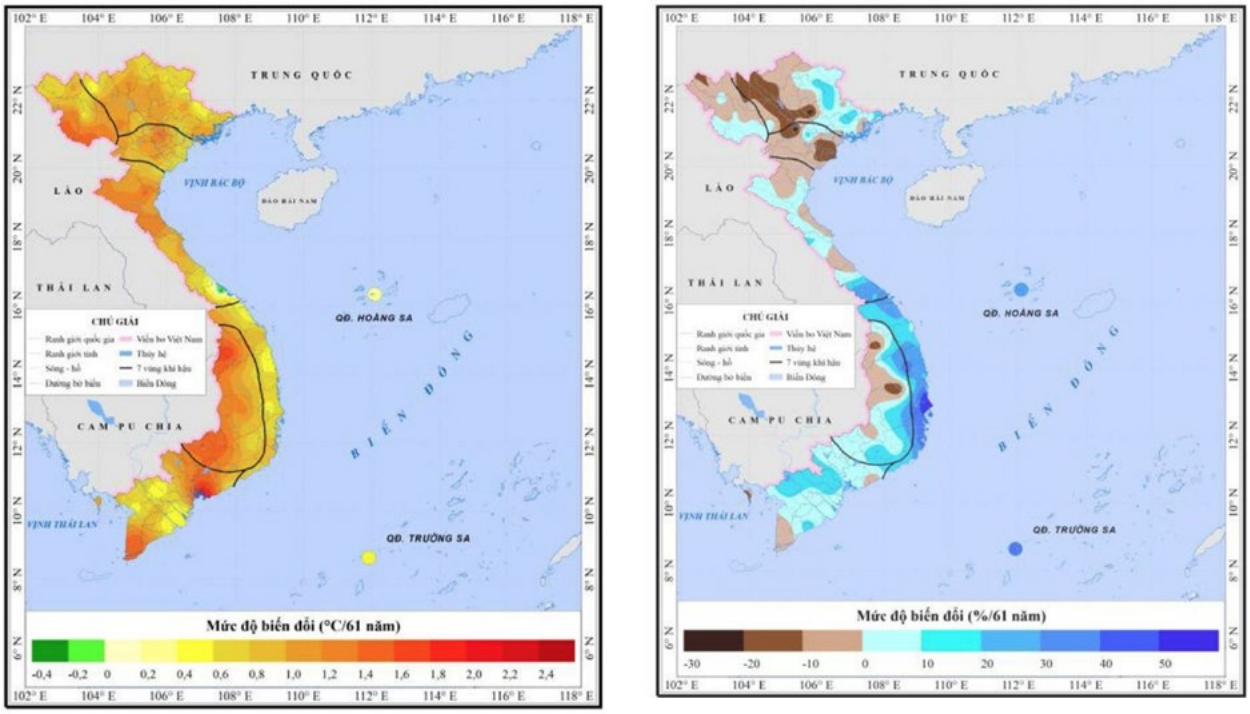
In Viet Nam, the signs of climate change have been already observed at the present time. According to the latest Climate Change Scenarios Report of Viet Nam Ministry of Natural Resources and Environment (MONRE) in 2021, several changes in terms of temperature, rainfall have been recorded over the past 60 years.[17] Specifically, the country's average temperature and rainfall have increased in the period 1958-2018; the highest temperature and number of hot days have significantly increased all over the country, especially in the recent years. While the annual number of cold days tends to decrease overall, there were several unusual periods of extreme cold coming along with unprecedented snow and ice in the Northern Mountains region in the winters of 2008, 2015 and 2016. Heavy precipitation has increased both in quantity and intensity and its pattern has become increasingly abnormal in the recent years. Regarding disasters, the number of typhoons is likely to increase, while the impacts of El Nino–Southern Oscillation (ENSO), an irregular periodic variation in winds and sea surface temperatures over the Pacific Ocean possibly causing extreme events (i.e., droughts, floods, and typhoons), on the weather of Viet Nam are intensified.

(15) IPCC (2021). Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change.

(16) NOAA (2021). Understanding the Arctic Polar Vortex. NOAA Climate.gov Website.

(17) MONRE (2021). Climate Change Scenarios: 2020 Update.

FIGURE 4. CHANGES IN THE AVERAGE ANNUAL TEMPERATURE (LEFT) AND AVERAGE ANNUAL RAINFALL (RIGHT) IN VIET NAM IN THE PERIOD 1958-2018



Source: MONRE

There are different climate change scenarios by the end of 21st century, depending on the greenhouse gas emission levels indicated by the Representative Concentration Pathway (RCP). The MONRE's report uses a set of stimulation models to forecast the climate change in Viet Nam in two scenarios of RCP4.5 (medium) and RCP8.5 (high), two emission levels most likely to happen according to the IPCC. While the climate change degree varies between the scenarios, the change patterns are consistent, involving some key matters such as temperature increase, rainfall increase, increase of extreme weather events, and sea level rise. A summary of those changes is described in Table 2.

TABLE 2. SUMMARY OF CLIMATE CHANGE AND SEA LEVEL RISE SCENARIOS IN VIET NAM IN THE 21ST CENTURY

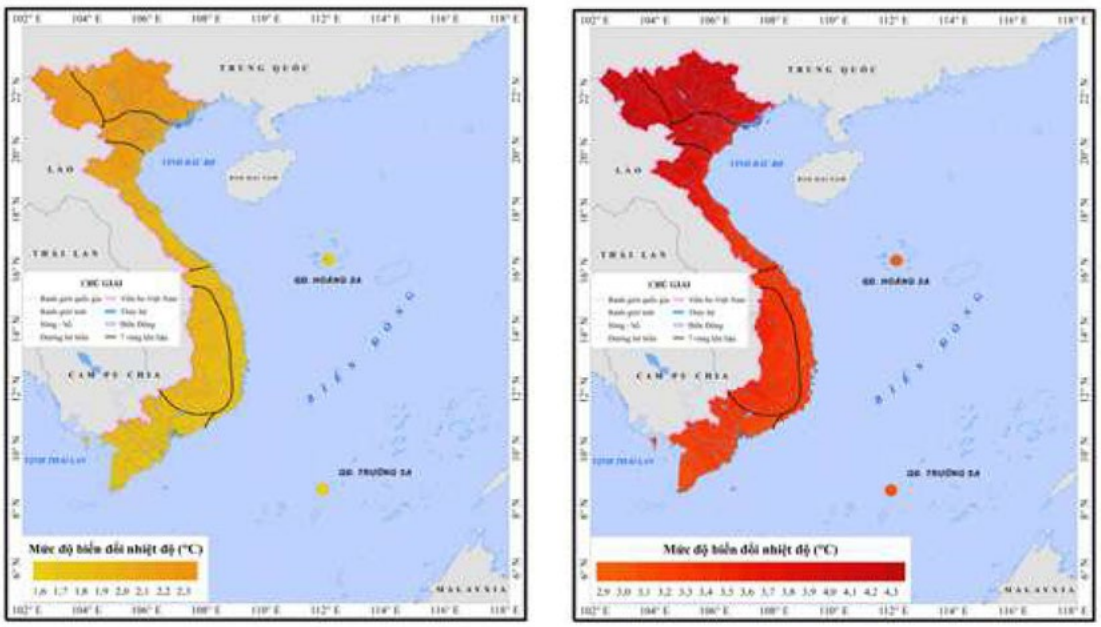
Factors	Expected scenarios
Temperature	• Average temperature would increase across the country. In the medium scenario, it would rise by 1.9–2.4°C in the North and 1.5–1.9°C in the South. In the high scenario, those increase levels are 3.5–4.2°C and 3.0–3.5°C, respectively. • Extreme hot temperature events would have an upward tendency.
Rainfall	• Annual precipitation would be on the rise of 10-20%. • Average maximum 1-day rainfall is predicted to also increase at the national scale.

Factors	Expected scenarios
Monsoon and extreme weather events	• The quantity and intensity of extreme climate events (such as typhoons) are projected to have an upward movement. • The monsoon cycle would be extended. Precipitation in the monsoon season would increase over the time. • The number of severe cold days in the provinces of the North, the Red River Delta and the North Central is likely to reduce. • The number of hot and extreme hot days tends to increase all over the country, of which the North Central Coast, South Central Coat and Southern Viet Nam would experience the largest increase. • The situation of droughts would become more intense as a result of rising temperature and the shortage in rainfall during the dry season.
Sea level rise	• Sea level in Viet Nam would rise by an average of 53 cm in the medium scenario and 73 cm in the high scenario. • Sea level rise in the Southern coastline tends to be higher than in the North. • Many coastal and riverine areas in the Mekong Delta, Southeast and Red River Delta face a high risk of permanent inundation.

Source: MONRE

The climate change scenarios predict a difficult future for Viet Nam with weather fluctuations, extreme weather events and natural disasters. The hotter and more humid weather, with heavier and more unusual precipitation will create a harsh environment for living, as well as causing negative health impacts to the population. Besides, higher number of disasters such as storms, floods, droughts, and sea level rise will cause more severe damages to the affected areas and ultimately lead to negative socio-economic impacts in the long term.

FIGURE 5. CHANGES IN AVERAGE TEMPERATURE BY THE END OF THE 21ST CENTURY IN THE MEDIUM SCENARIO (LEFT) AND HIGH SCENARIO (RIGHT)

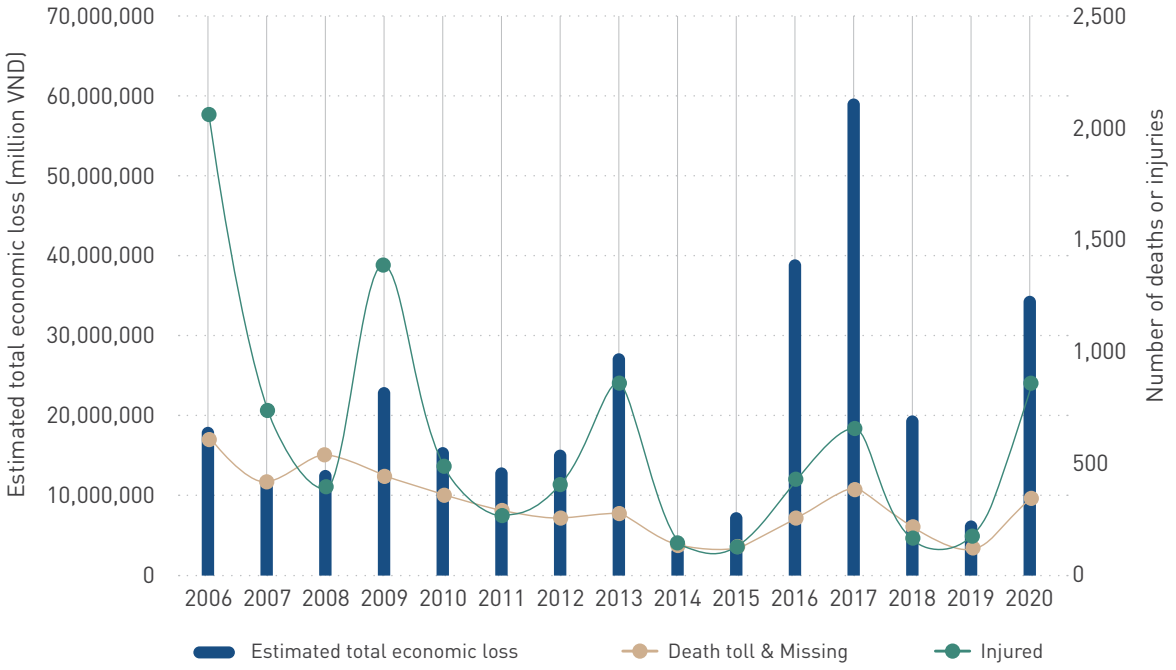


Source: MONRE

2.2 Impacts of Climate Change and Extreme Climate Events Across Different Regions and Population Groups in Viet Nam

As reported annually by Viet Nam Disaster Management Authority, Viet Nam has suffered heavy damage from various types of natural disasters, mainly tropical storms, floods, droughts, and soil salinity. The quantity and the intensity of those disasters, in general, tend to increase over the time, causing loss of human life and property in affected regions. For instance, 2017 became a "catastrophic year" that recorded many strong storms and typhoons, namely Doksuri (Storm no. 10) and Damrey (Storm no.12), and floods. Meanwhile, the Linfa typhoon (Storm no. 6) in 2020 caused a period of heavy precipitation, leading to floods and landslides in the Central Coast and Central Highlands and causing great damages to people and property. In time-series statistics, while human loss due to the disasters tends to decrease, probably thanks to better rescue system, the economic loss is likely to increase over time due to the occurrence of more intense climate events (Figure 6).

FIGURE 6. TOTAL DAMAGE CAUSED BY NATURAL DISASTERS IN VIET NAM



Source: Viet Nam Disaster Management Authority, MARD

A closer look at the natural disasters' damages shows that during the period 2006-2020, Viet Nam has experienced plenty of disasters, each of which ended up with the economic loss of more than VND 10 thousand billion and hundreds of dead and missing people (Table 3). The Central Coast and part of Central Highlands are the most affected regions by the storms, typhoons, and floods over the time. In addition, droughts and soil salinity in the Mekong Delta regions are becoming an alarming issue in recent years, with a reported economic loss of VND 15.7 thousand billion in 2016.

TABLE 3. TOTAL DAMAGE IN A SERIES OF NATURAL DISASTERS IN VIET NAM

Time	Natural disaster	Affected regions	Estimated economic loss (million VND)	Loss of human life (people)	
				Death toll & missing	Injured cases
6-20 October, 2020	Tropical storm Linfa (Storm no. 6) and flood in the Central Coast	North Central Coast and a part of Central Highland	15,657,998	154	408
28 October, 2020	Typhoon Molave (Storm no. 9) and flood	South Central Coast and Central Highland	13,271,755	83	140
15 October, 2017	Typhoon Doksuri (Storm no. 10)	North Central Coast	18,402,008	6	152
10-14 October, 2017	Flood	Northern regions and North Central Coast	13,142,109	102	42
4 November, 2017	Typhoon Damrey (Storm no.12)	South Central Coast and a part of Central Highland	22,679,932	123	342
March 2016	Drought and soil salinity	Mekong River Delta	15,700,686	-	-
30 September, 2013	Typhoon Wutip (Storm no. 10)	From Ha Tinh to Thua Thien Hue	13,605,197	17	208
27-28 October, 2012	Typhoon Son-Tinh (Storm no. 8)	Thanh Hoa, Ninh Binh, Nam Dinh	11,169,795	10	90
October 2009	Typhoon Ketsana (Storm no. 9)	Quang Tri, Thua Thien Hue, Da Nang, Quang Nam, Quang Ngai, Kon Tum	16,077,890	187	1,140
1 October, 2006	Typhoon Xangsane (Storm no. 6)	Da Nang and a part of Quang Ngai, Quang Nam, Thua Thien Hue	10,401,624	76	532

Source: Viet Nam Disaster Management Authority, MARD

Extreme weather events and natural disasters are expected to continue increasing both in quantity and intensity in the possible climate change scenarios of Viet Nam, leading to a series of socio-economic impacts on the country. Those impacts can be found in all short term, medium term, and long term, as indicated in a report of Asian Development Bank in 2013 (Table 4).[18]

(18) Asian Development Bank (2013). Viet Nam Environment and Climate Change Assessment

TABLE 4. CLIMATE CHANGE AND NATURAL DISASTER IMPACTS IN VIET NAM

	Climate Change and Natural Disaster Impacts
Short term	• Increased number and severity of typhoons striking Viet Nam, leading to loss of life and large-scale damage to property and infrastructure. Recent natural disasters: o Typhoon Linda (Nov 1997): 3,111 casualties and more than 1 million people affected, approximately 77,000 houses destroyed o Central Viet Nam Flood (Nov 1999): 749 casualties, destroyed 49,094 houses o Tropical Storm Kammuri (Aug 2008): hit Northern Viet Nam, causing heavy rains and storm wind, and subsequent floods and landslides; 133 casualties with 34 missing, 990 houses destroyed • Reduced productivity of coastal fisheries • Reduced agricultural land and productivity in coastal and other areas prone to flooding and erosion
Medium term	• Increased migration of people from susceptible areas, especially in mountainous and delta regions and in floodplains of large rivers, due to more frequent and extensive flooding • More frequent outbreaks and spread of old and new diseases due to more regular flooding and more intensive wet season • More extensive saline intrusion reducing water quality for agriculture, drinking, and industrial uses due to reduced dry season rainfall and flow along with sea level rise • Increased energy and water consumption due to increase in temperature
Long term	• Permanent inundation of coastal and low-lying areas due to sea level rise • Permanent losses of land for cultivation and aquaculture due to increased intensity and duration of drought periods in some areas • Changes in the ecosystems and failure of some agricultural crop species due to increased temperature

Source: Asian Development Bank

The character and severity of impacts from climate extremes depend on the extremes and on exposure and vulnerability, which is in turn determined by geographic and socio-economic characteristics.[19] Therefore, the impacts of climate change and disasters in Viet Nam are uneven across different regions and population subgroups. The different exposure and sensitivity levels and the featured vulnerabilities of each region of Viet Nam were suggested in a World Bank's study on social dimensions of adaptation to climate change (Table 5). Accordingly, Mekong Delta region and Central Coast have the highest exposure while Central Highlands and Northern Mountains possess the most sensitivity to climate change. The study also mentioned the vulnerable sectors including agriculture, water resources, and public health with vulnerable regions being coastal areas (including deltas) and mountain regions (especially those with flash floods and landslides).[20]

(19) IMHEN and UNDP (2015). Viet Nam Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation.

(20) World Bank (2010). Ibid.

TABLE 5. REGIONAL VULNERABILITIES TO CLIMATE CHANGE

Region	Exposure level	Sensitivity level	Main physical vulnerabilities	Main social vulnerabilities
Mekong Delta	High	Moderate	Sea level rise, flooding, saline intrusions, rising rates of storms, lack of fresh water in the dry season.	Several provinces with poor Khmer ethnic minority; rising rates of landless; large number of migrants.
Central Coast	High	Moderate	Increased storms, coastal surges, flooding, some drought-prone areas, especially in south of the coast.	High poverty rate; pockets of ethnic minorities; many fishing communities; dependence of rainfed agriculture in many areas.
Central Highlands	Moderate	High	Flash floods, droughts, floods.	High number of ethnic minorities; high rates of poverty; many migrants; high numbers of dependent on rainfed and subsistence agriculture.
Northern Mountains	Low	High	Landslides, flash floods, droughts, storms.	High poverty rates; dominated by diverse ethnic minorities; high illiteracy rates and large families; low rates of female education; many remote areas with poor road access; high rates of subsistence and rainfed agriculture.
Red River Delta	Moderate	Low	Storms, floods and flash floods, inundation.	Low poverty rate but large number of poor people overall; high rates of outmigration; female-headed households.
Southeast	Low	Low	Coastal storms, drought in inland areas.	Low rates of poverty overall but some pockets, particularly for ethnic minorities; many migrant workers.

Source: World Bank

Those classifications are mostly in line with other studies and reports that the impacts of climate change in Viet Nam will be diverse and differ by regions. For example, the 2020 updated on National Determined Contributions estimated that a 100-centimeter sea level rise would lead to different levels of land loss due to permanent inundation in different regions, namely as Mekong River Delta (38.9%), Ho Chi Minh city (17.8%), Red River Delta (16.8%), Quang Ninh (4.8%), Ba Ria-Vung Tau (4.8%), and Central coastal provinces (1.5%). With 70 percent of the population living in coastal areas and low-lying deltas, Viet Nam is highly exposed to riverine and coastal flooding.[21] While some regions like the Northern Mountains face devastating floods, some others like the Central Highlands and the Mekong Delta are experiencing extensive droughts and consequent reduction of groundwater availability.[22]

By affecting livelihood options and threatening property, homes and lives, climate change and extreme events can affect different population groups differently. As suggested by the 2010 social study of World Bank, vulnerable people to climate change are assumed to be farmers, fishers, ethnic minorities, senior citizens, women, children, and poor people in urban areas. Besides, the impacts may also be specific among each of the socially vulnerable groups, including women, children, ethnic minorities, the illiterate, those who suffer food shortages, those under the poverty line, the disabled, families with many children and those in remote areas.

The following sections will look closely at the impacts of climate change and disasters on several domains of life including life and health, education and learning, dignified work, financial security, and adequate living conditions. By using those MIF domains, the research team expects to achieve a thorough understanding of the different impacts on each population group and to identify the changes in gap between them in the context of climate change.

(21) Bangalore, M. et al. (2018). Exposure to Floods, Climate Change, and Poverty in Vietnam. Economics Of Disasters and Climate Change.

(22) FAO (2016). 'El Nino' Event in Vietnam: Agriculture Food Security and Livelihood Needs Assessment in Response to Drought and Salt Water Intrusion.

3

IMPACTS OF CLIMATE CHANGE AND DISASTERS ON MULTIDIMENSIONAL INEQUALITY

3. IMPACTS OF CLIMATE CHANGE AND DISASTERS ON MULTIDIMENSIONAL INEQUALITY

3.1 Impacts on Life and Health

According to the Updated Nationally Determined Contribution,[23] increased temperatures, prolonged heatwaves, air pollution, as well as other climate extremes negatively affect human health, leading to increased vulnerability especially among the elderly, women, children and people with such chronic diseases as cardiovascular, neurological, musculoskeletal, respiratory and allergic conditions. Among its many effects on human well-being, climate change may affect human health and more specifically human mortality.[24] This is not only a consequence of extreme events (heatwaves, floods), this is also due to the prevalence of some diseases, for instance through the exposure to infectious or toxic agents (dengue fever, malaria).

3.1.1 Rising Temperatures and Heatwaves

Rising temperatures facilitates the development of vector-borne diseases, increasing the likelihood of outbreaks and spread of such diseases as influenza A (H1N1, H5N1, H7N9), diarrhea, cholera, dysentery, malaria, dengue fever, yellow fever, typhoid, viral encephalitis, Japanese encephalitis, severe acute respiratory syndrome (SARS), plague, and zika.[25] For example, air pollutants and heat can cause higher ozone concentrations, reducing lung function and irritating the respiratory system. As a result, heatwaves can cause heart attacks and aggravate the incidence of asthma, bronchitis, and other cardiopulmonary diseases, leading to premature death.[26] Recent statistics indicate that an average temperature rises by 1°C results in a 3.8 percent increase of hospitalization rate for children aged under five due to respiratory infections.[27]

Findings from the qualitative interviews of this study confirm those impacts of temperature rise, suggesting that the rising temperatures in the environment and heatwaves can lead to several potential health problems such as heat exhaustion, heat stroke, heat stress, accidents, and injuries, especially for outdoor labour. An example is found in the study commune of Quang Nham (A Luoi district, Thua Thien Hue), where there is a harsh climate with hot and dry southwest winds [which are known in Vietnamese as *gió Tây Nam*, or also as *gió Lào*] usually active from May to June. Over the past three years, the study interlocutors have observed that the hot and dry wind tends to start early around April and last longer till August. As such, residents performing physical outdoor labour are exposed to higher temperatures combined with body heat generated by the jobs themselves. Chronic exposure to extreme heat without sufficient protection in workplace during dry seasons (e.g., January to June) also increases the risk of heat-related illness for working population in fisheries and aquaculture in the coastal areas of Thua Thien Hue and Ca Mau provinces. Among workers (mostly males) in these outdoor occupations, they tend to lack a high school degree and are mainly from the Khmer ethnic group as in the case of the study commune of Nguyen Viet Khai (Phu Tan district, Ca Mau).

> *"Comparing to the previous years, temperature is now becoming higher, the heat intensity is stronger, and there are more hot days. The southwest winds may start earlier and end later. During hot periods, the temperature can rise to 38 degree Celsius."*
>
> *KII with a commune leader, Quang Nham commune, Thua Thien Hue*

(23) The Socialist Republic of Viet Nam (2020) Updated Nationally Determined Contribution, page 16.

(24) Fleurbaey, Marc, Aurélie Méjean, Antonin Pottier, Stéphane Zuber (2020). The welfare implications of climate change-related mortality: Inequality and population ethics.

(25) Ibid.

(26) Reckien, D., Lwasa, S., Satterthwaite, D., McEvoy, D., Creutzig, F., Montgomery, M., Schensul, D., Balk, D., and Khan, I. (2018). Equity, environmental justice, and urban climate change. In Climate Change and Cities: Second Assessment Report of the Urban Climate Change Research Network, 173–224. Cambridge University Press. New York.

(27) The Socialist Republic of Viet Nam (2020). Updated Nationally Determined Contribution, page 14.

"During the hot season, it's already too hot in the morning. I couldn't do much because I'm too tired [due to the heat]. Sometimes I had to take a break."

KII with a poor household representative, Nguyen Viet Khai commune, Ca Mau

Furthermore, the uncomfortable heat might cause people to engage in less physical activity which increases the risk of non-communicable diseases (NCDs) such as diabetes, cardio-vascular illnesses and cancers (endometrial, breast, rectal and colon), especially for the elderly or people with disabilities (PWD) who typically have lower mobility.[28] Older individuals are more susceptible to the negative health consequences of heat exposure, in part due to the exacerbation of heat stress on pre-existing cardiac conditions. It has been observed that primary health care is provided by health communes but only a small proportion of the elderly have health insurance cards eligibly registered for NCD examination and treatment. This is partly due to the fact that under the Health Insurance Law some health check-up services for early detection of non-symptomatic NCDs are not covered.[29] This reveals inequalities within the elderly population in relation to access to healthcare. Older people are generally more likely to be excluded if they have low levels of education or income, live in rural areas or belong to ethnic minority groups.[30] Additionally, poor transportation, shortage of equipment at medical facilities and the negative attitudes and behaviours of medical staff might also discourage older people from accessing health services.[31] An interviewed public health officer from Ca Mau indicates that there is recently an increase in the prevalence of NCDs among relatively young age group (30-49 year).

Heatwaves and temperature fluctuations due to climate change are also suggested to affect health of people sensitive to weather changes like the elderly and children. For example, a young Khmer man in Nguyen Viet Khai commune (Ca Mau) shared that there were months with extreme heats during day but rains in the evening, making the temperature to fluctuate and causing fever and sickness to his one-year-old child. In those months, his child might get sick up to 3 times per month. A 70-year-old Pa Ko woman in Quang Nham commune also informed that if the weather was too hot, both children and the elderly like her would get cough and fever. However, she considered that hot temperature might be less uncomfortable for her than cold temperature. Since she lived in a mountainous area, she usually experienced cold weather in the winter, especially at night, which caused several health issues to her like illness, cough, back pain, bone and joint pain. Another old Pa Ko woman also claimed that the weather change and cold winter in the mountainous area aggravated her chronic asthma, making her breathless and unable to sleep at night. The situation usually got worse at the seasonal changes or when it was cold, making her go the hospital for oxygenation sometimes (3 to 4 times per year).

In the quantitative analysis of this study, the research team looks for the health impacts of temperature rise and other extreme weather events at the country level. The research team firstly estimated the effect of temperature and rainfall extremes on the probability of reporting sickness or injury during the past 12 months of individuals using the model of extreme weather (model 2), with results represented in Table 6. It shows that both children and adults are more likely to have sickness when being exposed to cold temperature. The number of sickness and injury also tends to increase when the annual number of days with low temperature increases. The effect of high temperature days is positive with sickness rate, but it is not statistically significant. High temperature only has a small positive effect on the sickness probability of adults, those who might have high exposure to the heat when working outdoors. Meanwhile, the rainfall extremes do not affect health status in general; there is only a small positive effect of high precipitation on the number of sick days of adults.

(28) Nugent, Rachel and Edward Fottrell (2019) Non-communicable diseases and climate change: linked global emergencies. The Lancet 394 (10199): 622-623.

(29) Help Age International (2019) Vietnam insights: the right to health and access to universal health coverage for older people. London: HelpAge International.

(30) Le Duc Dung & Giang Thanh Long (2016) Gender differences in relevance and associated factors of multi-morbidity among older persons in Vietnam. International Journal on Ageing in Developing Countries 1 (2): 113-132.

(31) UN Women (2021) Final Report: An Independent Gender Review and Impact Assessment of the National Target Programme on New Rural Development (NTP NRD) for the period of 2010-2020.

TABLE 6. IMPACTS OF WEATHER EXTREMES ON HEALTH

Explanatory variables	Dependent variables			
	Sickness or injury during the past 12 months of children (yes=1, no=0)	Number of sickness or injury times during the past 12 months of children	Sickness or injury during the past 12 months of adults (yes=1, no=0)	Number of sickness or injury times during the past 12 months of adults
Number of days with low temperature	0.00048***	0.00124***	0.00057***	0.00142***
	(0.00017)	(0.00040)	(0.00017)	(0.00040)
Number of days with high temperature	0.00014	0.00054	0.00023*	0.00057
	(0.00012)	(0.00034)	(0.00012)	(0.00039)
Number of days with low precipitation	0.00015	0.00016	0.00006	-0.00040
	(0.00018)	(0.00046)	(0.00018)	(0.00057)
Number of days with high precipitation	0.00018	0.00065	0.00026	0.00088*
	(0.00023)	(0.00057)	(0.00021)	(0.00048)
Control variables	Yes	Yes	Yes	Yes
Province-year fixed-effects	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes
Constant	0.01122	0.03170	0.01895	0.12392
	(0.04156)	(0.10124)	(0.04143)	(0.11483)
Observations	246,067	246,067	586,545	586,545
R-squared	0.114	0.120	0.096	0.072

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

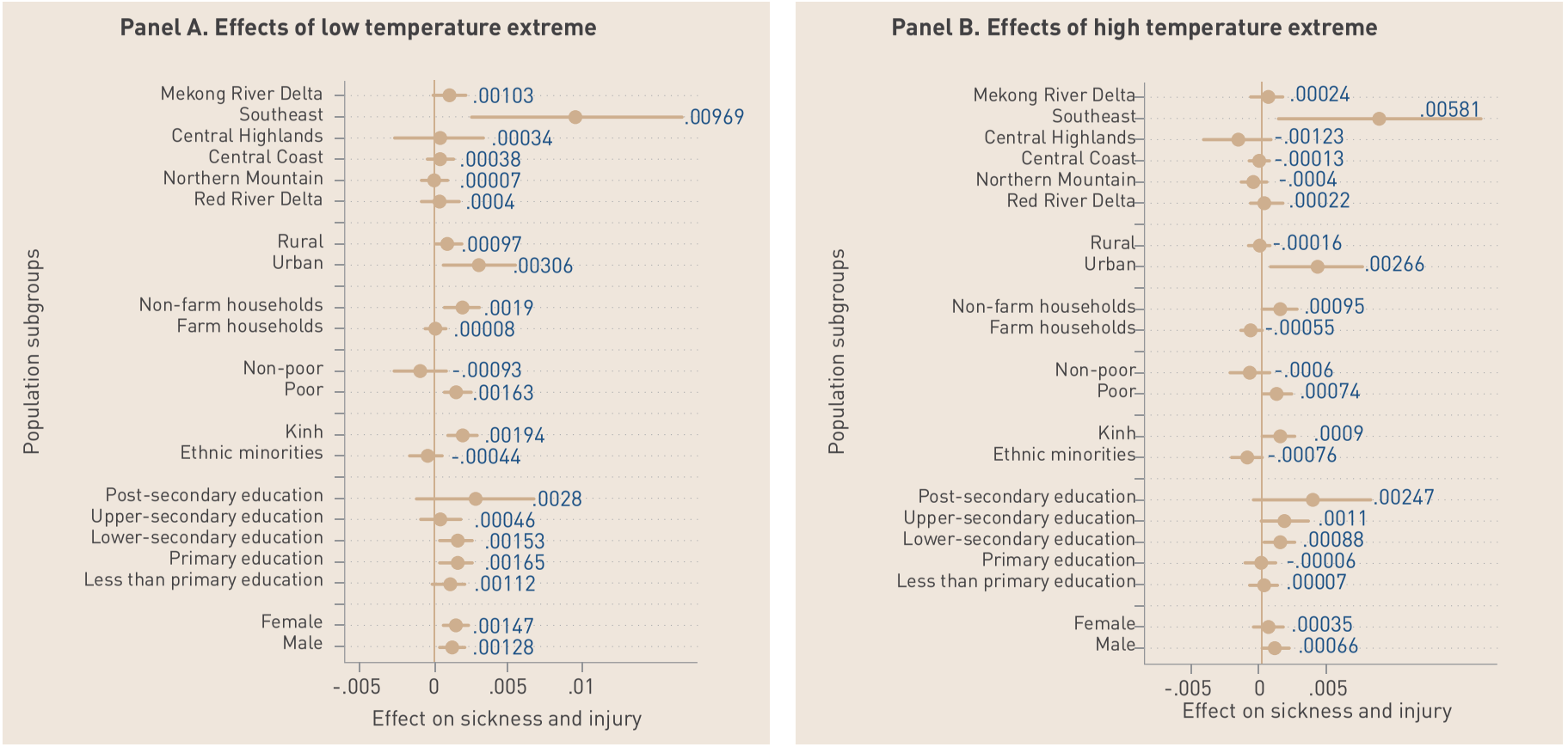
Those results suggest that temperature extremes can increase the probability of sickness of people in the affected areas. At the present time, low temperature extremes are found to have more significant health impacts than high temperatures. This result is reasonable given that Viet Nam is a tropical country where people are more familiar with hot weather than the cold, thus, the current temperature rise possibly remains in the heat tolerance of the majority of Vietnamese people. Nonetheless, as the effect of high temperature extremes are found positive with the probability of sickness, it can be expected that the health impacts of high temperature would be significant in the future when the temperature rise sharply.

To explore the effect of extreme weather on inequality in health, the research team estimated the effect of temperature extremes on the probability of reporting sickness in the past 12 months for different population subgroups. Figure 7 reports the coefficients and the 95 percent confidence intervals of the low and high temperature extremes in regressions of the sickness rate of children for different population subgroups. Results suggest that the negative effect of low temperature extremes is higher for children of poor households (those having per capita expenditure below the poverty threshold) and children living in households with lower-education head (i.e., those who only finished lower secondary school or below) (Panel A of Figure 7). High temperature extreme is also more likely to affect poor children than non-poor ones (Panel B of Figure 7). On adults, the impact patterns are similar as those from poor households are more likely to get sick at extreme low and high temperatures (Figure 8). Besides, it is found that the temperature extremes pose more significant health impacts on Kinh people and people from non-farm households.

By geography, there are significant effects of both low and high temperature extremes on health of children and adults in Southeast region and urban areas. Children and adults living in both rural and urban areas are more likely to get sick when the number of low temperature days increases, while significant health impacts of high temperature extremes are only found among those living in the urban area. A possible explanation for this result is the Urban Heat Island phenomenon, which are caused by hard surface, residential and industrial sources of heat, and air pollution, and amplify the intensity and impact of extreme heat in the urban areas. [32]

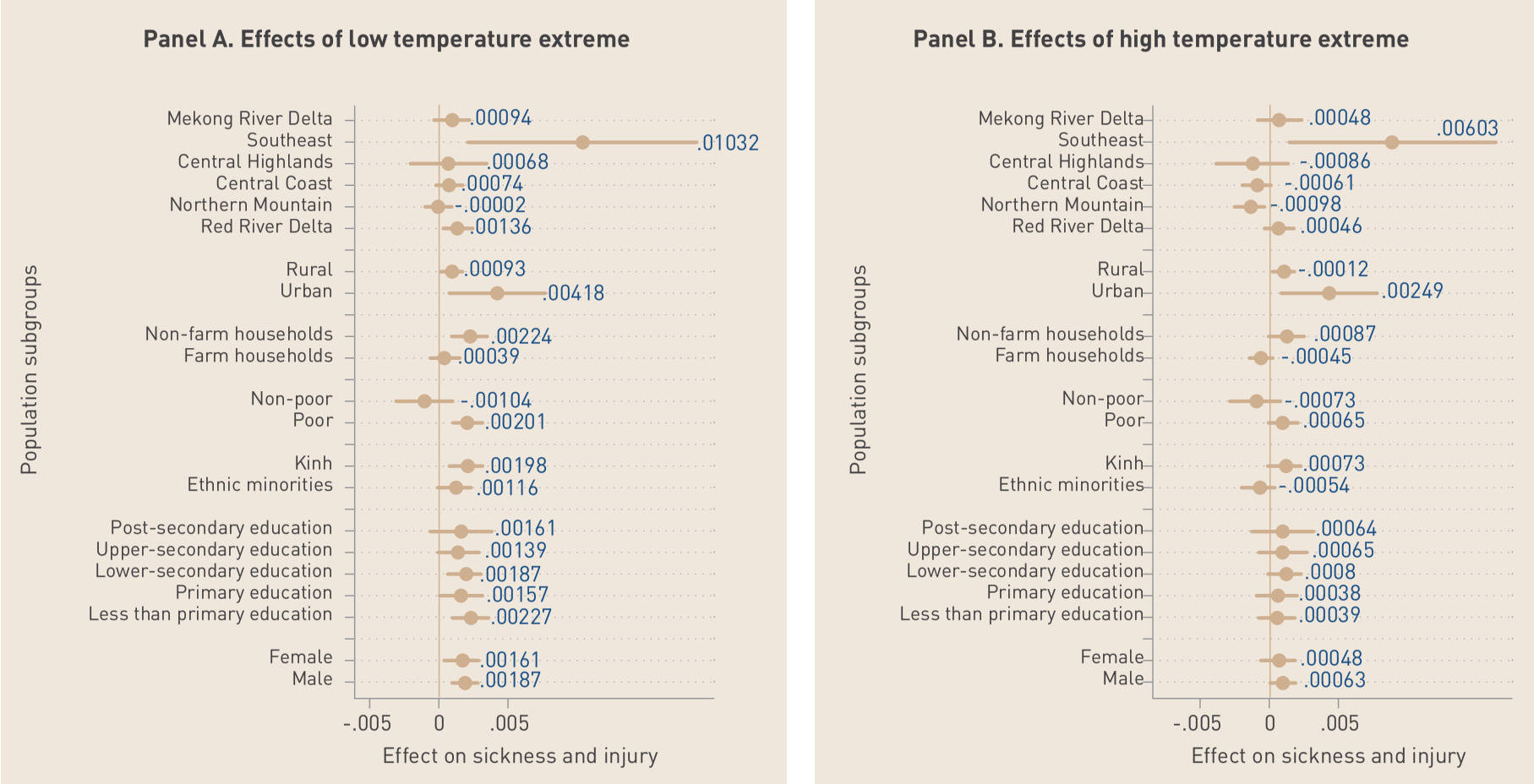
(32) World Bank and Asian Development Bank (2020). Climate Risk Country Profile: Viet Nam.

FIGURE 7. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON HEALTH OF CHILDREN



Source: Estimation from VHLSSs 2010 to 2018

FIGURE 8. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON HEALTH OF ADULTS



Source: Estimation from VHLSSs 2010 to 2018

3.1.2 Rising Sea Levels, Storms and Floods

From the literature review it is noted that the health consequences of flash floods and floods associated with storms and sea level rise can be early, immediate and late.[33] The immediate public health concerns of flooding include a wide range of consequences such as drowning, injuries, hypothermia, outbreak of gastroenteritis, respiratory infections, poisoning, communicable diseases, epidemic diseases such as cholera, diarrhoea, and dengue fever.[34]

Regarding flood deaths, the primary cause of flood-related fatalities was drowning. On the one hand, gender differences are directly linked to constraining cultural practices which translate into girls and women not being taught how to swim (i.e. hampering them from escaping when water levels rise) or read (i.e. preventing them from reading public governmental warnings).[35] On the other hand, men may be much more vulnerable to accidents than women probably due to taking more risky or "heroic" acts.[36] In the study settings of Ca Mau and Thua Thien Hue, all stakeholders reported that when destructive flooding strikes, men seem to be more confident in their abilities to cope with floods, perceiving greater knowledge, experience and physical strength. Therefore, men are very likely to stay to protect their household property, whereas women and other vulnerable groups such as the elderly, children, people with disabilities are subject for evacuation.

Health risks also are associated with the evacuation of residents, loss of health workers, and loss of health infrastructure including essential drugs and supplies. Often health hazards are exacerbated by the conditions at the temporary shelters which are the medium-high public buildings such as the school, the commune people's committee hall as also observed in the study communes of Quang Nham and Nguyen Viet Khai. At these public facilities, usually there are no more than two toilets and no bathroom, posing extreme challenges without adequate sanitation facilities. Qualitative findings from group discussion with Pa Ko and Ta Oi female residents and local authorities in Quang Nham revealed that during the 2020 Central Floods, a number of households in their hamlet were evacuated to the commune secondary school. There were two latrines which were under pressure from constant overuse, and often in a run-down state. Dreading these unhygienic conditions, female evacuees tried to hold out for hours and reduce drinking water to limit their toilet times. As such, not dehydration and "holding on" can severely effect levels of concentration and can lead to significant health problems. Additionally, there was no bathroom or available hot water for bathing. Some women abstained from bathing for three days, taking risks of gynaecologic infections and other water-borne diseases. Many evacuees including the elderly and children experienced a flu, cough or lower abdominal pain in women during their menstrual periods, following a bath with cold water.

> *"In the case of relocation during a natural disaster, people are many but the toilets are few. Adults prepare the potty for their children. There was no hot water there so we often had to go home to take a shower. The elderly and women are usually relocated while men stay at home to look after the house. "*
>
> *Female FGD in Quang Nham commune, Hue*

Moreover, destructive floods alter the balance of the environment and often creates a conducive environment (breeding ground) for the development of pathogens and vectors. The diseases that are most likely to be affected by flooding are those that require vehicular transfer from host to host (waterborne) or a host/vector as part of its life cycle (vector-borne).[37] Information from key informant interview with provincial representative of health sector indicates that infectious diseases like cholera and diarrhea diseases are highly climate-sensitive and may rise significantly, especially due

(33) WHO (2014) Quantitative risk assessment of the effects of climate change on selected causes of death, 2030s and 2050s.

(34) Tran Huu Bich, La Ngoc Quang, Le Thi Thanh Ha, Tran Thi Duc Hanh & Debarati Guha-Sapir (2011) Impacts of flood on health: epidemiologic evidence from Hanoi, Vietnam, Global Health Action, 4:1, 6356, DOI: 10.3402/gha.v4i0.6356.

(35) Nguyen Thu Huong and Helle Rydstrom (2018) Men's Infliction of Harm upon Women in the Philippines and Vietnam. Women's Studies International Forum. Volume 71, November–December 2018, Pages 56-62. https://authors.elsevier.com/c/1Xy5C-6kqPaJ1

(36) WHO (2014) Gender, Climate Change and Health.

(37) Okaka, Fredrick Okoth and Beneah D. O. Odhiambo (2018). Relationship between Flooding and Outbreak of Infectious Diseasesin Kenya: A Review of the Literature, Journal of Environmental and Public Health Volume 2018, Article ID 5452938 | https://doi.org/10.1155/2018/5452938.

to flooding. Thua Thien Hue used to be in the list of provinces at highest risks for cholera infection and diarrhea diseases in times of floods. Evidence shows that flooding may hinder access and provision of urgent medical services to suppress the spread of infectious diseases leading to a wider spread given the overcrowding at temporary shelters.[38] Further, pregnant women are particularly vulnerable to malaria, because they are twice more attractive to malaria carrying mosquitos than non-pregnant women.[39] Since pregnancy reduces women's immunity to malaria, it makes them more susceptible to infection and increasing their risks to illness and secondary diseases. Anaemia which can result from malaria infection is responsible for a quarter of maternal mortality.[40]

In addition to the above, limited access to transportation during a flood has been shown to cause missed or delayed medical care appointments, and more, generally, to limit access to health care for especially the elderly, children, people with disabilities, and pregnant women. Traffic delays associated with climate change induced floods may further exacerbate this vulnerability. It has been reported that a pregnant woman on her way to the hospital for labour died after being swept away by floodwater during the 2020 floods in Thua Thien Hue.[41]

Another problem worth to be considered is the risk of lightning kills during thunderstorms. As climate becomes hotter and more humid, rains and storms will be stronger and come with heavier clouds that lead to higher chances of lightning. In fact, the lightning frequency is predicted to increase by 12 percent by each degree Celsius of temperature rise,[42] and coastal areas may be at the highest risk.[43] This finding is reaffirmed by the qualitative interviews with local people in Nguyen Viet Khai commune (Ca Mau), as such, many study participants in the coastal hamlet of Go Cong Dong indicated an increase in lightning incidents over the past three years. According to those local people, lightning rarely occurred before, but it happens now more frequently at the start of rainy season between May and June, and people who work in capture sea fishing are very likely more exposure to lightning hazard. For instance, it has reported that three fishermen were struck by lightning in 2020 and all were fatal. Those who got struck were mostly inshore fishermen, who were far from shelters when the thunderstorms approached. In contrast, the aquaculture farmers could hide in their houses and the offshore fishermen can hide in their boats, so they were less likely to get struck. Although the death toll due to lightning strike is not too big at the moment, these incidents have repeated in the recent years, causing a constant threat that made local people scared.

In the medium-term, infected wounds, complications of injury, poisoning, poor mental health, communicable diseases, and starvation are indirect effects of flooding.[44] New research has shown that flooding of soils contaminated with arsenic, which may occur as sea levels rise due to climate change, could lead to the mobilisation of this toxic element in the environment.[45] Water pollution usually means that women are likely more vulnerable to water-related diseases given their primary role as cooks, cleaners and care providers as also observed in the visited sites of this study. Especially, women involving in low-paying informal jobs and micro-businesses that all have in common a dependence on water such as cleaning and laundry services are vulnerable to polluted water resources given their exposure more frequently and intensely.

In the long-term, chronic disease, disability, poor mental health, and poverty-related diseases including malnutrition are the potential legacy of destructive floods. Most notably, food shortages and hunger potentially resulting from crop and income losses following destructive floods and typhoons were reported by household stakeholders in both Ca Mau and Thua Thien Hue. When sea level rise (SLR) led to saltwater flooding overtopped pond

(38) Okaka, Fredrick Okoth and Beneah D. O. Odhiambo (2018). Ibid.

(39) WHO (2014). Gender, Climate Change and Health.

(40) WHO (2014). Ibid.

(41) VnExpress Online Newspaper (2020). https://vnexpress.net/san-phu-bi-lu-cuon-4175319.html

(42) Romps M. D., Seeley T. J., Volland D., and Mollinari J. (2014). Projected Increase in Lightning Strikes in the United States Due to Global Warming. Science Vol 346, Issue 6211, pp. 851-854. DOI: 10.1126/science.1259100.

(43) Chakraborty, R., Chakraborty, A., Basha, G., and Ratnam, M. V. (2021). Lightning occurrences and intensity over the Indian region: long-term trends and future projections. Atmospheric Chemistry and Physíc. Vol. 21, Issue 14. https://doi.org/10.5194/acp-21-11161-2021.

(44) Okaka and Odhiambo (2018). Ibid.

(45) LeMonte, J.J., Stuckey, J.W., Sanchez, J.Z., Tappero, R.V., Rinklebe, J. & Sparks, D.L. (2017). Sea level rise induced arsenic release from historically contaminated coastal soils. Environmental Science & Technology, 51(11): 5913– 5922 DOI: 10.1021/acs.est.6b06152.

embankments, allowing escapes of mud crabs and prawns, local farmers experienced a dead loss in the coastal commune of Nguyen Viet Khai. Similarly, floods caused huge damage to the local banana [*chuối già lùn*] plantations in the mountainous commune of Quang Nham. Given that the combined faming ponds of mud crabs and prawn or the banana gardens are often viewed as "poverty escape route" for many low-income households of Kinh, Khmer, Ta Oi, and Pa Ko ethnic groups in the study communes of Nguyen Viet Khai and Quang Nham, respectively. Facing significant losses in their agriculture productivity and resultant increases in food prices, these residents often bear the largest burden in times of food insecurity. And women are the hardest hit, struggling to maintain nutritious diets. There is growing evidence that the children most likely to be undernourished are in the poorest households, in rural areas, and often among minority groups.[46]

In addition to the above, some national stakeholders notice the potential increases in domestic violence usually exerted by the husband when extreme weather conditions damage the harvest. According to these interviewed stakeholders, the combination of financial hardship, uncertainty and other mental stresses attributed by extreme weather events may lead men to be more violent towards their wife and children, thereby affecting women and children's mental health, physical safety, and well-being. This observation is consistent to the findings of the rapid needs assessment on the 2020 Central Floods, which indicated the potential risk of sexual harassment, intimidation and violence against women, girls, and boy due to overcrowding in evacuation sites.[47] In this regard, climate change-induced crises can be recognized as a serious aggravator of gender-based violence.

3.1.3 Coping Strategies, Capacities and Hindering Factors

To avoid the negative impacts of extreme weather on health, people in the studied sites usually choose to limit their exposure to those events. For example, in the communes of Quang Nham (Thua Thien Hue), farmers tend to adjust their working time in the fields to avoid the heat. They tend to work earlier in the morning and later in the afternoon (when the weather is less hot) and are less likely to visit the fields during hot days. Similarly, to reduce the risk of lightning strike, people in Nguyen Viet Khai commune (Ca Mau) limit going out in the month of June when there are high chances of rains and thunderstorms. Nevertheless, this measure does not apply to all people. Some poor fishermen who are in need of money still take risks to go fishing even in the thunderstorms. Other fishermen are reported to have no choice but accept to work under extreme hot temperatures since their job depends on the water streams and the flow of fish.

> *"In the hot days, farmers are less likely to go to the fields, especially from 10 AM to 3 PM."*
>
> ***KII with a commune leader, Quang Nham commune, Thua Thien Hue***

> *"Local people adapt with the situation [of lightning strikes] by avoiding going out in the month of June when it rains heavily. When there are thunderstorms, people only go fishing if they expect to catch a lot of fishes. Otherwise, they are less likely to go to the sea, for example, only 30 to 40 boats go fishing in the rainy days instead of 100 boats in a normal day. Only those who are really in need of money would go fishing in those days."*
>
> ***Female FGD in Nguyen Viet Khai commune, Ca Mau***

(46) Paul Dornan, Maria Jose Ogando Portela, and Kirrily Pells (2014). Climate Shocks, Food and Nutrition Security: Evidence from the Young Lives cohort study. Oxfam Research Reports.

(47) UN Women, CRS, UNICEF, Save the Children (2020). Gender & Protection Joint Need Assessment Floods in Quang Binh, Quang Tri, Thua Thien Hue, Quang Nam and Quang Ngai. Inputs from Gender and Protection Group members, 21-23 October 2020.

In the case of sickness or health problems due to weather change or extreme weather, local people in the studied sites usually look for primary healthcare at the commune health centres. During the qualitative interviews in both Quang Nham and Nguyen Viet Khai communes, the participants, who are mostly from poor households, informed that they tended to go to the commune health centres for health check or taking medicine once they got health problems due to weather change. However, if the problems remained, they would go to the nearest hospital, which were usually district hospitals. For instance, when his child got fever due to temperature changes, the poor Khmer man in Nguyen Viet Khai commune usually went to the commune health centre to take medicine for his child, then he would take the child to the hospital which was 10 km away from home if the child did not recover. The trips to the hospital were quite difficult as he had to ask for a boat ride from his neighbours.

This qualitative finding reaffirms the importance of grassroots health services in providing primary healthcare for poor people, EM people and those living in remote mountainous and coastal areas, where are prone to climate change and disasters. As geographical distance is reported to prevent access of those vulnerable groups to quality health services in provincial and national hospitals,[48] poor and EM people are likely to depend on the commune and district-level healthcare in their daily life as well as in emergency cases like natural disasters. Thus, investments in upgrading facilities and improving the healthcare quality of the commune health centres and district hospitals will bring great benefits to those vulnerable people as they will not need to travel far and can access to the healthcare services timely. The risk of accidents on the way to the health facilities during natural disasters such as floods can also be reduced.

On the health expenditure, qualitative findings suggest that the free health insurance policy plays a great role in supporting poor and EM people access to necessary healthcare for climate change-induced health problems. Most of the poor and EM interlocutors in the studied sites informed that they could use their health insurance cards for healthcare services and medicine at health facilities. For instance, the old Pa Ko woman suffering from asthma shared that she could go to the hospital for oxygenation when needed because she had health insurance card and was exempt from hospital bills. With a coverage of 90 percent of poor people, the provision of free health insurance to poor households can be considered as an effective policy.[49]

Prolonged dry seasons due to climate change pose water shortage challenges to local residents in the study communities of Quang Nham and Nguyen Viet Khai, but varying considerably in their degree of severity. Most worrisome is compound risks of domestic water supply shortages due to saline intrusion associated with sea level rise and droughts in southernmost point of the country.[50] It has reported that the existing centralized water supply system could provide piped water to only 18 percent of rural population in Ca Mau, mainly households residing along the main roadways. Accordingly, 74 percent of rural population in the province rely heavily on 137,590 private groundwater wells for daily needs and agriculture.[51] To cope with water scarcity which is getting more frequent and severe during dry seasons, most households try to reach groundwater, tapping the Pleistocene aquifers between 120 and 200m. A recent assessment of groundwater quality for drinking and agricultural purposes in Ca Mau shows that about 31 percent of groundwater samples in the area were classified into poor and unsuitable for drinking purpose.[52] In the study commune of Nguyen Viet Khai, there is a handful of households who cannot afford the home water filtration systems, a majority of families adopt a common method of leaving the pumped underground water sit in the storage tank overnight in order to allow harmful microbes to sink to the bottom of the tank. This type of water treatment can neither remove completely harmful microbes nor other types of contaminants that may be present.

> *"In Ca Mau, people mainly use groundwater or water from self-drilling well [tap water coverage is not high]. Water from these sources is unsanitary. Sometimes, the locals just drill up to get water and use directly [without filtration] but the water might already be contaminated with arsenic, iron, etc. In such cases, their health will be affected a lot."*
>
> ***KII with the provincial representative of DONRE, Ca Mau***

(48) MDRI (2020). Research on Multidimensional Inequality in Viet Nam.

(49) MDRI (2020). Ibid.

(50) Bauer, Jonas, Nicolas Börsig, Van Cam Pham, Tran Viet Hoan, Ha Thi Nguyen, Stefan Norra (2022). Geochemistry and evolution of groundwater resources in the context of salinization and freshening in the southernmost Mekong Delta, Vietnam. Journal of Hydrology: Regional Studies 40 (April) https://doi.org/10.1016/j.ejrh.2022.101010

(51) Ca Mau People's Council (2020). Assessment Report of the Monitoring Results of Clean Water Provision Program in Ca Mau Province. Report No. 26/BC-DCS, dated 25/6/2020.

(52) Quang Khai Ha et al 2022 IOP Conference Series: Earth and Environmental Science. 964 012008.

There are health risks involved in using poorly-treated groundwater for human consumption. Disease-causing microorganisms found in water supplies can cause diarrhoea, vomiting or other gastrointestinal illness. Some of these microbes can also lead to more serious illnesses, even death. This has health implications for people with weakened immune systems, the elderly, young children, and pregnant women. Information from group discussion with male residents of the coastal hamlet of Sao Luoi (Nguyen Viet Khai commune, Ca Mau) indicates that bathing in the groundwater which has very high concentrations of salinity (TDS) and iron levels on regular basis caused skin irritation and other skin infestation among hamlet residents. The locals in Quang Nham commune (Thua Thien Hue) also reported negative health consequences from using surface water that had already been contaminated by pesticides/herbicides.

Women are more vulnerable to poor water quality due to their specific hygiene needs during menstruation, pregnancy and child rearing. Recent studies have shown that high nitrate levels in drinking water during the first trimester of pregnancy are associated with birth defects in newborns, methemoglobinemia is directly related to high nitrate levels in drinking water.[53] Climate-related safe water scarcity affects all social groups, but it affects them differently, depending on the resources they have and the alternate opportunities available. The ones most affected are the low-income households, especially the elderly and women heads of household. Their water is inadequate in quantity and quality because they have no large reservoirs for storage and sedimentation, posing a remarkably high risk to waterborne diseases. Also, the main sources of water used for bathing are ponds, rivers, and streams. Nevertheless, bathing at night, in a public, nature-like pond might likely pose risks for sexual harassment to women and girls as indicated in some development reports.[54]

"People on the hill still use herbicides a lot. The families that drink water directly from the spring [without filtration] will definitely be affected [health].

Spring water is so dirty that I don't dare to bathe in. It causes me rashes."

Male FGD in Quang Nham commune, Thua Thien Hue

FIGURE 9. A WOMAN WASHING CLOTHES BY A ROAD-CROSSING STREAM IN QUANG NHAM COMMUNE, THUA THIEN HUE

Source: The research team

(53) Quang Khai Ha et al 2022 IOP Conference Series: Earth and Environmental Science. 964 012008.

(54) Yu, Guimei, Jiu Wang, Lei Liu, Yun Li, Yi Zhang & Songsong Wang (2020) The analysis of groundwater nitrate pollution and health risk assessment in rural areas of Yantai, China. BMC Public Health 20, 437. https://doi.org/10.1186/s12889-020-08583-y

Given the potential of groundwater depletion associated with groundwater overuse, it has been observed that the pumping time takes longer, resulting in additional electricity cost per kilowatt hour. To save this energy consumption, women and girls in many cases take the primary role in water collection for domestic purposes and they must walk to fetch water from the public ponds, streams and rivers. The burden of daily hauling water to their homes has negative health implications for women and girls such as spinal pain or insufficient sleeping hours and subsequently stress and mental health issues. Additionally, overexploitation of underground water observed in the study rural and coastal areas of Ca Mau led to the ground surface collapse, causing accidents to residents, especially the elderly, children and women more often, and the responsibility of caring for sick family members falls on women.

In the mountainous hamlets of Quang Nham of the Central region, the Pa Ko and Ta Oi ethnic residents notice that the Summer-Autumn crop losses following prolonged droughts have implications for food shortages, hunger and especially childhood stunting associated with poor maternal health and nutrition, inadequate infant and young child feeding practices. Recent data also indicates that the rates of childhood stunting in the Northern Mountain and Central Highlands regions remain alarmingly high at 30.7 percent and 34.9 percent, respectively.[55] Chronic childhood undernutrition (stunting) levels amongst largely ethnic minority regions in Viet Nam remain among the highest in the world. The causes of stunting in minority ethnic groups are multidimensional and linked to the socially derived determinants of health that appear in the definition of multidimensional poverty as well as economic models that tend to link causal elements to monetary poverty. In this regard, climate change exacerbates the problem and makes this worst. Consultations with provincial stakeholders of Thua Thien Hue and Ca Mau reveal a concern that broad impacts of climate change (temperature increase, an accelerated water cycle, ocean acidification, and changes in the degree of weather disturbances and rainfall patterns) may increase the concentrations of contaminants in marine animals that are vital to local communities' traditional diets, something which could be particularly threatening to pregnant women and their unborn children. Prenatal exposure to contaminants such as methyl mercury, for example, has been correlated with cognitive disorders in children.[56]

3.2 Impacts on Education and Learning

Climate change threatens to exacerbate current and future hurdles to the global achievement of Sustainable Development Goal 4 in terms of providing a universal education for all children and adolescents. The ways in which climate change may impact the education sector are complicated. There are direct consequences like school destruction or learning time delays, as a result of such natural disasters as floods and storms. Some other connections are more indirect: gradually increasing temperatures and changing rainfall patterns, for example, can produce adverse effects to agricultural livelihoods, putting additional financial strain on vulnerable households who may be forced to engage their children in income earning rather than studying.

Evidence from many countries has proven that each additional year of schooling increases an individual's income by 8-10 percent.[57] In contrast, a 3 percent reduction in one's lifetime earnings is the projected price to pay for each one-third loss of a school year, according to global analyses of missed education.[58] However, the costs of learning losses must be considered beyond the reduced income that a student cohort might expect. In fact, a less skilled work force also implies slower economic growth of an entire nation.

The impacts of climate change on education are anticipated to be disproportionate across countries and population groups due to existing inequalities in climate risk management and resilience capacity. Developing countries, particularly with more fragile schooling systems, are likely to face additional challenges.

(55) Mbuya, Nkosinathi V. N., Stephen J. Atwood, and Phuong Nam Huynh (2019) Persistent Malnutrition in Ethnic Minority Communities of Vietnam: Issues and Options for Policy and Interventions. International Development in Focus. Washington, DC: World Bank. doi:10.1596/978-1-4648-1432-7.

(56) Katarzyna Kordas, Bo Lönnerdal, Rebecca J. Stoltzfus (2007) Interactions between Nutrition and Environmental Exposures: Effects on Health Outcomes in Women and Children. The Journal of Nutrition 137 (12): 2794–2797, https://doi.org/10.1093/jn/137.12.2794.

(57) The World Bank (2018). World Development Report: Learning to Realize Education's Promise. Washington, DC: World Bank Group.

(58) Hanushek, E. A., & Woessmann, L. (2020). The Economic Impacts of Learning Losses. OECD.

3.2.1 On School Attendance

Some of the effects of temperature extremes are reflected in quantitative statistics. The quantitative findings indicated that extreme cold weather reduces school attendance, specifically when the number of cold days increases. In particular, the effects of climate change on education in Viet Nam are analysed by regressing educational outcomes on temperature extremes, using VHLSS household data and climate national data. The results showed that an additional day with low temperature extreme within a year reduces the probability of school enrolment by 0.00079 (see Table 7). When translating to the percentage, it means that a 1 percent increase in the number of days with low temperature extremes will likely result in a 0.05 percent decrease in the enrolment rate of children aged below 18.

TABLE 7. IMPACTS OF WEATHER EXTREMES ON EDUCATION

Explanatory variables	Dependent variables				
	Attending school (yes=1, no=0)	Tuition exemption (yes=1, no=0)	Log of education expenditure	Have purchased toys (yes=1, no=0)	Have homemade toys (yes=1, no=0)
Number of days with low temperature	-0.00079***	-0.00082	0.00073	0.00063	0.00109*
	(0.00025)	(0.00061)	(0.00159)	(0.00068)	(0.00061)
Number of days with high temperature	0.00000	-0.00086**	0.00171	0.00018	-0.00065
	(0.00017)	(0.00036)	(0.00113)	(0.00041)	(0.00041)
Number of days with low precipitation	-0.00011	-0.00045*	0.00004	0.00022	0.00052**
	(0.00010)	(0.00023)	(0.00060)	(0.00023)	(0.00025)
Number of days with high precipitation	0.00003	-0.00003	0.00119	-0.00108*	-0.00001
	(0.00026)	(0.00055)	(0.00149)	(0.00060)	(0.00064)
Control variables	Yes	Yes	Yes	Yes	Yes
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes
Constant	-0.12087***	-0.01292	-0.37102**	0.29914***	0.00499
	(0.02489)	(0.05813)	(0.14657)	(0.05700)	(0.06198)
Observations	246,067	49,246	246,067	64,010	64,010
R-squared	0.510	0.402	0.041	0.411	0.157

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

On the other hand, the research team found no significant effects of hot days on the proportion of children attending school (Table 7). In other words, the effects of high temperature extremes are not visible in our quantitative model. The Vietnamese government has yet to adopt a policy permitting schools to be temporarily closed in the event of high heat, which could be one reason, albeit conjectural, why it is difficult to accurately capture the impact of extreme heat through quantitative models (such a policy exists for extreme cold).

To further supplement the quantitative results, our qualitative interviews and field observation shine a light on some deleterious effects of extreme temperatures (hot or cold) on school attendance. Firstly, extreme weather events have a significant impact on school roads, especially in remote and rural areas where public infrastructure is under-invested and under-developed. For example, in mountainous areas, cold weather is frequently accompanied by heavy fog or sleet in the morning, making roads slippery and reducing the vision of

travellers. Besides, when it rains, the dirt roads would become muddy and difficult to travel, as the research team's first-hand experience when driving on the mountainous trails in Quang Nham commune after a heavy rain in the winter. The inherently bad road condition, when combined with unfavourable weather, is truly a stumbling block for any traveller. Even if students still go to class in these conditions, commuting to school will be time-consuming and dangerous due to heavy layers of mud and sludge.

FIGURE 10. POOR ROAD CONDITIONS IN QUANG NHAM COMMUNE (THUA THIEN HUE)

Source: The research team

FIGURE 11. CHILDREN GOING TO SCHOOLS IN QUANG NHAM COMMUNE (THUA THIEN HUE)

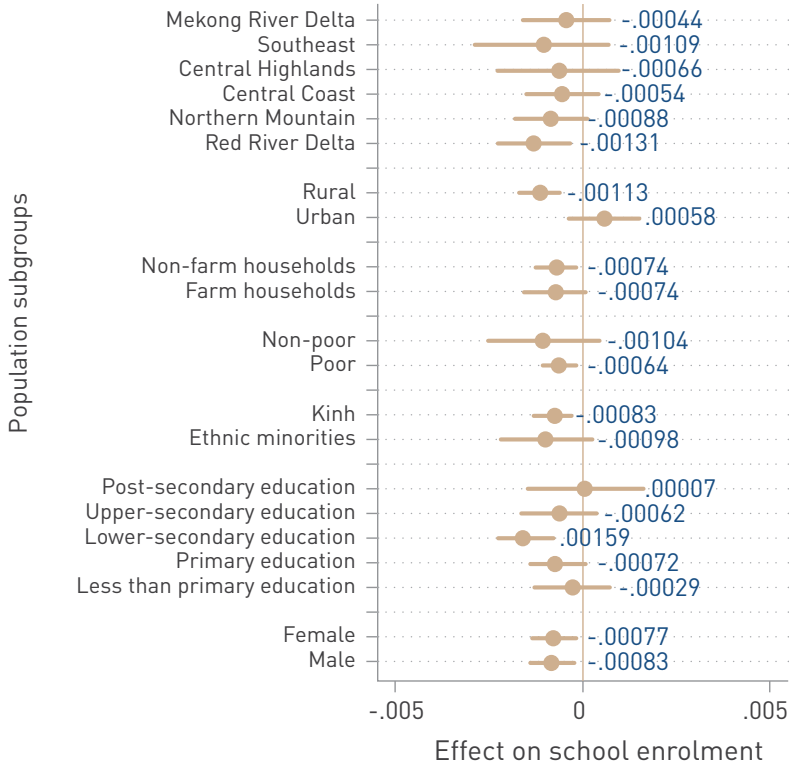
Source: The research team

Extreme heat, on a similar note, is also difficult to cope with. The commune chief in Quang Nham commune (Thua Thien Hue) noticed that the temperature has been slowly rising over time, with more intensity and a greater number of hot days (longer summer) than in the past. In light of climate change, the southwest wind can bring temperatures up to 38 degrees Celsius in the summer, making it difficult for children to get to school because most of them walk. The representative from DOLISA Ca Mau had similar thoughts, noting that extreme droughts and high temperature extremes would undoubtedly pose extra difficulties for children on their route to school.

Natural disasters, in addition to weather extremes, also leave devastating consequences on school attendance in the sense that they destroy school infrastructure and disrupt children's studies. A real-life case in point is Nguyen Viet Khai commune (Ca Mau), where students are frequently compelled to travel to school by boat (instead of by road) as a result of flooding or rising sea levels. In a bigger context, after the 2020 widespread flooding and landslides caused by prolonged heavy rain in the Central region of Viet Nam, at least 862 school buildings were reportedly damaged, having broken latrines, or unroofed. Strong wind and flooded water also ruined many school facilities and learning supplies, affecting around 153,000 children.[59] Additionally, adverse weather conditions could also reduce teachers' incentives to work in flood-prone or drought-prone areas, which consequently affects education quality, according to a study conducted by UNDP.[60]

Given the aforementioned implications of climate change, this study seeks to go even farther, proving that the effects are uneven among different population groups. According to the results from our past analysis about multidimensional inequality, children from ethnic minority groups, low-income families, and children living in rural areas, are already falling behind their peers in terms of access to education.[61] As shown in the below figure, the effects of low temperature extremes on school enrolment are indeed stronger among children of poor households and/or living in rural settings, compared to their non-poor and urban counterparts (see Figure 12). The results for high temperature extremes are not reported here because their overall effects on school enrolment are not observed in our model.

FIGURE 12. HETEROGENEOUS EFFECTS OF LOW TEMPERATURE EXTREMES ON SCHOOL ENROLMENT



Source: Estimation from VHLSSs 2010 to 2018

(59) UNICEF (2021). Floods and Storms in Central Viet Nam: Situation Report No. 7. Hanoi.

(60) UNDP (2017). Climate Change and Human Development: Towards Building a Climate Resilient Nation. Zimbabwe.

(61) MDRI (2020). Ibid.

3.2.2 On Educational Investment and Abilities

Aside from serious consequences in terms of school attendance, the overarching effects of climate change are also extended to household's ability to invest in education for children as well as the child's ability to perform in school, both of which are less documented but carry pronounced long-term implications.

First and foremost, income loss due to extreme weather and disasters can lead to school break or dropout because the extent to which people invest in education is largely determined by household's economic situation. In the face of climate change, the immensity of such an effect tends to be magnified for people whose livelihoods heavily rely on natural resources, hence depending on weather and climate conditions for productivity. In this regard, poor rural households are particularly vulnerable as they are burdened from both their economic situation and the state of the environment.

> *"In some areas, children have to go into the forest to find firewood. Last year, there was a case when a child went to the forest to earn extra income [by picking mushrooms] for the family during the flood season but then got lost. Fortunately, he/she could still be found."*
>
> *KII with the representative of Provincial Women's Union, Thua Thien Hue province*

For example, the fieldwork carried out in Quang Nham, a poor-classified commune located in Thua Thien Hue province on the central coast of Viet Nam, discovered that local residents have been constantly battling the annual rainy season, which is characterised by heavy rainfall and frequent flooding. The majority of inhabitants in this commune are Ta Oi and Pa Ko ethnics. Beyond agriculture and the extraction of forest resources, sources of income in their communities are limited. As a result of climate change, weather patterns and natural disasters are becoming more catastrophic and peculiar, leading to an increase in the number of children from low-income, agricultural families being forced to take a school break or even drop out of school due to their family's financial circumstances.

> *"When it rains, I let my children stay at home. Even if I want them to go to school, I can't make money to pay for my children's schooling. There was continuous rain from September through to October, all the crops died of waterlogging. In 2020, the flash floods left us empty-handed. We lost an entire season of cassava and rice."*
>
> *Female FGD in Quang Nham commune, Thua Thien Hue*

The situation is not much better in the south region of Viet Nam, notably in the Mekong Delta where drought and saline intrusion have put people's livelihoods in jeopardy. An expert from the DRAGON Institute (Can Tho University) was interviewed for this study and stated that in some rural locations where the locals subsist on precarious jobs like shrimp farming, only after they won a harvest did they have the money to send their children to school.

Another impact would be climate-related migration, which is a barrier impeding children's enjoyment of a high-quality education, regardless of whether they relocate or stay. For migrating children, school transitions can cause academic disruption, which potentially damages youngsters' educational abilities and social skills. Furthermore, the lack of a permanent registered inhabitant stats [*hộ khẩu*] is a current policy barrier, preventing many migrant families from accessing basic social services including education for children. Other children do not move out but are nevertheless affected. These left-behind children often stay with the grandparents or one of the parents (often the women). Frequent separations from parent figures or inadequate parental care in early childhood has been found to have a negative impact on children's health, daily behaviours, and school achievement, according to a large body of research.[62,63,64]

Speaking of the most affected population groups by climate change-induced migration, it is nearly impossible to draw an evidence-based judgement because Vietnam has so far not developed a national database to monitor this matter. Furthermore, the relationship between environmental/climate change and migration is often complicated by the multifaceted associations with other individual,

(62) Mao, M., Zang, L., & Zhang, H. (2020). The Effects of Parental Absence on Children Development: Evidence from Left-Behind Children in China. International Journal of Environment Research and Public Health, 17(18), 6770.

(63) Lam, T., Ee, M., Hoang, L., & Yeoh, B. (2013). Securing a Better Living Environment for Left-Behind Children: Implications and Challenges for Policies. Asian and Pacific Migration Journal, 22(3), 421-446.

(64) Fellmeth, G. et al. (2018). Health impacts of parental migration on left-behind children and adolescents: a systematic review and meta-analysis. Lancet. London, England.

cultural, social, political and economic factors.[65] However, it can still infer from climate change assessments that Mekong Delta, Central Coast, Central Highlands, and Northern Mountains are the locations where people are most likely to migrate, owing to the regions' high exposure/high sensitivity to climate change. Although climate change does not directly displace people or force them to relocate, it increases the frequency and intensity of natural disasters and other environmental stresses, making it more difficult for people to stay put. A recent empirical analysis covering 470 communes in 12 provinces across Vietnam proved that communes where flood events became either more frequent or more severe in the last decade also experienced a considerable increase in emigration.[66]

"When migrating, children's education will be affected (e.g: sending children to grandparents). The child's access to education opportunities will be restricted, compared to other children even from similar school. This puts a lot of pressure on the women: If both the husband and the wife go together, they can keep the marriage but the children don't receive regular education from parents. "

KII with the representative of the DRAGON Institute (Can Tho University)

BOX 1. CASE STUDY: MIGRATION – THE LAST LIFELINE

A 70-year-old interviewed women from A Luoi district (Thua Thien Hue) shared that her three sons never or only finished high school, then went straight to work as hired laborers in big cities. The youngest child, now 18 years old (at the time of interview) used to work as a garment worker in Ho Chi Minh city for a while. With neither a degree nor a relative in such a major metropolis, he often confided in the family about his life struggles, having to work overtime on a regular basis while still being underpaid. During the peak of the COVID-19 outbreak in Ho Chi Minh city, he lost his job, owed his salary, and had no other choice but to return to this hometown. However, the life in poverty of his family did not help, either. Two "sào" of banana and one "sào" of rice field are the only means of production in this family, yet the total number of family members is up to seven (including the elderly, children, and women). Because of the unusual cold weather and heavy rain, the most recent sowing of bananas (from September) was not successful, making it much more difficult to provide substenance for the family during tough times. In order to improve the meal, the family's men often trek to the forest for 1 to 3 weeks at a time to trap animals. However, rainstorms sometimes occurred while visiting the forest, and people's tools have been washed away by floods (not fatal). When the pandemic situation is under control, all of the sons intend to reapply for job in the cities, in which the two oldest, married brothers are forced to leave behind their wives and young children at home.

The study location of Quang Nham commune (Thua Thien Hue) was freshly established by merging the two previous communes of Hong Quang and Nham, each has distinctive land conditions. One half is forest land, characterised by large cultivating area yet the land is not fertile hence only suitable to growing cassava or acacia. The other half is farmland, which is more productive but very fragmented due to high population density. Both features make agricultural activity a very challenging task for the ethnic minority who live in this newly formed commune. For people whose livelihood depends primarily on agriculture, the loss of income due to climate change has landed a heavy blow. The head of Quang Nham commune recently detected an emerging trend of outmigration to large cities' industrial zones for improved job opportunities among a certain group of people in his locality.

Author's note: 1 "sào" = 500 m2.

(65) UNDP (2014). Migration, Resettlement and Climate Change in Viet Nam. Hanoi: UNDP.

(66) Berlemann, M., & Tran , T. (2020). Climate-Related Hazards and Internal Migration Empirical Evidence for Rural Vietnam. Economics of Disasters and Climate Change, 385–409.

Last but not least, climate change is anticipated to exacerbate nutrition-related issues such as food shortage, hunger, and stunting, all of which have been linked to children's academic achievement. To be more specific, study results have shown that undernourished children have lower attendance, shorter attention span, lower performance scores, and more health-related problems than their well-nourished counterparts.[67,68]

In Viet Nam, children from the poorest households are three times more likely to suffer from stunting than those from well-off families, with the Central Highlands, Northern Midlands, and Mountainous regions being the hardest hit.[69] A Khmer father from a poor household near Sao Luoi estuary (Nguyen Viet Khai commune, Ca Mau) said his family could not afford nutritious weaning food for his one-year-old infant, particularly during stormy season. Instead, the baby had been given solid food quite early when following the parents' diet. Inadequate infant and young child feeding practices (IYCF) puts children at risk of poor brain development, weak learning, low immunity, increased infections and in many cases, death.[70] On the contrary, a non-poor household in Quang Nham commune (Thua Thien Hue) still managed to overcome the stormy season, despite heavy damages caused to the family's agricultural activities, because the two elderly members of the household receive a fixed amount of pension every month.

3.2.3 Coping Strategies, Capacities and Hindering Factors

Firstly, different vulnerabilities of each community or population group can be further explained by the ways in which households choose to cope with and adapt to climate change in education. For example, to eliminate the impact of heatwaves on students' academic achievement, many schools in Ca Mau province have begun to install air conditioning in classrooms. However, the cost for having and maintaining air-conditioned classrooms is prohibitively expensive for schools at the district level and below, leaving fans as their only viable option. In the case of electricity black-outs or brown-outs prompted by extreme heat, students in affected areas faced a higher probability of absenteeism due to the unavailability of electric fans.

Another example can be found in Nguyen Viet Khai commune (Ca Mau). When extensive flooding caused substantial damage to public infrastructure, particularly roadways, the residents in this study commune have to take children to school by canoe/motorboat. This adds to the burden of women especially those having small children (kindergarten or primary school-aged), with responsibilities for child-rearing. From an inequality perspective, the choice of whether to canoe (un-powered) or to motorboat (powered) are closely connected to both socioeconomic differences and gender dimensions. Automotive means of transportation reduce time poverty but cost higher than manually driven vehicles. Furthermore, women's mobility needs in these circumstances are also limited because they are significantly less likely than men to own and use private transport. Besides, a study participant cited that insufficient investment in seacoast road infrastructure is another key factor contributing to unequal access to basic services including education, for people living in coastal hamlets.

> *"People in my place travel mostly by motorbikes now but people living on the periphery still use boats because coastal mangrove forests make it very difficult to build the road. When the water rises, the village is flooded, causing many troubles for children on their way to school. When the water level is low, the boat could not reach the shore. In that case, wooden planks will be used as temporary bridges for children to walk to school."*
>
> ***KII with the head of a hamlet in Nguyen Viet Khai commune, Ca Mau***

(67) Galal OHJ. The relationship between nutrition and children's educational performance. British Journal of Nutrition. 2003;25:11–20.

(68) Shariff, M., Bond, J., & Johnson, N. (2000). Nutrition and educational achievement of urban primary schoolchildren in Malaysia. Asia Pac J Clin Nutr, 9(4), 264-73.

(69) UNICEF Vietnam.

(70) UNICEF (2019). The State of the World's Children.

FIGURE 13. CHILDREN GOING TO SCHOOL BY CANOE (LEFT) AND FLOODED ROAD IN NGUYEN VIET KHAI COMMUNE (RIGHT)

Source: Women's Unions of Nguyen Viet Khai commune

Secondly, what needs to be emphasized is the fact that climate change does bring a lot of problems to the education sector but education per se is also part of the answer. To put it another way, education is a critical component of climate change adaptation and mitigation. It teaches people about the impacts of the climate crisis, and most importantly equips them with appropriate knowledge, skills, values, and attitudes to act as agents of change. However, this role of education has not been well recognised as countries are failing to include educational issues in their national priority for climate change adaptation and mitigation.[71] Another hindering factor is socioeconomic inequalities, which are reflected in unequal access to and quality of educational services. It is because of this that disadvantaged populations have limited awareness of the role of education in general and the role of education in climate change adaptation and mitigation in particular.

In addition, our research also finds that children suffered from storms are of higher chance to receive exemption and reduction of education tuition fees. Specifically, an additional storm during a year increases the probability of receiving tuition fee reduction by one percentage point (Table A.5). Possibly, as it can be seen in the following section, storms reduce household income and increase the poverty status. Therefore, children are more likely to fall into poverty, thus being eligible for tuition fee reduction policy for poor households or affected areas.

In conclusion, the consequences of climate change on the education sector are far-reaching and further compounded by multidimensional inequality in terms of poverty status, gender, ethnicity, and other factors. A way to move forward would be educating the public about the multi-layered impacts of climate change whilst continuing to work towards poverty alleviation and inequality reduction in a multilateral and collaborative manner.

(71) UNICEF (2019). It is getting hot: Call for education systems to respond to the climate crisis. UNICEF East Asia and Pacific Regional Office.

3.3 Impacts on Dignified Work

According to most research and analysis, climate change already affects labour markets, and they depend on the environment in many ways, while adaptation and mitigation policies closely link employment and climate change.[72] The link between climate change and employment is not, however, simply a matter of industrial change, job loss and green jobs' inferior wages and conditions; climate change is also directly shaping the labour process. The real impact on jobs and employment depends, however, also on regulations and policies adopted; they can be very different depending on the response put in place. The labour impacts will also vary across sectors as their labour and emissions intensity are different.[73] For Viet Nam, rising sea levels in the Mekong Delta, bigger and more frequent natural disasters (for example, storms) along the Central coast, and higher and variable temperatures are all affecting labour productivity and destroying assets and human lives, according to the World Bank.[74]

3.3.1 Rising Temperatures and Heatwaves

From labour productivity perspectives, qualitative results of the present study help demonstrate the ill effects of the rising temperatures on outdoor workers. Increased exposure to extreme heat without sufficient protection in workplace poses the risk of heat-related illness and also result in productivity loss, especially for fishing workers as observed in the coastal lines of Thua Thien Hue and Ca Mau.

Information from group discussion with male residents of coastal hamlet of Sao Luoi (Nguyen Viet Khai commune, Ca Mau) shows that adult men from households who hold limited land assets or even landless opt to become hired workers on-board fishing vessels or shore fishing workers for a living. A high number of these fishing workers are from the Khmer ethnic group who are most often unskilled and have lower levels of literacy and educational attainment than their Kinh ethnic counterparts. For these fishermen, they have to watch for the ocean current lines and fish along them, regardless of weather conditions. Routinely working in summer heat and being surrounded by seawaters could overwhelm their body's coping mechanisms leading to a variety of heat illness (e.g., heat stroke as the most severe) and resultant decline in productivity.

> *"During the hot months, us fishermen were forced to endure [the heat]. When the sun is burning, saltwater vapor from the sea makes us feel exhausted, dizzy and heat shocked. But our job is tied to the water [regardless of time], just like fish and shrimp. We must go to work when the water goes up, no matter if it's daytime or nighttime."*
>
> *Male FGD in Sao Luoi hamlet, Nguyen Viet Khai commune, Ca Mau*

> *"Hot weather extreme affects our crops a lot. The heat makes the lagoon water become hot and the iron level in the water go up, which adversely impacted shrimp farming."*
>
> *Female FGD in Go Dong Cong hamlet, Nguyen Viet Khai commune, Ca Mau*

Further, as indicated earlier in the life and health section, there has been an increase in the incidents of lightning kills in the study coastal hamlet of Go Cong Dong (Nguyen Viet Khai commune, Ca Mau). The risk of lightning strikes is perceived to be higher for fishermen working inshore or on a ship than farmers working in their farm ponds. Put it differently, potential mortality or climate induced lightning death seem to be more prevalent among workers in capture fisheries production than aquaculture production. With regards to ethnicity, it has been observed that the Khmer ethnic outnumber the Kinh at hired labour in this particular hamlet. This suggests combinations of risks, vulnerabilities and hazards facing the Khmer workers of low-income households. From a gender perspective, the dominance of men in this fishing practice suggests that men may be vulnerable to accidents if the environments in which they carry out their traditional activities, including fishing, become more hazardous as a result of climate change.

Notably, it has been reported that due to climate change the oceans are absorbing more heat, resulting in an increase in sea surface temperatures. Steadily rising ocean temperatures are forcing fish to move to temperature zones where they have evolved to live, potentially causing significant consequences

(72) IOE (2020).

(73) Ibid, page 1.

(74) World Bank (2021). How will Vietnam blossom? Reforming institutions for effective implementation: Vietnam Systematic Country Diagnostic Update 2021.

for the composition of fish stocks, the displacement of individual species, and a decline in fish stock in some traditional fishing areas.[75, 76] The reality facing local vessel owners is that they may incline to seek for alternative fishing areas including the potential of illegal fishing in foreign waters. Recent study has shown that the situation of Vietnamese fishing vessels illegally fishing in foreign waters tends to increase.[77] Specifically, in 2018, coastal provinces and cities recorded 85 incidents, including 137 ships and 1,162 fishers violating foreign waters, which is an increase of 28 cases with 46 ships and 379 fishers violating compared to 2017.[78] Such incidents of illegal fishing may directly, negatively and profoundly affect the entire seafood export industry of Viet Nam given the yellow card of Viet Nam's seafood industry sanctioned by the European Union since 2017.

In view of the growing hardship of on-board fishing workers against the backdrop of increasing weather extremes, it has been noted that many young fishermen have quitted their job, seeking alternative livelihoods in off-farm domains such as industrial areas in Binh Duong or Ho Chi Minh City. This mechanism of labour mobility – an aspect to be addressed further later on – cause manpower shortage in the local fishing sector, posing serious difficulties for vessel owners to retain and recruit needed labourers for fishing trips. To deal with the current labour shortage, a solution of raising wages has been adopted by local vessel owners to recruit needed fishing workers, leading to a sort of "offered wage" competition between vessel owners in the study areas. In order to pay off the additional cost of employee pay and benefits, these local vessel owners had to intensify capture fisheries either by increasing fishing efforts, the catch rate of targets, the number of days for each fishing trip, usage of smaller mesh size of nets to maximize bycatch, or fishing in the no-catch zones. Taken altogether these overfishing practices caused the decline of local fish stock, which, in turn, contributed to job losses or job displacements for coastal residents.

Besides, recent evidence shows that during prolonged droughts in the Mekong Delta, canals are drying up, and residents have been experiencing significant losses of their main income and food sources from fishing. Vulnerable households sought to engage in alternative cash labour activities, both agricultural and non-agricultural (motorcycle taxi, house construction, house painting, fish processing factory, etc.) to gain additional income.[79]

3.3.2 Rising Sea Levels, Storms and Floods

During the occurrence of tropical depressions typically between June and December, offshore fishing is very likely inactive in Ca Mau, leading to job loss and lack of income not only among fishermen but also other residents (mostly women) who earn their livelihood from the inshore work such as seafood processing [*làm khô, mắm*] or fishing net repair jobs.

FIGURE 14. A WOMAN SITTING BY A BATCH OF CLAMS FRESHLY CAUGHT FROM THE SEA

Source: Women's Union of Nguyen Viet Khai commune

(75) Tin Tuc TTXVN Online Newspaper (2019). https://baotintuc.vn/tay-bac-tay-nguyen-tay-nam-bo/cong-khai-han-ngach-giay-phep-khai-thac-thuy-san-cho-hon-3400-tau-ca-o-ca-mau-20190910165959769.htm

(76) Tin Tuc TTXVN Online Newspaper (2019). https://baotintuc.vn/kinh-te/nganh-khai-thac-thuy-san-tai-ca-mau-doi-mat-nhieu-kho-khan-20191004164944398.htm

(77) Nguyen, Tien Hoang (2021). Current situation and solutions in Vietnam's national legislation on fisheries subsidies to prevent illegal, unreported and unregulated (IUU) fishing. World Maritime University Dissertations. 1725. https://commons.wmu.se/all_dissertations/1725.

(78) Ibid.

(79) UN, CRS and Save the Children (2020). Viet Nam Drought and Salt Water Intrusion in the Mekong Delta. Joint Assessment Report.

"Speaking of climate change impacts, it is the vulnerable group such as the poor, near-poor, and women who are more affected. Ca Mau people make a living from aquaculture and farming. Female workers are often unskilled labour with unstable job. Even though the province has many livelihood-supporting policies and vocational programme for poor women, such could not compensate for the difficulties caused by weather and natural disasters. Poor households become poorer because they don't have arable land. They could only work around the house, thus highly dependent on nature."

IDI with the representative of DOLISA, Ca Mau

For those engaging in shore fishing, during rainy seasons, massive flood waters run up the shorelines, disrupting the entire eco system and affecting the abundance of shoreline habitats, and potentially resulting in low fish outputs. It has been observed in the study commune of Nguyen Viet Khai that a large proportion of local farmers who suffered from climate change-induced crop yield loss turned to shore fishing for a living. This reported increase in shoreline exploitation has led to a dramatic decline in fish stock. More worrisome is the fact that facing constantly decline in fish outputs, some of fishermen are very likely to invest more capital in the purchase of fishing equipment and for offshore fishing vessels. Nevertheless, a combination of poverty, limited access to capital, lack of experience in offshore fishing as well as a lack of awareness on sustainable fishery creates the vicious cycle of resource dependence and economic stagnation among fishing workers in the communes of Ca Mau.

From a quantitative perspective, the research team examines the effect of temperature extremes on a wide range of employment outcomes (Table 8). Most estimates are not statistically significant at the conventional levels. There are only significant effects of low temperature extremes on working status and wages. An additional day with low temperature extreme within a year reduces the probability of working by 0.04 percentage points and mean wages by 0.23 percent. There are no significant effects of precipitation extremes on employment.

It should be noted that in the VHLSS, employment was classified into three types: wage jobs, farm self-employment and non-farm self-employment, in which wage jobs were defined as all types of jobs that workers do in exchange for a regular payment, both in cash and in kind, and that workers do not have the rights to decide matters related to those jobs. Since wage jobs provide workers with a stable and secure source of income compared to the farm and non-farm self-employment, the research team estimated the proportion of people having a wage job from the survey data and used it as an indicator for employment opportunities. This outcome was estimated for people aged from 15 to 70, meaning those in the working age, and was disaggregated by demographic groups.

TABLE 8. IMPACTS OF WEATHER EXTREMES ON EMPLOYMENT

Explanatory variables	Dependent variables							
	Currently working	Have wage job	Have non-farm work	Have farm work	Have skilled job	Have a formal job	Log of monthly working hours	Log of wages
Number of days with low temperature	-0.00038**	-0.00051*	0.00031	-0.00018	-0.00046	-0.00019	-0.00042	-0.00226***
	(0.00016)	(0.00030)	(0.00027)	(0.00039)	(0.00040)	(0.00023)	(0.00052)	(0.00072)
Number of days with high temperature	0.00003	-0.00002	-0.00016	0.00021	-0.00019	0.00004	-0.00023	0.00049
	(0.00011)	(0.00020)	(0.00019)	(0.00026)	(0.00033)	(0.00017)	(0.00029)	(0.00046)
Number of days with low precipitation	0.00005	-0.00005	-0.00008	0.00018	0.00019	0.00005	0.00022	-0.00007
	(0.00008)	(0.00012)	(0.00011)	(0.00013)	(0.00015)	(0.00010)	(0.00017)	(0.00026)
Number of days with high precipitation	0.00007	-0.00002	0.00020	-0.00011	0.00034	-0.00019	-0.00086*	0.00036
	(0.00017)	(0.00029)	(0.00028)	(0.00035)	(0.00040)	(0.00026)	(0.00046)	(0.00068)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.16927***	0.28512***	-0.24741***	0.13156***	-0.18004***	0.08997***	4.32331***	7.21203***
	(0.02069)	(0.03109)	(0.02674)	(0.03837)	(0.04159)	(0.02691)	(0.04650)	(0.07426)
Observations	517,444	517,444	517,444	517,444	517,444	517,444	463,318	196,752
R-squared	0.133	0.162	0.061	0.257	0.223	0.132	0.163	0.297

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

Although the temperature and rainfall extremes does not have strong effects on employment, there are stronger and significant effects of disasters on employment. Storms and droughts have adverse impacts on labour market participation of rural people. An additional storm during the past year reduces the probability of having a wage job by 1.1 percentage points and the probability of having a self-employed nonfarm work by 0.7 percentage points (Table 9). Exposure to storms also decreases the probability of having a skilled job and formal job. Storms increase the probability of having farm employment. It means that exposure to storms move people from nonfarm to farm employment. Possibly, storms have adverse impacts on nonfarm business of households, and being employed causes people to work as self-employed farm workers. Interestingly, storms increase the probability of working slightly. An additional storm increases the probability of working by 0.26 percentage points. Probably, people have to work more when they loss income due to storms. This observation can be especially applied to women given they are most likely to shift to agriculture in response to marginal increases in crop prices.[80]

The effects of droughts on employment are very similar to those of storms. Droughts do not have significant effects on overall employment. Droughts reduce wage jobs but increase farm employment. An additional drought during the past year reduces the probability of having a wage job by 1.3 percentage points but increases the probability of having a self-employed farm work by 1.8 percentage points. Droughts also reduce wages of wage workers. An additional drought reduces the total annual wage by 2.2 percent. Probably, droughts are associated with heatwaves, which reduce labour supply for outdoor jobs.

In Figure 15, the research team looks at the effect of low temperature extreme on wages of different groups. Overall, temperature extremes tend to have more adverse effects on more disadvantaged people, and therefore exaggerate wage inequality. For example, despite no significant effect of high temperature extremes on wages (Table 8), there are significant effects on several population subgroups (Panel B of Figure 15). High temperature extremes decrease wages of farm people, ethnic minorities and people with less than primary education. Similarly, the effect of low temperature extreme is significant for ethnic minority and poor people but not for Kinh and non-poor people (Panel A of Figure 15). This quantitative analysis seems applicable to the reported low rate of labour market access facing many Ta Oi ethnic residents in the study hamlet of Nham (Quang Nham commune) given the often linkages between low temperature and rainy weather and resultant travel difficulties in the muddy mountain trails during a rainy season. As such, increased travel times may likely reduce the accessibility of employment or social engagement, exacerbating trends of reduced proximity to job opportunities experienced by these minority populations. Whereas the Pa Ko ethnic group who reside largely along the main roadways and closer to the administrative centre of Quang Nham commune, indicating greater social interactions with the majority Kinh ethnic and subsequently more proficiency in the national language, appear to outnumber their Ta Oi fellows in out-migration for better wage employment. This suggests that a combination of language barriers, social stigma and poor educational attainment have limited the economic integration of ethnic minorities given the importance of networks and education in migration.

(80) World Bank (2019). Better Opportunities for All: Vietnam Poverty and Shared Prosperity Update.

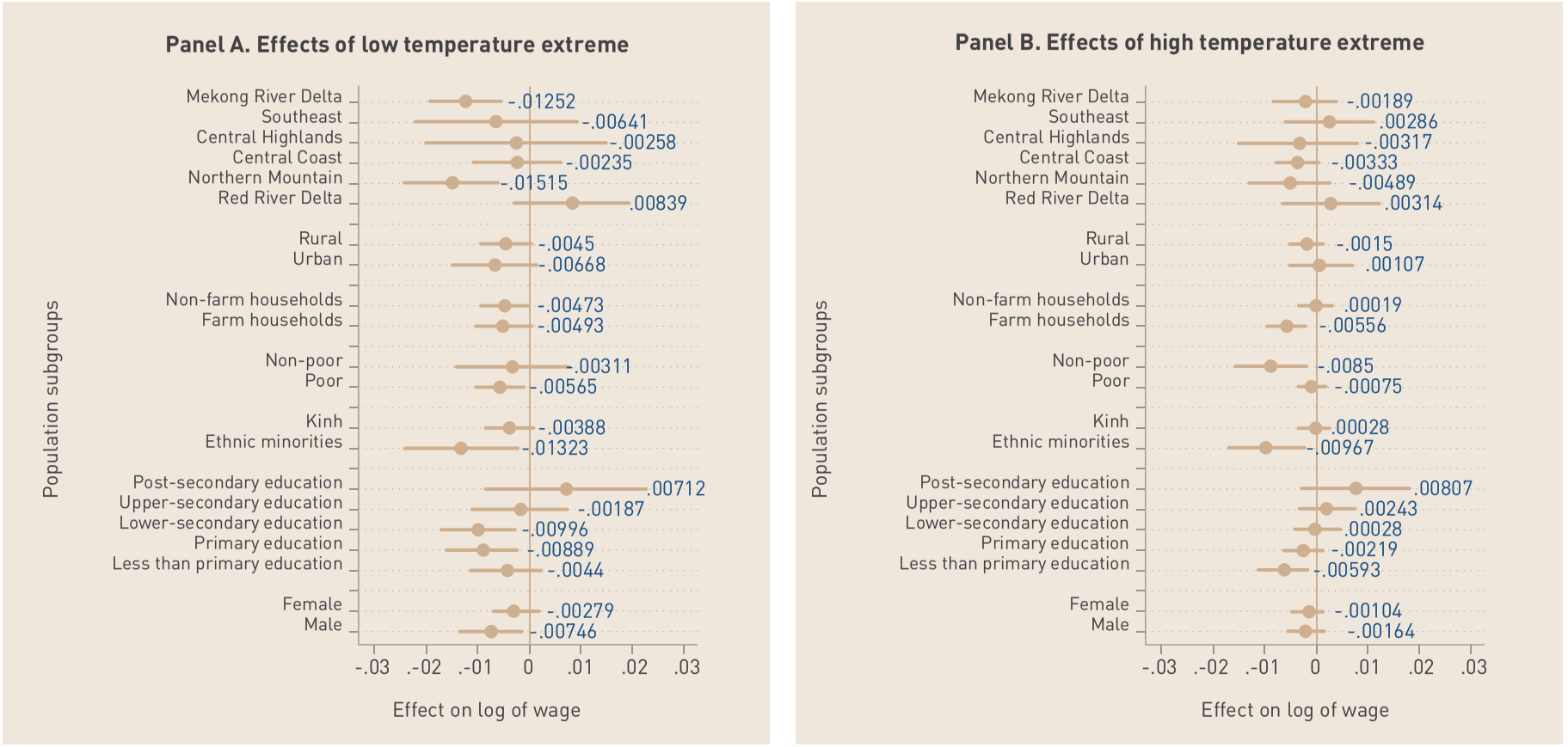
TABLE 9. IMPACTS OF DISASTERS ON EMPLOYMENT OF RURAL HOUSEHOLDS

Explanatory variables	Dependent variables							
	Currently working	Have wage job	Have non-farm work	Have farm work	Have skilled job	Have a formal job	Log of monthly working hours	Log of wages
Number of floods during the past year	0.00204	0.00019	0.00128	0.00057	-0.00553	-0.00435**	-0.00664	0.00051
	(0.00151)	(0.00324)	(0.00182)	(0.00423)	(0.00480)	(0.00200)	(0.00476)	(0.00804)
Number of storms during the past year	0.00261**	-0.01097***	-0.00685***	0.02043***	-0.01521***	-0.00405*	0.00291	-0.00262
	(0.00127)	(0.00289)	(0.00198)	(0.00377)	(0.00460)	(0.00207)	(0.00400)	(0.00677)
Number of droughts during the past year	0.00253	-0.01254***	-0.00268	0.01776***	-0.03042***	-0.00514**	-0.00158	-0.02211**
	(0.00182)	(0.00439)	(0.00243)	(0.00574)	(0.00701)	(0.00259)	(0.00640)	(0.01091)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.23980***	-0.08659*	-0.22730***	0.55369***	-0.21639***	0.07810***	4.29585***	7.13450***
	(0.01884)	(0.04860)	(0.02429)	(0.06211)	(0.06339)	(0.02962)	(0.06453)	(0.11397)
Observations	368,612	368,612	368,612	368,612	368,612	368,612	340,060	129,654
R-squared	0.099	0.122	0.032	0.149	0.126	0.066	0.110	0.211

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

FIGURE 15. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON WAGES



Source: Estimations from VHLSSs 2010 to 2018

3.3.3 Coping Strategies, Capacities and Hindering Factors

The adaptive capacity of a household is grounded on several factors, including financial resources, access to information, social resources, human capital and infrastructure. In the context of climate change, migration can be perceived as both an impact (forced displacement in the face of life-threatening risks) and a proactive adaptation strategy. Due to uncertainty related to climate-sensitive occupations, households are forced to engage in livelihood diversification, a major coping strategy for various economic and environmental challenges. In this regard, farmers choose to migrate in pursuit of other livelihoods under the risk of crop loss or low crop yield as a result of climate change. In addition to delivering a predictable income, migration also provides opportunities to learn new techniques and farming practices that can help farmers earn more money from agriculture. As a prime example, The Mekong Delta, a disaster-prone area, has witnessed a net migration rate twice as that of the national average. It is even higher in its most climate-vulnerable localities.[81]

Looking into gender differences in the labour mobility pattern at the studied settings reveals that more men migrate to work than women among ethnic minority communities as research elsewhere.[82] This observation is similar to the findings of the latest study on perceptions of gender disparities in Viet Nam's labour market that women, especially those from ethnic minorities, face more disadvantages in terms of language, culture, customs, and traditions.[83] Among the interviewed women of Pa Ko, Ta Oi and Khmer ethnic groups in Thua Thien Hue and Ca Mau, a number of young unmarried women are becoming highly mobile as migrant workers in urban contexts. After getting married and giving birth, these EM young women have to take care of their children and house chores. This indicates that having young children might induce women to seek employment outside the household-farm to complement household income, as they are often responsible for child raising. All the ethnic minority female stayers, however, have their husband either engaged in out-migrating or doing off-farm jobs in their vicinity. This suggests that marital status before migration is expected to be a determinant of migration (e.g., duration and distance of migration), leading to opposite effects on men's and women's entry into off-farm activities. Thus, in spite of the general assumption that migration is an adaptive response by the most vulnerable, women are not always the ones who migrate. Gender, marital status and availability of childcare arrangements addition to other variables such as poverty and ethnicity, is among the various factors that influence migration decisions and patterns. Migration as a coping strategy is gendered because it requires not only physical mobility but also economic and physical capacities that are not equally available to women as observed in all study communities.

In addition to that, the more resourceful households may opt for immobility. It has reported by many study participants in both Ca Mau and Thua Thien Hue that while the poorest households do not have the resources needed for migration, the more resourceful households face the larger opportunity costs, and therefore, will not seek out migration. For instance, among Kinh residents and a handful of Khmer ethnic in coastal hamlet of Go Cong Dong where job opportunities are plenty in aquaculture production, they appear to not make moves that offer higher welfare. The possible reason is that migrating to other provinces also incurs additional costs.[84]

From an employment creation perspective, the Decree No. 20/2021/ND-CP includes provision on urgent support for job and production development in the wake of natural disasters (Article 17), responding to particular vulnerability of households whose primary income earner was found dead or missing or production means were lost/damaged in the disaster. This is indeed necessary because women in poor households are often the most affected by disasters as they have less access to information on risks and adaptive measures compared to men. Nevertheless, there is no explicit regulation on support scheme for these vulnerable people, particular women to acquire the skills and resources to engage in income generation activities, such as employment and entrepreneurship.[85] Women with disabilities already face additional barriers in the employment and income generating activities as a result of stigmatisation and discrimination and accessibility of workplaces which might be also exacerbated by climate change and can be heightened by other intersecting factors such as age, displacement, indigenous origin or minority status.[86]

(81) Chapman, A., & Tri, V. (2018, January 9). Climate change is triggering a migrant crisis in Vietnam.

(82) CARE and Irish Aid (2020) Summary Report on Labor Migration among Ethnic Minority Communities in Vietnam: Situation and Policy Implications.

(83) Buchhave, Helle, Wendy Cunningham, Giang Tam Nguyen and Nina Weimann-Sandig (2020). Ibid.

(84) World Bank and CEMA (2019). Ibid.

(85) UN Women (2021b). A Gender Review of the Disaster Risk Reduction Policies and Institutional Coordination in Viet Nam. Draft Report.

(86) WOW (2021). Women's Economic Empowerment and Climate Change: A Primer. WOW Helpdesk Guidance Note No. 3 UK AID.

FIGURE 16. WOMEN TAKING PART IN A SEWING CLASS IN CA MAU

Source: Women's Union of Nguyen Viet Khai commune

It should also be mentioned that the promotion of technical, vocational education and training (TVET) has been materialized under the Project 1956, which has become an integral component of the National Target Programme on New Rural Development (NTP NRD) since 2016. Since then vocational training in agriculture was the content set under the NTP NRD 2016-2020 while non-agricultural technical training was structured into the National Target Programme on Sustainable Poverty Reduction (NTP SPR) 2016-2020. Under these two major NTPs, there is the principle of "giving priority" to women in poor households and ethnic minority women for participation in and benefit from the livelihood support programs. Furthermore, the Decree No. 20/2021/ND-CP includes provision on urgent support for job and production development in the wake of natural disasters (Article 17). Findings of independent gender assessments of these two NTPs recently commissioned by development partners indicate that there has been a great improvement in the quality and effectiveness of vocational training for rural labourers. It has reported that the proportion of employed labourers working in agriculture, forestry and fishery decreased from 49.5 percent in 2010 to 33.5 percent in 2020, implying that the proportion of non-farm employment has increased.[87] Yet, the results remain rather modest.[88]

3.4 Impacts on Financial Security

At a high level, the impacts of climate change on financial stability are typically divided into: physical risks, that is, the possibility that the economic costs of the increasing severity and frequency of climate-change related extreme weather events, as well as more gradual changes in climate, might erode the value of financial assets, and/or increase liabilities; and transition risks that relate to the process of adjustment towards a low-carbon economy.[89] At a sector level, shocks can stem from the increasing frequency and intensity of natural disasters or from sudden changes in policy, technology, or consumer preferences that leave carbon-intensive assets and fossil fuel reserves obsolete and ultimately stranded. The resulting financial sector losses and volatility in financial and commodity markets can adversely impact funding, liquidity, and lending conditions and weaken financial sector balance sheets, giving rise to negative feedback loops with macro-fiscal implications.[90] According to World Bank, climate change is also increasingly recognized as a financial sector risk in Viet Nam, yet there has been no assessment of the potential risks.[91] Within the scope of this present study, this section is devoted to discuss the potential implications of climate change for financial security at the household level.

(87) GSO (2022). Report on Labour Force Survey 2020. Hanoi: Department of Population and Labour Statistics.

(88) UN Women (2021a). Final Report: An Independent Gender Review and Impact Assessment of the National Target Programme on New Rural Development (NTP NRD) for the period of 2010-2020.

(89) Financial Stability Board (2020). The Implications of Climate Change for Financial Stability, page 4.

(90) World Bank (2021). How will Vietnam blossom? Reforming institutions for effective implementation: Vietnam Systematic Country Diagnostic Update 2021.

(91) Ibid.

3.4.1 Financial Health of Vietnamese Households

To begin with, a glance at the household income and expenditure structures is needed to understand the financial health of Vietnamese households in the face of growing climate risks. From a quantitative perspective, the research team focuses on the income outcomes and use expenditure for comparison. Table 10 below presents the average per capita income and per capita expenditure, at 41.3 and 35.0 million VND respectively at the national level, varying by gender of the household head, ethnicity, poverty status, and living areas. For instance, by gender, female-headed households tend to have a slightly higher income than male-headed households. However, this difference should be considered with caution since the male-headed households outnumber their counterparts in the population, and thus, may include more households with low income. Meanwhile, figures show a big income gap between Kinh and EM people, as well as between poor and non-poor households. The average per capita income of EM people is 21.4 million VND, just equal to half of the income of Kinh groups, while poor people receive an average income of 14.3 million VND/person/year, equal to one third of the non-poor income. The income gap between people living in the rural and urban areas is also high.

TABLE 10. ANNUAL PER CAPITA INCOME AND EXPENDITURE BY DEMOGRAPHICS

Groups	Per capita income (thousand VND)	Per capita expenditure (thousand VND)
Total	**41,336**	**35,035**
Gender of household head		
Female	44,852	40,254
Male	40,319	33,600
Ethnic group		
Ethnic minorities	21,376	19,267
Kinh	45,882	38,528
Poverty status		
Non-poor	43,955	37,030
Poor	14,309	13,992
Rural/urban		
Rural	34,707	28,310
Urban	57,316	51,355

Source: Estimation from the 2018 VHLSS

Table 11 shows the negative effects of disasters on households' income. An additional flood during the past 12 months decreases per capita income of households by 0.68 percent. The corresponding figures for storms and droughts are 2.4 percent and 1.2 percent, respectively. Floods also reduce the per capita expenditure. The effect of storms and droughts on per capita expenditure is also negative but not statistically significant at the conventional levels. Exposure to storms increases the probability of being poor.

TABLE 11. IMPACTS OF DISASTERS ON PER CAPITA INCOME, PER CAPITA EXPENDITURE AND POVERTY

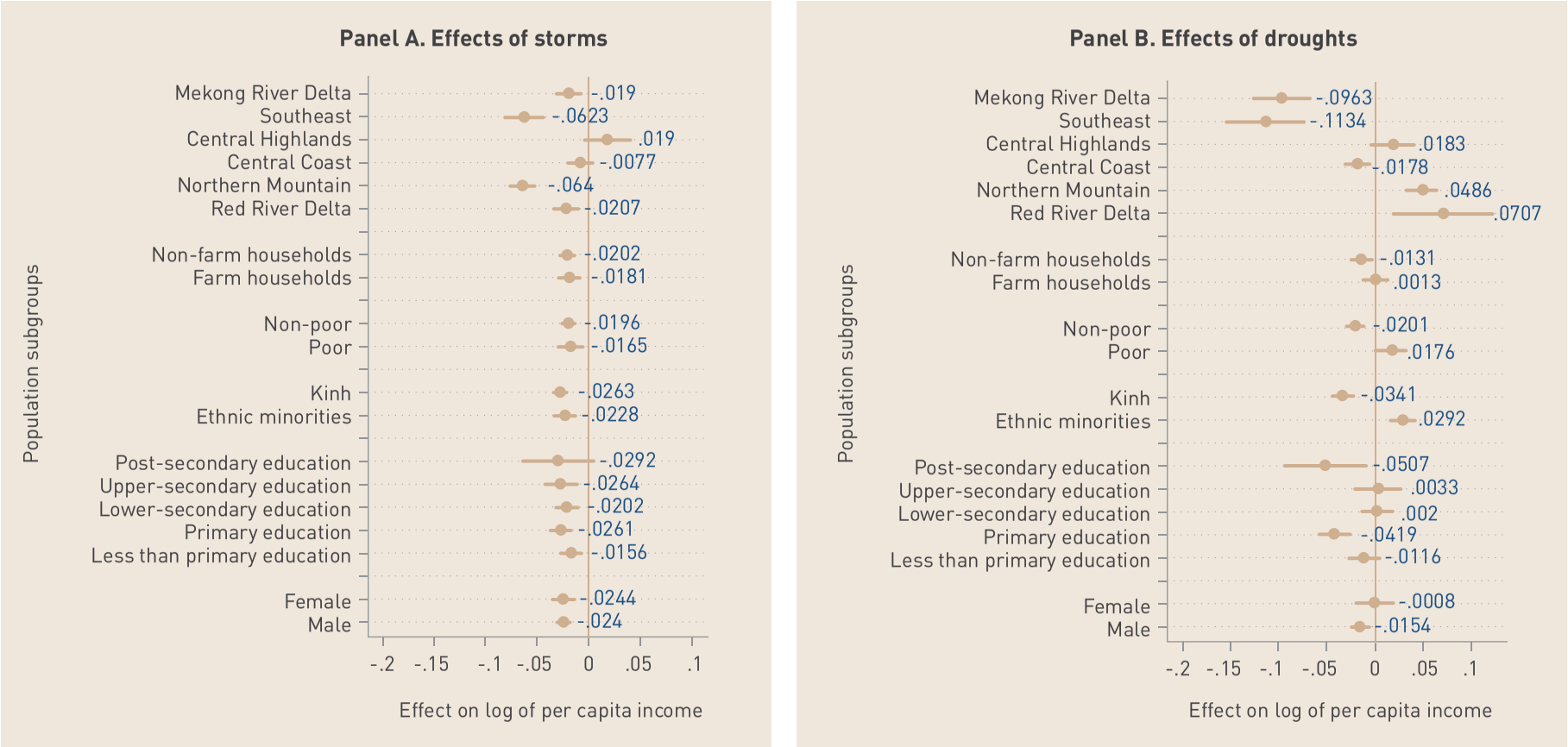
Explanatory variables	Dependent variables		
	Log of per capita income	Log of per capita expenditure	Expenditure poverty
Number of floods during the past year	-0.0068**	-0.0142**	0.0043
	(0.0034)	(0.0058)	(0.0040)
Number of storms during the past year	-0.0240***	-0.0076	0.0067**
	(0.0030)	(0.0052)	(0.0031)
Number of droughts during the past year	-0.0124***	-0.0129	0.0019
	(0.0045)	(0.0079)	(0.0053)
Control variables	Yes	Yes	Yes
Province-year fixed-effects	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes
Constant	8.9613***	9.2084***	0.6496***
	(0.0328)	(0.0605)	(0.0394)
Observations	155,506	31,113	31,104
R-squared	0.235	0.237	0.215

Source: Estimation from VHLSSs 2010 to 2018

In Figure 17, the research team estimates the effect of storms and droughts on per capita income for different population subgroups. It is found that the effect of storms on per capita income is negative and significant for most demographic subgroups. Meanwhile, the impacts of storms and droughts vary by geographical areas. Storms tend to have a stronger effect on per capita income of households in Northern Mountain and the Southeast than other regions, suggesting that storms can widen the discrepancy in per capita income between regions. The effects of droughts are also different between regions, by which droughts reduce per capita income in Mekong River Delta, Southeast and Central Coast, but increase per capita income in Northern Mountain and Red River Delta.

Qualitative findings from the study communes in Thua Thien Hue and Ca Mau help illustrate further the linkages of main income losses following climatic hazards and household financial insecurity. As indicated early in the life and health sector, agricultural products such as local banana [*chuối già lùn*] or mud crabs and prawns are viewed as "poverty escape route" for many low-income households of Kinh, Khmer, Ta Oi, and Pa Ko ethnic groups in the study communes of the Program 30A-benefited Nguyen Viet Khai and the Program 135-benefited Quang Nham, respectively. Agriculture contributed the largest share to income and wage labour was the second in households whose male adults manage to work on acacia plantations or hired jobs such as construction workers, cargo carriers in their vicinity. There is a handful of households in these two settings had savings, while the majority live from hand-to-mouth. In the aftermath of climatic hazards, for instance the 2020 central floods or the 2016 historic droughts in Ca Mau, these vulnerable households face daunting challenges in livelihood restoration, of which access to financial capital is vital – an aspect to be explored in the following.

FIGURE 17. HETEROGENEOUS EFFECTS OF DISASTERS ON LOG OF PER CAPITA INCOME



Source: Estimation from VHLSSs 2010 to 2018

FIGURE 18. ACACIA WOOD (LEFT) AND BANANA GARDEN (RIGHT) IN QUANG NHAM COMMUNE, THUA THIEN HUE

Source: The research team

3.4.2 Coping Strategies, Capacities and Hindering Factors

Results of the quantitative analysis of this study demonstrate the estimated impacts of different types of natural disasters (floods, storms, droughts) on types of credits on household-level outcomes. At the household level, in times of shocks brought about by natural disasters, loans are often sought from both formal and informal credit as presented below in Table 12. Quantitative analysis of the effect on borrowing reveals that weather extremes do not have significant effects but disasters have a positive effect on loans. Exposure to disasters tend to increase borrowing of households, both from formal and informal sources. It suggests that households have to borrow to cover income loss caused by disasters.

TABLE 12. IMPACTS OF DISASTERS ON BORROWING OF HOUSEHOLDS

Explanatory variables	Household-level outcomes	
	Log of formal loan	Log of informal loan
Number of floods during the past year	-0.0282	0.0181**
	(0.0199)	(0.0086)
Number of storms during the past year	0.1796***	0.0219***
	(0.0179)	(0.0084)
Number of droughts during the past year	0.1347***	0.0429***
	(0.0269)	(0.0117)
Control variables	Yes	Yes
Province-year fixed-effects	Yes	Yes
District fixed-effects	Yes	Yes
Constant	1.8784***	-0.0611
	(0.1922)	(0.0769)
Observations	155,506	155,506
R-squared	0.081	0.028

Source: Estimation from VHLSSs 2010 to 2018

Access to formal credit schemes

In the formal credit landscape of Viet Nam, the Viet Nam Bank for Social Policies (VBSP) is known as the largest microfinance provider not only in the country but also one of the largest providers of microfinance in Asia.[92] Besides, the Viet Nam Bank of Agriculture and Rural Development (Agribank) which is specialized in serving rural areas and small and medium enterprises engaged in agricultural activities, the system of People's Credit Funds (PCFs), and two licensed microfinance institutions (TYM and CEP) are the leading formal providers in rural areas. Other commercial banks such as Lien Viet Post Bank and BIDV have recently shown their interests in the microfinance industry.[93] The semi-formal sector is occupied by non-licensed national programs, microfinance programs, and saving and credit schemes supported by NGOs and development donors, targeting the poor and disadvantaged women populations. However, these semiformal institutions usually incur high operating costs and have limited outreach due to their small-scale implementation.[94]

Notably, there are a number of VBSP credit schemes specifically targeted at providing support to vulnerable groups in relation to natural disaster response. For instance, there are loans for the poor to construct houses against flood; loans for supporting production and job change, or the extremely disadvantaged ethnic minority households in Cuu Long River Delta Program. Moreover, climatic risks have been taken into consideration in the VBSP's regulations on non-performing loans (i.e., Decision No. 50/2010/QD-TTG and Decision 15/2011 QD-HDQT). Accordingly, extension is applicable for damages in large scope, when the borrowers are not able to pay the debt on time due to natural disasters. VBSP coordinates with relevant organizations and individuals to verify level of damage to customers' loan and assets; if the damage level is below 40 percent, the borrowers can be considered for loan extension. A borrower's loss is also considered under specified conditions such as natural disasters affecting livestock or crops.

BOX 2. ACTIVITIES OF THE VIET NAM BANK FOR SOCIAL POLICIES

For VBSP, it has currently maintained a number of 20 credit schemes for different policy target audience, varying from the credit lines for the poor and "near poor", labour export, housing for the poor, job creation, credit to finance for education of students and pupils, to credit line for clean water and rural sanitation, and small and medium-sized enterprises (SMEs), with women accounting for the largest proportion of the priority beneficiaries. By the end of 2017, the total outstanding loans reached VND 171,790 billion (≈USD 7.4 billion). Out of these outstanding loans, the preferential loans for the poor, near-poor, and newly-escaped from poor accounted for nearly 52.4 percent. For the remaining, loans for rural water and sanitation accounted for 15.5 percent, loans for disadvantaged students for 9.2 percent, loans for household businesses in the poor and ethnic minority areas for 10.5 percent, the remaining 12.4 percent was for 14 credit lines of the VBSP.

According to the national demand side survey conducted by VBSP in 2019, the penetration of VBSP credit varies among geographic regions and by educational attainment. In the Northern midland and mountainous area, VBSP is the second most popular financial source after borrowing family and friends (19.98 percent), while it is commercial banks in other economic regions. The survey results show that the higher the education level, the higher rate of borrowing from commercial banks and the lower the rate of borrowing from VBSP. In addition to that, the provision of credit at favorable terms (relatively long maturities of 3 to 5 years at interest rates that are often below market) makes VBSP's lending products attractive to borrowers, especially poor clients. The same survey found that of the 3 million poor and near poor households in Viet Nam, 2.5 million households have loans with VBSP.

(92) World Bank (2019). Review of the Vietnam Bank for Social Policies (VBSP).

(93) Thi Hoai Linh TRUONG, Thi Nhu Quynh LE, Hong Mai PHAN (2020). Formal versus Informal Credit: Which is Better in Helping Rural Areas in Vietnam? Journal of Asian Finance, Economics and Business 7 (5): 119 - 130.

(94) Truong et al (2020). Ibid.

During the study data collection in Quang Nham commune, some local staff noted that in the aftermath of the 2020 Central floods, 134 hectares of paddy fields were submerged, and therefore each affected household was supported with VND 5 million for restoration. At the same time the local authorities signed contracts with private infrastructure companies to drain out the excess water and up-strengthen the edge system of the paddy field before returning it to the affected household. Furthermore, for some programs, vulnerable households were provided paddy seeds for free. In terms of loan extension, these staff stated that they would go to the affected household following a natural disaster to assess the actual damage or economic loss. When a borrower's loss has been objectively verified, an extension could be approved, for instance, by being allowed to pay off the interest rate every three times, instead of every two months. Nevertheless, according to interviewed staff in Quang Nham commune, these responses taken by the local authorities were able to meet about 70 percent of the need of the affected households. This indicates that not all eligible borrowers are able to get the needed credit from VBSP due to a capital shortage following excess demand.

> *"Under normal conditions, the province will prioritize loans for non-agricultural and technology purposes because these industries can help create sustainable labour force. However, when a natural disaster happens, priority will be given to agricultural labourers."*
>
> *KII with a representative of DOLISA, Thua Thien Hue*

> *"There is a total of 1,005 households in our commune that are borrowing from VBSP - mainly for afforestation purposes. A maximun loan package is 50 million per programme. Actually, the need is much higher but many households are reluctant for fear of not being able to repay, especially the ones whose economic conditions are still difficult. "*
>
> *KII with a leader of Quang Nham commune*

In Ca Mau, consultation with the VBSP coordinator of coastal Tan Quang B hamlet reveals that many local borrowers very often turn to other higher cost credit sources (i.e., Agribank and other commercial banks) because the current credit lines provided by VBSP are insufficient for their productive investments (e.g., aquaculture production). For instance, it has been observed that the credit needs for investment in aquaculture production hover between VND 300 million and VND 600 million especially for intensive shrimp farming. Meanwhile the maximum applicable loan size from VBSP is VND 50 million, which, according to the interviewed small-scale shrimp farmers might be only enough for the purchase of shrimp breeding.

FIGURE 19. MANTIS SHRIMP GROWN BY A HOUSEHOLD (LEFT), AND AN EXAMPLE OF POND EMBANKMENT BY AVICENNIA TREES (RIGHT)

Source: Women's Union of Nguyen Viet Khai commune

Moreover, it has reported that women's access to preferential loans has been constrained by some loan appraisal procedures. Recent study has noted that the authority certification procedure does not facilitate favourable conditions for women who need loans from VBSP. For instance, the requirement of having all family members to be present alongside the loan applicant at the People's Committee for authentication is found complicated by many loan applicants given their family members are very often migrating out for work or study in other cities/provinces. Whereas Agribank's loan size is higher but requires a land certificate and specific conditions such as having a business plan and a good financial performance during the past three years. These criteria appear to be complicated for most rural informal business owners, and especially for women entrepreneurs.[95]

In the study commune of Quang Nham, little use of financial services led to a lack of capital to invest in the banana plantation, even though this particular plant has been promoted by the local authorities as a poverty escape route. It has been observed that there is a handful of Pa Ko households who have the credit capital to invest in post-flooding soil restoration for recultivation. For the rest of Pa Ko farmers, they tend to leave the banana grow naturally without any crop production measures such as protecting soil fertility or against insects, strong winds, storms and floods.

Access to Informal Credit Markets

In the context of Viet Nam, the informal credit providers often engage an array of actors including family relatives, friends, moneylenders, rotating savings and credit associations (ROSCAs), and pawnshops.[96] Informal credit systems have some important advantages over the formal sector indicating ready availability, quick and easy delivery, flexible conditions, unintimidating application procedures, and the perception of being less risky than loans contracted in the formal sector. Further, although interest rates on informal loans vary depending on the source, there is often little or none on those from close friends or family relatives.[97] The physical and social proximity between lenders and borrowers facilitates the collection of information by the former about the creditworthiness, reputation, level of indebtedness, the use of the loan and the repayment capacity of the latter.[98] Informal credit is a complementary source to formal credit in helping families meet the needs of funding for production, asset purchase, healthcare cost, and education fees.[99]

Qualitative findings from interviews and focus group discussions with study interlocutors in both Ca Mau and Thua Thien Hue help confirm these borrowing options. The rigidity of procedures and a lack of collateral to access loans from formal credit institutions as well limited credit provided by semi-formal loans drive a large number of households to the informal finance. Among these indebted households, there is a certain segment of households who are not always close to the multidimensional poverty line as defined by the Ministry of Labour, War Invalids and Social Affairs (MOLISA). For instance, most of small-scale shrimp farmers in the extreme point of Ca Mau or banana farmers in the mountainous Central region tend to raise credit by combining funds obtained from a formal bank (i.e., VBSP, Agribank) with those raised from one or more informal sources (i.e. either from family members or money lenders). It should be mentioned that these households may not be "poor" by the official poverty definition, but their economic stability is fragile, particularly in the face of changing climate on their day-to-day and longer-term productive operations.

Observations from the study communes of Nguyen Viet Khai and Quang Nham indicate that obtaining credit from family members and close relatives is the most and the first source of informal finance among local borrowers. Nevertheless, the amounts of borrowings appear to be different between two study sites. While the amounts borrowed from family members and relatives are small, often hundreds of thousands of VND or more rarely a few million, depending on the loan usage, as reported by the Pa Ko and Ta Oi ethnic study participants, the loan size obtained from family circle could range usually from a few million to ten or twenty million, only rarely a few hundreds of millions among coastal residents of Ca Mau. These slight differences capture and reflect the relative affluence of the general population in the Mekong Delta and the generally poor economic condition of the ethnic minority populations in Central region.

(95) UN Women (2021a). Ibid.

(96) Truong et al (2020). Ibid.

(97) Ruddle, Kenneth (2011). "Informal" Credit Systems in Fishing Communities: Issues and Examples from Vietnam Human Organization 70 (3): 224-232.

(98) Lainez, Nicolas (2014). Informal Credit in Vietnam A Necessity Rather Than an Evil Journal of Southeast Asian Economies 31 (1): 147–54.

(99) Truong et al (2020). Ibid.

In many cases, borrowers have to rely on moneylenders or traders for their emergency loans. Loans from money lenders are often known as "black credits" which has a negative connotation that transaction is dubious.[100] In fact, moneylenders seem not a popular source of funds among small-scale shrimp farming owners in Ca Mau because interest rates are relatively high hovering about 5.0 percent to 10 percent per month. Research findings among fishing communities in five provinces of Ba Ria – Vung Tau, Binh Thuan, Khanh Hoa, Quang Nam, and Quang Binh indicate that most moneylenders were also fish market intermediaries; as a condition of the loan, boat owners were required to sell their catch at a discount of 10-15 percent to the moneylender who extended credit to them.[101] This type of "catch sales" business arrangements between moneylenders and boat owners seem identical with the informal credit link between local shop owners/investors/traders/retailers and ethnic minority farmers in agriculture production. Accordingly, ethnic minority farmers tend to owe traders and retailers for input supplies; and hence at harvest they are bound to repay the debt, very often at the expense of these poor farmers. The traders, retailers, or "investors" usually impose the output prices to their advantage due to the pre-existing loans that tie the indebted farmers to them.[102] However, the market power of shop owners and traders is generally weaker in areas with better connectivity, physically and economically as noted in the case of the Khmer ethnic group in Soc Trang and Tra Vinh.[103]

Ethnic minority women are particularly vulnerable to financial exclusion given financial illiteracy, technical and awareness barriers that they have to face. Especially those from low-income households with limited financial buffers or borrowing options following a natural disaster may incline to recuperate their income loss by cutting spending on essential things such as food and healthcare. Whereas climate change induced crisis often causes food more expensive and poses health risks through waterborne diseases particularly in areas with poor infrastructure and sanitation such as the study settings, leading to negative impacts on health among local residents, and especially women, children, the elderly and PWD.

3.5 Impacts on Adequate Living Conditions

Climate change is leading to rising temperatures, acute heatwaves, unpredictable precipitation in parallel with more frequent and intense storms, floods, dry spells, and bushfires. These anticipated changes have an adverse bearing on human wellbeing, especially for vulnerable populations with existing destitution and risks. This impact on wellbeing can be well observed in the domain of living conditions, which include housing conditions, access to necessities such as clean water, sanitation, energy, and ownership of necessary home appliance for a comfortable life. On the one hand, weather extremes and disasters induced by climate change can cause several damages to the housing conditions as well as prevent households accessing to those necessities. On the other hand, adequate housing and living conditions can assist with relieving these risks and may be a part of the climate change coping strategies of the households. With regard to the gap in living conditions across regions and between population subgroups, the climate change susceptibility level and coping capacity of each subgroup would be significantly different.

3.5.1 On Housing Conditions

Evidence from Viet Nam shows that climate change and natural disasters cause negative impacts to housing conditions of the households. The qualitative findings suggest that high precipitation can damage houses and make houses degrade, especially among temporary and semi-permanent houses. Since those houses are usually made from non-durable materials like wooden, tiles, and cement sheets, rainwater can easily seep into the wall and through the leaking roof. For example, a 70-year-old woman living alone in Quang Nham commune (Thua Thien Hue) shared that her corrugated cement roof usually leaked whenever it rained, making her house damp and flooded during heavy rain in the rainy season. Such damp houses face even higher danger during thunderstorms since they can easily get hit by lightning strikes. As the thunderstorms are becoming more common in the future, those temporary houses and semi-permanent houses are not a safe shelter.

(100) Lainez, Nicolas (2014). Ibid.

(101) Ruddle, Kenneth (2011). Ibid.

(102) World Bank (2019). Ibid.

(103) World Bank (2019). Ibid.

In addition, several natural disasters in the recent years are reported to heavily damage houses of the affected areas. Local people in both Quang Nham commune (Thua Thien Hue) and Nguyen Viet Khai commune (Ca Mau) informed that storms and typhoons in the past five years had blown off the roof of many local houses. Meanwhile, sudden hailstorms in the winters of 2020 and 2022 had causes severe damages to thousands of houses in the Northern Mountainous region. In fact, the 2020 hailstorm happening right at the Lunar New Year's Day destroyed 640 houses and damaged, blew off the roof of 13,193 houses in 9 Northern provinces such as Cao Bang, Bac Kan, Lang Son, Tuyen Quang, etc.[104] The sudden hailstorm in Son La province on early March 2022 is reported to destroy 1 house and damaged 435 others.[105] In the most extreme case, the 2020 typhoon and heavy rainfall period in the Central region caused flooding and landfalls that destroyed houses and deleted several villages in three provinces of Thua Thien Hue, Quang Tri, and Quang Nam. Beside a high number of casualties, the disaster made the local people lose their homes and must relocate to safer locations.

FIGURE 20. HOUSES DESTROYED BY THE STORMS AND FLOOD IN THE CENTRAL REGION IN 2020

Source: UNICEF Viet Nam

FIGURE 21. HAILSTORM DAMAGING HOUSES IN SON LA IN 2022

Source: Tuoi Tre online newspaper

(104) Data retrieved from website of the General Department of Disaster Prevention, MARD of Viet Nam.

(105) Thanh Nien Online Newspaper (2022). https://thanhnien.vn/mua-da-xuyen-thung-mai-435-nha-dan-o-son-la-post1436650.html

The above examples help highlight the potential impacts and enormous damages of climate change and natural disasters on the housing conditions in Viet Nam. It is obvious that temporary houses and semi-permanent houses are more prone to climate change and natural disasters than permanent houses. Besides, the fact that households in the areas mostly affected by natural disasters, i.e., mountainous area, coastal area, tend to own temporary and semi-permanent houses makes those households suffer more severe impacts and damages from the disasters. This finding is supported by the regression results, as represented in Table 13, showing that households living in communes with higher frequency of disasters like floods and droughts are less likely to have permanent houses.

TABLE 13. IMPACTS OF DISASTERS ON HOUSING CONDITIONS

Explanatory variables	Dependent variables	
	Log of per capita living area	Permanent house (yes=1, no=0)
Number of floods during the past year	-0.0015	-0.0122***
	(0.0031)	(0.0021)
Number of storms during the past year	-0.0083***	-0.0025
	(0.0028)	(0.0019)
Number of droughts during the past year	-0.0004	-0.0201***
	(0.0041)	(0.0027)
Control variables	Yes	Yes
Province-year fixed-effects	Yes	Yes
District fixed-effects	Yes	Yes
Constant	2.4132***	0.5509***
	(0.0301)	(0.0204)
Observations	155,380	155,506
R-squared	0.085	0.123

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

Depending on the house type, the impacts of climate change and natural disasters on each household would be different. This difference leads to the unequal impacts of climate change and disasters on the population subgroups, by which those with lower shares of permanent houses would have lower capacity to cope with the climate change and disasters. While this inequality is not found in the regression results, it is still represented by statistics results and qualitative findings.

Table 14 presents the estimated proportion of households living in a permanent, semi-permanent or temporary house by some demographic characteristics. While there is no difference between gender of the household heads, notable gaps can be found between subgroups of other criteria such as ethnicity, poverty status, and living area. Accordingly, poor households and EM households have the least share of permanent house at 11% and 18%, respectively, and those proportions are significantly lower than those of non-poor households (41%) and Kinh households (43%). The proportion of temporary house of poor households (22%) and EM households (14%), by contrast, are many times higher than their counterparts. There are also some gaps between living areas, as the proportion of permanent house in rural areas is significantly lower than the proportion in urban areas. Those results reflect that households of lower income, i.e., the poor, EMs, rural households, tend to have lower housing conditions than their counterparts, thus, their houses would be more vulnerable to the damages induced by climate change and disasters.

In addition, among six geographical regions of Viet Nam, the regions with high exposure and sensitivity to climate change like the Mekong Delta, Northern Mountains, Central Highlands and Central Coast witness high proportion of temporary houses and low share of permanent houses. This suggests a certain relation between the climate change and natural disasters and poverty in Viet Nam.

TABLE 14. PROPORTION OF HOUSEHOLDS LIVING IN DIFFERENT TYPES OF HOUSES

Groups	% living in permanent house	% living in semi-permanent house	% living in temporary house
Total	**38.6**	**55.4**	**6.0**
Gender of household head			
Female	39.0	55.6	5.4
Male	38.5	55.3	6.2
Ethnic group			
Ethnic minorities	18.4	68.1	13.5
Kinh	43.2	52.5	4.3
Poverty status			
Non-poor	41.3	54.3	4.4
Poor	10.8	66.9	22.3
Rural/urban			
Rural	32.9	59.5	7.6
Urban	52.1	45.4	2.5
Region			
Red River Delta	74.7	24.7	0.6
Northern Mountains	38.7	52.5	8.8
Central Coast	32.4	63.9	3.7
Central Highlands	15.4	76.9	7.7
Southeast	43.7	54.3	2.0
Mekong River Delta	12.7	72.0	15.3

Source: Estimation from the 2018 VHLSS

Similar to the quantitative results, qualitative interviews and field observations in the study sites also suggest that poor households (many of which are from EM groups) tend to live in houses made by wooden and fibrous cement sheets, while households of higher living standards tend to build houses of better quality. Thus, the poor households are more likely to get their roof leaked when it rains or even blown off during heavy storms. Moreover, the poor households tend to live in the locations of high sensitivity to disasters while non-poor households can choose a better place to build their houses. This common finding was found in both field sites in Quang Nham commune (Thua Thien Hue) and Nguyen Viet Khai commune (Ca Mau), two separate locations with different background. For instance, poor Pa Ko households in Quang Nham commune shared that they had to live on the hillside, where rainwater and flood usually flowed through and flooded their houses during rainy season. Households with higher living standards, meanwhile, had the financial ability to move to a place that was not affected by flood. In Nguyen Viet Khai commune, a poor Khmer household informed that their hamlet of Sao Luoi, where poor households mostly resided, was a low land near the sea gate and thus, faced the risk of being flooded due to high tide in the rainy season. Other households with better income, in contrast, could move to the upper land and reduce the flood risk.

FIGURE 22. A TEMPORARY HOUSE (LEFT) AND A PERMANENT HOUSE (RIGHT) IN THE MOUNTAINOUS COMMUNE OF QUANG NHAM, THUA THIEN HUE

Source: The research team

FIGURE 23. A TEMPORARY HOUSE (LEFT) AND A PERMANENT HOUSE (RIGHT) IN THE COASTAL COMMUNE OF NGUYEN VIET KHAI, CA MAU

Source: Women's Union of Nguyen Viet Khai commune

3.5.2 On Clean Water and Sanitation

In addition to the housing conditions, access to clean water and sanitation is among the key measures of secure and comfortable living conditions, according to the MIF. Clean water and sanitation provide people with necessities and hygiene conditions to maintain a healthy life. Nonetheless, access to those resources in many regions in Viet Nam is currently affected by the climate change and disasters.

In regard to clean water sources, while tap water is generally acknowledged to be a secure and safe water source for drinking and cooking, the coverage of tap water in Viet Nam is still limited and unequal between subgroups of population. Household survey data in 2018 reveal that only 40% of the households have access to tap water, most of them are living in the urban area as the proportion of access to tap water in the urban area is up to 76%, three times higher than the figure of rural area (Table 15). Poor households and EM households witness an extreme low level of access to tap water (13%) and significantly lag behind non-poor and Kinh households. Among the regions, the mountainous regions such as Northern Mountains and Central Highlands have the least tap water coverage.

TABLE 15. PROPORTION OF HOUSEHOLDS HAVING ACCESS TO TAP WATER, FLUSH LATRINE AND GARBAGE COLLECTION SERVICES

Groups	% living in house with tap water source	% living in house with flush latrine	% having garbage to be collected by other people
Total	**40.3**	**79.8**	**55.5**
Gender of household head			
Female	51.0	83.2	63.5
Male	37.2	78.8	53.3
Ethnic group			
Ethnic minorities	12.8	43.1	12.7
Kinh	46.6	88.1	65.3
Poverty status			
Non-poor	43.0	84.4	59.4
Poor	12.6	31.5	15.3
Rural/urban			
Rural	25.7	73.3	43.5
Urban	75.6	95.3	84.6
Region			
Red River Delta	51.9	94.3	89.7
Northern Mountains	17.4	61.7	24.1
Central Coast	36.8	77.1	63.6
Central Highlands	17.3	67.0	36.2
Southeast	62.4	96.9	78.3
Mekong River Delta	44.9	75.0	25.3

Source: Estimation from the 2018 VHLSS

The lack of access to tap water in the rural and remote areas leads to the look for alternative water sources that, in fact, depend heavily to the weather and environment changes. Qualitative findings found that local people in the mountainous commune of Quang Nham (Thua Thien Hue) used dug wells and water from the nearby streams and rivers for irrigation since tap water was just enough for daily use. Stream water used to be another source of drinking water, but it was nowadays polluted by the use pesticides and herbicides in agriculture and was avoided by most local people. Meanwhile, in the coastal commune of Nguyen Viet Khai (Ca Mau), tap water covered only two hamlets in the vicinity of the commune centre, so people in the other hamlets depended heavily on rainwater in the rainy season and purchase of compact water filters in the dry season for drinking and cooking. Besides, groundwater was pumped via drilled wells and stored in water tanks for bathing, washing, and irrigating. Water from rivers, according to the local officials and residents, was unusable due to pollution.

With that high dependency on rainwater and groundwater, local people in those two communes both reported to experience water scarcity in the dry season, especially in the recent years when temperature increased and drought prolonged. In Quang Nham commune, a group of local Pa Ko and Ta Oi men informed that the commune usually suffered from drought during summer, especially in the months of July and August, drying most water from the streams and the dug wells and causing lack of water for irrigation. Severe drought also happens in Nguyen Viet Khai commune of the Mekong Delta from the months of January to May, so people cannot store rainwater to use. The only available source of drinking water is from purchase of 20-litre compact water filters, which are reported to cost from VND 10,000 to 12,000 each and be enough for the use of a four-member family in 1 to 2 days, equal to the need of 20 to 30 water filters per month. Meanwhile, groundwater in the commune is reported be scarcer due to longer and more severe dry season, as well as the overuse of local people, leading to water shortage for bathing and washing. Salt intrusion due to sea level rise and lack of water supply from upstream of the Mekong River also reduces the volume of usable groundwater and worsen the water shortage in the dry season.

While water scarcity due to climate change is a common threat to Viet Nam, field evidence suggests that some population subgroups bear heavier burdens than the others. Among the regions, Mekong Delta is the most affected area due to high exposure to temperature increase, prolonged drought, and sea level rise. Besides, water shortage is expected to happen in the remote mountainous areas of the Northern Mountains, Central Coast, and Central Highlands, where tap water coverage is low, thus, it mostly hits the EM groups who reside there. Water shortage also leave more financial burdens on poor households than the non-poor as it raises the costs of purchasing drinking water and using electric water pump to get groundwater. In some cases, the high costs for clean water may force the poor households to use unhygienic water sources for drinking and cooking, which possibly causing health problems for them.

> *"Households with higher income can buy compact water filters to drink and cook. For bathing and washing clothes, they use groundwater pumped from drilled wells, however, it can cause skin itchiness or fungus.*
>
> *[...] A few poor households sometimes have to use water from drilled wells for cooking, although that water is still salted."*
>
> *Male FGD in Nguyen Viet Khai commune, Ca Mau*

When it comes to the sanitation, the proportion of household having access to flush latrine and garbage collection services are among the household survey indicators that reflect best the households' hygiene. The household survey data show that 80% of households have used flush latrines, suggesting a relatively high level of hygienic waste treatment (Table 15). The only point for consideration is that the level of flush latrine use among poor households and EM households remains limited at 32% and 43% respectively, about half of the level of the non-poor and Kinh households. Data also shows that 56% of households have access to garbage collection services, however, this practice is mostly done in urban areas (85%) rather than in the rural area (44%). The proportion of poor households and EM households having access to garbage collection services is extremely low, at 15% and 13% respectively, and those subgroups lag far behind the non-poor and Kinh households. People living in the Mekong Delta and the mountainous areas of Northern Mountains and Central Highlands also have low access to garbage collection services.

Field research findings are in line with the quantitative results that most households currently have access to hygienic latrines, i.e., flush latrines, thus, they did not report many impacts of climate

events and disasters such as floods and storms on their sanitary conditions. Nevertheless, poor households, who are the minority group of the population, are unable to afford flush latrines and usually have problems to use their latrines in case of long rains, floods, and storms.

For example, a poor Pa Ko woman in the mountainous commune of Quang Nham (Thua Thien Hue) shared that her household used a dry latrine by digging a hole in the backyard, setting a board for sitting and covering it with corrugated iron sheets (Figure 24). The use of this latrine is uncomfortable when it rains, as the users need to wear raincoats and go outside of the house. The latrine also becomes polluted during rain as the rainwater leaks into the waste hole. *"Pollution is for sure when it rains because we only dug a hole in the ground and covered it with a lid. But we have no choice, only households with high income can build convenient restrooms"*, said she.

Similar pollution situation is also reported by poor Khmer households in Nguyen Viet Khai commune of the Mekong Delta. Since their houses mostly locate in the riverine low land areas, the separate dry latrine can be easily flooded by heavy rains during rainy season and becomes a good environment for the growth of mosquitoes and other insects.

FIGURE 24. DRY LATRINE OF A POOR HOUSEHOLD IN QUANG NHAM COMMUNE, THUA THIEN HUE

Source: The research team

> *"When it rains, rainwater was stagnating around the toilet (a dry toilet next to the house), leading to lots of larvae and adult mosquitoes. This happens only to the houses in the lowland area, not to the upper land."*
>
> ***A poor Khmer household in Nguyen Viet Khai commune, Ca Mau***

Heavy precipitation and sea level rise also pose a threat of water pollution to the Mekong Delta, such in the case of Nguyen Viet Khai commune, as the high tide can penetrate more into inland, leading to increased flooding and washing domestic garbage into the rivers. As shared by the commune officials, most of the local people treat their domestic waste by their own due to lack of dumpsites and garbage collection services. Garbage is usually gathered and burned by each household in the fields near their houses. When the tide rises and flood the fields, especially during rainy season, untreated garbage is washed into the rivers and floats to the sea gate, polluting the coastal water and causing negative impacts to the ecological health. In the scenario of sea level rise, the pollution is expected to be exacerbated and cause unhygienic living conditions to the households living along the rivers and low-land areas, who are mostly the poor.

FIGURE 25. FLOOD DURING RAINY SEASON IN NGUYEN VIET KHAI COMMUNE, CA MAU

Source: Women's Union of Nguyen Viet Khai commune

The above-mentioned impacts of climate change and disasters on access to clean water and sanitation of households are partly reaffirmed by regression results. When running regression models on two key outcomes of the household survey data on using tap water and flush latrines, the results suggest that households living in communes with higher frequency of disasters are less likely to have access to those necessities. Specifically, floods and droughts tend to decrease the probability of using tap water among the households, while storms and droughts tend to have a negative impact on the probability of having flush latrine. Nonetheless, regression results do not show significant impacts when it comes to the subgroups of poverty status, ethnicity, and living areas.

TABLE 16. IMPACTS OF DISASTERS ON ACCESS OF TAP WATER AND FLUSH LATRINE

Explanatory variables	Dependent variables	
	Have tap water source (yes=1, no=0)	Have flush latrine (yes=1, no=0)
Number of floods during the past year	-0.0089***	-0.0006
	(0.0017)	(0.0024)
Number of storms during the past year	0.0065***	-0.0050**
	(0.0017)	(0.0020)
Number of droughts during the past year	-0.0151***	-0.0333***
	(0.0019)	(0.0031)
Control variables	Yes	Yes
Province-year fixed-effects	Yes	Yes
District fixed-effects	Yes	Yes
Constant	0.1333***	-0.1100***
	(0.0177)	(0.0225)
Observations	155,506	155,506
R-squared	0.083	0.210

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

3.5.3 On Home Appliances and Energy Usage

Climate change is increasingly causing changes in the temperature and weather in Viet Nam, leading to an extreme environment for living. While the average temperature is expected to increase by 2 degrees Celsius by 2100,[106] its signs can be already found at the present time. Summer and dry season in Viet Nam are becoming hotter every year, with higher frequency of heatwaves and extreme hot periods.[107,108] Meanwhile, high humidity and unusual cold waves induced by the melting of polar ice and disruption of the polar vortex have led to a higher frequency of storms and severe cold during winter and rainy season.[109] To adapt to those changes, households have a higher need for electricity and other types of energy for cooling and heating.[110, 111]The demand for electric equipment such as electric fan, air conditioner, refrigerator, and heater would raise as a consequence.

The impacts of climate change and disasters on those home appliances are demonstrated by regression results using the household survey data and climate data. Results of the weather extremes model (Table 17) show that households who experience high temperature extremes are more likely to own electric fan and fridge for cooling and preserving food. Similarly, a higher number of days with low precipitation also increases the probability of having electric fan among the households. When it comes to natural disasters, floods, storms and droughts are generally reported to decrease the ownership of most home appliances such as fridge, water heater, and air conditioner (Table 18). The only exception is that droughts tend to increase the probability of having electric fan, which is in line with the above impacts of high temperature extremes.

While the regression results do not find significant impacts on each demographic subgroup, the statistics and qualitative results suggest that the impacts of climate change and disasters vary among those subgroups due to unequal ownership of home appliances to cope with climate change. As represented in Table 19, there is a big gap in terms of ownership of air conditioner, electric fan, refrigerator, and water heater between the poor and non-poor households, as well as between the EM and the Kinh subgroups. The proportion of poor households who can afford air conditioner or water heater is especially low (at 1% and 4% respectively), while the ownership of electric fan and refrigerator are also at a modest level compared to the non-poor group. The same trend can also be found among the EM households, who are fall behind the Kinh households in all outcomes. It is also noticed that the household ownership of air conditioner and water heater in the rural area is lower than the urban area.

(106) MONRE (2021). Climate Change Scenarios Report.

(107) VnExpress Online Newspapers (2019). https://e.vnexpress.net/news/news/vietnam-experiences-its-hottest-temperature-ever-3913738.html.

(108) Thanh Nien Online Newspapers (2020). https://thanhnien.vn/nang-nong-pha-vo-nhieu-ky-luc-lich-su-cao-nhat-trong-64-nam-qua-post957884.html.

(109) Nguoi Lao Dong Online Newspapers (2022). https://nld.com.vn/thoi-su/mien-bac-dang-chim-trong-dot-ret-co-nen-nhiet-thap-nhat-cung-ky-trong-40-nam-qua-20220221205909135.htm.

(110) Viet Nam Electricity (EVN) (2020). https://www.evn.com.vn/d6/news/Tieu-thu-dien-tang-cao-do-thoi-tiet-nang-nong-keo-dai-66-142-25855.aspx.

(111) Viet Nam Electricity (EVN) (2022). https://www.evn.com.vn/d6/news/Canh-bao-tinh-trang-hoa-don-tien-dien-co-the-tang-cao-do-nhu-cau-su-dung-nhieu-thiet-bi-suoi-am-vao-mua-lanh-6-12-30110.aspx.

TABLE 17. IMPACTS OF WEATHER EXTREMES ON HOME APPLIANCES

Explanatory variables	Dependent variables			
	Have air-conditioner (yes=1, no=0)	Have electric fan (yes=1, no=0)	Have fridge (yes=1, no=0)	Have water heater (yes=1, no=0)
Number of days with low temperature	-0.00004	0.00073**	-0.00029	-0.00056
	(0.00029)	(0.00035)	(0.00044)	(0.00038)
Number of days with high temperature	-0.00006	0.00059**	0.00056*	0.00024
	(0.00020)	(0.00023)	(0.00031)	(0.00025)
Number of days with low precipitation	0.00016	0.00043***	0.00015	0.00015
	(0.00012)	(0.00014)	(0.00018)	(0.00014)
Number of days with high precipitation	-0.00024	0.00028	-0.00010	-0.00032
	(0.00030)	(0.00038)	(0.00043)	(0.00038)
Control variables	Yes	Yes	Yes	Yes
Province-year fixed-effects	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes
Constant	0.06278**	0.63575***	0.30742***	0.07680**
	(0.02811)	(0.03570)	(0.04540)	(0.03482)
Observations	216,023	216,023	216,023	216,023
R-squared	0.238	0.244	0.254	0.283

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

TABLE 18. IMPACTS OF DISASTERS ON HOME APPLIANCES

Explanatory variables	Dependent variables			
	Have air-conditioner (yes=1, no=0)	Have electric fan (yes=1, no=0)	Have fridge (yes=1, no=0)	Have water heater (yes=1, no=0)
Number of floods during the past year	0.0005	0.0064***	-0.0032	-0.0046**
	(0.0012)	(0.0017)	(0.0024)	(0.0018)
Number of storms during the past year	-0.0027**	0.0018	-0.0070***	-0.0006
	(0.0012)	(0.0014)	(0.0021)	(0.0016)
Number of droughts during the past year	-0.0025*	0.0152***	-0.0077**	-0.0091***
	(0.0013)	(0.0023)	(0.0031)	(0.0021)
Control variables	Yes	Yes	Yes	Yes
Province-year fixed-effects	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes
Constant	-0.0074	0.1669***	-0.1315***	0.2724***
	(0.0110)	(0.0184)	(0.0225)	(0.0167)
Observations	154,830	154,830	154,830	154,830
R-squared	0.078	0.142	0.180	0.175

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018

TABLE 19. PROPORTION OF HOUSEHOLDS HAVING SOME KEY HOME APPLIANCES

Groups	% having air conditioner	% having electric fan	% having refrigerator	% having water heater
Total	**24.7**	**90.0**	**78.6**	**33.4**
Gender of household head				
Female	29.0	91.0	78.5	32.6
Male	23.5	89.7	78.7	33.7
Ethnic group				
Ethnic minorities	4.2	68.3	43.6	9.8
Kinh	29.4	94.9	86.5	38.8
Poverty status				
Non-poor	27.0	92.7	83.9	36.3
Poor	0.7	61.7	23.3	3.5
Rural/urban				
Rural	16.2	88.1	73.4	28.1
Urban	45.2	94.6	91.1	46.2
Region				
Red River Delta	45.7	96.7	90.9	71.1
Northern Mountains	15.8	80.3	69.3	35.2
Central Coast	17.1	92.1	76.2	29.4
Central Highlands	2.1	64.2	62.2	25.8
Southeast	42.1	97.4	90.4	24.4
Mekong River Delta	15.4	93.5	74.1	6.4

Source: Estimation from the 2018 VHLSS

Given the lower level of home appliance ownership, poor households and EM households are reported to have lower capacities to adapt to the extreme weather, thus, they suffer more negative impacts of climate change than their counterparts. The qualitative interviews in Nguyen Viet Khai commune (Ca Mau) in the Mekong Delta suggest that poor households, which include mostly Khmer households, are less likely to have enough electric devices such as electric fan or air conditioner to cope with the heat of the dry season. For example, a poor Khmer woman living alone shared that unlike other households, she did not have any electric fan in her house, so she had to use paper sheets as a hand fan; however, it did not help much and she still felt hot. She also mentioned that in her hamlet which was mostly composed of low-income households, there was no house with air conditioner; it can only be found in another hamlet with higher living standards. Another young Khmer man shared that his poor household was given only one electric fan, but it had degraded and did not working properly. Therefore, in the hot nights of the dry season, his wife and he had to take turns to manually fan their one-year-old child to sleep, otherwise it would be too hot, the child would not be able to sleep and would cry the whole night. This practice made the young man sleep-deprived, reducing his productivity at work in the following morning; sometimes, he even had to take the morning off because of tiredness.

Meanwhile, in the mountainous commune of Quang Nham (Thua Thien Hue), a poor Pa Ko woman has to suffer the cold winter nights due to the lack of water heater and electric heater. Since her house does not have a private bathroom and water heater, she and other family members have to take the bath outdoor at their only tap water pillar at night, even during winter. To get hot water, they boil water using their firewood stove. Firewood is also their

only energy source to heat up and cope with the cold winter nights. *"We cope with the cold by burning the firewood into coal, then put it into a basin to heat the bedroom. We need to take the charcoal basin next to our beds, otherwise, it would be too cold to sleep. [...] The households having adequate blankets and electric heaters may not need to do so, but we can't afford those items"*, said she. Although burning firewood and coal indoor is a dangerous practice that may lead to poisoning and death[112], as the woman admitted, this is the common practice and only choice of many poor households and EM households in Viet Nam to cook and heat up due to its economic benefits.

3.5.4 Coping Strategies, Capacities and Hindering Factors

From the above sections, it can be found that climate change-induced disasters have been imposing negative impacts to the living conditions of Vietnamese households. Besides, adequate housing conditions, domestic appliances, and access to necessities such as clean water and sanitation are proved to be essential to help people cope with the extreme weather and disasters.

Through the qualitative interviews in the study sites, housing conditions are believed to play the most important role for people to cope with the climate change and disasters. First, the house locations in a safe and dry area are vital to prevent the risks of flooding (in the river delta), flash flood and landslide (in the mountainous areas). In addition, in the case of heavy rainfall, thunderstorm, and typhoon, a permanent house is suggested to be a safe shelter for local people and reduce the risk of housing damages that usually happen to semi-permanent and temporary houses (i.e., blown roof, leaking roof). Permanent houses (and semi-permanent houses) are also more airtight than temporary houses, thus, they have higher insulation ability to prevent severe cold (which usually happens in the mountainous areas), and at a certain level, to prevent extreme heatwaves. The houses also need to be upgraded to meet the weather changes, for example, using heat-resistant paint or corrugated iron roof to adapt to the increasing temperature.

Home appliances, clean water and energy sources, and sanitation are also necessary items to cope with the extreme weather. As the average temperature is increasing rapidly, electric devices such as electric fan, air conditioner, refrigerator become essential for cooling the house and preserving food, helping people cope with the extreme heatwaves. Meanwhile, water heater and electric heater would be useful for people in the mountainous areas to cope with the cold in winter. It is also worth to highlight the vital role of clean water sources and water desalination and refining technologies to supply enough water for the population in the scenarios of drought and sea level rise which are coming in a near future. Regarding clean energy, renewable energies (i.e., rooftop solar power) and energy efficient technology (i.e., energy saving lights) are needed to ensure the power supply and mitigate climate change.

Nonetheless, vulnerable groups such as poor households, EM households, and those living in the remote coastal and mountainous areas seem to be left behind in the process of coping with climate change. On the one hand, low housing and living conditions have made them more vulnerable to the impacts of climate change and disasters. On the other hand, the low living standards also limit their abilities to cope with natural disasters and adapt to the weather changes.

When being asked about the most urgent need during the qualitative interviews and group discussions, most of the poor households expressed their wishes to have a better and more stable house to cope with the extreme weather. However, this is still an illusory wish because they know that they cannot afford such houses. Even housing repair after the storms costs them much time and effort, as they usually have to choose the inexpensive and nondurable solutions. For example, after the roof are partly or fully blown off by a storm, the poor households usually ask their neighbours for old corrugated cement sheets or old leaves to repair it.

> *"My house is roofed with leaves so the roof is usually blown off during storms. I have to wait until the storms are over to temporarily re-roof it instead of building a stable house because my family can't afford it. During a rainy season lasting for 3 to 4 months, the roof can be blown off for 1 to 2 times.*
>
> *When repairing the roof, I usually go around the neighbourhood asking for old leaves from my neighbours, then bring them home to do it myself. I only ask for help from other men when the damages are too heavy. Those men all live in the neighbourhood, and we voluntarily help each other if needed."*
>
> *A poor Khmer man in Nguyen Viet Khai commune, Ca Mau*

(112) Whiting, Kate (2021) Cooking with polluting fuels is a silent killer - here's what can be done. World Economic Forum.

The poor households also do not have the financial ability to buy and use electric equipment that help them cope with the extreme weather. The first reason lies in the high prices of such devices such as refrigerators and air conditioners, which can be up to millions of VND and are unaffordable for the poor. In fact, many poor households interviewed by the research team do not have a working electric fan, although its price is only a few thousands VND. For those households, their monthly income of less than VND 1.5 million per person[113] is just enough to cover basic needs, so any added expense should be considered with care.

Besides, power shortage and power tariff are believed to be the additional barriers for using those electric devices among poor households. Some poor households, especially in the Mekong Delta, are not officially connected to the power grid and use the "under-grid" [*điện chia hơi*], a type of power share in which one household connect to the power grid and share it to another, instead. The "under-grid" households usually pay a higher price, for example, a young Khmer man in Nguyen Viet Khai commune shared that he usually paid 55% of the total power tariff of two households, which might be up to VND 250 thousand per month. Even with those having normal connection to the power grid, the monthly bills of VND 100-200 thousand are still a burden for poor households. Meanwhile, the current ladder tariff system means that higher electricity usage levels cost much higher than the low levels. Therefore, the poor households are likely to restrict their use to the basic lighting need and scarcely use electricity for other purposes. Regarding the energy efficient solutions, qualitative results suggest that some poor households have known about the energy saving lights through viral communication; however, those lights are not widely used by the poor since they have not seen many benefits of those devices (there is not much difference compared to the use of normal lights, probably due to low electricity usage level). Meanwhile, current renewable energy technologies such as rooftop solar power system are out of the poor households' reach due to their high prices from approximately VND 40 million to more than VND 100 million.[114]

Without the electric equipment, the poor households tend to look for cheaper alternative solutions, if possible, to adapt to the extreme weather. For example, to replace the refrigerator, the young Khmer man shared that he bought and store ice it into a plastic bin to preserve leftover food and to have ice water during the hot season. A large ice piece cost less than VND 20 thousand and could be used for about two days. However, he acknowledged that it was a temporary solution, he only did so in the hot days and when he had money. This solution also has its drawback as the ice sometimes melts all and leads to food spoilage, causing stomachache for his family.

In terms of coping with climate change and disasters, another limitation of poor households (as well as EMs and those living in the remote areas) that should be taken into consideration is the lack of access to information, especially weather forecast, due to lack of telecommunication devices.[115] Weather forecast information is becoming more essential in the context of unusual weather patterns and natural disasters induced by climate change, helping people adjust their living and production activities properly to the weather changes and be well prepared for the disasters. Beside traditional communication channels such as commune loudspeaker, television, and radio, the promotion of Internet and smartphones provides a new and potential method of dissemination live weather information and disaster warnings via social medias, i.e., Facebook or Zalo. Nevertheless, the field study found that most poor households did not have necessary devices for accessing live weather information such as television, radio and smartphones due to financial difficulties. The poor are also less likely to be interested in the weather information from the commune loudspeakers. They are only aware of a coming disaster, i.e., a typhoon, when the village heads or their neighbours warn them.

Lacking information on the climate change and disasters, poor households and other disadvantaged groups depend heavily on the support of the communities, local authorities, mass organizations and civil society organizations (CSOs) to cope with natural disasters and adapt to climate change. It should firstly highlight the local communities' mutual support as the main safety net for poor and disadvantaged households in the cases of emergency like disasters. For example, poor EM households in both study sites mentioned that in the case of heavy storms that risked damaging their houses, they usually took shelter in more stable

(113) According to the poverty threshold issued by the Government's Decree 27/2021/ND-CP.

(114) Rooftop solar system prices are retrieved from online sources in May 2022. An example can be found at https://intechsolar.vn/bang-gia-lap-dien-mat-troi/

(115) In the MIF, access to necessary information to participate in society is a sub-domain of Education and learning, however, the lack of access to weather forecast information is mainly due to lack of telecommunication devices, which relates more to the domain of Living conditions.

houses of their relatives or neighbours. Those neighbours also provided the poor households with building materials and human resources to repair their damaged houses after the storms, and as shared by the young Khmer man in Nguyen Viet Khai commune, the support is "*voluntary and mutual when needed*". This fact suggests that social capital is the most valuable capital of poor and disadvantaged people and will be highly needed in the coming context of climate change.

Besides, it should underline the crucial role of the local government and commune response task forces (involving local militia, local police, members of Women's Union and Youth Union) in supporting the vulnerable households to cope with disasters. As suggested by the field results, the commune government takes the main responsibility of warning local people about the upcoming disasters and mobilizing human resources to prevent the disaster damages. For example, the disaster warnings are spread via the commune loudspeaker system or by the village heads. In case heavy storms, commune officials and commune response task forces in Quang Nham commune (Thua Thien Hue) and Nguyen Viet Khai commune (Ca Mau) are also in charge of urging and guiding local people to take shelter in a safe place, i.e., in the community houses or commune schools. After the storms, the local government manages the distribution of financial aids provided by the provincial government to the affected households, while the response task forces support local people in housing repair and debris cleaning.

FIGURE 26. FLOATING HOUSE MODEL WORKING EFFECTIVELY IN THE 2020 FLOOD IN THE CENTRAL REGION OF VIET NAM

Source: Nha Chong Lu's Facebook page and Tuoi Tre online newspaper

Meanwhile, mass organizations and CSOs are the main forces to support vulnerable households to adapt to climate change and disasters. Some disaster-coping solutions supported by the CSOs such as the floating house model have worked effectively and saved many lives in the 2020 flood in the Central region. Moreover, the qualitative interviews suggest that mass organizations and the CSOs have been collaborating in many programs to provide poor and vulnerable households living in the disaster-prone areas with necessities to adapt to the weather changes. For example, the Women's Union of Nguyen Viet Khai commune (Ca Mau) had collaborated with a CSO to provide local poor households with 1,000-litre water tanks so they can store adequate amount of rainwater and groundwater for their daily use, especially in the dry season's droughts. The commune Women's Union also promotes a model of composting organic fertilizers from domestic and agricultural wastes and using those fertilizers to grow clean vegetables. According to the local authorities and local people, those climate change adaptation initiatives have effectively helped the households, especially the poor groups, cope better with the increasing water scarcity and pollution caused by climate change.

FIGURE 27. A PROGRAM TO SUPPORT WATER TANKS FOR RAINWATER STORAGE TO POOR HOUSEHOLDS IN NGUYEN VIET KHAI COMMUNE, CA MAU

Source: Women's Union of Nguyen Viet Khai commune

FIGURE 28. A MODEL OF COMPOSTING FERTILIZERS TO GROW CLEAN VEGETABLES BY WOMEN IN NGUYEN VIET KHAI COMMUNE, CA MAU

Source: Women's Union of Nguyen Viet Khai commune

3.6 Cross-cutting themes

3.6.1 Climate Change Awareness

In terms of exposure to climate change, all the household participants in the study sites experienced livelihood impacts due to one or numerous climate hazards such as tropical storms, floods, droughts, sea level rising, and changes in seasons. Despite repeated exposure to climate change induced crisis, the interviewed residents from two study sites showed significant differences in terms of climate change awareness. The study participants both women and men, both the Kinh and the Khmer from Ca Mau appear to have better understanding of the serious risks of climate changes and could make a link between their farming and livelihoods losses with the effects of climate change than their Pa Ko and Ta Oi fellows in the Central region. For instance, during focus group interactions, they used the words "climate change" spontaneously to refer to the most devastating environmental threats in their vicinity over the past few years. This fact may result from the endless efforts taken by the VWU and local authorities on raising community awareness under development projects on strengthening women's capacity in disaster risk reduction to cope with climate change in Ca Mau supported development partners over the past decade. Meanwhile, no usage of the words "climate change" was observed among ethnic minority respondents (regardless of their gender) in A Luoi district. For these ethnic minority respondents, they could recall the occurrence of weather extreme event in their hamlets but they did not clearly know its causes. This may be partly due to the climate-change risk message incongruence coupled with existing language barriers among ethnic minorities given the inherently uncertain and abstract nature of climate change. These insights suggest that "*knowledge about the causes and effects of global warming has to be mediated and can only become socially relevant at particular sites if it connects to life experiences and culture-specific patterns of interpreting the environment*."[116] These differences are a topic worthy of further exploration.

> *"Climate change has a great influence, changing the customs of people a lot. Climate patterns do not follow the rules anymore. For example, even when the storms did not hit Ca Mau directly, the impacts of spiral rain bands left by the storms was phenomenal. Furthermore, the passing of a storm could also lead to a very sudden whirlwind."*
>
> *KII with the leader of Nguyen Viet Khai commune, Ca Mau*

> *"This year particularly, we are suffering so bad from climate change. Due to sea level rise, our shrimp and crabs were all dead. The Covid-19 situation even makes our lives more miserable."*
>
> *Female FGD in Nguyen Viet Khai commune, Ca Mau*

At the national level, it has been also observed that stakeholders, both male and female, especially those who are neither working on climate issues nor from areas that are vulnerable to climate change are very likely to perceive it as a distant phenomenon. As shown in climate change communication research, when the perceived psychological distance between an individual and a risk increases, the risk is construed more abstractly.[117] Subsequently, individuals that experience a risk as psychologically distant and abstract, across a variety of domains, are more likely to downplay the risk than those who perceive it as psychologically proximal and concrete. This reflects underexplored individual differences or contextual variables as drivers for climate change perception and behavioural change. These findings have meaningful implications for climate change communication strategies.

Additionally, some government officials and development practitioners express a view that climate change offer opportunities. While, according to these study stakeholders, the potentially disastrous effect of climate change to development and people's well-being and livelihoods is the imperative for action, the

(116) Greschke, H. (2015). The social facts of climate change: An ethnographic approach. In H. Greschke, & J. Tischler (Eds.), Grounding global climate change. Contributions from the social and cultural sciences (pp. 121–138). New York: Springer. Crossref, page 123.

(117) Zwickle, A.; Wilson, R. (2013) Construing Risk. In Arvai, J., Louie, R.I (Eds) Effective Risk Communication; 1–21. Abingdon, UK Routledge.

knock-on effects of this may bring the opportunity for a solution that will be positive for everyone, sectors, and the society at large.

> *"Since 2008, there has been a severe shortage of skilled state management personnel at all levels who have a thorough, systematic and accurate understanding of climate change issues. During my fieldtrips, we found that a number of staff (mainly part-time officers) [cán bộ kiêm nhiệm] still have a very vague understanding of climate change management. At the present, the government is putting more and more investment in capacity building and training for staff working in climate-change related fields, particularly at the local level. In the future, if we want to build a good climate change management system, we will need a lot of individuals who are both knowledgable and skilled."*
>
> ***KII with the representative of the Department of Climate Change, MONRE***

3.6.2 Institutional Framework on Climate Change and Multidimensional Inequality

The relevance of social inequality in the context of climate change has been a persistent issue in the climate change related policies of Viet Nam. In general, it has been part of the discussion on especially "vulnerability" and gender equality issues.

By legal definition, the term "vulnerable person" is referred to children, the elderly, pregnant women or mother of under 12 months old, people with disabilities, people diagnosed with serious diseases and the poor (Law on Natural Disaster Prevention, Control No. 33/2013/QH13). The recognition of differential vulnerability and exposure of vulnerable persons to natural disasters remains intact in the amendments to a number of articles of the Law on Natural Disaster Prevention, Control and the Law on Dyke (No. 60/2020/QH14). Notably, the recent Circular No 10/2021/TT-BKHDT dated 22 December 2021 guiding the integration of natural disaster prevention and control contents into sectoral and socio-economic development planning and plans has not only added single women as household head in the list of vulnerable people but also highlighted the importance of gender-based needs (Article 8, item 4d). Furthermore, from social welfare perspectives, the definition of "vulnerable person" has been recently expanded to other vulnerable populations such as victims of human trafficking, victims of domestic violence, injecting drug users, people living with HIV, or people within the LGBT community in the Legal Aid Law No11/2017/QH14 (Article 7), or a number of sub-law documents including the Decision No 29/2014/QD-TTg; Guidance No 3337/NHCS-TDSV guiding the implementation of the National Target Program on Sustainable Poverty Reduction 2016-2020, and the Ministry of Justice's Handbook on a number of personal and property rights of vulnerable groups.

Additionally, building on the "Leave No One Behind" spirits of the United Nations Sustainable Development Goals 2030 Agenda, the flagship national emulation movement for National Target Program on Sustainable Poverty Reduction 2016-2020 entitled "Whole Nation to Join Hands for the Poor – Leave No One Behind" has been officially launched since 2017. More recently, three new National Targeted Programs (NTPs) for the next five and ten-year periods, including the Sustainable Poverty Reduction (SPR), the New Rural Development (NRD), and the Socio-Economic Development of Ethnic Minority and Mountainous Areas (SEDEMA) NTPs have been approved by National Assembly. Further, the Government's revision and approval of the national multidimensional poverty standards for 2021-2025, adding new indicators for non-income deprivations in nutrition, employment and skills, social protection support will be expanded to over 7.5 million vulnerable people. These policy initiatives were taken to allow more vulnerable people access to development support and provide greater space for local innovation and strength.[118]

Besides, there are a number of sector-specific policies responding to the needs of vulnerable groups in the context of climate change induced natural disasters, for instance, the Decision No. 48/2014/QD-TTg (dated 28 August 2014) on policy supporting poor households to build resilient houses in the Central region. More recently, in the occurrence of floods and storms in October 2020 in Central Provinces, the Government introduced the Resolution No. 165/NQ-CP (dated 05 November 2020) on providing financial assistance to rebuild and repair houses damaged or destroyed. In terms of urgent support provisions, the Decree No. 02/2017 /ND-CP set forth mechanisms and policies to support agricultural production in order to recover the production of damaged areas by natural disaster and epidemics. There is provision of support for plant seeds, livestock, products or part of initial production costs to restore agricultural production damaged by natural disasters. In addition to that, the

(118) UN (2020) UN Analysis on Social Impacts of COVID-19 and Strategic Policy Recommendations for Viet Nam.

Decree No. 20/2021/ND-CP includes provision on urgent support for job and production development in the wake of natural disasters (Article 17).

With respect to gender equality, Viet Nam has also made an international commitment to mainstream gender equality and women's empowerment in responding to climate change.[119] In the new Law on Environment Protection No.72/2020/QH14 dated 17 November 2020, gender equality has been explicitly stipulated as an important principle in environment protection activities (Article 4). At an implementation level, gender has been integrated as a content for vulnerability assessments in responding to climate change (Article 6) according to the Circular 01/2022/TT-BTNMT dated 07 January 2022 detailing the implementation of a number of articles of the Law on Environmental Protection in response to climate change. Further, the updated Nationally Determined Contribution (NDC) to the United Nation Framework Convention for Climate Change (UNFCCC), submitted in September 2020, made specific reference to gender equality in the context of climate change. Significantly, the National Plan on climate change adaptation (CCA) for 2021 - 2030, with a vision towards 2050 (Decision No. 1055/2020/QD-TTg) has explicitly set out how to integrate gender equality into related policies. Strategically the National Plan aims to adopt gender equality as principle for the implementation phase of "a vision towards 2050" (Section IV, item 3). There are medium-term objectives specifically mandated to Ministry of Labour, War Invalids and Social Affairs (MOLISA) in order to: i) strengthen capacity building for women, enhancing the participation of female labour force in the process of climate change adaptation; ii) to develop a communication Project aiming to foster Green Growth including Gender and Climate Change; Gender Equality and Climate Change; iii) to build up soft skills for female labour force to participate in economics of CCA.

Despite the progress above, the discussion of the interlinkages between climate change and multidimensional inequality has been rather limited. The existing climate related provisions have generally addressed the direct effects of climate change on the affected people, especially the vulnerable groups, with relatively less effort devoted to responding to the prospective long-term effects of climate change on human welfare. For instance, one of the important ways in which inequality increases susceptibility of the disadvantaged groups to damages caused by climate change is through its health effects.[120] Yet, both the Action Plan for Climate Change Adaptation for 2019-2030 with a vision towards 2050 for health sector (Decision No 7562/QD-BYT 2018) and the Decision No. 1355/2021/QD-BYT on the approval of the Action Plan on Natural Disaster Prevention, mitigation, search and rescue in the health sector have neither addressed vulnerability nor gender issues. According to the latest report on gender equality results of implementation of the NSCC for the period of 2011-2020, gender has not been considered as a cross-cutting principle, and subsequently has not been materialized in the climate change related tasks and solutions.[121] It has been noted that rapid population ageing will add to fiscal pressures, while social inequalities are likely to increase, in light of the discrepancy between the large and growing informal sector on the one hand, and the FDI sector and emerging domestic conglomerates on the other hand.[122] Therefore, to ensure that economic growth remains inclusive and to continue the socioeconomic progress made so far, Viet Nam needs to overcome social vulnerabilities, particularly in the face of climate change induced crisis and pandemics such as the COVID-19.

3.6.3 Development Initiatives on Climate Change and Multidimensional Inequality

From the evidence gathered from stakeholder interviews, it appears CSOs within multi-stakeholder partnerships have an active role to play in advocating for considerations of social inequality in climate change impacts and response over the past decade. A number of stakeholders have been working in this area to support an enhanced enabling environment for social inclusion and gender equality in climate policies and actions.

UN Women has various projects such as "Strengthening women's capacity in disaster risk reduction to cope with climate change in Viet Nam" (2012-2016) implemented in five provinces of Binh Dinh, Thua Thien Hue, Quang Binh, Ca Mau and Dong Thap funded by the Government of Luxembourg and the more recent project Strengthening women's livelihoods and participation for greater resilience to disasters and climate change in Viet Nam funded

(119) Institute of Strategy and Policy on Natural Resources and Environment, the UN Environment Programme, and UN Women (2021). The State of Gender Equality and Climate Change in Viet Nam.

(120) Islam S. Nazrul and John Winkel (2017). Climate Change and Social Inequality. DESA Working Paper No. 152 ST/ESA/2017/DWP/152.

(121) GIZ (2021). Results of implementation of the National Strategy on Climate Change through a gender lens.

(122) Kim, J. and K. Poensgen (2019). Transition Finance Country Study of Viet Nam: On the threshold of transition. OECD Development Co-operation Working Papers, No 60, OECD Publishing, Paris.

by the Chanel Foundation, implemented between 2018-2020 in Lao Cai, Phu Yen and Ca Mau provinces. These projects aimed to build the capacity of the VWU to enhance the enabling environment, with a focus on increasing the voice of women in climate change decision making while at the same time working with rural ethnic minority women to increase their economic empowerment through climate-resilient livelihoods. The projects have also worked with national counterparts, such as MARD and MONRE, to ensure gender responsive climate action and commitments have associated budgets and relevant monitoring frameworks to support greater implementation of these commitments.

Further, based on the Government's Housing Programme Decision No. 48/2014, under the framework of the "Improving the resilience of vulnerable coastal communities to climate change-related impacts in Viet Nam" project funded by the Green Climate Fund (2017-2022), UNDP in collaboration with the VNDMA, Ministry of Construction and the Central VWU have promoted the construction of 4,000 storm and flood resilient houses in 100 communes of five coastal provinces: Quang Ngai, Thua Thien Hue, Thanh Hoa, Quang Nam, Quang Binh. The new storm and flood resilient houses are based on simple designs to create a stronger structure, allowing residents to comfortably stay in their houses during a disaster, safe from high flood levels. This level can also be used as an area to store valuables during disasters and avoid it being washed away or spoiled by flooding waters. Among project beneficiaries, there are women of poor households, single-woman headed households, and women of vulnerable groups in the project areas.

Another initiative working on gender equality in secured livelihoods and resilient communities is the Gender Transformative and Responsible Agribusiness Investments in South East Asia phase two (GRAISEA 2) funded by the Embassy of Sweden in Bangkok and implemented by Oxfam in Kien Giang, An Giang, Soc Trang, Bac Lieu, and Ca Mau provinces (2018-2023). This project builds on the work of the previous phase (GRAISEA 1) implemented in Soc Trang, and Ca Mau of Viet Nam (2015-2018), which aimed to transform opportunities for small-scale producers in the rice and shrimp value chains, thereby acting as a catalyst for the emergence of inclusive value chains and responsible business practices that respect human rights and drive women's economic empowerment and climate resilience. The new GRAISEA 2 continues to focus on promoting women's rights and addressing unequal power relations; strengthening climate resilience and reducing vulnerability; and collaboration with, and influencing of, the private sector on inclusive business practices and models. It should be noted that Oxfam has recently offered the Government a gender responsive budgeting framework, which helps them to see the differential gender impact of policies.

With respect to climate change mitigation, CARE International in Viet Nam is working on entrepreneurship through supporting women starts up in micro-enterprise to sell efficient cookstoves. Leveraging CARE's existing Village Saving and Loan Association (VSLA) networks, and in partnership with Global Alliance Clean Cookstove, this initiative focuses on identifying ethnic minority women who can be trained and become entrepreneurs for the GreenGen cookstoves in some of the most remote areas of Viet Nam. Through the "Empower Me" project (2016-2017) in Dien Bien and Bac Kan, this initiative has increased the number of women entrepreneurs in micro-businesses and support those who can buy the stoves to reducing time spent on cooking, reduce costs spent on fuel and allow women to spend more time on income generating opportunities.

Other Vietnamese NGOs such as the Centre for Sustainable Rural Development (SRD) can play an important role to forward cross-cutting objectives of social inclusion and gender equality on the agendas of climate actions. An example of this is the initiatives taken by SRD on capacity building on climate change for civil society organizations in order to strengthen the role of VNGOs in climate change communication and advocacy as aiming to increase the participation of civil society organizations in the development of the National Adaptation Plan (NAP).

Despite the considerable efforts from multiple stakeholders to enhance gender responsiveness and social inclusiveness of the enabling environment, there remains a number of challenges hindering the potential contribution and supports of CSOs in partnership activities. All the interviewed government staff and development practitioners express their concern about project sustainability after its closure. According to these stakeholders, most of the climate related projects are short-term of four years or less in length, while continued and consistent technical mentoring and guidance is still needed to improve the implementation of social inclusive and gender policies and programmes. Moreover, it has been observed that a majority of projects focuses on the Mekong Delta, leading to the imbalanced support for adaptation and mitigation in mountainous areas where the poorest and vulnerable ethnic minorities live, as well as in the Red River Delta, which is a typhoon hotspot and where livelihood strategies are sensitive to climate change.[123]

(123) CARE and SRD (2020). Adaptation Finance Tracking Report for Vietnam.

4

CONCLUSION AND RECOMMENDATIONS

4.CONCLUSION AND RECOMMENDATIONS

4.1 Conclusion

The study findings presented above help illustrate that the relationship between the adverse effects of climate change and inequality is characterized by a vicious cycle. Accordingly, climate change-induced crisis has aggravated multidimensional inequality through three channels including a rise in the exposure of the disadvantaged social groups to the adverse effects of climate change, an increase of the disadvantaged groups' susceptibility to problems caused by climate change, and a decline in these groups' relative ability to cope with and recover from damages and losses they suffer in five selected areas of research priorities.

With respect to life and health, the quantitative analysis indicates that the adverse effect of low temperature extremes is statistically significant for children and adults of poor households and those living in households with lower-education head. Further, people in Southeast region, urban areas and those in non-farm and poor households are more affected by temperature extremes. Qualitative findings demonstrate that inequality increase the exposure of the disadvantaged social groups to the adverse health effects of climate hazards.

Given the exposure level, inequality increases the disadvantaged groups' susceptibility to health problems caused by climate hazards. Limited access to transportation during a flood has been shown to cause missed or delayed medical care appointments, and more, generally, to limit access to health care for especially the elderly, children, people with disabilities, and pregnant women. Moreover, crop losses following prolonged droughts have implications for food shortages, hunger and especially childhood stunting associated with poor maternal health and nutrition, inadequate infant and young child feeding practices among low-income households of ethnic minorities.

From perspectives of coping abilities, people in the studied sites are likely to limit their exposure to the extreme weather to avoid its negative health impacts, however, this measure does not apply to all people as some poor and outdoor labour still have to work even in bad weather conditions. In the case of sickness due to weather changes, local people usually look for primary healthcare at the commune health centres. Thus, investments in those grassroots health services will bring great benefits to those people living in remote areas. The study also shows that climate-related safe water scarcity affects all social groups, but it affects them differently. The ones most affected are the low-income households, especially the elderly and women heads of household because they have no large reservoirs for storage and sedimentation, resulting in a remarkably high risk to waterborne diseases. Furthermore, often health hazards are exacerbated by the conditions at the temporary shelters which are the medium-high public buildings, posing extreme challenges without adequate sanitation facilities as well the potential risk of sexual harassment, intimidation and violence against women, girls, and boys due to overcrowding in evacuation sites.

The education sector is particularly vulnerable to the impacts of climate change. Evidence from both quantitative and qualititative study components suggests that climate-change associated effects can include a host of impacts from direct – such as reducing school attendance and destroying educational facilities/learning supplies, to indirect – through affecting children's health and nutritional status, living conditions, study environment, and household's investment in education. However, the understanding of climate change impacts on education needs to take into accounts different vulnerabilities of population groups because the effects are asymmetric between women and men, children from poor and non-poor families, children living in rural and urban areas, children belonging to ethnic minority groups and Kinh group. In our study locations, the majority of children do not complete high school or, at most, leave school after the 12th grade and begin working. When the long-term benefits of education cannot overcome the immediate urgent need to earn a living, climate change will only add fuel to the fire. On the one hand, climate change exacerbates current and future hurldes faced by the poorest and the most vulnerable who are already suffering from multiple deprivations. On the other hand, it is the existing socioeconomic inequality that inhibits them from realizing the importance of education as a sustainable adaptive measure to cope with climate change. This necessitates dual purpose of improving equal access and quality of education while

simultaneously advocating for the involvement of the education sector in the development of national climate change strategy.

As regards employment, qualitative results suggest the linkage between rising temperatures on labour productivity, indicating combinations of risks, vulnerabilities and hazards facing the workers of low-income ethnic minority households. In view of the growing hardship of fishing workers against the backdrop of increasing weather extremes, it has been noted that many young fishermen have quitted their job, seeking alternative livelihoods in off-farm domains.

From an employment creation perspective, existing provisions on urgent support for job and production development in the wake of natural disasters address the vulnerability of households whose primary income earner was found dead or missing or production means were lost/damaged in the disaster. Nevertheless, there is no explicit regulation on support scheme for these vulnerable people, particular women to acquire the skills and resources to engage in income generation activities, such as employment and entrepreneurship.

On the living conditions domain, extreme weather and disasters induced by climate change impose negative impacts to the housing conditions, access to clean water and sanitation of the affected households, while creating more need for electric equipment and energy for cooling and heating. Besides, adequate housing conditions, domestic appliances, and access to necessities are proved to be essential to help people cope with those severe climate phenomena. Nonetheless, vulnerable groups such as poor households, EM households, and those living in the remote coastal and mountainous areas seem to be left behind in the process of coping with climate change. On the one hand, low housing and living conditions have made them more vulnerable to the impacts of climate change and disasters. On the other hand, the low living standards limit their abilities to improve the housing conditions and afford necessary items to better cope with natural disasters and adapt to the weather changes.

In views of the linkages between climate change and financial security at the household level, results of the quantitative analysis of this study reveal that in times of shocks brought about by natural disasters, loans are often sought from both formal and informal credit. For formal finance, the provision of many credit lines at favourable terms particularly provided by policy bank such as VBSP makes the Bank lending products attractive to low-income borrowers. Besides, obtaining credit from family members and close relatives is the most and the first source of informal finance among local borrowers. It has been observed that in some cases borrowers have to rely on moneylenders or traders for their emergency loans, varying in credit power dynamics between the lenders and the borrowers in agriculture production.

The relevance of social inequality in the context of climate change has been a persistent issue in climate change related policies of Viet Nam. In general, it has been part of the discussion on especially "vulnerability" and gender equality issues. Despite the progress, the discussion of the interlinkages between climate change and inequality has been rather limited. The existing climate related provisions have generally addressed the direct effects of climate change on the affected people, especially the vulnerable groups, with relatively less effort devoted to responding to the prospective long-term effects of climate change on human welfare. For development sector, CSOs within multi-stakeholder partnerships have an active role to play in advocating for considerations of social inequality in climate change impacts and response over the past decade.

4.2 Recommendations

The following presents a number of suggested recommendations for formulating policies and programmes that can address these different inequality-enhancing effects of climate change and disasters.

On measuring and monitoring climate change impacts on multidimensional inequality:

- Elaborate a thorough monitoring system and database of climate change and natural disasters at the district level to support the evaluation and forecast of the different impacts of climate change-induced hazards to different areas and population subgroups. Those data should be collected officially and periodically, and should be widely disseminated to relevant line ministries, agencies, and researchers;

- Ensure a systemic collection of sex, age, ethnicity and disability disaggregated data, development of inclusive and gender sensitive indicators in design, planning, implementation, monitoring and evaluation of climate policy and action in all sectors and at all levels;

- Conduct and expand rigorous research in both qualitative and quantitative approaches on the inequality-enhancing effects of climate change by sector and region to build an evidence base for climate change-related policies in the future. Besides, there is a need for policy discussions on the correlation between climate change and multidimensional inequality, and on the linkage between climate change adaptation and mitigation interventions and poverty and inequality reduction programmes

On capacity building for climate change adaptation and mitigation:

- Enhance institutional capacity building, including short-term and long-term training on inclusive and gender-responsive climate action in ministries, institutions, agencies, organizations with a mandate to tackle climate change and promote social inclusion and gender equality including for both male and female leaders;

- Empower and train women, ethnic minorities and other vulnerable groups such as the elderly, people with disability, etc. to act as change agents in climate change action at community level, building on the existing dialogue platforms, participatory, leadership trainings of development organizations and other agencies.

On support provision to vulnerable groups:

- Evaluate the needs and provide necessary support to the poor, EM groups, and those living in the areas susceptible to climate change and disasters (i.e., the mountainous and coastal areas). The support can focus on some key domains of life such as improving housing conditions, improving access to clean water, sanitation, quality healthcare services, and weather forecast information, as well as building sustainable livelihoods to adapt to and mitigate climate change.

APPENDICES

APPENDIX 1. QUANTITATIVE ESTIMATION METHODS

In this study, the research team ran three regression models to measure the effects of weather extremes and disasters on individual-level outcomes (health, education, and employment) and household-level outcomes (household income, expenditure, and housing conditions) (Table A.1). Specifically, the district-level climate data were connected with the VHLSS household and individual data of the corresponding districts to estimate the correlation between the climate change and the changes of those socio-economic outcomes over time.

TABLE A.1. LIST OF VHLSS OUTCOMES USED FOR THE QUANTITATIVE STUDY

Domain	Outcome	Level
Health	• Proportion of children and adults having sickness or injury during the past 12 months • Number of sickness or injury times of children and adults during the past 12 months • Proportion of children and adults having health insurance	Individual level
Education	• Proportion of children attending school in the past 12 months • Proportion of students having tuition exemption • Education expenditure	Individual level
Employment	• Proportion of people at working age currently working • Proportion of workers having wage job • Proportion of workers having non-farm job • Proportion of workers having farm work • Proportion of workers having skilled job • Proportion of workers having formal job • Monthly working hours of workers • Wages	Individual level
Income, Expenditure & Access to financial credits	• Per capita income • Per capita expenditure • Expenditure poverty • Proportion of households having loans from formal credit sources • Proportion of households having loans from informal credit sources	Household level
Living conditions	• Proportion of households living in a permanent house • Per capita living area • Proportion of households using tap water source • Proportion of households having flush latrine • Proportion of households having air conditioner • Proportion of households having electric fan • Proportion of households having refrigerator • Proportion of households having water heater	Household level

Source: VHLSS

Firstly, a common method to estimate the effect of temperature is to use daily mean temperature and compute the number of days within different bins.[124, 125, 126] Specifically, temperatures are classified in different bins: 0-15 degree Celsius; 15-18; 18-21; 21-24; 24-27; 27-30; and above 30. The proportion of the average number of days which have daily mean temperature above 33 during a year is less than 0.2% and there are not enough observations above 33°C to have robust estimates. Figure A.1 shows the average number of days per year with daily mean temperatures falling into 7 bins for the 2010-2018 period. The figure presents the temperature distribution for 6 regions. Compared with other regions, Red River Delta and Northern Midlands and Mountains have a lower average temperature, but these two regions have a higher number of days below 15°C as well as above 30°C. Temperature in Southeast and Mekong River Delta mainly fall into the range 24-30°C. There are almost no days with daily mean temperature below 15°C in these two regions.

Model 1 can be described as follows:

$$y_{idt} = \alpha + \sum_{j=1}^{7} \beta_j Temp_{dt} + X_{idt}\theta + D_d + P_t + \varepsilon_{idt}$$

where y_{idt} is an outcome of an individual (or household) *i* living in district *d* in year *t* and $Temp_{dt}$ is the number of days in district *d* in year *t* with daily mean temperature falling into each of the 7 temperature bins. X_{idt} is a vector of control variables which are composed of a small set of exogenous variables. The control variables should not be affected by temperature.[127] The research team also controls for district fixed-effects D_d and province-year fixed-effects P_t. Meanwhile, ε_{idt} stands for unobserved variables.

A limitation of using temperature bins is that people can be familiar with temperature and the estimate can be biased. For example, if high-income people move from high-temperature areas to low-temperature temperature ones, there will be a negative relation between the income and temperature. People can be also familiar with temperature and the effect of temperature can capture the effect of adaption. For example, people in Southeast region of Viet Nam are familiar with high temperature and temperature above 30°C does not matter to their living standards. Thus, in the second model, the research team estimates the effect of weather extremes on outcomes as follows:

$$y_{idt} = \alpha + Low\_Temp_{dt}\pi + High\_Temp_{dt}\mu + Low\_Rain_{dt}\theta + High\_Rain_{dt}\rho + X_{idt}\tau + D_d + P_t + u_{idt}$$

where y_{idt} is an outcome of an individual (or household) *i* living in district *d* in year *t*. $Low\text{-}Temp_{dt}$ is the number of days in district *d* in year *t* with daily mean temperature at or below the 5th percentile of the district-specific temperature distribution over the past 20 years, while $High\text{-}Temp_{dt}$ is the number of days with daily mean temperature at or above the 95th percentile of the temperature distribution. Similarly, $Low\text{-}Rain_{dt}$ denotes the number of days with precipitation at or below the 5th percentile of the district-specific precipitation distribution over the past 20 years. $High\text{-}Rain_{dt}$ is the number of days with precipitation at or above the 95th percentile of the district-specific precipitation distribution over the past 20 years.

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(124) Deschenes, O., and Moretti, E. (2009). "Extreme weather events, mortality, and migration," The Review of Economics and Statistics, 91(4), 659-681.

(125) Deschenes, O., and Greenstone, M. (2011). "Climate change, mortality, and adaptation: Evidence from annual fluctuations in weather in the US", American Economic Journal: Applied Economics 3: 152–185.

(126) Deryugina, T., & Hsiang, S. M. (2014). Does the environment still matter? Daily temperature and income in the United States (No. w20750). National Bureau of Economic Research.

(127) Angrist, J. D., & Pischke, J. S. (2008). Mostly harmless econometrics. Princeton University Press.

Figure A.2 presents the average number of days with low and high temperature over the 2010-2018 period. The research team first computes the number of days with low and high temperature within a year for each district, then estimates the average over districts. In 2018, the average number of days with low temperature across districts was 19, while the average number of days with high temperature was 15. This figure also presents the number of days within a year with low and high precipitation, showing a large number of days with low rainfall.

In this study, the research team estimates the effect of both temperature bins (model 1) and temperature extremes (model 2). However, only results of model 2 are presented and used for interpretation since this model is more likely to capture the causal effect of the temperature shocks.

In addition, the research team also examines the effect of disasters in a third model, given that climate change is associated with higher frequency of disasters.[128, 129] Disasters are measured in the commune-level data from VHLSSs, including the number of floods, storms, and droughts that happened in the survey communes during the past 12 months (Figure A.3). It should be noted that data on disasters are only available for rural areas, thus, the research team can only estimate the effect of disasters for rural areas. Model 3 can be described as follows:

$$y_{ict} = \alpha + Flood_{ct}\pi + Storm_{ct}\theta + Drought_{ct}\tau + X_{idt}\tau + D_d + P_t + u_{idt}$$

where $Flood_{ct}$, $Storm_{ct}$, $Drought_{ct}$ and are the number of floods, storms, and droughts happening in commune c in year t.

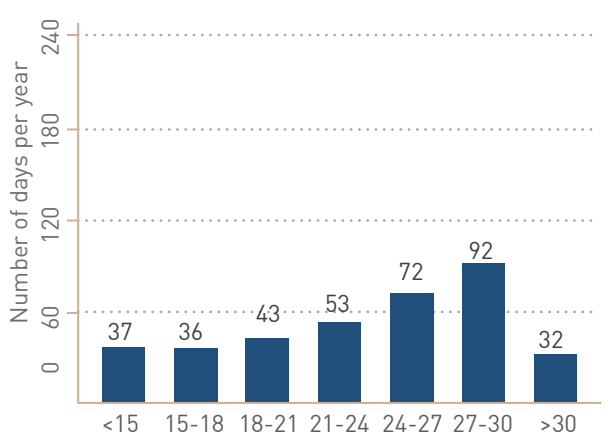
For each model, the estimation of climate and weather events on inequality are conducted in two steps. Firstly, the effects of those events are estimated on the outcome indicators of the four MIF domains using regressions. Secondly, the estimates are disaggregated for different population subgroups, i.e., urban and rural, males and females, Kinh and ethnic minorities, poor and non-poor. By comparing the discrepancies between those subgroups, the research team can figure out and estimate the impacts of climate change on the inequality. For example, temperature extremes would increase inequality if they had higher (negative) effects on more disadvantaged people than those who are less disadvantaged.

(128) Van Aalst, M. K. (2006). The impacts of climate change on the risk of natural disasters. Disasters, 30(1), 5-18.

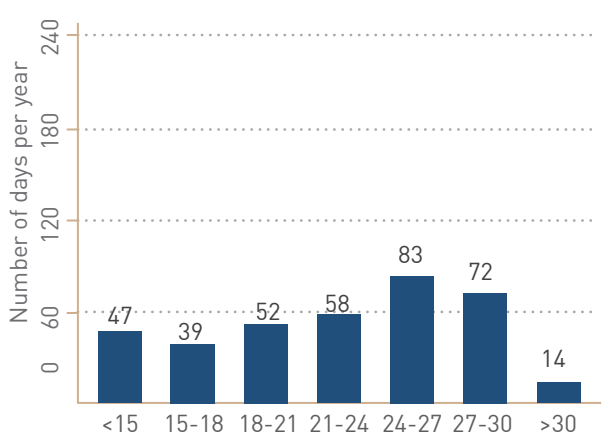
(129) Hore, K. et al. (2018). Climate change and disasters. In Handbook of disaster research (pp. 145-159).

FIGURE A.1. DISTRIBUTION OF DAILY TEMPERATURE BY BINS, 2010-2018

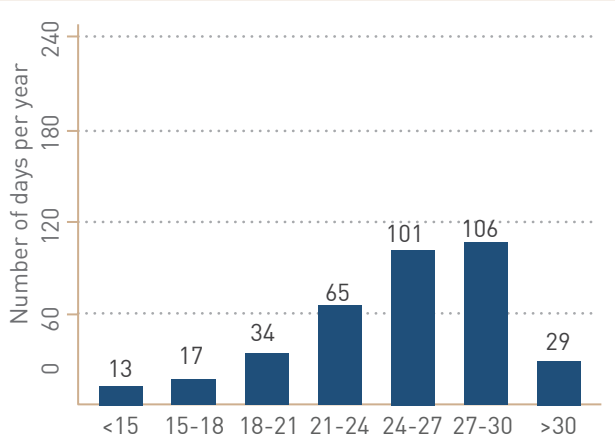
Panel A. Red River Delta



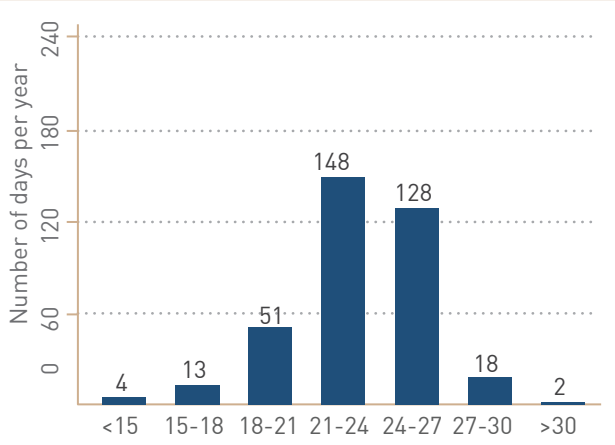
Panel B. Northern Midlands and Mountains



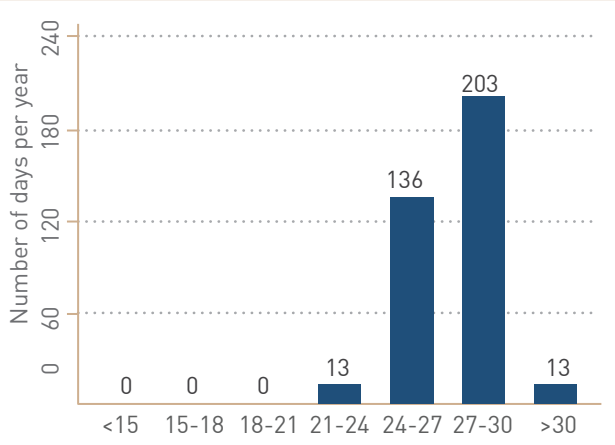
Panel C. Central Coast



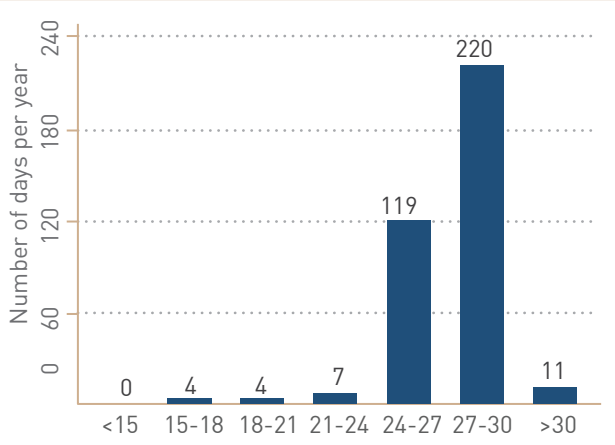
Panel D. Central Highlands



Panel E. Southeast

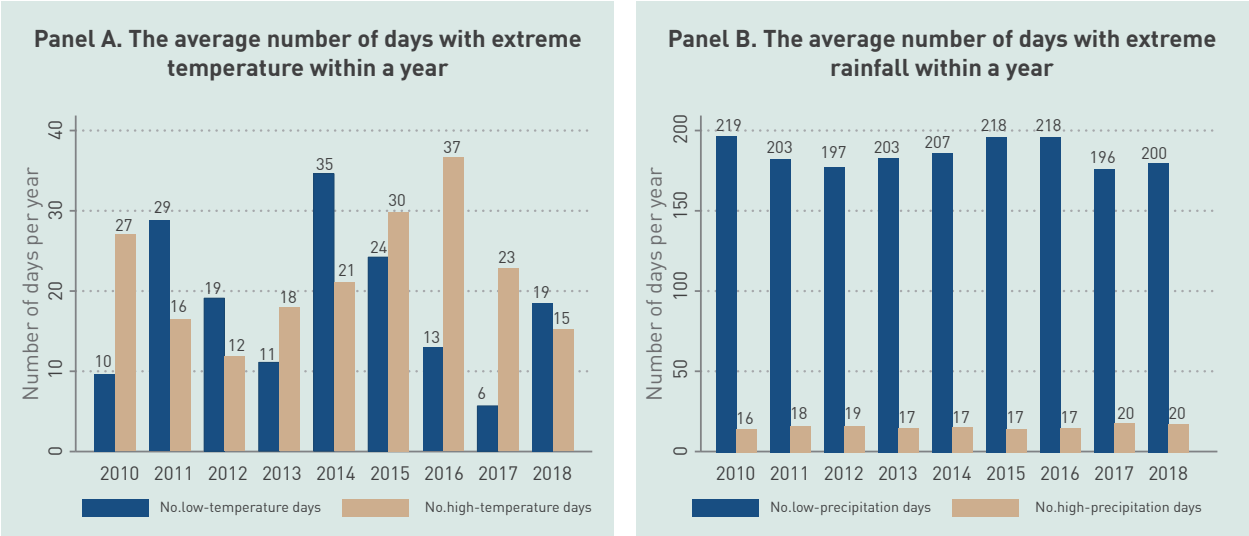


Panel F. Mekong River Delta



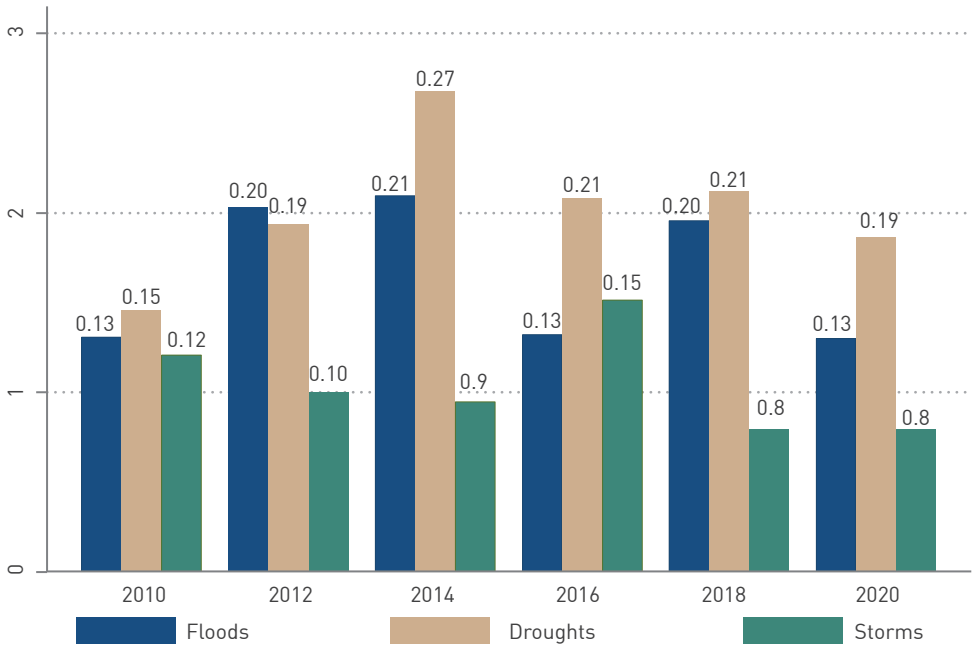
Note: This figure presents the average number of days per year with daily mean temperatures falling into 7 bins for the 2010-2018 period. The figure presents the temperature distribution for 6 regions. The horizontal axis presents the temperature bins, and the vertical axis presents the number of days within each range.

FIGURE A.2. DISTRIBUTION OF DAYS WITH WEATHER EXTREMES, 2010-2018



Note: This figure presents the average number of days per year with low and high extremes in temperature and precipitation.

FIGURE A.3. THE AVERAGE NUMBER DISASTERS IN RURAL AREAS



Note: This figure presents the average number of disasters, which happened in communes, across rural communes per year.

APPENDIX 2. FULL REGRESSION RESULTS

TABLE A.2. IMPACTS OF WEATHER EXTREMES ON HEALTH

Explanatory variables	Dependent variables			
	Sickness or injury during the past 12 months of children (yes=1, no=0)	Number of sickness or injury times during the past 12 months of children	Sickness or injury during the past 12 months of adults (yes=1, no=0)	Number of sickness or injury times during the past 12 months of adults
Number of days with low temperature	0.00048***	0.00124***	0.00057***	0.00142***
	(0.00017)	(0.00040)	(0.00017)	(0.00040)
Number of days with high temperature	0.00014	0.00054	0.00023*	0.00057
	(0.00012)	(0.00034)	(0.00012)	(0.00039)
Number of days with low precipitation	0.00015	0.00016	0.00006	-0.00040
	(0.00018)	(0.00046)	(0.00018)	(0.00057)
Number of days with high precipitation	0.00018	0.00065	0.00026	0.00088*
	(0.00023)	(0.00057)	(0.00021)	(0.00048)
Male (male=1; female=0)	0.00562***	0.00858***	-0.00345***	-0.00692***
	(0.00075)	(0.00171)	(0.00073)	(0.00230)
Age	-0.00480***	-0.00991***	-0.00174***	-0.00395***
	(0.00036)	(0.00117)	(0.00014)	(0.00040)
Age squared	0.00016***	0.00029***	0.00003***	0.00008***
	(0.00002)	(0.00006)	(0.00000)	(0.00001)
Kinh majority	-0.00790***	-0.01083**	-0.00253	-0.00328
	(0.00250)	(0.00506)	(0.00217)	(0.00509)
Province-year fixed-effects	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes
Constant	0.01122	0.03170	0.01895	0.12392
	(0.04156)	(0.10124)	(0.04143)	(0.11483)
Observations	246,067	246,067	586,545	586,545
R-squared	0.114	0.120	0.096	0.072

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.3. IMPACTS OF DISASTERS ON HEALTH

Explanatory variables	Dependent variables			
	Sickness or injury during the past 12 months of children (yes=1, no=0)	Number of sickness or injury times during the past 12 months of children	Sickness or injury during the past 12 months of adults (yes=1, no=0)	Number of sickness or injury times during the past 12 months of adults
Number of floods during the past year	0.00139	0.00295	0.00022	0.00141
	(0.00126)	(0.00245)	(0.00125)	(0.00233)
Number of storms during the past year	-0.00027	-0.00075	-0.00061	-0.00123
	(0.00144)	(0.00278)	(0.00122)	(0.00239)
Number of droughts during the past year	0.00291	0.00298	0.00227	0.00207
	(0.00198)	(0.00359)	(0.00167)	(0.00336)
Male (male=1; female=0)	0.00556***	0.00760***	-0.00235***	-0.00192
	(0.00086)	(0.00198)	(0.00069)	(0.00155)
Age	-0.00496***	-0.00923***	-0.00138***	-0.00261***
	(0.00036)	(0.00087)	(0.00013)	(0.00031)
Age squared	0.00018***	0.00032***	0.00003***	0.00006***
	(0.00002)	(0.00004)	(0.00000)	(0.00000)
Kinh majority	-0.00645***	-0.00917**	-0.00408**	-0.01011**
	(0.00201)	(0.00406)	(0.00198)	(0.00401)
Average temperature during the past 12 months	0.00030	0.00075	0.00018	0.00044
	(0.00063)	(0.00140)	(0.00063)	(0.00127)
Province-year fixed-effects	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes
Constant	0.01578	0.02513	-0.00630	-0.02075
	(0.01566)	(0.03377)	(0.01602)	(0.03178)
Observations	184,371	184,371	416,687	416,687
R-squared	0.028	0.019	0.051	0.030

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.4. IMPACTS OF WEATHER EXTREMES ON EDUCATION

Explanatory variables	Dependent variables				
	Attending school (yes=1, no=0)	Tuition exemption (yes=1, no=0)	Log of education expenditure	Have purchased toys (yes=1, no=0)	Have homemade toys (yes=1, no=0)
Number of days with low temperature	-0.00079***	-0.00082	0.00073	0.00063	0.00109*
	(0.00025)	(0.00061)	(0.00159)	(0.00068)	(0.00061)
Number of days with high temperature	0.00000	-0.00086**	0.00171	0.00018	-0.00065
	(0.00017)	(0.00036)	(0.00113)	(0.00041)	(0.00041)
Number of days with low precipitation	-0.00011	-0.00045*	0.00004	0.00022	0.00052**
	(0.00010)	(0.00023)	(0.00060)	(0.00023)	(0.00025)
Number of days with high precipitation	0.00003	-0.00003	0.00119	-0.00108*	-0.00001
	(0.00026)	(0.00055)	(0.00149)	(0.00060)	(0.00064)
Male (male=1; female=0)	-0.01803***	-0.00021	-0.02726*	0.00845***	0.01047***
	(0.00167)	(0.00400)	(0.01472)	(0.00304)	(0.00288)
Age	0.21439***	0.20570***	0.28613***	0.13349***	0.05056***
	(0.00091)	(0.00151)	(0.00468)	(0.00447)	(0.00361)
Age squared	-0.01025***	-0.01164***	-0.01301***	-0.02512***	-0.00844***
	(0.00006)	(0.00008)	(0.00029)	(0.00097)	(0.00083)
Kinh majority	0.08996***	-0.10183***	0.26961***	0.18492***	-0.04194***
	(0.00614)	(0.01071)	(0.03385)	(0.01202)	(0.00800)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes
Constant	-0.12087***	-0.01292	-0.37102**	0.29914***	0.00499
	(0.02489)	(0.05813)	(0.14657)	(0.05700)	(0.06198)
Observations	246,067	49,246	246,067	64,010	64,010
R-squared	0.510	0.402	0.041	0.411	0.157

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.5. IMPACTS OF DISASTERS ON EDUCATION

Explanatory variables	Dependent variables				
	Attending school (yes=1, no=0)	Tuition exemption (yes=1, no=0)	Log of education expenditure	Have purchased toys (yes=1, no=0)	Have homemade toys (yes=1, no=0)
Number of floods during the past year	0.00207	0.00650	0.00830	0.00108	-0.00272
	(0.00233)	(0.00540)	(0.01295)	(0.00696)	(0.00598)
Number of storms during the past year	-0.00000	0.00999**	-0.01589	-0.00980*	0.00880*
	(0.00230)	(0.00459)	(0.01179)	(0.00560)	(0.00504)
Number of droughts during the past year	0.00102	-0.00208	0.01284	0.00021	-0.00465
	(0.00298)	(0.00665)	(0.01754)	(0.00858)	(0.00717)
Male (male=1; female=0)	-0.01791***	-0.00081	-0.02219	0.01217***	0.01325***
	(0.00183)	(0.00474)	(0.01604)	(0.00414)	(0.00385)
Age	0.21938***	0.20960***	0.28208***	0.13422***	0.05720***
	(0.00070)	(0.00157)	(0.00493)	(0.00520)	(0.00448)
Age squared	-0.01059***	-0.01176***	-0.01289***	-0.02577***	-0.00950***
	(0.00005)	(0.00009)	(0.00031)	(0.00117)	(0.00111)
Kinh majority	0.09153***	-0.16884***	0.33605***	0.27214***	-0.05560***
	(0.00509)	(0.01001)	(0.02473)	(0.01258)	(0.01085)
Average temperature during the past 12 months	-0.00213*	-0.00746***	0.00022	0.00917***	-0.00043
	(0.00127)	(0.00238)	(0.00599)	(0.00307)	(0.00262)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes
Constant	-0.11093***	0.02736	-0.35605**	0.14978**	0.18995***
	(0.03058)	(0.05757)	(0.14517)	(0.07424)	(0.06346)
Observations	184,371	36,814	184,371	47,485	47,485
R-squared	0.496	0.371	0.034	0.313	0.044

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.6. IMPACTS OF WEATHER EXTREMES ON EMPLOYMENT

Explanatory variables	Dependent variables							
	Currently working	Have wage job	Have non-farm work	Have farm work	Have skilled job	Have a formal job	Log of monthly working hours	Log of wages
Number of days with low temperature	-0.00038**	-0.00051*	0.00031	-0.00018	-0.00046	-0.00019	-0.00042	-0.00226***
	(0.00016)	(0.00030)	(0.00027)	(0.00039)	(0.00040)	(0.00023)	(0.00052)	(0.00072)
Number of days with high temperature	0.00003	-0.00002	-0.00016	0.00021	-0.00019	0.00004	-0.00023	0.00049
	(0.00011)	(0.00020)	(0.00019)	(0.00026)	(0.00033)	(0.00017)	(0.00029)	(0.00046)
Number of days with low precipitation	0.00005	-0.00005	-0.00008	0.00018	0.00019	0.00005	0.00022	-0.00007
	(0.00008)	(0.00012)	(0.00011)	(0.00013)	(0.00015)	(0.00010)	(0.00017)	(0.00026)
Number of days with high precipitation	0.00007	-0.00002	0.00020	-0.00011	0.00034	-0.00019	-0.00086*	0.00036
	(0.00017)	(0.00029)	(0.00028)	(0.00035)	(0.00040)	(0.00026)	(0.00046)	(0.00068)
Male (male=1; female=0)	0.04781***	0.11908***	-0.02310***	-0.04817***	0.09391***	-0.00619***	0.09658***	0.18807***
	(0.00277)	(0.00285)	(0.00172)	(0.00426)	(0.00368)	(0.00235)	(0.00370)	(0.00561)
Age	0.03755***	0.00847***	0.01614***	0.01294***	0.02840***	0.00498***	0.04502***	0.03984***
	(0.00062)	(0.00060)	(0.00046)	(0.00059)	(0.00083)	(0.00065)	(0.00096)	(0.00135)
Age squared	-0.00046***	-0.00020***	-0.00018***	-0.00008***	-0.00041***	-0.00011***	-0.00065***	-0.00057***
	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00001)	(0.00002)
Kinh majority	-0.03029***	0.05439***	0.09114***	-0.17582***	0.20302***	0.07262***	0.04734***	0.31086***
	(0.00301)	(0.00784)	(0.00457)	(0.01110)	(0.01063)	(0.00554)	(0.00763)	(0.02377)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.16927***	0.28512***	-0.24741***	0.13156***	-0.18004***	0.08997***	4.32331***	7.21203***
	(0.02069)	(0.03109)	(0.02674)	(0.03837)	(0.04159)	(0.02691)	(0.04650)	(0.07426)
Observations	517,444	517,444	517,444	517,444	517,444	517,444	463,318	196,752
R-squared	0.133	0.162	0.061	0.257	0.223	0.132	0.163	0.297

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.7. IMPACTS OF DISASTERS ON EMPLOYMENT OF RURAL INDIVIDUALS

Explanatory variables	Dependent variables							
	Currently working	Have wage job	Have non-farm work	Have farm work	Have skilled job	Have a formal job	Log of monthly working hours	Log of wages
Number of floods during the past year	0.00204	0.00019	0.00128	0.00057	-0.00553	-0.00435**	-0.00664	0.00051
	(0.00151)	(0.00324)	(0.00182)	(0.00423)	(0.00480)	(0.00200)	(0.00476)	(0.00804)
Number of storms during the past year	0.00261**	-0.01097***	-0.00685***	0.02043***	-0.01521***	-0.00405*	0.00291	-0.00262
	(0.00127)	(0.00289)	(0.00198)	(0.00377)	(0.00460)	(0.00207)	(0.00400)	(0.00677)
Number of droughts during the past year	0.00253	-0.01254***	-0.00268	0.01776***	-0.03042***	-0.00514**	-0.00158	-0.02211**
	(0.00182)	(0.00439)	(0.00243)	(0.00574)	(0.00701)	(0.00259)	(0.00640)	(0.01091)
Male (male=1; female=0)	0.03860***	0.11946***	-0.01659***	-0.06427***	0.09043***	-0.01941***	0.11791***	0.19983***
	(0.00178)	(0.00252)	(0.00132)	(0.00306)	(0.00274)	(0.00146)	(0.00295)	(0.00592)
Age	0.03208***	0.00486***	0.01292***	0.01430***	0.02143***	-0.00067*	0.04750***	0.03045***
	(0.00042)	(0.00050)	(0.00036)	(0.00058)	(0.00060)	(0.00039)	(0.00078)	(0.00143)
Age squared	-0.00038***	-0.00015***	-0.00015***	-0.00008***	-0.00031***	-0.00004***	-0.00069***	-0.00050***
	(0.00001)	(0.00001)	(0.00000)	(0.00001)	(0.00001)	(0.00000)	(0.00001)	(0.00002)
Kinh majority	-0.03483***	0.12895***	0.08039***	-0.24418***	0.26045***	0.08133***	0.04350***	0.39261***
	(0.00246)	(0.00843)	(0.00296)	(0.01048)	(0.01100)	(0.00369)	(0.00984)	(0.01968)
Average temperature during the past 12 months	-0.00189***	0.01171***	0.00215**	-0.01576***	0.00361	0.00228*	-0.00291	-0.00278
	(0.00073)	(0.00198)	(0.00097)	(0.00254)	(0.00269)	(0.00121)	(0.00261)	(0.00465)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.23980***	-0.08659*	-0.22730***	0.55369***	-0.21639***	0.07810***	4.29585***	7.13450***
	(0.01884)	(0.04860)	(0.02429)	(0.06211)	(0.06339)	(0.02962)	(0.06453)	(0.11397)
Observations	368,612	368,612	368,612	368,612	368,612	368,612	340,060	129,654
R-squared	0.099	0.122	0.032	0.149	0.126	0.066	0.110	0.211

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.8. IMPACTS OF WEATHER EXTREMES ON PER CAPITA INCOME, PER CAPITA EXPENDITURE AND POVERTY

Explanatory variables	Dependent variables		
	Log of per capita income	Log of per capita expenditure	Expenditure poverty
Number of days with low temperature	-0.00010	-0.00045	-0.00007
	(0.00069)	(0.00098)	(0.00049)
Number of days with high temperature	0.00042	-0.00063	-0.00024
	(0.00048)	(0.00063)	(0.00029)
Number of days with low precipitation	0.00053**	0.00099**	-0.00048***
	(0.00025)	(0.00041)	(0.00016)
Number of days with high precipitation	0.00048	-0.00069	-0.00065
	(0.00066)	(0.00128)	(0.00042)
Kinh majority	0.46326***	0.47359***	-0.25270***
	(0.02222)	(0.02881)	(0.01723)
Province-year fixed-effects	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes
Constant	9.61782***	9.59517***	0.45572***
	(0.06536)	(0.10280)	(0.04316)
Observations	216,841	43,386	43,371
R-squared	0.368	0.415	0.298

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.9. IMPACTS OF DISASTERS ON PER CAPITA INCOME, PER CAPITA EXPENDITURE AND POVERTY

Explanatory variables	Dependent variables		
	Log of per capita income	Log of per capita expenditure	Expenditure poverty
Number of floods during the past year	-0.0068**	-0.0142**	0.0043
	(0.0034)	(0.0058)	(0.0040)
Number of storms during the past year	-0.0240***	-0.0076	0.0067**
	(0.0030)	(0.0052)	(0.0031)
Number of droughts during the past year	-0.0124***	-0.0129	0.0019
	(0.0045)	(0.0079)	(0.0053)
Kinh majority	0.6107***	0.5877***	-0.3707***
	(0.0053)	(0.0104)	(0.0077)
Average temperature during the past 12 months	0.0134***	0.0091***	-0.0052***
	(0.0014)	(0.0025)	(0.0016)
Province-year fixed-effects	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes
Constant	8.9613***	9.2084***	0.6496***
	(0.0328)	(0.0605)	(0.0394)
Observations	155,506	31,113	31,104
R-squared	0.235	0.237	0.215

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.10. IMPACTS OF WEATHER EXTREMES ON HOUSING CONDITIONS

Explanatory variables	Dependent variables							
	Have air-conditioner (yes=1, no=0)	Have electric fan (yes=1, no=0)	Have fridge (yes=1, no=0)	Have water heater (yes=1, no=0)	Log of per capita living area	Permanent house (yes=1, no=0)	Have flush latrine (yes=1, no=0)	Have tap water source (yes=1, no=0)
Number of days with low temperature	-0.00004	0.00073**	-0.00029	-0.00056	0.00052	0.00064	-0.00027	-0.00036
	(0.00029)	(0.00035)	(0.00044)	(0.00038)	(0.00062)	(0.00051)	(0.00054)	(0.00057)
Number of days with high temperature	-0.00006	0.00059**	0.00056*	0.00024	0.00044	0.00048	0.00067*	-0.00013
	(0.00020)	(0.00023)	(0.00031)	(0.00025)	(0.00041)	(0.00032)	(0.00039)	(0.00042)
Number of days with low precipitation	0.00016	0.00043***	0.00015	0.00015	0.00025	0.00001	0.00009	0.00003
	(0.00012)	(0.00014)	(0.00018)	(0.00014)	(0.00023)	(0.00027)	(0.00019)	(0.00025)
Number of days with high precipitation	-0.00024	0.00028	-0.00010	-0.00032	-0.00055	-0.00024	0.00015	-0.00035
	(0.00030)	(0.00038)	(0.00043)	(0.00038)	(0.00059)	(0.00060)	(0.00048)	(0.00066)
Kinh majority	0.04787***	0.13927***	0.27331***	0.13763***	0.28343***	0.10183***	0.24883***	0.07938***
	(0.00421)	(0.01156)	(0.01433)	(0.00968)	(0.01959)	(0.00858)	(0.01415)	(0.01152)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.06278**	0.63575***	0.30742***	0.07680**	2.65174***	0.22415***	0.38559***	0.27707***
	(0.02811)	(0.03570)	(0.04540)	(0.03482)	(0.05862)	(0.06362)	(0.04835)	(0.06300)
Observations	216,023	216,023	216,023	216,023	216,667	216,841	216,841	216,841
R-squared	0.238	0.244	0.254	0.283	0.134	0.296	0.362	0.523

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.11. IMPACTS OF DISASTERS ON HOUSING CONDITIONS

Explanatory variables	Dependent variables							
	Have air-conditioner (yes=1, no=0)	Have electric fan (yes=1, no=0)	Have fridge (yes=1, no=0)	Have water heater (yes=1, no=0)	Log of per capita living area	Permanent house (yes=1, no=0)	Have flush latrine (yes=1, no=0)	Have tap water source (yes=1, no=0)
Number of floods during the past year	0.0005	0.0064***	-0.0032	-0.0046**	-0.0015	-0.0122***	-0.0006	-0.0089***
	(0.0012)	(0.0017)	(0.0024)	(0.0018)	(0.0031)	(0.0021)	(0.0024)	(0.0017)
Number of storms during the past year	-0.0027**	0.0018	-0.0070***	-0.0006	-0.0083***	-0.0025	-0.0050**	0.0065***
	(0.0012)	(0.0014)	(0.0021)	(0.0016)	(0.0028)	(0.0019)	(0.0020)	(0.0017)
Number of droughts during the past year	-0.0025*	0.0152***	-0.0077**	-0.0091***	-0.0004	-0.0201***	-0.0333***	-0.0151***
	(0.0013)	(0.0023)	(0.0031)	(0.0021)	(0.0041)	(0.0027)	(0.0031)	(0.0019)
Kinh majority	0.0499***	0.2531***	0.3424***	0.1542***	0.3707***	0.1473***	0.3176***	0.0665***
	(0.0013)	(0.0034)	(0.0034)	(0.0023)	(0.0047)	(0.0031)	(0.0034)	(0.0023)
Average temperature during the past 12 months	0.0018***	0.0204***	0.0089***	-0.0062***	0.0015	-0.0088***	0.0142***	-0.0016**
	(0.0005)	(0.0008)	(0.0009)	(0.0007)	(0.0012)	(0.0008)	(0.0009)	(0.0007)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	-0.0074	0.1669***	-0.1315***	0.2724***	2.4132***	0.5509***	-0.1100***	0.1333***
	(0.0110)	(0.0184)	(0.0225)	(0.0167)	(0.0301)	(0.0204)	(0.0225)	(0.0177)
Observations	154,830	154,830	154,830	154,830	155,380	155,506	155,506	155,506
R-squared	0.078	0.142	0.180	0.175	0.085	0.123	0.210	0.083

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

TABLE A.12. COPING TO WEATHER EXTREMES

Explanatory variables	Individual-level outcomes				Household-level outcomes	
	Children having health insurance	Adults having health insurance	Immigrants	Having nonfarm employment	Log of formal loan	Log of informal loan
Number of days with low temperature	-0.00055	-0.00072*	0.00022	0.00031	-0.00058	0.00007
	(0.00036)	(0.00042)	(0.00014)	(0.00027)	(0.00356)	(0.00153)
Number of days with high temperature	0.00011	0.00024	0.00000	-0.00016	0.00025	0.00122
	(0.00022)	(0.00029)	(0.00010)	(0.00019)	(0.00241)	(0.00104)
Number of days with low precipitation	-0.00001	-0.00004	0.00015*	-0.00008	0.00057	0.00090*
	(0.00013)	(0.00017)	(0.00008)	(0.00011)	(0.00128)	(0.00050)
Number of days with high precipitation	0.00049	-0.00022	0.00011	0.00020	0.00406	-0.00088
	(0.00031)	(0.00041)	(0.00015)	(0.00028)	(0.00321)	(0.00133)
Male (male=1; female=0)	-0.01148***	-0.02006***	-0.00277***	-0.02310***		
	(0.00118)	(0.00176)	(0.00059)	(0.00172)		
Age	0.01030***	-0.01359***	-0.00215***	0.01614***		
	(0.00088)	(0.00040)	(0.00030)	(0.00046)		
Age squared	-0.00101***	0.00017***	0.00001***	-0.00018***		
	(0.00005)	(0.00000)	(0.00000)	(0.00001)		
Kinh majority	-0.02159***	-0.17224***	0.00718***	0.09114***	-0.31152***	-0.03010
	(0.00749)	(0.01239)	(0.00257)	(0.00457)	(0.06833)	(0.02493)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.94815***	1.02170***	0.05466***	-0.24741***	1.75073***	0.09420
	(0.03179)	(0.04411)	(0.01619)	(0.02674)	(0.31914)	(0.12906)
Observations	246,067	586,545	517,444	517,444	216,841	216,841
R-squared	0.115	0.198	0.154	0.061	0.162	0.061

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

Source: Estimation from VHLSSs 2010 to 2018.

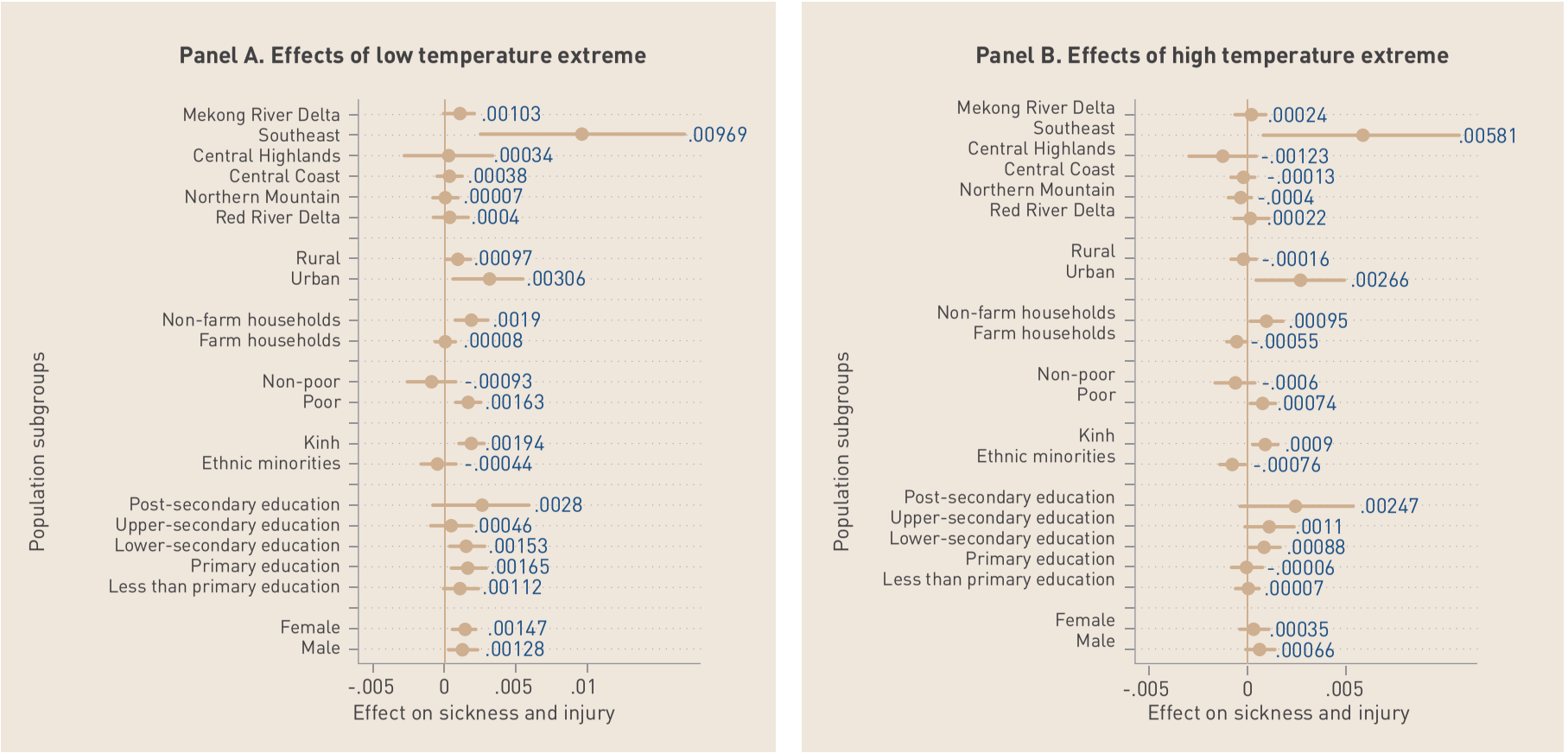
TABLE A.13. COPING TO DISASTERS

Explanatory variables	Individual-level outcomes				Household-level outcomes	
	Children having health insurance	Adults having health insurance	Immigrants	Having nonfarm employment	Log of formal loan	Log of informal loan
Number of floods during the past year	0.00299	0.00249	-0.00108	0.00128	-0.0282	0.0181**
	(0.00252)	(0.00392)	(0.00086)	(0.00182)	(0.0199)	(0.0086)
Number of storms during the past year	0.00515**	0.01369***	-0.00285**	-0.00685***	0.1796***	0.0219***
	(0.00225)	(0.00353)	(0.00122)	(0.00198)	(0.0179)	(0.0084)
Number of droughts during the past year	-0.00266	-0.00081	-0.00103	-0.00268	0.1347***	0.0429***
	(0.00368)	(0.00643)	(0.00143)	(0.00243)	(0.0269)	(0.0117)
Male (male=1; female=0)	-0.01080***	-0.02269***	-0.00338***	-0.01659***		
	(0.00146)	(0.00147)	(0.00050)	(0.00132)		
Age	0.00845***	-0.01473***	-0.00116***	0.01292***		
	(0.00074)	(0.00033)	(0.00018)	(0.00036)		
Age squared	-0.00094***	0.00019***	0.00001***	-0.00015***		
	(0.00004)	(0.00000)	(0.00000)	(0.00000)		
Kinh majority	-0.02679***	-0.27450***	0.00793***	0.08039***	-0.8130***	0.0729***
	(0.00525)	(0.00924)	(0.00122)	(0.00296)	(0.0321)	(0.0130)
Average temperature during the past 12 months	-0.00069	-0.00903***	0.00180***	0.00215**	-0.0390***	0.0039
	(0.00117)	(0.00223)	(0.00060)	(0.00097)	(0.0080)	(0.0032)
Province-year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
District fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.93320***	1.14166***	-0.00057	-0.22730***	1.8784***	-0.0611
	(0.02852)	(0.05253)	(0.01575)	(0.02429)	(0.1922)	(0.0769)
Observations	184,371	416,687	368,612	368,612	155,506	155,506
R-squared	0.076	0.182	0.037	0.032	0.081	0.028

Robust standard errors in parentheses. Standard errors are clustered at the district level.
*** p<0.01, ** p<0.05, * p<0.1.

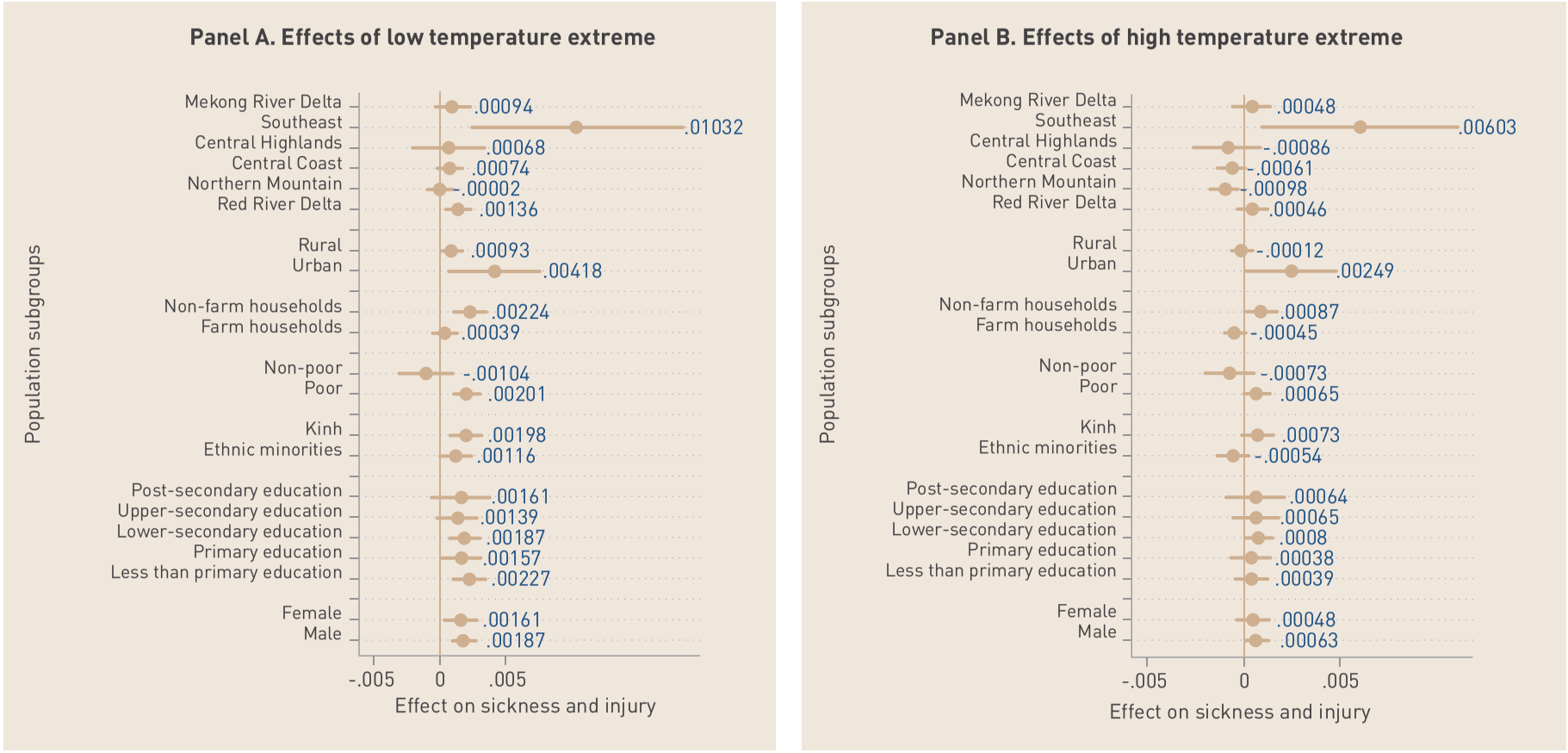
Source: Estimation from VHLSSs 2010 to 2018.

FIGURE A.4. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON HEALTH OF CHILDREN



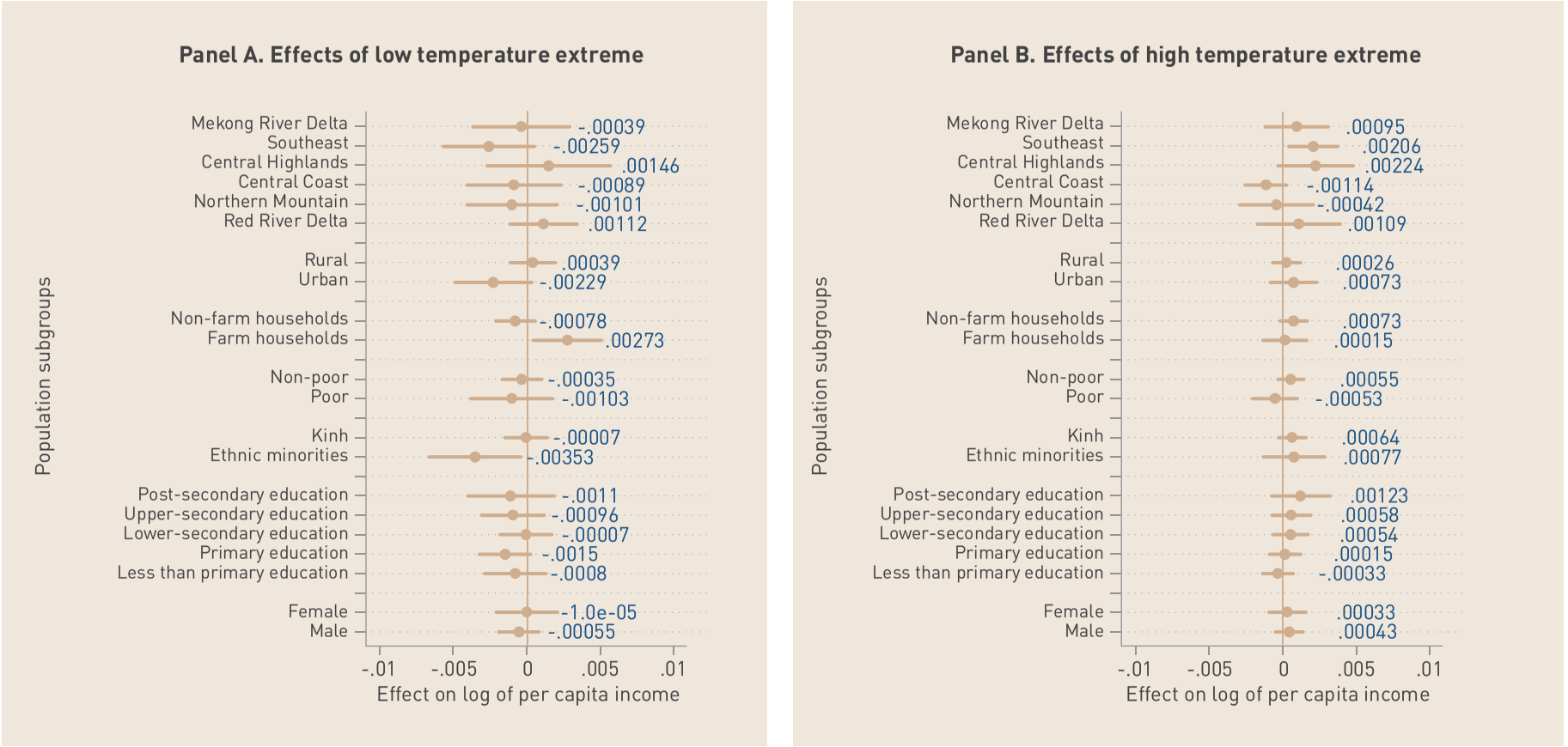
Note: This figure reports the coefficients and the 95% confidence interval of the low and high temperature extremes in regressions of the number of sickness or injuries of children for different population subgroups. The model specification is the same as the model using for the full sample. It should be noted that the education level, which is used to group children, is education of household head.

FIGURE A.5. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON HEALTH OF ADULTS



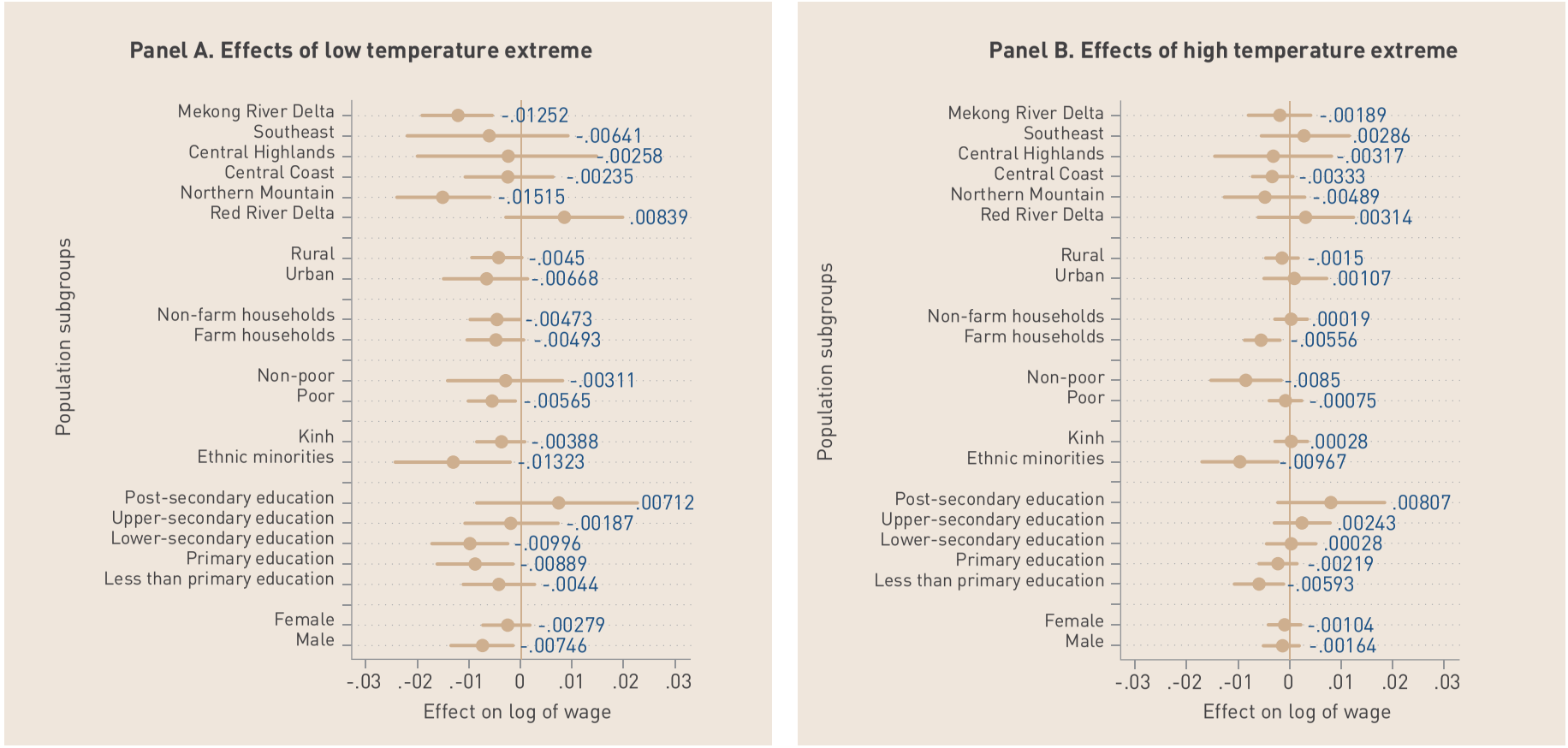
Note: This figure reports the coefficients and the 95% confidence interval of the low and high temperature extremes in regressions of the number of sickness or injuries of adults for different population subgroups. The model specification is the same as the model using for the full sample.

FIGURE A.6. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON SCHOOL ENROLMENT



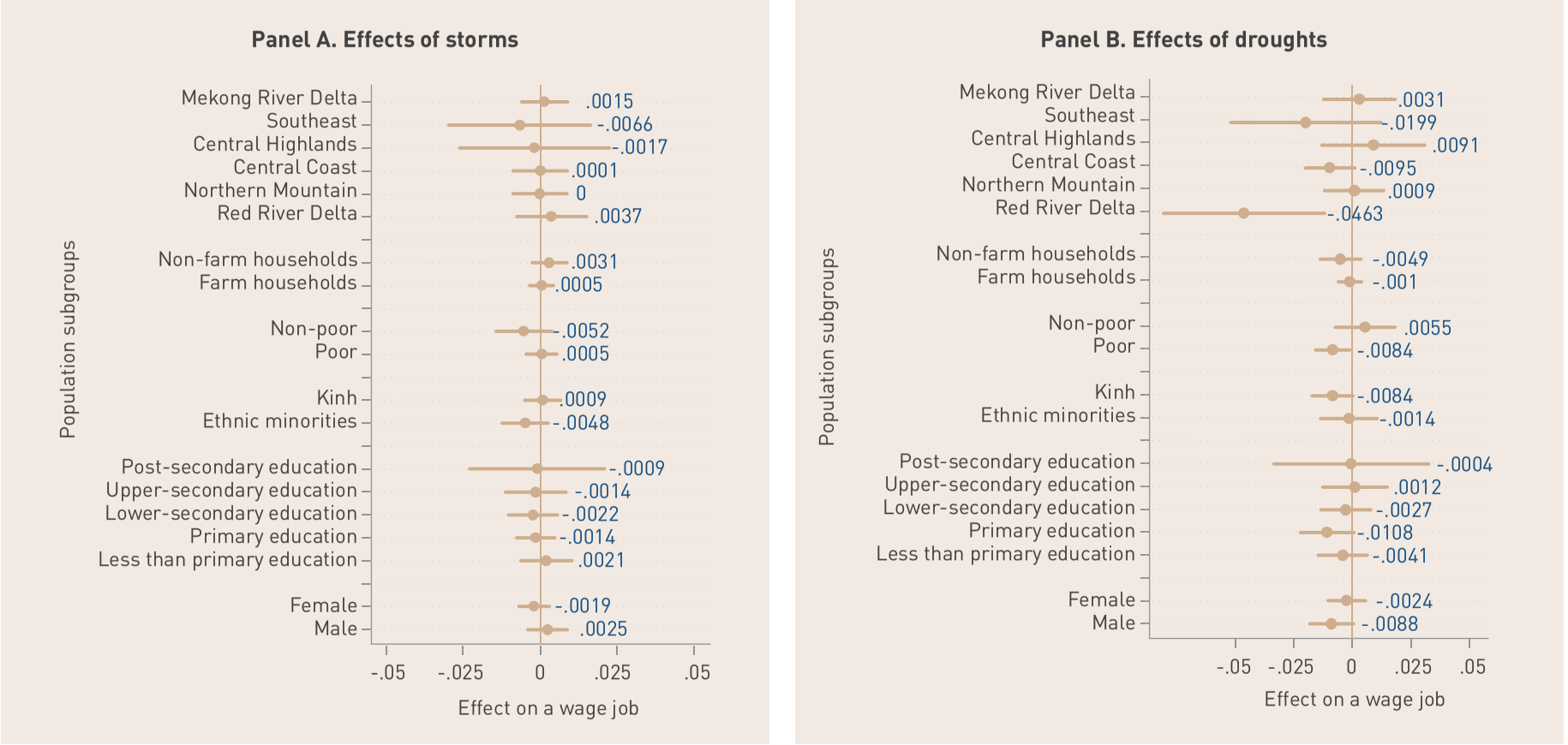
Note: This figure reports the coefficients and the 95% confidence interval of the low and high temperature extremes in regressions of school enrolment of children for different population subgroups. The model specification is the same as the model using for the full sample. Education levels are education of household heads.

FIGURE A.7. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON WAGES



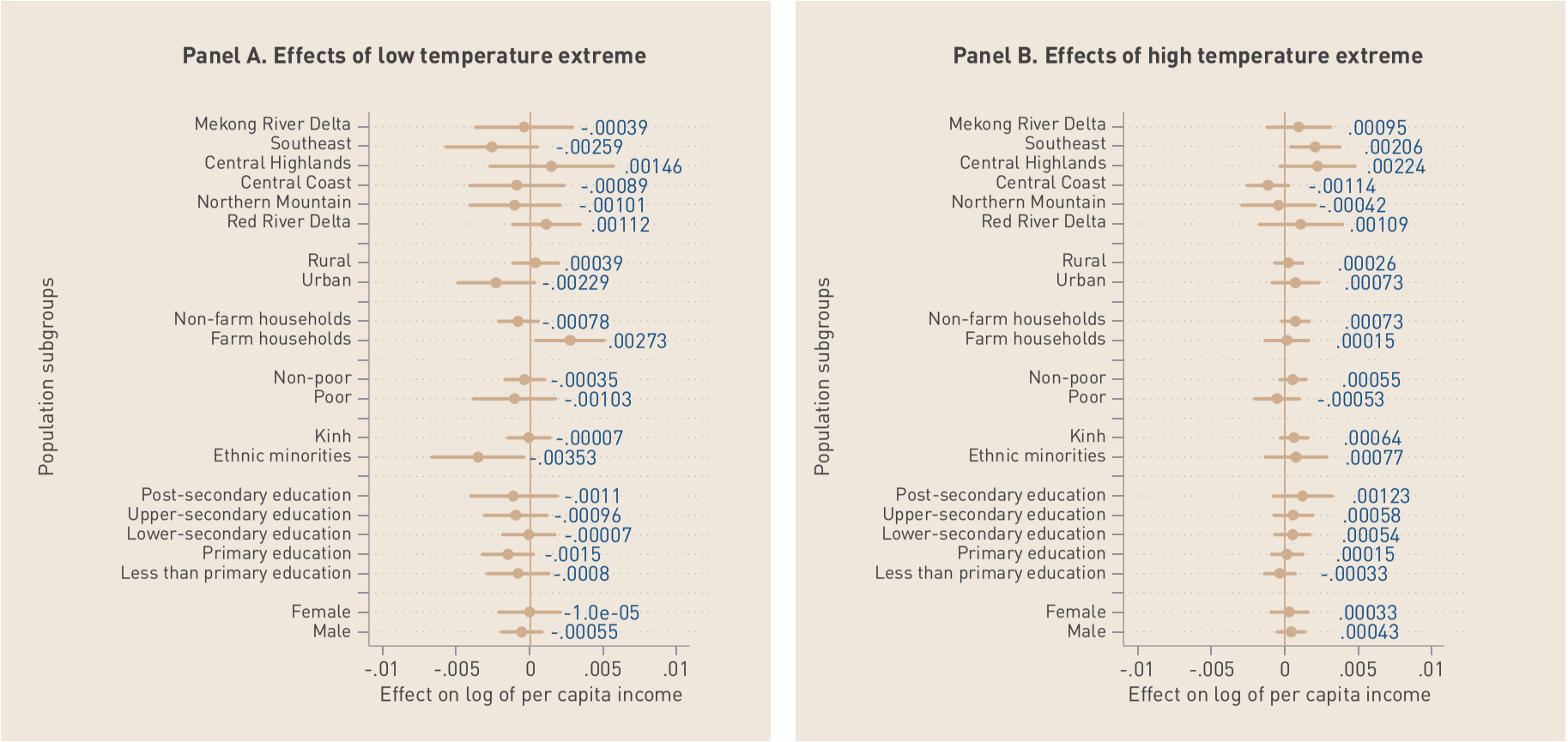
Note: This figure reports the coefficients and the 95% confidence interval of the low and high temperature extremes in regressions of log of wage for different population subgroups. The model specification is the same as the model using for the full sample.

FIGURE A.8. HETEROGENEOUS EFFECTS OF DISASTERS ON THE PROBABILITY OF HAVING A WAGE JOB OF INDIVIDUALS



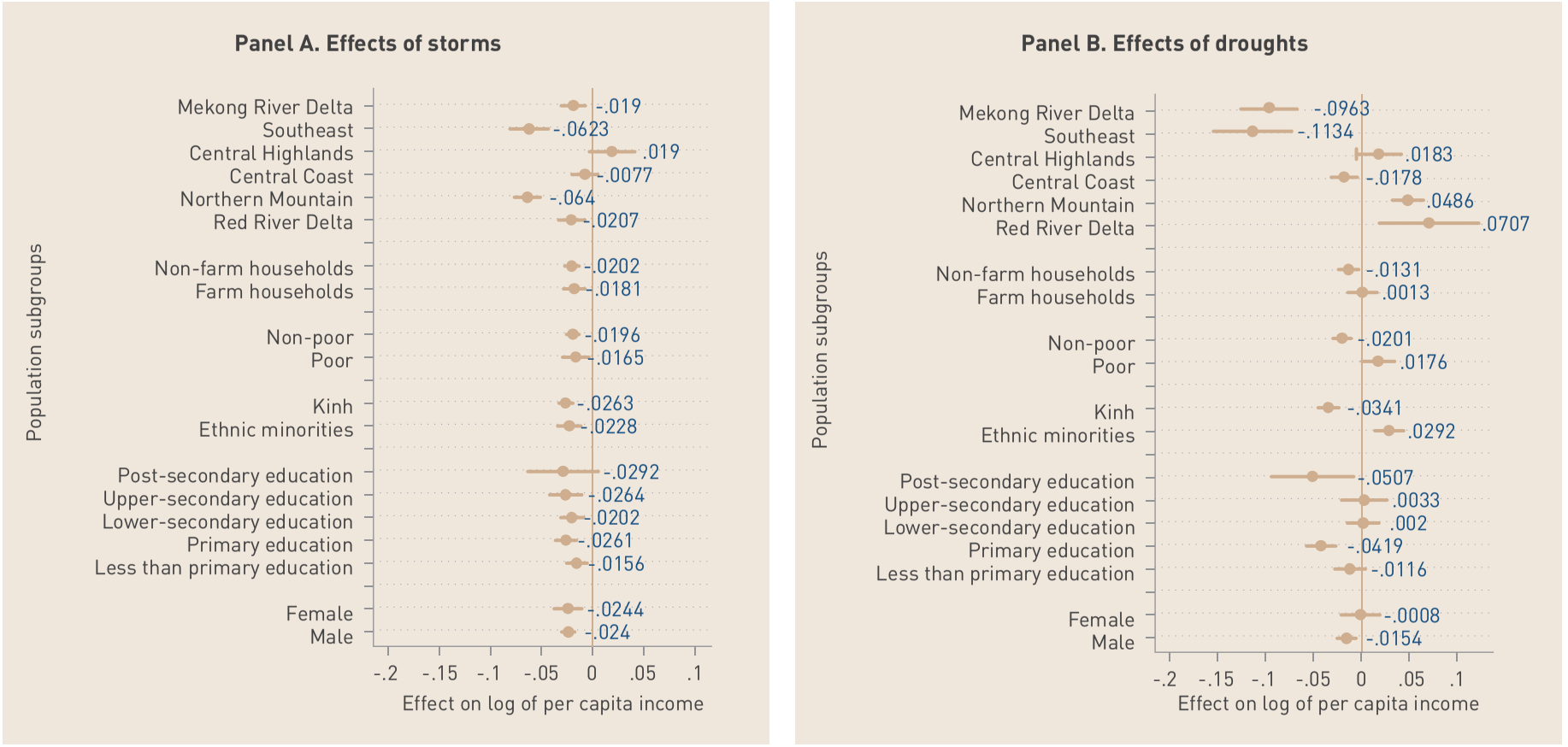
Note: This figure reports the coefficients and the 95% confidence interval of storms and droughts in regressions of probability of having a wage job for different population subgroups.

FIGURE A.9. HETEROGENEOUS EFFECTS OF TEMPERATURE EXTREMES ON LOG OF PER CAPITA INCOME



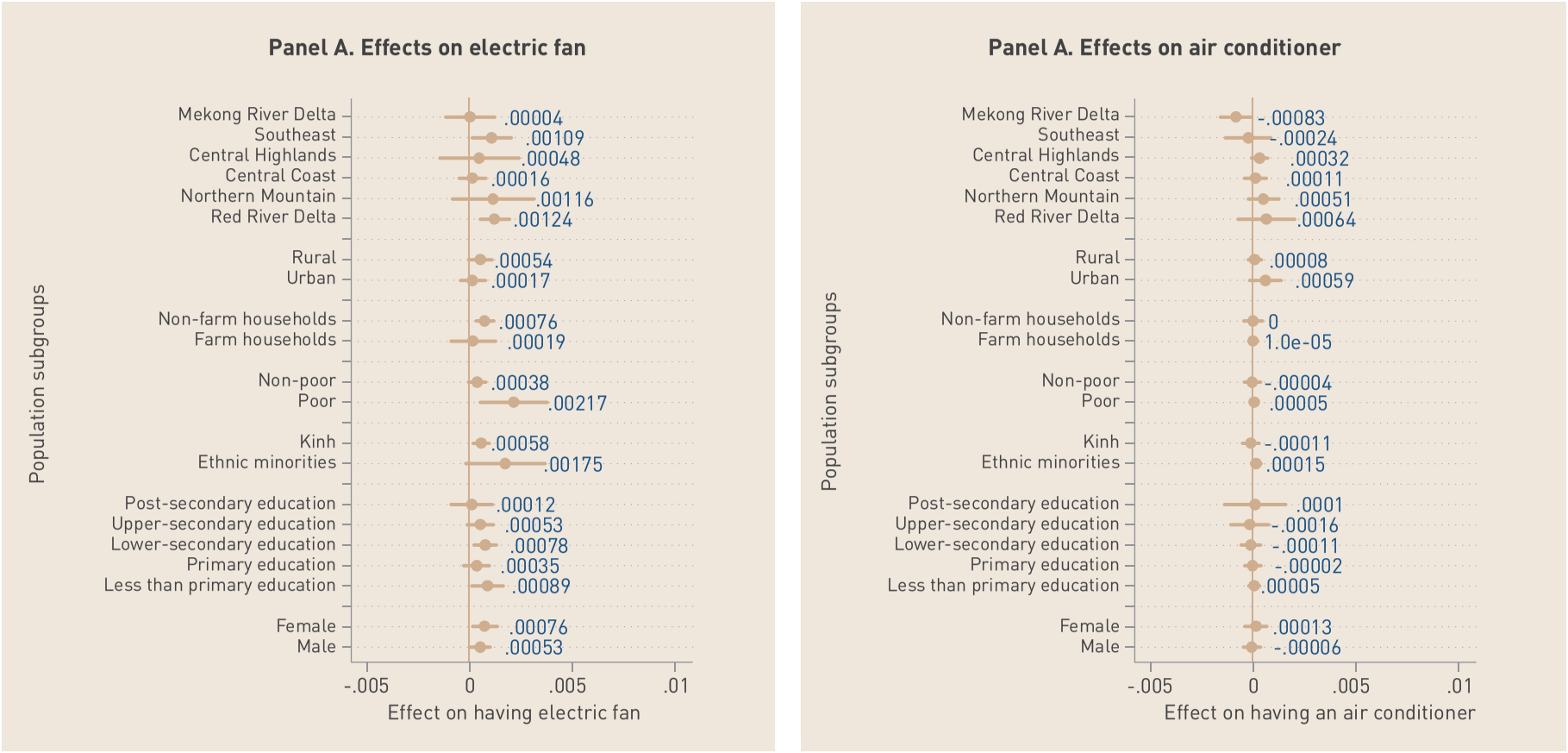
Note: This figure reports the coefficients and the 95% confidence interval of the low and high temperature extremes in regressions of log of per capita income for different population subgroups. The model specification is the same as the model using for the full sample.

FIGURE A.10. HETEROGENEOUS EFFECTS OF DISASTERS ON LOG OF PER CAPITA INCOME



Note: This figure reports the coefficients and the 95% confidence interval of storms and droughts in regressions of log of per capita income for different population subgroups.

FIGURE A.11. HETEROGENEOUS EFFECTS OF HIGH TEMPERATURE EXTREMES ON THE PROBABILITY OF HAVING AN ELECTRIC FAN OR AN AIR CONDITIONER



Note: This figure reports the coefficients and the 95% confidence interval of the high temperature extremes in regressions of households having an electric fan or an air-conditioner for different population subgroups. The model specification is the same as the model using for the full sample.

APPENDIX 3. LIST OF ORGANIZATIONS CONSULTED IN THE QUALITATIVE STUDY

Location	Organization	Department / Person
National level (Hanoi)	**Online interview**	
	Ministry of Natural Resources and Environment	Department of Climate Change
	Ministry of Labour, War Invalids and Social Affairs	Department of Social Assistance
	Ministry of Agriculture and Rural Development	Institute of Policy and Strategy for Agriculture and Rural Development (IPSARD) - Center for Agricultural Policy
	Vietnam Women's Union	Department for Publicity and Education
	Climate change research centre	Can Tho University - DRAGON Institute
Province 1 (Central Coast - Thua Thien Hue)	**Online interview**	
	Department of Natural Resources and Environment	Thua Thien Hue DONRE – Department of Sea, Island, Lagoon and Climate Change Management
	Department of Labour, War Invalids and Social Affairs	Thua Thien Hue DOLISA
	Department of Agriculture and Rural Development	Thua Thien Hue DARD
	Provincial Women's Union	Thua Thien Hue Women's Union
	Field study in Quang Nham commune (A Luoi district)	
	Commune officer	Commune People's Committee Vice chairman and President of Women's Union of Quang Nham commune
	Male residents' focus group	FGD with male residents of Quang Nham commune
	Female residents' focus group	FGD with female residents of Quang Nham commune
	Household representatives	IDI with a village leader, two poor ethnic minority households, and a poor single mother in Quang Nham commune

Location	Organization	Department / Person
Province 2 (Mekong Delta - Ca Mau)	**Online interview**	
	Department of Natural Resources and Environment	Ca Mau DONRE – Department of Water Resource, Metorology and Hydrology
	Department of Labour, War Invalids and Social Affairs	Ca Mau DOLISA
	Department of Agriculture and Rural Development	Ca Mau DARD – Irrigation Sub-department
	Provincial Women's Union	Ca Mau Women's Union
	Online study of Nguyen Viet Khai commune (Phu Tan district)	
	Commune officer	Commune officer of socio-cultural issues and President of Women's Union of Nguyen Viet Khai commune
	Male residents' focus group	FGD with male residents of Nguyen Viet Khai commune
	Female residents' focus group	FGD with female residents of Nguyen Viet Khai
	Household representatives	IDI with a village leader, two poor ethnic minority households, and an in-need single mother in Nguyen Viet Khai commune

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RESEARCH REPORT

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Tác giả: ***Viện Nghiên cứu phát triển Mekong***

Chịu trách nhiệm xuất bản:
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