EDUCATION TO INCREASE CLIMATE CHANGE ADAPATATION FOR A VIETNAMESE COMMUNITY'S COASTAL MEMBERS

Thesis submitted by
Thi Huong Tra NGUYEN
B.Sc. Vietnam National University, MSocSc James Cook University
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Abstract

Climate change is a global environmental phenomenon which many countries throughout the world have been trying to address. Climate change has affected almost all economies and societies as well as creating environmental problems worldwide. Over recent decades, numerous regions have suffered from dangerous disasters, such as heavy storms and floods, severe heatwaves and droughts, as well as adverse weather conditions which have caused loss and damage to both human life and property.

Vietnam, the focus of this research, is highly affected by climate change impacts and natural hazards, especially in coastal zones. In acknowledging climate change, the Vietnamese government has planned for and employed National Climate Change Adaptation Programs in order to adapt to its threats. However, these National programs seem to focus on finding solutions relating to infrastructure, livelihoods, migration and so on, while efforts to change individuals' behaviour towards the environment are not seriously considered. Education to improve the awareness and adaptive capacity of Vietnamese coastal community residents to address climate change has been identified as a priority which was unresolved in the study site.

This research aims to help bridge the gap by designing and implementing a climate change education program for a specific Vietnamese coastal community in order to enhance knowledge about and perceptions of climate change, and actions to adapt to it. To best achieve the main goal of the study, it was developed in three phases: a data gathering phase, an intervention phase, and finally an evaluation phase. Mixed methods were employed to address the research objectives, involving questionnaires, observations and interviews.

Preliminary results from a sample of 108 Vietnamese coastal participants and qualitative analyses of interviews and observations in Phase One revealed a low level of climate change knowledge, especially among school students and farmers. However, residents were very concerned about climate change and predicted with a high level of accuracy a range of negative future effects of climate change. They also agreed that a climate change education program is necessary for the Thinh Loc community.

Phase Two implemented a climate change education program to 98 participants. They were divided into three classes, comprising 58 school students, 10 teachers, 17 farmers, and 13 local government staff members. The educational intervention was designed from the results from the baseline data obtained in Phase One and using guidelines from climate change education programs found in the literature review. Constructivist teaching methods were applied to encourage students to actively engage in a variety of learning activities to build understanding, skills and the ability to critically analyse and discuss climate change knowledge, mitigation and adaptation strategies.

Phase Three involved a post-intervention evaluation phase that measured the effectiveness and impact of the intervention on the participants. Analysis of 88 survey recipients, interview transcripts, and field observations demonstrated changes in awareness, perception and attitudes towards climate change, as well as the application of strategies to mitigate and adapt to climate change 6 months after the intervention. It was concluded that the climate change education program was effective in enhancing awareness and adaptive capacity to cope with climate change in this specific Vietnamese coastal community, with the potential to become a model that could be duplicated in other communities in Vietnamese coastal regions. Thereby, this research helps to contribute to developing climate change adaptation theory and practice.

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CHAPTER ONE: INTRODUCTION

1.1 Introduction

Climate change is a global environmental phenomenon that countries throughout the world spend much time and effort addressing. Climate change has affected almost all economies and societies as well as creating environmental problems worldwide. Over recent decades, numerous regions have suffered from disasters, such as heavy storms and floods, severe heatwaves and droughts, as well as other adverse weather conditions, which cause loss and damage to both human life and property (Adger et al., 2004; Anderson, 2012; Simoes et al., 2010). For example, climate change has led to massive erosion and inundation of African coastal settlements. The disappearance of many Pacific Islands has caused by sea level rise as well as environmental damage in European countries due to a wetter and warmer climate, which results in the dramatic melting of ice cover in Alaska and Russia (Dimento & Doughman, 2009, Intergovernmental Panel on Climate Change [IPCC], 2014). Meanwhile, warmer conditions in North America have damaged locals' livelihoods in agricultural areas (Dimento & Doughman, 2009), and Asia and Pacific regions have experienced a significant rise in the frequency and intensity of severe natural disasters (Srinivasan & Hunt, 2011; IPCC, 2014). By 2020, many countries may face food shortages and an increased incidence of tropical disease due to global warming and severe natural disasters (Beniston, 2010).

Much research points to a significant association between disasters and climate change (Institute of Meteorology, Hydrology and Environment [IMHEN], 2010). In the case of temperature rise and an increase in the intensity, scale, and density of disasters, it is clear that research on climate change adaptation and mitigation is urgent and needs to be enhanced (IMHEN, 2010). According to Anderson (2012), there are two key strategies to address climate change: mitigation and adaptation. While mitigation focuses on efforts to reduce greenhouse gas emissions, adaptation aims to reduce the vulnerability of natural and human systems to the impacts of climate change (Anderson, 2012; Adger et al., 2004).

Enhancing adaptation is urgently needed to safeguard existing and future development from the progress of climate change and minimize its vulnerability to extreme weather events (Anbumozhi, Breiling, Pathmarajah, & Reddy, 2012). Despite the fact that climate change adaptation is widely accepted as necessary to addressing climate change and its associated disasters, it still faces numerous difficulties at both strategic and

implementation levels (Rickards & Howden, 2012; Anbumozhi et al., 2012). The main barriers to adaptation are the unavailability of valuable climate information, the lack of communication about climate change, absence of successful measures after interventions (Anbumozhi et al., 2012; Ford, Berrang, & Paterson, 2011).

Enhancing capacity to adapt to climate change should include several steps, starting with assessing the causes and impacts of climate change, and then identifying the best practical strategies to achieve adaptation. Therefore, the overriding priorities are to generate accurate climate change information, to build awareness and understanding of climate change impacts and response strategies, to evaluate implementations aimed at improve benefits of the adaptation machines, and adjust implementations in the later steps (Anbumozhi et al., 2012). This study aimed to increase climate change adaptation, beginning by identifying the current levels of knowledge and the behaviour of participants in a small coastal community in Vietnam to adapt to climate change. Then, an intervention aimed to enhance human capital - thereby increasing awareness and changing behaviour to adapt to climate change - was implemented. In the final stage, an evaluation was undertaken to monitor and measure the effectiveness of this educational intervention program. Three steps of baseline, intervention, and evaluation were identified and employed in this study as an essential and logical process proven by enhancing Thinh Loc community participants' awareness and adaptive capacity in response to climate change. Thereby, the research helps to contribute to developing methodology and theory of climate change adaptation.

1.2. Background of the Problem

A review of the literature revealed that there have been many studies and projects to evaluate the influence of climate change, as well as to investigate and model adaptation measures in dealing with climate change both globally and in Vietnam (Jung, 2012; Pathmarajah, 2012; Sovacool et al., 2012; Oxfam, 2009; Wang, Huang, & Yang, 2014; Shrestha et al., 2016; Dang et al., 2014; Toan et al., 2014; Nguyen, 2008; Tran, 2015). A systematic review in several countries showed that although acknowledging the impacts of climate change, adaptation initiatives in many nations are still limited in scope (Ford et al., 2011). Where applied, recent adaptations were mainly conducted at a municipal level and a household and non-governmental organization or civil society levels were rarely reported (Ford et al., 2011). In addition, adaptations were predominantly focused on infrastructure, transportation, and utilities, while other forms of adaptation such as education seemed to be neglected (Ford et al., 2011; Muttarak & Lutz, 2014; Sharma, 2011). In other words, the world has concentrated more on

technical, physical and financial solutions while efforts to increase awareness and change the behaviour of individuals and communities have not been developed and measured. Scholars worldwide have suggested that adjustments in human activities will play a crucial role in slowing down the climate change process (Lutz, Muttarak, & Striessnig, 2014; Kawata, 2005; Vo, Nguyen, & Chau, 2013; Vize, 2012), and in this regard, education can be a key factor to help enhance adaptive capacity to cope with climate change.

Vietnam, the focus of this research, is located in Southeast Asia; a region that is one of the most vulnerable to climate change because it is affected by monsoons, and has a hot and wet climate, 3,444km of coastline, and consists of approximately 3,000 islands of various sizes (Institute of Strategy and Policy on Natural Resources and Environment [ISPONRE], 2009; Ministry of Natural Resource and Environment [MONRE], 2010). Climate change is associated with damage to crop production, danger to coastal ecosystems, serious water shortages, increased risks associated with fire, pests and diseases in forests and an increased incidence of injury and ill-health (ISPONRE, 2009; Zhai & Zhuang, 2012; MONRE, 2010; World Bank, 2011; Ojomo & Bartram, 2016; Tuyet-Hanh et al., 2016; Trinh et al., 2013; World Bank et al., 2011; Rocklöv et al., 2014).

In acknowledging climate change, the Vietnamese government has planned and employed National Climate Change Adaptation Programs to adapt to its threats. Under these programs, several adaptive strategies have been developed and implemented. For example, in the Mekong River Delta, alternative livelihoods and migration were the best solutions for vulnerable residents to address climate change (Warner, Hamza, Smith, Renaud, & Julca, 2010). Meanwhile, central coastal provinces focused more on developing irrigation, changing crop and livestock practices or applying modern technology in agriculture (Lam, Tran, & Le, 2006), as well as providing funds to establish hard and soft infrastructure (MONRE, 2010). Education has also been suggested and employed as a national strategy to raise awareness and change behaviour in response to climate change in sectoral levels (MONRE, 2010; United States Agency for International Development [USAID], 2015; Toan et al., 2014; Few et al., 2004; Nguyen, Miller, Bowen, & Tan Sinh, 2017). However, efforts to change individuals' behaviour towards the environment through education and training have faced several challenges (MONRE, 2010). Unavailability of climate change education programs at the national level, a lack of course material at schools, or a lack of critical evaluations of pilot programs are examples of barriers in climate change education in Vietnam.

Climate change education (CCE) has not emerged globally as a distinct area for study; instead, it appears as part of general environmental education and education for sustainable development) (United Nations Educational Scientific and Cultural Organization [UNESCO], 2012). Despite the fact that climate change education is in its infancy, CCE has been gradually established and independently identified in the last ten years (UNESCO, 2012). The aim of CCE is to equip learners with knowledge, adaptive skills, and attributes to deal with climate change. These will be required at all levels (primary, secondary, tertiary, and adult education) and can be delivered in three modes of education comprised by formal, non-formal, and professional development (UNESCO, 2012). A variety of content areas and specific topics are required to deal with environmental issues, but in terms of climate change education, the CCE often focuses on three components, these being basic science knowledge of climate change, climate change mitigation, and climate change adaptation (Anderson, 2012; UNESCO, 2012). Recently, many climate change education projects around the world have been applied in both developed and in developing countries, such as Japan, South Korea, Sri Lanka, South Africa, Iran, and so on (Lotz-Sisitka, 2010; UNESCO, 2012; Ashtiany, 2005). These programs have focused on enhancing students and citizens' capacity to adapt to climate change by using indigenous, new knowledge innovations as well as multi-educational methods aiming to encourage vulnerable participants. However, CCE in many nations including Vietnam has faced three main challenges:

- CCE is a relatively new field in many countries and has been considered as a key part of Education for Sustainable Development (ESD); therefore, guidelines or a curriculum for CCE have not yet been established.
- Climate change education programs were mainly employed at school institutions, whereas conducting CCE in the community levels has been neglected, especially in developing countries
- There was deficiency in the evaluation system from most previous climate change education programs; therefore, learning outcomes and application results from CCE program have not been measured.

1.3. Statement of the Problem

As outlined, there are several approaches to addressing the issue of climate change in the world. Education however, remains a crucial stage in fostering adaptation as strongly recommended by several scholars (Lutz et al., 2014; Kawata, 2005; Vo et al., 2013; Vize, 2012; UNESCO, 2012). Education is identified to be a key adaptation strategy to address climate change due to several reasons:

First, the United Nations Framework Convention on Climate Change (UNFCCC) identified that education ought to play a crucial role in responding to climate change at all levels: local, national, and global (UNESCO, 2012). Further, scholars argue that global technological, financial and physical solutions are insufficient to respond to climate change, while education is a cost - effective approach. Education also is one of the most appropriate measures to enhance capacity to adapt to climate change through preparing knowledge and skills for individuals and communities. Finally, education helps to improve gender equality and women's empowerment in coping with climate change.

In Vietnam specifically, although many studies on climate change have been conducted in order to help local residents to minimize the impacts of climate change, more educational programs aiming to enhance a knowledge of, and the ability to adapt to, climate change are needed. Education to improve the awareness and adaptive capacity of Vietnamese coastal community residents to address climate change has been identified as apriority, which was unresolved in the study site (Vo et al., 2013; MONRE, 2010; Social Republic of Vietnam, 2011). My research aimed to contribute to bridging the gap by designing and delivering a climate change education program to a Vietnamese coastal community in order to enhance human capital, thereby increasing knowledge and adaptation to cope with climate change.

1.4. Purpose of the Study

The key purpose of this project was to help local residents enhance their adaptation to climate change, thereby finding the most effective strategy to improve the adaptability of a Vietnamese coastal community was required. Among multiple strategies, an educational intervention was identified as a key measure to increase human capital, thereby enhancing the capacity of Thinh Loc community members to adapt to climate change. In order to achieve this purpose, the project followed a specific procedure.

Firstly, the project investigated the knowledge and adaptive capacity of the Vietnamese coastal community residents in the Thinh Loc community. Data to establish baseline knowledge and attitudes of the target community were obtained from participants using a mixed methods approach including a questionnaire, observations, and semi-structured interviews. The data established the need for an intervention in the community.

Secondly, the project delivered an educational intervention about climate change to Thinh Loc community participants. Community members who were invited to participate

in the intervention comprised school students, teachers, farmers, and local government staff members. The intervention program aimed to provide knowledge and strategies for community members to mitigate and adapt to climate change.

Third, the project examined levels of awareness and adaptive capacity of Thinh Loc community attendees through a post-intervention evaluation phase. This phase aimed to assess the efficiency and impact of the intervention on the local residents. The evaluation of the intervention program also helped to identify the potential to broaden the climate change education program to the other communities in the Vietnamese coastal region.

1.5. Research Questions

The purpose of the study is encapsulated in the primary research question: Can an educational program enhance Thinh Loc community members' adaptive capacity for the Thinh Loc community to cope with climate change?

To address the key research question, two sub-research questions emerged:

Question 1: What is the current level of awareness and ability to adapt to climate change in the Thinh Loc community?

Question 2: Does the evaluation of awareness and behavioural change indicate effectiveness of education as a strategy to increase climate change adaptive capacity of the Thinh Loc community members?

Question 3: May this educational intervention become a model for replication in other Vietnamese coastal communities?

1.6. Hypotheses

The research was based upon two hypotheses:

- The baseline current level of awareness and adaptive capacity for the Thinh Loc community to cope with climate change is low.
- Applying a climate change educational intervention program is likely to be one of the most effective ways to help improve the awareness and adaptive capacity of the Thinh Loc community to address climate change. The educational intervention may become a model for replication in other Vietnamese coastal communities.

1.7. Research Design

In order to address the research questions, the study was designed to include three phases in the Thinh Loc community:

- Phase One: Identifying the baseline level of Thinh Loc community residents' awareness and behaviour to cope with climate change.
- Phase Two: Designing and delivering a climate change educational intervention to enhance knowledge and the capacity to adapt to climate change.
- Phase Three: Evaluating whether any changes in the awareness and adaptive capacity of Thinh Loc community residents could be observed after the intervention program.

While a climate change education program was identified as an independent variable, the knowledge, attitudes, and ability to adapt to climate change of the people in the study were considered to be dependent variables. The research design examined whether there were any changes in the dependent variables after conducting the education intervention (the independent variable). The mixed methods project included a questionnaire, interviews, and field observations to address the research problem. As this study was a quasi-experimental study, it was not possible to control mediating variables such as financial capacity, intelligence, and cultural values and so on.

1.7.1 Quantitative research design (baseline and evaluation questionnaires):

Samples:

Phase One: 115 individuals were selected to participate in the survey. This sample comprised of 30 secondary school students, 11 teachers, 54 farmers and 20 local government staff members. The random sample and convenient sample methods were used to recruit participants.

Phase Two: 65 out of the original survey participants of Phase One and 33 new community members volunteered to attend the educational intervention.

Phase Three: All 98 participants of Phase Two were invited to participate in the data collection part of Phase Three. However, only 88 people were available to participate in the survey. As a result, in Phase Three, 88 individuals participated in the post-intervention survey and were used to evaluate the educational intervention.

Instruments:

The instruments designed to be used in the initial phase measured the perceptions of Thinh Loc community members were: climate change knowledge, climate change attitudes, activities related to enhancing and minimizing climate change, climate change

communication, and their views about the need for climate change education. The instruments used in the post-intervention phase measured any changes of awareness and behaviour of participants to cope with climate change 6 months after the intervention. These assessed climate change knowledge, climate change attitudes and climate change mitigation and adaptation strategies.

1.7.2 Qualitative research design (interviews and field observations):

Interviews: Eight interviewees were invited to attend semi-structured interviews. Snowball sampling was employed to recruit four interviewees in Phase One and purposive sampling was applied to recruit four interviewees in Phase Three. Content analysis techniques were applied to analyse the interview transcripts.

Field observations: The first field observations were conducted in Phase One with a view to gain basic knowledge of economic and environmental issues in the study site. This provided a fuller understanding of the first primary research question. The second set of field observations, conducted in Phase Three, focused on any change in the participants' activities in mitigating and adapting to climate change. The second set of observations also helped to supplement data to answer the third primary research question.

1.8 Assumption and delimitation of study

1.8.1 Delimitations of study:

Study site

The research was carried out in the Thinh Loc community, which is located in the coastal area of Central Vietnam. The community is identified as the smallest institution in the social and political structure of Vietnam. The Thinh Loc community is a medium-sized village, which contains nearly 7000 people, and is managed by the Thinh Loc community government (Thinh Loc Community Government Report [TLCGR], 2014). Thinh Loc community is representative of almost all communities along the Vietnamese coast, which sustain severe impacts from climate change; therefore, adaptive strategies to cope with climate change are urgently required.

The extent of the study

Participants of the research comprised of school students, teachers, farmers, and local government staff members who live in the Thinh Loc community. The scope of the study aimed to identify awareness, attitudes, and behaviour of Thinh Loc community members to address climate change. Afterwards, an appropriate educational intervention was designed and delivered to 98 Thinh Loc community members to improve their knowledge and adaptive capacity in dealing with climate change. Finally, an evaluation of the consequences of the intervention program was performed in order to assess its effectiveness and develop a climate change education model for other coastal communities in Vietnam.

1.8.2 Assumptions

It was assumed that participants would answer truthfully and accurately on the questionnaire and interviews, based on their experience and the perceived potential benefits of the program. It was also assumed that the local government, schools, and households in the Thinh Loc community would support the researcher to undertake the surveys, interviews, and educational intervention program. Furthermore, it was assumed that objective conditions such as weather, leisure after harvest time, school timetables, and study equipment would be propitious to carry out the research. In addition, to enable the surveys to be utilised they were made suitable to respondents' education levels while covering the goals of the research.

1.9 Significance of the Study

The literature review revealed that there were few studies on climate change education, especially concerning Vietnamese coastal inhabitants. Therefore, conducting research on whether and how education programs could enhance awareness and adaptive capacity of Vietnamese coastal communities to cope with climate change was urgently needed for the following reasons:

- It was expected that education would help improve knowledge of and attitudes to climate change; these would encourage residents to undertake regular actions to mitigate and adapt with climate change in the study site.
- Results from the research could be developed into a program to be used for studies in Vietnam as well as other developing countries.

- The research was expected to become a useful reference and guideline for policy makers and Vietnamese local governments to formulate policy to support locals in dealing with climate change.
- It was also expected that the project would contribute towards the development of an adaptation framework to help mitigate and adapt to climate change in developing countries worldwide.

1.10 Thesis Outline

The structure of this thesis takes the following format:
Chapter Two: Literature review. In this chapter, research on climate change, trends, predictions and climate change adaptation strategies worldwide and in Vietnam are presented. This chapter also discusses identified climate change education projects, which have been beneficial for schools and communities. This chapter presents identification of an interventional education as a possible adaptation strategy for this study and establishes the research questions.

Chapter Three: Methodology. This chapter delineates the precise methods used in the research and explains why these were selected.

Chapter Four: Results Phase One - Awareness of, attitudes to, and behaviour concerning climate change in the Thinh Loc community. This chapter presents both qualitative and quantitative analyses of Phase One of the research using content analysis techniques for qualitative data and statistical analyses for quantitative data. The first research question is addressed in this chapter.

Chapter Five: Educational Intervention. This chapter outlines and describes the climate change education intervention program, including the curriculum, course structure, course delivery, participant sample, and evaluation of learners after finishing the educational program. Also the chapter illustrates the constructivist teaching methods employed in the delivery of the program.

Chapter Six: Results Phase Three - Evaluation of the educational intervention. This chapter measures changes in the participants' awareness and attitudes, as well as applications of the educational intervention program to cope with climate change. Both quantitative and qualitative analyses of the evaluation strategies are presented in Chapter Six. This chapter answers the second and third research question.

Chapter Seven: Summary, discussion and conclusion. The final chapter summarises the main findings of the research, discusses main findings, acknowledges limitations, suggests applications, proposes directions for further research, and concludes the thesis.

CHAPTER TWO: LITERATURE REVIEW

In this review, a picture of global climate change trends, predictions and impacts is presented. Then, a systematic analysis of climate change adaptation worldwide, comprising physical, technological, financial, and educational measures is outlined. A survey of climate change trends, impacts and adaptation in Vietnam is subsequently identified. Next, the review moves to present some main factors influencing the ability to adapt to climate change in Vietnamese rural communities. The chapter concludes by analyzing the roles of education in enhancing climate change adaptation, proposing a climate change education program as an approach in this study, and raising the research questions of the thesis.

2.1 Review global climate change trends, predictions and impacts

2.1.1 Defining climate change

Climate change was recognized as a global environmental problem for the first time in the late 1970s. The American climatologist James Hansen developed the hypothesis that burning fossil fuel over a long period would heat the Earth (Dimento & Doughman, 2007). In the first World Conference on Climate organized in 1979 in Geneva, scholars asserted that human activity could cause climate change which would lead to damage of both humans and the environment. Then, from the 1980s, international organizations and developed countries invested a huge amount of money in research to explore the hypothesis of climate change (Dimento & Doughman, 2007).

According to Healey (2009), the simplest way to understand climate change is that it is a global issue that affects us all. Changes in climate patterns mean that extreme weather events such as heatwaves, floods, storms, droughts and bushfires will become more frequent, more widespread, or more intensive. Healey (2009) also asserted that climate change is caused by increasing the global average temperature. This effect is increased by the build-up of greenhouse gases (GHGs)[1], which "soak up heat from the sun but

[1] Greenhouse gases are "those gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of terrestrial radiation emitted by the earth's surface, the atmosphere itself, and by clouds. This property causes the greenhouse effect. Water vapour (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary GHGs in the earth's atmosphere. Moreover, there are a number of entirely human-made GHGs in the atmosphere, such as the halocarbons and other chlorine- and bromine containing substances, dealt with under the Montreal Protocol. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with the GHGs sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs)" (IPCC, 2014, p. 1263). Retrieved from http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_annex-i.pdf

instead of the heat leaving the Earth's atmosphere, some of it is trapped, making the Earth warmer" (Healey, 2009, p1).

For most people, climate change means the world's climate is altered by humans through fossil fuel burning, clearing forests, and other components that contribute to increasing concentrated GHGs in the atmosphere. This is in line with the definition proposed by the United Nations Framework Convention on Climate Change (UNFCCC). In its Article 1, the UNFCCC (1992) referred to climate change as a change in climate that is attributed "directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods" (p.7). However, researchers often use the term for any change in the climate, whether by natural or human causes (International Strategy for Disaster Reduction [ISDR], 2008). In its Fifth Report (AR5), the IPCC (2014) noted that "climate change refers to a change in the state of the climate that can be identified (e. g., by using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer"[2] (p.1255). Both definitions are relevant and important to keep in mind.

2.1.2 Climate change trends in the world

Temperature rise

Climate change is a reality (Adger, Arnell, & Tompkins, 2005). According to the latest report from the IPCC (2014), the Earth's surface was consecutively warmer over the period 1983-2012 than in any preceding decade since 1850. The globally averaged combined land and ocean surface temperature increased by 0.85°C over a 30-year period (1980-2012).

Cryosphere decrease

The most recent IPCC report (2014) also showed that over the period 1992-2011, the Greenland and Antarctic ice sheets have been losing mass. Glaciers have receded in almost all parts of the world; in addition, the Northern Hemisphere spring snow cover has continued to shrink.

[2] IPCC. (2014). Annex 1: Glossary, Acronyms and Chemical Symbols, p. 1255. Retrieved from http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_annex-i.pdf

Sea level rise

The global mean sea level rose by 0.19 m from 1901 to 2010 (0.17 to 0.21m). Since the 1970s, global glacier reduction and ocean thermal expansion were responsible for about 75% of the global mean sea level rise (IPCC, 2014).

Extreme weather and climate events

Changes in many extreme weather and climate events also have been observed since 1950. It has been observed that the number of cold days and nights have decreased, while the number of warm days and nights has increased worldwide. Asia, Europe, and Australia are among the most affected parts with an increase in the frequency of heatwaves. There are likely to be more land regions where the number of heavy precipitation events has increased than regions where it has decreased. Further, there is an increase in extreme sea levels (for instance, storm surges) since 1970 mainly because of global sea level rise. It is also notable that recent extreme climate events, such as heatwaves, droughts, floods, cyclones and bushfires have been more severe (IPCC, 2014).

2.1.3 Main projections for climate change worldwide

The IPCC (2014) has predicted the following changes in the climate system for the period 2016-2035 compared to 1986-2005:

- The global mean surface temperature is similar for the four Representative Concentration Pathway[3] (RCP) scenarios and will increase from 0.3^0C to 0.7^0C. There are likely to be more frequent hot and less frequent cold temperature extremes over most land regions.

[3] "Representative Concentration Pathways (RCPs): Scenarios that include time series of emissions and concentrations of the full suite of greenhouse gases (GHGs) and aerosols and chemically active gases, as well as land use/land cover (Moss et al., 2008). RCPs usually refer to the portion of the concentration pathway extending up to 2100, for which Integrated Assessment Models produced corresponding emission scenarios. Extended Concentration Pathways (ECPs) describe extensions of the RCPs from 2100 to 2500 that were 127 calculated using simple rules generated by stakeholder consultations and do not represent fully consistent scenarios. Four RCPs produced from Integrated Assessment Models were selected from the published literature and are used in the present IPCC Assessment as a basis for the climate predictions and projections presented in WGI AR5 Chapters 11 to 14 (IPCC, 2013b):

- RCP2.6: One pathway where radiative forcing peaks at approximately 3 W/m2 before 2100 and then declines (the corresponding ECP assuming constant emissions after 2100).
- RCP4.5 and RCP6.0: Two intermediate stabilization pathways in which radiative forcing is stabilized at approximately 4.5 W/m2 and 6.0 W/m2 after 2100 (the corresponding ECPs assuming constant concentrations after 2150).
- RCP8.5: One high pathway for which radiative forcing reaches >8.5 W/m2 by 2100 and continues to rise for some amount of time (the corresponding ECP assuming constant emissions after 2100 and constant concentrations after 2250)" (IPCC, 2014, p.1270). Retrieved from http://www.ipcc.ch/pdf/assessment-report/ar5/wg3/ipcc_wg3_ar5_annex-i.pdf

- Extreme precipitation events over most mid-latitude land and wet tropical regions will likely become more intense and frequent, caused by the global surface temperature rise. However, the distribution of precipitation in a warming world will be different. There will be an increase in annual mean precipitation at high latitudes and the equatorial Pacific by the end of the twenty-first century under the RCP8.5 scenarios. Meanwhile, this figure in many mid-latitude and subtropical dry places will be decreased.
- The global ocean is expected to be warmer during the twenty-first century, especially in the tropical and Northern Hemisphere subtropical regions. In addition, sea ice in the Arctic will recede continuously. The spring snow cover in the Northern Hemisphere is also likely to be reduced by 7% for RCP2.6 and by 8.5% for RCP 8.5 7^0C.
- During 2081-2100, global sea levels are predicted to rise by about 8-16mm per year under RCP8.5 scenarios, but at different levels across different regions (IPCC, 2014, p58-62).

2.1.4 Prediction of impacts of climate change worldwide

a. Prediction of climate change affects key sectors

The changes in climate cause potentially severe impacts for biodiversity, ecosystem services, economic development, as well as higher risks for livelihood, food, and human security (IPCC, 2014). Four key risks span sectors and regions:

- Risk of severe ill health and disrupted livelihoods resulting from storm surges, sea level rise and coastal flooding; inland flooding in some urban regions; and periods of extreme heat.
- Systemic risks of extreme weather events leading to breakdown of infrastructural networks and critical services.
- Risk of food and water insecurity and loss of rural livelihoods and income, particularly for poorer populations.
- Risk of loss of ecosystems, biodiversity and ecosystem floods, functions and services (IPCC, 2014, p.65)

b. Prediction of climate change affects the different regions of the world

Climate change will affect all nations, but people living in poor socioeconomic conditions in both developing countries and developed counties are likely to suffer most (ISDR, 2008). Many of these people - such as those whose livelihoods rely on agriculture - depend on climate conditions and have less capacity to cope with climate change (ISDR,

2008). Their conditions may mean they have low income and savings, no property insurance or limited-access to public services.

Africa: Africa is one of the most vulnerable continents in the world, because of its high exposure and low adaptive ability. This arises from poverty, weak institutions, and associated conflicts (ISDR, 2008; IPCC, 2014). Continuous temperature rises over Africa, combined with a decline in precipitation, will continue to be a primary concern for many people in African nations (ISDR, 2008; IPCC, 2014). Climate change will magnify existing stresses on water availability and food security in this continent. In addition, risks to health will become a major problem because of inadequate access to safe water and sanitation, food security, and health care (IPCC, 2014).

Asia: Climate change is exacerbated in the Asia/Pacific region (Srinivasan & Hunt, 2011; Dimento & Doughman, 2007). Here there has been a dramatic increase in the intensity and frequency of severe disasters, such as heatwaves, cyclones, droughts, floods, intense rainfall, as well as increases in snow avalanches (Srinivasan & Hunt, 2011). Scholars have suggested that a significant number of Asians who live in low-lying coastal areas would face the loss of their homes due to sea level rise (Dimento & Doughman, 2007). In addition, the number of higher temperature nights was 16 per year during 1980-1999, but it is predicted that this figure will increase to 137 per year during the period of 2090-2099 (Srinivasan & Hunt, 2011).

The IPCC (2014) identified that sustainability of development in the Asian continent will change due to negative impacts of climate change and multiple stresses caused by rapid urbanization, industrialization, and economic development. Water scarcity will be one of the main challenges for most areas in Asia due to droughts, increases in water demand, and a lack of good water management. Furthermore, extreme climate events will threaten human health, security, livelihood and income across Asia. Especially, sea level rise is expected to lead to increased stresses on coastal and marine systems in many parts of Asia (ISDR, 2008; IPCC, 2014).

Australia and New Zealand: The newest IPCC report (2014) also shows that Australia and New Zealand continue to display long-term trends towards higher air surface and sea surface temperatures, more hot extremes and fewer cold extremes, as well as altered rainfall patterns. As a result, Australia and New Zealand are expected to face more extreme weather events in many regions, such as fires, tropical cyclones, droughts, hail, and floods (ISDR, 2008; IPCC, 2014). These conditions will increase

stresses on agriculture, rural livelihoods, ecosystems, and urban water supplies in both Australia and New Zealand. Coastal areas are projected to be threatened by the effects of sea level rise by 2050. In addition, mangroves and coral reefs will be at risk, and several animal species may face extinction (Dimento & Doughman, 2007; ISDR, 2008; IPCC, 2014).

Europe: Climate change projections show a large increase in high temperature extremes, droughts and heavy precipitation events, as well as sea level rises across Europe (IPCC, 2014). Due to climate change, Europe has experienced several challenges to economy, energy production and agriculture. Particularly, the European agricultural sector will be seriously affected by a foreseeably wetter and warmer climate (Dimento & Doughman, 2007; ISDR, 2008; IPCC, 2014).

Latin America and North America: Latin America has experienced changes in precipitation, an increase in temperature, and the disappearance of glaciers during 1950-2008. This trend is also projected to continue until at least 2100 (IPCC, 2014). Climate change will continue to cause multiple vulnerabilities in natural and human systems in the Latin American region. For example, 613 climatological and hydro-meteorological extreme events occurred in the period 2000-2013, causing 13,883 fatalities, affecting 53.8 million people, and resulting in economic losses of $52.3 (IPCC, 2014). Furthermore, it is predicted that by the end of the 21st century, Latin American people will be threatened by the eradication of animal species, a reduction of agricultural productivity and a decline in livestock (Dimento & Doughman, 2007; ISDR, 2008; IPCC, 2014).

In North America, warmer conditions in some mountainous places have led to a decrease in levels of precipitation, and this has affected the locals' agricultural livelihood. Also, there is a notable increase in the frequency and intensity of bushfires in several zones, such as the Pacific Northwest, California, Alaska, Colorado, Arizona, Texas, and Oklahoma (Brown, Hall, & Westerling, 2004; ISDR, 2008; IPCC, 2014). Coastal regions will be more vulnerable if the intensity of tropical storms increases (IPCC, 2014). Further, many locations in North America are expected to experience severe heat, heavy precipitation, and declining snow packs in the next decade (IPCC, 2014).

Polar Regions, small island states, coastal systems and other low-lying locations: Polar Regions are likely to experience loss of sea ice in summer and increased ocean temperatures, as well as changes in the energy pathways within the marine ecosystem

(IPCC, 2007, 2014). The further thawing of permafrost and changing of precipitation patterns because of temperature rise will potentially affect infrastructure and related services in the Arctic region (IPCC, 2014). Small island states, coastal systems and other low-lying locations are especially vulnerable to sea level rise and extreme weather events. Many people in these regions are likely to be affected by multiple stresses arising from floods, storms, erosion, and other coastal hazards every year (IPCC, 2014).

2.2 Overview of climate change adaptation worldwide

To address climate change, in June 1992, many nations signed an international treaty-the United Nations Framework Convention on Climate Change [UNFCCC] and 192 parties became members of the UNFCCC in October 2009. The main purpose of the UNFCCC is to consider effective measures to minimize and cope with climate change. The UNFCCC highlighted two fundamental response strategies to address climate change, comprising of mitigation and adaptation (UNFCCC, 2017). This study is focused on how to enhance the ability of a community to adapt to climate change; therefore, adaptation is identified as the most important concept.

2.2.1 Defining adaptation and mitigation

The United Kingdom Climate Impact Program (UKCIP) argues that adaptation is a process or result of a process, which causes a mitigation of disadvantages from climate change (UKCIP, 2003 cited in Levina & Tirpak, 2006). Similar to the UKCIP's definition, Smit and Wandel (2006) argued that adaptation is a process, action, or result conducted by a household, group, community or country which allows it to cope, manage or adjust to changing conditions, stresses, hazards, risks, or opportunities. IPCC (2014) also proposes that adaptation is "the process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects" (p.1251). Below is a summary of adaptation definitions represented by (Schipper, 2007):

Table 1 Summary of adaptation definitions

Source	Definition
Burton *et al.,* (1998)	Refers to all those responses to climate change that may be used to reduce vulnerability
Burton (1992)	Adaptation to climate is the process through which people reduce the adverse effects of climate on their health and well-being and take advantage of the opportunities that their climatic environment provides.
Downing *et al.,* (1997)	Adaptation is synonymous with "downstream coping".
Füssel and Klein (2002)	All changes in a system, compared to a reference case, that reduce the adverse effects of climate change
Pielke (1998)	Refers to adjustments in individual, group and institutional behaviour in order to reduce society's vulnerabilities to climate.
Rennie and Singh (1996)	Adaptive strategies are ways in which local individuals, households and communities have changed their mix of productive activities, and modified their community rules and institutions in response to vulnerabilities, in order to meet their livelihood needs.
Scheraga and Grambsch (1998)	Adaptive actions are those responses or actions taken to enhance resilience of vulnerable systems, thereby reducing damage to human and natural systems from climate change and variability.
Smit (1993)	Involves adjustments to enhance the viability of social and economic activities and to reduce their vulnerability to climate, including its current variability and extreme events as well as longer-term climate change.
Stakhiv (1993)	Means any adjustment, whether passive, reactive or anticipatory, that is proposed as a means for ameliorating the anticipated adverse consequences associated with climate change.

Source: Schipper (2007, p.5)

Adaptation varies depending on the climate change–related stress. However, in general, adaptation consists of actions that people take in response to or in anticipation of

changes in climate, as well as to reduce severe impacts or take benefit of the opportunities posed by climate change (Hulme, 2002).

According to the IPCC (2001), adaptation refers to “adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities” whereas mitigation is “an anthropogenic intervention to reduce the sources or enhance the sinks of greenhouse gases” (IPCC, 2007).

It follows from these definitions that adaptation reduces the consequences of climate change impacts, whereas mitigation reduces the impacts of climate change itself, and therefore reduces its causes. As a result, the benefits of mitigation conducted today will be evidenced in several decades’ time because of the long residence time of greenhouse gases in the atmosphere, whereas many adaptation measures would be effective immediately and yield benefits by reducing vulnerability to climate variability (IPCC, 2007). Mitigation efforts can foster adaptive capacity through mitigating the causes of climate change. Consequently, activities that mitigate the causes of climate change have intended to facilitate adaptive activities.

From this viewpoint, the proposal intervention would cover both actions related to mitigation and adaptation. The provision and discussion of knowledge and information regarding mitigation would be crucial to the targeted participants in facilitating adaptive activities to cope with climate change.

2.2.2 Worldwide climate change adaptation strategies

2.2.2.1 Physical, financial and technical solutions

As discussed earlier, while climate change is a global phenomenon, its impact on developing countries seems to be more severe due to their dependency on natural resources and weather conditions, as well as a low level of adaptive capacity (Adger et al., 2003). This review section will present the impacts and adaptation measures demonstrated in developing countries which exhibit similar conditions to Vietnam.

South Asia is one of the regions most vulnerable to climate change (Jung, 2012). Currently, millions of people in many parts of this area are affected by increasing sea levels and temperatures, as well as greater intensity and frequency of heatwaves, droughts, floods, and tropical cyclones (Jung, 2012). This has caused extensive damage to property, assets, and human life (Jung, 2012). From here, adaptation to manage climate change impacts has become urgent for the whole continent (Jung, 2012).

In South Asia, Bangladesh is a very vulnerable country due to its geography (Pathmarajah, 2012). It is flood prone, consisting of 80% floodplains (Brounwer, Akter, Brander, & Haque, 2007; Pathmarajah, 2012). People mainly live in poor and rural conditions in these floodplains with an average annual income of 325USD (Bangladesh Bureau of Statistics, 2005 cited in Brounwer et al., 2007). Floods cause a scarcity of drinking water, diseases such as diarrhoea, cholera and other intestinal disorders, as well as worsening poverty. Therefore, flooding is one of the most considerable problems that local people face, followed by other crucial issues, such as bad roads, unemployment, and lack of electricity. Most of the Bangladeshi population have pointed out that they suffer from diarrhoea during the rainy season and 90% of these cases need medical treatment (Brounwer et al., 2007). Flooding also causes damage to houses (27%), crops (27%), and fishponds (19%) and other issues. To address the effects of climate change, especially flooding, local governments have adopted policies to protect people by building embankments along the river. Flood-affected families with low incomes are given temporary accommodation in village schools or local government buildings for weeks or months. The current adaptation strategies in Bangladesh focus on four approaches, involving:

- Community-based adaptation interventions to strengthen the resilience of coastal communities and protective ecosystems,
- Improving local officials' knowledge of climate change risks to the coastal area,
- Revising coastal management,
- Developing functional systems for collecting and distributing climate change knowledge (Sovacool, D'Agostino, Rawlani, & Meenawat, 2012).

Being a vast country covering 3.28 million km^2, India also has experienced major threats because of projected changes in climate (Government of India, 2009). According to Nair (2009), the major impact of climate change in this country is water shortage. The national economy of India significantly depends on agriculture and related industries that provide employment for millions of people. Therefore, a lack of water has severely affected all facets of workers' lives (Nair, 2009). Further, the growing frequency and intensity of tropical cyclones, storms, floods, and increases to the sea level have affected life and development in coastal zones that in a way contributes to increasing poverty and declining national economic development. Nair (2009) also found the impact of climate change on the forest environment threatens the livelihood of tribal communities who depend on forest resources. To help Indian people address climate change, the Indian

Government has called for and undertaken several plans and actions. These strategies focus on improving surface and underground water storage, rainwater harvesting, and efficient irrigation, such as sprinklers or drip irrigation (Pathmarajah, 2012). Many solutions have been suggested and employed to help India's agricultural sector to be more resilient to climate change. They include developing drought and pest resistant crop varieties, improving methods to conserve soil and water and providing finance to enable farmers to invest in and adopt relevant technologies to overcome climate related-stresses (Government of India, 2009; Pathmarajah, 2012).

Several islands in Pacific are facing severe impacts from sea level rise, shown by Beniston (2010). According to Beniston (2010), sea level rise will influence most of the world's population living on or close to the sea, including those in the Maldives in the Indian Ocean, the Marshall Islands in the Pacific Ocean, and certain parts of Indonesia. Changes in precipitation patterns may affect water demand, supply balance and water quality for people on these islands. In many parts of these regions, difficulty in supplying water for irrigation, industrialization, and drinking water has become an urgent problem. Food security is also threatened by climate change through direct and indirect impacts. Agricultural production may continue to decrease significantly due to changes in temperature and precipitation patterns, loss of agricultural land by sea level rise, land erosion, pests, and natural diseases (Beniston, 2010). The Government of the Maldives are conducting key adaptation measures for predicted climate change such as resettling populations through incentive programs, improving and promoting eco-friendly sustainable housing technology, building resilience in fisheries, acquiring technologies to manage water resources, and strengthening agricultural production among other initiatives (Pathmarajah, 2012).

In China, climate change has negatively influenced agriculture, especially in terms of crop yield (Wang, Huang, & Yang, 2014). For example, from 1979-2002 changes in climate, primarily warming in the growing season, have led to wheat yields in China falling dramatically. There has been a negative correlation between maize yields and increases in temperature during the crop-growing seasons at both national and local levels. The Chinese government is considering several strategies to support its agricultural sector, such as improving irrigation, strengthening research, and developing new technologies. Meanwhile, farmers are also encouraged to change crop times, increase investment in irrigation, as well as adopt water saving technologies.

In Africa, the research from Collier, Conway, and Venables (2008) showed the impact of climate change is likely to be severe. Recently, Africa has become hotter, wetter, and drier, with an increased frequency and tendency of extreme weather events (Collier et al., 2008). Temperature rise is by far the most important influence on agriculture, resulting in worsening chronic hunger due to the drop of crop productivity. Higher temperatures will also affect health by aggravating the spread of malaria and dengue. Damage to and loss of infrastructure and property are unavoidable due to severe floods and sea level rise. In order to address effects of climate change, Africans undertake suitable responses by transferring labour and capital towards the favoured places to preserve livelihoods in agricultural households (Collier et al., 2008). McLeman and Smit (2006) paid attention to the ways in which changes in environmental conditions can affect migration patterns. These scholars showed that over recent decades, African people in rural areas have been forced to migrate to avoid recurring drought. Specifically, in Western Sudan, where income is generated primarily from agricultural products, male household members were frequently forced to migrate to Khartoum. By doing this they could find work in periods when low rainfall prevented agricultural production. In dry places, family migration often occurs after droughts have exhausted families' other solutions, such as reducing food consumption or selling possessions (McLeman & Smit, 2006).

The Southeast Asian (SEA) region, which includes Vietnam, is facing many challenges posed by climate change. Climate change seriously influences the population, whose livelihoods almost entirely depend on natural resources. This population includes poor farming and fishing families, and vulnerable populations living in urban, peri-urban and rural areas on coasts and deltas (Resurreccion, Sajor, & Fajber, 2008). It is also projected that there will be increases in the frequency and intensity of tropical cyclones, storm surges, sea level rise, and increased flooding, especially in Vietnam, the Philippines and Indonesia. Increased variability in rainfall patterns has occurred throughout the region. For instance, changes in rainfall patterns in the Mekong River Delta have resulted in severe droughts and floods, which have seriously influenced people's livelihoods and food security (Resurreccion et al., 2008). In addition, millions of Southeast Asian residents living on or near the coast are vulnerable to severe tropical storms, floods, seawater intrusion, and beach erosion, potentially leading to loss of livelihoods, land, property, and community infrastructure (Resurreccion et al., 2008; Anbumozhi et al., 2012). To respond to climate change, various climate change adaptation measures have been carried out in this region. Adaptation measures to cope with climate stress in some Southeast Asian countries are illustrated below.

- Cambodia is one of the most vulnerable countries in the Southeast Asian region due to floods, windstorms, seawater intrusions, and droughts. To adapt to climate related disasters, the Royal Government of Cambodia has undertaken several adaptation practices to help local residents. For example, recommendations have been made to households to reinforce housing structures, strengthen protective property, and build high enclosures for people and livestock. For the community, local governments have encouraged locals to move to safer areas, shift planting dates, switch to flood resistant crop varieties, and reduce water consumption (Royal Government of Cambodia, 2006; Ung et al., 2016).
- Due to its geography, Indonesia faces several severe climate-related stresses such as droughts, sea level rises, tidal flooding, and coastal inundation (Keil, Zeller, Wida, Samin, & Birner, 2008). Many practices have been adopted in Indonesia to help minimize and adapt to climate change. Some examples of adaptive measures include: diversification of crops planted, alterations in the number and quantity of agricultural products applied to crops, storage of food stocks, construction of protective structures such as dykes and small dams, movement of physical assets to safer areas, and reinforcement of housing structures (Keil et al., 2008; JICA [Japan International Cooperation Agency], 2014).
- Like Indonesia, the Philippines is a country that is highly exposed and vulnerable to climate change, which there results in climate-related disasters such as tropical cyclones, increased floods, coastal erosion, sea level rise, drought, and saltwater intrusion (Sales, 2009; Lasco et al., 2006). The Philippines Government cooperated with NGOs to carry out adaptation initiatives and actions to help mitigate disasters. As in other countries, adaptation strategies in this nation have been focused on physical solutions, such as reinforcement of housing structures, movement to safer areas, building protective structures (such as sandbags and dykes), and increasing the level of food stocks. Temporary migration in order to seek alternative income has also been adopted to cope with climate-related disasters. In the agricultural sector, the Filipino people have carried out effective solutions, such as changes in planting schedules, construction of water storage tanks, use of shallow tube wells, construction of water impounding basins, and changes to irrigation schedules (Sales, 2008; Lasco et al., 2006).

2.2.2.2 Educational adaptation approaches

Along with physical, technological and financial solutions, education has been employed as a strategy to raise climate change awareness in several countries in order to help enhance climate change adaptation. Examples of climate change adaptation education programs at both school and community levels include the following:

Climate change education (CCE) at school level:

CCE in Dominican Republic

The Dominican Republic is one of the most vulnerable countries due to the impacts of climate change, such as the increasing frequency and intensity of storms, severe hurricanes, sea level rise and coastal erosion (UNESCO, 2015). Recently, although the Dominican Republic has not established national climate change education [CCE] curricula, this country has been involved in a variety of CCE programs that have helped build local capacity. For example, 45 trainers and facilitators participated in the CCE workshop run by the UNESCO. These educational trainers then reached 400 teachers in 18 regions of the Dominican Republic. Trained teachers then take responsible for monitoring the implementation of CCE in the training institutions to ensure that students attending school will enhance their awareness about climate change issues and be more engaged in their learning about climate change, supported by teachers and materials (UNESCO, 2015). Constructivist teaching methods are applied in many CCE classrooms that promote participatory learning (UNESCO, 2015). Nevertheless, the CCE programs in this nation still stop short at broadening public knowledge about climate change, while efforts to measure the effectiveness of these educational interventions has not yet been developed.

CCE in Ethiopia

Ethiopia has experienced a clear temperature rise over the past 55 years (Tadege, 2008), leading to a high level of concern about climate change and its impacts (Dalelo, 2011). Similar to the Dominican Republic, Ethiopia has not yet established a national CCE curriculum. However, CCE is integrated in Geography curriculum at the secondary (grade 9 & 10) and preparatory level (grade 11 &12). In an analysis of the curriculum guides, Dalelo (2011) showed that 64% of the knowledge related to the scientific basis of climate change, 22.9% of the knowledge related to climate change impacts, and 15.6% of the knowledge related to actions taken to combat climate change are designed and taught in four Geography curricula (Dalelo, 2011). From the perspective of climate

change education in Ethiopia, the researcher concluded that school geography curricula play a role in providing understanding about climate change for school students. However, because of a lack of evaluation systems - which demonstrate learning outcomes in this subject - the effectiveness of teaching about climate change in Ethiopia schools is still limited (Dalelo, 2011).

CCE in Philippines

The Republic of the Philippines, located in South-East Asia, is among the top ten countries most vulnerable to climate change (http://reliefweb.int/country/phl). Under the National Climate Change Action Plan 2011-2028, education related to climate change in some subjects is implemented in all levels of the formal and non-formal education sectors (Wals, 2012). However, like in other developing countries, Philippines has not established a specific climate change education subject; additionally, assessment of CCE application in responding to climate change has not been addressed.

CCE in Japan

Suwa (2005) presented examples of the educational activities at Maiko High School for coping with climate change in Japan. Climate change education is practical and able to reach a large proportion of participants. For example, guests were invited to school to talk about their experience during extreme events such as floods, storms, and droughts; and what they are now doing to cope with the next extreme events. This helps students in understanding the importance of preparedness to save human lives as they learn human wisdom from real life stories. Japan also has a special education program to deal with climate change, named “Transfer live lesson of catastrophic disasters.” According to the author, the concept of transfer live lesson is “a powerful tool for evoking sympathy for people who have experience and motivating people to act for the vulnerability of society against disasters” (Kawata, 2005, p63). The main goal of this education program is to transfer to future generations an awareness of severe impacts, as well as adaptive and mitigation experience from previous natural disasters. This program uses communication through accessing media, such as films, cartoons, cultural events, videos, multi-media information websites and other educational activities. By transferring live lessons of climate related-disasters, the Japanese government strongly believes that the number of future victims will decrease significantly. Furthermore, the Disaster Reduction and Human Renovation Institution in Japan proposes the establishment of a ‘Transfer Live Lesson Network’ as a useful method to share and transfer “live experience and lesson learnt from the past disasters on a citizen to citizen basis worldwide” (Kawata, 2005, p63). CCE programs in Japan have employed multiple education methods which

attract and encourage learners' participation. Therefore, it was expected to bring benefits to targeted learners.

CCE in South Korea

South Korea has not established a national curriculum or guideline for CCE yet. However, the government is instituting an independent subject related to climate change in the secondary school curriculum. At the primary school level, the environment is introduced within each subject. Furthermore, the South Korean government provides grants; 32 primary schools and junior high schools have been provided finance to designate and conduct research projects for energy conservation education. Importantly, in order to encourage activities directed towards young learners, Korea is running the following education and training programs:

- Educational programs on the causes of climate change and atmospheric pollution for those in fields related to hazard prevention, weather and environment.
- Over 500 teachers in primary and secondary schools have attended the annual "weather education program for science teachers" to better understand the mechanisms and causes of climate change.
- The "weather education program for women" provides homemakers with an opportunity to expand their knowledge of climate change by learning what climate change is and how it occurs (Kim et al., 2009 cited UNESCO, 2012, p14).

Climate change education projects for communities

Community education has been at the forefront of overcoming disadvantages for many years (AONTAS, 2004). According to the Irish National Association of Adult Education, community education is "education and learning which is rooted in a process of empowerment, social justice, challenge, respect and collective consciousness. It is within the community and of the community, reflecting the developing needs of individuals and their locales. It builds the capacity and structural advantage to take part in decision- making and policy - formation within the community. It is distinct from general adult education provision, due both to its ethos and to the methodologies it employs" (AONTAS, 2004, p18). This definition emphasises community education as a movement and catalyst for social change. It also exhibits a high capacity for social action, a sense of collective empowerment and an ability to address social justice

(AONTAS, 2004). According to Poster and Kruger (1990), three principal features of community education can be specified:

- Community education is about education, whereby residents can develop new skills, new knowledge and greater confidence.
- Community education is about communities, about using resources, about integrating learning with other aspects of living, and increasing community operation and understanding.
- Community education ought to be about empowerment, about helping people to gain control over their own lives, thereby working towards a more equal distribution of power in our society.

To sum up, community education is a way for people to enhance individuals' lives and communities through learning, collaboration, and participation. Community education thereby increases involvement of community members as well as providing opportunities for local community members and organizations to become partners in addressing community concerns including climate change.

Costa Rica

Vaughan, Gack, Solorazano and Ray (2003) examined the effect of environmental education on schoolchildren, their parents, and community members through a study of intergenerational and intercommunity learning in Costa Rica. The study compared the changing awareness of three groups including students who participated in a one-month environmental education course, their parents and an adult control group whose children did not participate in the one-month environmental course. This research was conducted over a four-week period (1/7/2001- 5/8/2001). About 60 of the Third and Fourth grade school children received the two hour per week course based on colouring books, which taught them natural history and about conservation of the Scarlet Macaw (study site). In addition, students had to do homework with their parents by reading two or three colouring books and colouring them in. The children and their parents then had to answer questions in the book. By doing a pre-test, a first post-test, and a second post-test, it was possible to see that there was a significant increase in correct answers in the questionnaires after eight months of finishing the education course. The authors concluded that there was a significant increase in knowledge in the three research groups. Furthermore, the study discovered that parents learned from children and both groups (students and their parents) transmitted course information to neighbours (adult control group) because there was a true improvement in control group education (Vaughan et al., 2003).

Iran

In Iran, an education program related to disasters caused by climate change was conducted with the public using media tools. The Iranian government used audio-visual and publication tools to provide the population with information related to disasters caused by climate change. The audio-visual presentations were run on a regular 15-minute weekly television program and five to ten-minute weekly radio sessions. Other special programs addressing safety issues in order to address climate change included three sessions, speaking to the people, asking question and answering questions to prepare for safety during climate change impacts. As a result, there was less fear and rumour within the population during climate change impacts and earthquakes. As well, booklets, pamphlets, posters, and articles in newspapers have been used to show the facts of disasters caused by climate change and how to prepare to stay safe (Ashtiany, 2005).

Sri Lanka

CCE for the community is also adopted in Sri Lanka. Women and men have participated in an integrated program for drought risk reduction, better land use and water management with the aim of enhancing their knowledge about the environment and climate change related hazards, as well as improving their livelihoods. Both women and men were provided with knowledge and skills, then worked on planning and deciding the ways each household would contribute and benefit, and were involved in identifying the crops, trees and land use plans that would increase resistance to drought. This project not only helped households to build their resilience and adaptation to drought, but it also increased women's participation in educational and social activities as well as enhancing gender equality (UNESCO, 2012).

South Africa

The Southern African Development Community's (SADC) Regional Environmental Education Programme (REEP) currently conducts an educational program in response to climate change in Southern Africa. This program was established in 1993 and aimed to empower environmental education practitioners in the South African region. Since 1997 the program has provided various training programs with networking opportunities, and material development for environmental education across region. Recently, climate change has been on the agenda of the SADC REEP as South Africa is always ranked as at high risk from climate change. This program provides a number of available pedagogical resources to individuals and communities to help strengthen resilience and

respond to climate change, such as booklets and worksheets that focus on “what is climate change?”, a poster produced by a national energy company presenting a proposal that nuclear energy is the solution to climate change, “handprint” material to encourage positive actions for climate change at community level, and a number of research and training resources that focus on supporting and engaging people in understanding the risks related to climate change (Lotz-Sisitka, 2010).

Sandwatch program (Pacific Ocean, Indian Ocean, the Caribbean, and many countries in Europe, Africa, Asia and South America)

Sandwatch is an educational program that modifies the lifestyle and habits of children, youths, and adults to monitor and conserve local beaches and near-shore environments as well as build these communities’ resilience to climate change. Sandwatch started in the Caribbean in 1999, and has become an international activity in the Cook Islands in the Pacific Ocean, the Seychelles in the Indian Ocean, and the Bahamas in the Caribbean, as well as many countries in Europe, Africa, Asia and South America. It is funded by UNESCO and the University of Puerto Rico through the Sea Grant College Program**.**

Each Sandwatch school or group adopts a local beach and regularly takes a series of measurements and tests of the beach which can determine whether the beach is stable and healthy or stressed and deteriorating, and the nature of the stressors. If a group identifies a problem with their local beach, they and the community can develop a project to address and mitigate the challenges. Project activities may include: conducting beach clean-ups, replanting mangroves or dune stabilization vegetation, creating signage for proper beach use, monitoring and protecting marine turtle nesting sites, or monitoring the effects of coral bleaching. By keeping the beach and related ecosystems healthy, Sandwatch teams increase resilience and adaptability of local residents to climate change (http://www.sandwatch.ca; UNESCO, 2012).

It is clear that climate change is one of the most significant challenges to global development. Every nation contributes to enhancing GHG emissions which cause climate change. Climate change affects all continents, but the Asia and Pacific region is one of the most vulnerable to climate change risks. This is because, among other things, of its dependence on natural resources, poverty, and densely populated coastal areas (Anbumozhi et al., 2012). Adaptation efforts to reduce harmful climate change impacts have been pursued by almost all nations. Based on the review of countries’ adaptive

experiences, several strategies have been implemented focused on technological applications, physical solutions, financial investments, and education.

The literature also revealed a number of examples of programs relating to climate change education in different countries at both school and community levels, including Ethiopia, South Korea, Japan and Iran (Lotz-Sisitka, 2010: UNESCO, 2012). On the one hand, it cannot be denied that CCE programs have faced significant challenges. At both school and community levels, a national curriculum including CCE has not been established in most nations; it is therefore evident that building a CCE curriculum is urgently needed, especially at the community level in developing countries (UNESCO, 2012). Furthermore, previous CCE programs have not provided convincing evidence of their effectiveness because most of these programs have not been monitored, tested or evaluated (Anbumozhi et al., 2012). Global strategies which have invested billions of dollars are token gestures unless they can be tested for their effectiveness. Therefore, an educational intervention that is evaluated to measure awareness and behavioural change is necessary in order to increase climate change adaptation.

On the other hand, it is clear that these educational programs bring benefits to targeted participants by providing more knowledge about climate change and the means of climate change adaptation (Kagawa & Selby, 2012). The content and methodology of educational activities worldwide have emerged as follows:

- Both CCE activities at school and community levels have provided understanding of climate change, including climate change identification and evidence, climate change impacts, and climate change causes.
- Reviewed CCE has focused on knowledge and activities to mitigate the cause of climate change.
- Reviewed CCE has focused on preparation, plans, actions, and innovations to adapt to climate change.
- Many CCE programs have used multiple teaching and learning methods to encourage learners' participation.

The content of these educational activities has attempted to meet urgent requirements for providing knowledge, skills and preparedness actions to mitigate the causes and adapt to the consequences of climate change. Thereby, they may play a crucial role in guiding the development of further educational programs.

2.3 Climate change in Vietnam

2.3.1 Country overview

Vietnam, with its S-shaped coastline, extends around 1,660 km from north to south with a land area of approximately 330,000 km^2. The territory measures 600 km from east to west at its widest and 50 km at its narrowest sections. Vietnam consists of three geographical sections, comprising hills, mountains, and fertile plains which are heavily cultivated and densely populated. Two major river deltas comprising the Mekong River Delta and the Red River Delta are mainly responsible for producing and supplying most of the food for domestic consumption and export (MONRE, 2010).

Out of 91.7 million people, an estimated 70 percent of the population lives in the coastal area and the low-lying deltas, where they face an increased risk of flooding (World Bank, 2017). According to the World Bank's assessment, Vietnam has been ranked among the five countries likely to be most affected by climate change (World Bank, 2017). This poses a significant risk to development gains and further progress. Already, Vietnam is experiencing a rise in temperature and sea level, as well as a greater intensity and frequency of stronger storms, floods, and droughts (Schmidt-Thomé, Nguyen, & Pham, 2015). As a result, the economy of Vietnam has lost 1-1.5 percent of GDP over the past two decades (International Labor Organization, 2011).

2.3.2 Climate baseline

Spanning 15 degrees of latitude, Vietnam has diverse climatic conditions, with a tropical climate in the South, and a humid subtropical climate with greater seasonal variation in the North (The Global Facility for Disaster Reduction and Recovery [GFDRR], 2011). The Ministry of Natural Resources and Environment summarized a climate baseline in Vietnam as below.

- Annual mean temperatures vary from 12.8^0C to 27.7^0C. Mean temperatures for the coolest month vary from 10^0C to 16^0C in the northern highlands, and from 20^0C to 24^0C in the southern highlands. Summer mean temperatures vary between 25^0C and 30^0C.
- Average annual precipitation varies between regions, ranging from 600 to 5000 mm, and is usually measured between 1,400 and 2,400 mm, with 80% to 90% occurring during the rainy season.

- Due to intra-year variability in rainfall and rainy days, some regions experiencing flooding during the rainy season may nonetheless suffer from drought in the dry season.
- Average annual hours of sunshine vary from 1,400 to 3,000 hours. The sunniest region has twice as many hours of sunshine as the least sunny one. Sunshine hour decreases going from south to north and from lowlands to highlands. Offshore islands tend to have more sunshine hours than the mainland. Annual average relative humidity is generally between 80% and 85%.
- Between 1956 and 2000, there were on average six to eight typhoons or tropical cyclones affecting Vietnam each year. In recent years, typhoon seasons have ended later and the country has been affected by an increased number of higher intensity typhoons. Typhoon tracks have gradually moved southwards with some exhibiting increasingly abnormal movements (MONRE, 2010).

2.3.3 Recent climate trends:

The current climate change observations were highlighted in the report "National Target Program in Coping with Climate Change", in which MONRE summarized recent climate trends in Vietnam with the following notable points (MONRE, 2008):

- *Temperature:*
  - ✓ Annual average temperature in Vietnam from 1950 to 2000 increased 0.7^0C.
  - ✓ A ten-year period from 1991-2000 was the hottest decade.
  - ✓ The number of hot days in the northwest, south-central, mountainous, and southern regions has increased during the past decades.
  - ✓ Annual average temperature in Hanoi, Da Nang and Ho Chi Minh City in the period from 1991-2000 was higher than in the 1930s at 0.8^0C, 0.4^0C, and 0.6^0C respectively.
  - ✓ It is predicted that by the end of 21st century the annual average temperature will increase by 3^0 C (around 1.6^0C to 3.6^0C depending on location).
- *Precipitation*
  - ✓ Rainfall varies between local areas. For example, in Hanoi and Ho Chi Minh City, annual average rainfall from 1970 has decreased. However, many provinces in the South-Central area have increased, especially from 1991 to 2000.
  - ✓ The number of drizzle days has declined in the last two decades. For example, the number of drizzle days in the northern area reduced by half,

from around 30 per year in the 1960s to about 15 days per year in the period 1991-2000.

- *Sea level:* The average sea level rose by around 2.5-3.0 cm per decade during the past 50 years. During the period 1933-2008, the average sea level rose by approximately 3mm per year. According to observations in the last 50 years at Cua Ong and Hon Dau stations, the average sea level increased by 20cm, which compared with the global tendency.
- *Extreme weather and climate events*
  - ✓ In the last two decades (the end of the 20th century and the beginning of the 21st century), the number of cold fronts affecting Vietnam has fallen considerably. For example, between 1994 and 2007, there were only 15-16 cold fronts, equalling 56% of the previous periods.
  - ✓ Recent climate abnormalities have included a cold front which resulted in extreme and damaging cold for 38 consecutive days in January and February 2008. This caused considerable damage to the agricultural sector.
  - ✓ The number and intensity of typhoons affecting Vietnam have been increasing, and many typhoons have been more abnormal than previously.

2.3.4 Projections of climate change in Vietnam

In 2016, the Ministry of Natural Resource and Environment published "Climate change and sea level rise scenario for Vietnam". Climate change and sea level rise scenarios developed for Vietnam are based on different GHG emission scenarios from the most recent IPCC's report, namely RCP 2.6, RCP 4.5, RCP 6.0, and RCP 8.5 (MONRE, 2016):

- *Temperatures in the 21st century in Vietnam*
  - ✓ Based on RCP4.5:
    - Annual average temperatures in the early 21st century (until the year 2030) will increase from 0.6-0.8 ^{0}C compared to the period 1986-2005
    - Annual average temperatures in the middle of the 21st century (until the year 2050) will increase from 1.3-1.7^{0}C compared to the period 1986-2005
    - Annual average temperatures at the end of the 21st century (until the year 2100) will increase from 1.7-2.4^{0}C compared to the period 1986-2005. Generally, temperature rise in the North is higher than the South.

- ✓ Based on RCP 8.5:
  - Annual average temperatures in the early 21st century will increase from 0.8-1.1^{0}C compared to the period 1986-2005
  - Annual average temperatures in the middle of the 21st century will increase from 2.2-1.3^{0}C in the North and 1.8-1.9^{0}C in the South, compared to the period 1986-2005
  - Annual average temperatures at the end of the 21st century will increase from 3.3-4.0^{0}C in the North and 3.3-3.5^{0}C in the South, compared to the period 1986-2005.

- *Precipitation in the 21st century in Vietnam*
  - ✓ Based on RCP4.5:
    - Annual precipitation in the early 21st century will increase by 5-10%.
    - Annual precipitation in the middle and the end of the 21st century will increase by 10-15%.
  - ✓ Based on RCP 8.5:
    - Annual precipitation in the early and middle period of the 21st century will increase by 10-15%.
    - Annual precipitation at the end of the 21st century will increase by 20%.

- *Sea level rise at the end of the 21st century in Vietnam* (MONRE 2016)
  - ✓ In the early 21st century, the average sea level rise will be similar for all RCPs at 13cm.
  - ✓ In the middle of the 21st century:
    - RCP 2.6: average sea level may increase by 21 cm (13÷32)
    - RCP 4.5: average sea level may increase by 22 cm (14÷32)
    - RCP 6.0: average sea level may increase by 22 cm (14÷32)
    - RCP 8.5: average sea level may increase by 25 cm (17÷35)
  - ✓ At the end of the 21st century:
    - RCP 2.6: average sea level may increase by 44 cm (27÷66)
    - RCP 4.5: average sea level may increase by 53 cm (32÷76)
    - RCP 6.0: average sea level may increase by 56 cm (37÷81)
    - RCP 8.5: average sea level may increase by 73 cm (49÷103)

2.3.5 Climate change impacts and adaptation in Vietnam

Various international and domestic sources demonstrate that Vietnam is both vulnerable and heavily exposed to the impacts of climate change, especially sea level rise, changing precipitation and typhoon patterns, and resulting changes in flood patterns, inter alia (Trung, 2013; Huong & Pathirana, 2013; Tam, Batelaan, & Beyen, 2016; Hien et al., 2016; Schmidt-Thome et al., 2015). Climate change is strongly predicted to result in socio-economic impacts in Vietnam, particularly upsetting poverty reduction efforts (Bruun & Casse, 2013; World Bank, 2017; Shrestha, & Trang, 2015). Over the past 20 years, climate-related disasters, such as storms, floods and droughts have caused the loss of over 13,000 lives, and an average annual loss of 1% of the GDP in Vietnam (Rocklöv et al., 2014).

Fully acknowledging the serious climate change impacts on the development of the nation, the Vietnamese government has joined and approved the UNFCCC and the Kyoto Protocol. In addition, the government has directed agencies to complete a system of legal documents, as well as approved policies in order to mitigate and adapt to climate change. According to the Socialist Republic of Vietnam (2011), to address climate change, several policy frameworks and programs were promulgated, such as: pro-actively responding to climate change, enhancing natural resource management and environmental protection (2013), Law on Natural Disaster Prevention and Control (2013), National Climate Change Strategy (2011), and National Target Programme to Respond to Climate Change (2008, 2012). The policy priorities to respond to climate change are comprised of: assessing vulnerability across sectoral, regional and community levels; enhancing the role of science and technology for adaptive solutions; broadening and increasing public awareness and participation; and integrating climate change into development strategies, plans, and programs in all sectors (World Bank, 2011). The following section reviews the specific impacts and practical examples of adaptation in key sectors, comprising various components which affect human livelihoods and well-being in Vietnam.

a. Impacts on agriculture and key adaptation strategies

Agriculture plays an important role in food security and poverty alleviation in Vietnam, as well as being an important sector of the Vietnamese economy, contributing about 18 % of the GDP (Food and Agriculture Organization [FAO], 2016). Cultivation of rice (the most important crop) is the livelihood of nearly 70% of farmers (World Bank, 2010). According to FAO (2011), Vietnam is the second-largest exporter worldwide and the world's seventh-largest consumer of rice. However, rice production in Vietnam has faced

several challenges, such as low soil fertility, salinity intrusion, and insect pest infestation, as well as unexpected impacts from climate change (Shrestha, Deb, & Bui, 2016). Studies show that climate change results in the increased intensity and frequency of floods, storms and droughts that damage crop production (IPONRE, 2009*;* Zhai & Zhuang, 2012*).* Yu, Zhu, Breisinger, and Nguyen (2010) projected that by 2050**,** Vietnam may lose 193,000 hectares of its paddy rice fields because of inundation, and 294,000 hectares due to salinity intrusion. Loss of rice cultivating lands could result in a decrease in rice production of about 2.7 million metric tons per year (based on 2007 rice yields), 0.9 million tons in the rainy season due to inundation, and 1.8 million tons in the dry season due to salinity intrusion (Yu et al., 2010).

Because of the significant contribution of the agricultural sector, especially in terms of food security and livelihood, global adaptation measures in the agricultural sector are highly focused on stabilizing and improving crop yields (Luo et al., 2013; Dharmarathna et al., 2014; Lizumi et al., 2011; Poudel & Kotani, 2013). General adaptation strategies have been carried out, including: altering the transplantation date (Shrestha et al., 2016; FAO, 2011), introducing supplementary irrigation (Shrestha et al., 2016; Deb, Tran, & Udmale, 2016; Shrestha, 2014; Thu et al., 2016; Yu et al., 2010), changing fertilizer application rates (Yaro, Lamai, & Oladimeji, 2005; Shrestha, et al., 2016; FAO, 2011), changing the number of fertilizer doses (Shrestha et al.,2016; FAO, 2011; Huan et al., 2005), and changing in cultivars (Nguyen et., 2014; Shrestha et al., 2016; FAO, 2011).

In specific regions, practical measures have been adopted based on climate-related disasters. For example, the Mekong Delta region is home to 22% of Vietnam's population, where it provides 40% of Vietnam's cultivated land surface and produces 50% of Vietnam's rice, 60% of its fish and shrimp harvest, and 80% of its fruit crop (Warner et al., 2010). Therefore, the Mekong Delta population directly depends on agriculture for its livelihood. However, this area is especially vulnerable because flooding damages their crops, which triggers a decision to migrate elsewhere to find an alternative livelihood during the flood season. This affects agricultural productivity and labour sources in the Mekong River Delta, as well as the total national rice export of Vietnam, given that 90% of Vietnam's total national rice export comes from the Mekong River Delta (Warner et al., 2010). To manage this problem, the Vietnamese national government has conducted a program known as 'Living with flood' to relocate people living in vulnerable zones along riverbanks. It is expected that approximately 20,000 landless and poor households will be targeted for relocation by 2020. Further, changing livelihood schemes have been implemented to save local people. An example is the

change from rice to fishery-based jobs. Migration and alternative livelihoods are considered reasonable adaptation strategies to cope with climate change in the Mekong River Delta. However, this leads to changes in social structures and the culture of the local people. This may cause stress and mental health impacts during and after flooding. Therefore, researchers have suggested that it is very important to relocate people to places with similar customs, lifestyle, and culture in order to mitigate psychological stress (Warner et al., 2010; Abery et al., 2009).

In the study site - Ha Tinh province - key climate-related disasters include storm surges, storm waves, heavy rain, inundation, severe cold, flash floods, and westerly winds, which adversely affect agriculture and food security (Oxfam, 2009; Shrestha et al., 2016). Climate change could cause a lack of fodder, water for cattle and irrigation purposes, and reduced crop yield and quality of the crops. To offset the negative impacts of climate change in the agricultural sector, Ha Tinh province has implemented several solutions, such as developing irrigation systems, changing crop and livestock systems to be more resilient to drought, applying modern technology in agriculture, developing appropriate livestock management plans, and establishing the sea dyke system in coastal areas (Oxfam, 2009; Shrestha et al., 2016).

b. Impacts on the coastal zone and key adaptation strategies

In its Fifth Assessment Report (AR5), the IPCC (2014) states “coastal systems and low-lying areas will increasingly experience adverse impacts such as submergence, coastal flooding, and coastal erosion” (IPCC, 2014, 17). Recent research has also indicated that sea level rise would increase the annual flooded area to about 18,000 km^2, affecting 44,000 km^2, while a 100cm rise in sea level would increase these figures to 40,000km^2 and 56,000 km^2, respectively (MONRE, 2010; World Bank, 2011). With rising sea levels, the Vietnamese coastal zone has faced higher risks of salinization of freshwater rivers and aquifers, increase in the intensity and frequency of storms and floods, as well as an exacerbation of coastal erosion. Sea level rise also puts coastal ecosystems in jeopardy. For instance, coral reef and seagrass are in danger of destruction, and many coastal species may lose their natural habitat due to mangrove clearance (MONRE, 2010; World Bank, 2011). Scholars also project that by 2100, between 3,600 and 11,000 km^2 of arable land would be lost due to coastal flooding. Loss of aquafarming regions is estimated to be from 128,000 to 345,000 km^2. Moreover, approximately 10% of the total embankment and 12% of the total number of industrial facilities may be submerged if the sea level rises by 100cm by 2100 (MONRE, 2010; World Bank, 2011).

Currently, Vietnamese coastal communities have been affected by climatic shocks and stresses including saline intrusion, erosion, floods, storms, typhoons, droughts, and sea level rise (Tam, Batelaan, & Beyen, 2016; Nguyen et al., 2017). These phenomena are becoming more prolonged, extreme in fluctuations, and are continuing to increase. From this, the researchers have suggested key adaptations for both government and residents, which address climate change. Specifically, it is necessary to improve environmental governance and provide more equitable support from local governments. First, maintaining and developing irrigation systems, changing crop and livestock systems to be more resilient to drought, and applying modern technology in agriculture are priorities to be adopted to secure livelihoods (Truong, 2010). Next, migration and relocation are considered as a livelihood diversification for local communities. Allotting budgets to build hard and soft infrastructure is also essential to minimize serious impacts and protect human beings from climate change (Truong, 2010). Particularly, building new sea dykes and dam systems is one of the most important activities to prevent floods and sea level rise. Finally, using local knowledge to predict disasters is considered as an important component of climate change adaptation in coastal zones. Local people can usually predict future hazards through experience in production and daily activities. These experiences are transferred from generation to generation. Making these predictions allows the local community to feel calm and better able to prepare for and mitigate disasters (Lam et al., 2006; Boateng, 2012).

c. Impacts on water and key adaptation strategies

Worldwide, water resources are under serious threat because of human intervention, such as growing domestic, industrial, and irrigation demands, as well as changing runoff patterns caused by climate change (Ty, Sunada, Ichikawa, & Oishi, 2012). It was reported that more than 700 million people in the world lack access to safe drinking-water, most in low-income countries (World Health Organization [WHO], 2016). In the year 2012, over 800,000 diarrhoea deaths were caused by inadequate water, sanitation, and hygiene practices worldwide (Ojomo & Bartram, 2016).

Vietnam has over two thousand rivers, eight river basins with a catchment area larger than 10,000km^2. However, due to exacerbation of rainfall variability, floods and droughts appear more often-causing water shortages, accessing unsafe drinking water, and diseases (Ojomo & Bartram, 2016; Tuyet-Hanh et al., 2016; Trinh et al., 2013). Further, sea level rise results in increases in inundation and saline intrusion in many rural

communities in the Central provinces and Mekong Delta region (World Bank, 2011). Currently, most Vietnamese rural residents do not have an opportunity to access a safe water supply. Some pilot communities have benefitted from the piped water project, but thirty percent of the population still cannot access this resource (World Bank, 2015). Water shortages seriously affect rice crops, which are the major livelihoods of nearly 70% Vietnamese population (World Bank, 2011). Thus, a limited water resource is one important component affecting the ability to recover from and adapt to climate change in many rural communities in Vietnam, especially in the agricultural sector.

In response to the impacts of climate change, the Vietnamese government has planned and undertaken priority adaptation to help improve water resources. For instance, from 2012-2015 the Vietnamese government invested $1.3 million to run a Rural Water Supply and Sanitation program in order to help improve water supply, sanitation and hygiene in all 63 provinces of the country (Ojomo & Bartram, 2016).

In Vietnam's Second National Communication to the United Nations Framework Climate Change Convention, the MONRE (2010) summarized the main adaptation strategies to help manage water resources and cope with water shortages as follows

- Planning for sustainable water resource development of all river basins and regions based on the national social and economic development planning.
- Strengthening and upgrading water resource infrastructure, including dams, reservoirs, drainage channel networks, irrigation systems, groundwater wells, and water tanks to improve operational efficiency and safety.
- Reinforcing and upgrading the existing system of river and sea dykes, flood diversion areas, flash flood relief channels, embankments for flood protection, and saltwater intrusion barriers. Beginning construction of new dykes and introducing new artificial drainage structures (pump stations) into low-lying plains and coastal flood-prone areas.
- Promoting water efficiency and conservation, and widely practise water-saving irrigation methods in agriculture, such as spray, and drip irrigation.
- Developing warning systems for flash floods and debris floods, with priority given to mountainous areas in Northern and Central regions).
- Raising public awareness of climate change impacts on water resources, improving water use efficiency and promoting the protection of water resources (MONRE, 2010, p.66-67).

d. Impacts on forestry and key adaptation strategies

There are about 25 million people living in or near forests in Vietnam (GFDRR, 2011). Out of this figure, the poorest sections derive their main source of income from and meet their basic needs using forest products. However, climate change is expected to increase rainfall variability and rainfall intensity, as well as to change temperature and humidity profiles. Therefore, Vietnam has faced a serious risk of droughts and bush fires (World Bank et al., 2011). Recent studies in relation to the forestry sector reported that rising sea levels, higher temperatures, unpredictable rainfall and extreme climatic events would influence the boundaries of forests, the distribution of species and biodiversity. It also predicted that the risk of fires, pests and diseases in forests would increase due to climate change (MONRE, 2010; World Bank et al., 2011). MONRE (2010) also predicted that by 2010 Vietnam's natural forest ecosystems would shrink, with tropical forests being the most vulnerable to climate change.

While many studies have been undertaken to address climate change in forestry sectors around the world (Muller et al., 2011; UNFCCC, 2008; Brown, Grais, Ambagis, & Pearson (2012, Locatelli, Pavageau, Pramova, & Di Gregorio, 2015), there are still few studies on mitigation and adaptation in forestry sectors in Vietnam (Hoa, Hasegawa, & Matsuoka, 2014). However, studies show that improvement of sustainable forest management is an urgent need to respond to climate change (Simelton & Dam 2014; Hoa et al., 2014; Simelton, Dam, & Catacutan, 2015). The key adaptation measures to address impacts of climate change in the forest sector in Vietnam include:

- Strengthening sustainable forest management and development, emphasizing afforestation and reforestation and preventing deforestation, to reduce forest ecosystem vulnerability and increase forest coverage.
- Conducting research to select and diversify plant species resistant to droughts, floods, and pests and less prone to causing forest fires. Establishing genetic conservation plans and gene banks.
- Developing a forest fire control and management program, and strengthening infrastructure for fire forecasting, warning and control.
- Improving timber-use efficiency, and developing timber and non-timber product processing technologies.
- Carrying out coastal mangrove forest restoration and development projects, planting protective dune forests (soft dykes) and implementing other forest development components of sea dyke projects.

- Supporting livelihoods and improving living conditions for people living near forests (MONRE, 2010, p79-80).

e. Impacts on human health and key strategies

It is argued by scholars that health and well-being are always determinate factors for development in each society (Lucia-Casademunt, Ariza-Montes, & Morales-Gutiérrez, 2013). There is some evidence that people have experienced an increase of injuries and ill health driven by changing weather patterns, climate extremes, and climate change (Rocklöv et al., 2014). Particularly in Vietnam, climatic hazards, such as typhoons, tropical cyclones, and droughts, exacerbate health risks for local populations (Phung et al., 2015). For example, accident and injury caused by exposure to vectors and pathogens, psychosocial effects, impacts on healthcare services and impacts on food supply are possible consequences of climate change in Vietnam. Furthermore, floods and typhoons have resulted in an increased risk of diarrhoea in their wake (Phung et al., 2015; Few, Pham, & Bui, 2004), and even more children were seen to contract this disease due to consuming unsafe river water without boiling it (Few et al., 2004).

In order to offset the negative impacts of climate change on human health, a few adaptive practices have been undertaken in affected areas (Toan et al., 2014; MONRE, 2010; Nguyen, 2009). One of the most important strategies employed in many Vietnamese communities is raising awareness. Local residents have been educated to protect their health after disasters by being given advice on how to render water safe, protect food, maintain a sanitary environment, and control mosquito-breeding sites. Leaflets, posters, loudspeaker announcements, community meetings, and visits by local health workers have become a prevalent method of communication (Toan et al., 2014; Few et al., 2004; Nguyen, Miller, Bowen, & Tan Sinh, 2017).

It is clear that climate change has an adverse influence on the Vietnamese population across many sectors. In acknowledgement of those impacts, the Vietnamese Government has cooperated with organizations, institutions, and independent stakeholders to employ several practical measures to help locals offset the impacts of climate change. Similar to global strategies, Vietnam has proposed and undertaken both physical and educational solutions to address climate change. However, current studies point out that the ability of Vietnamese communities to respond to climate change is still relatively weak, especially in rural areas (Oxfam, 2009; USAID, 2011). The following

section reviews some of the main components of community capacity that influence its ability to adapt to climate change in Vietnam.

2.4 Some main components of community capacity influencing ability to adapt to climate change in Vietnam

Community capacity refers "the collective ability of community members to: respond to external and internal stress; create and take advantage of opportunities; and meet the diverse needs of members" (Kusel, 1996, p.369 cited in Mendis, Mills, & Yantz, 2003, p.6). At the community level, four primary types of community capacity have been identified. These include ecological capital (natural resources, environmental services), economic capital (finance, infrastructure), human capital (formal and informal education, job experience, health, traditional and naturalized knowledge and so on), and social capital (norms, culture, and social network) (Pitzer & Streeter, 2016; Kwon, Heflin, & Ruef, 2013; Bowles, & Gintis, 2002; Kai & Slam, 2016; Mendis et al., 2003). In the context of climate change, assessing community capital is an attempt to determine a community's ability to reduce its vulnerability while increasing its resilience and adaptation to the impacts of climate change (Mendis et al., 2003). This research will assess the economic, infrastructure, and human capital capacity of Vietnamese communities to adapt to climate change.

Economic capacity is one of the strongest determinants of adaptation capacity (Adger, 1999; Williamson et al., 2012). Economic wealth from an individual level through to a national level affects the ability of communities to address climate change (Mendis et al., 2003; Adger, 2003; Adger et al., 2004). The IPCC (2007) noted that the more economically impoverished the community, the more limited their adaptive capacity to cope with climate change. Vietnam, at the beginning of the 1980s, was one of the world's poorest countries (World Bank, 2000). Since the *Doi Moi* [renovation], this nation has shown remarkable progress in poverty alleviation and has, as a result, shifted its status to that of a lower middle-income country (World Bank, 2013; Kang & Imai, 2012). However, approximately 14 million people in rural Vietnam were still estimated to be poor in 2006 (Kang & Imai, 2012). Many studies have shown that a significant proportion of Vietnamese rural households are often the most exposed and sensitive to climate change (Fortier, 2010; Adger, 1999; Rubin, 2004; Arouri, Nguyen & Youssef, 2015). This is due to their livelihoods, which are mainly derived from agriculture, aquaculture and fishery, which are all dependant on natural resources and climate conditions (Adger, 1999; Tran, 2015; Rossing et al., 2010; Shaw, 2006). As a result, Vietnamese

households have difficulties in adapting to alternative livelihoods after climate shocks, especially in the case of poverty (Fortier, 2010). In other words, the limited economic conditions of Vietnamese communities result in a low level of adaptive capacity to cope with the impacts of climate change.

Infrastructure is also an important resource that helps a community to recover in post-disaster periods and adapt to climate change (Mendis et al., 2003). A lack of flexibility in infrastructure may contribute to a reduction in the capacity of a community to respond to climate change (Tran, 2015; Mendis et al., 2003). Since the late 1980s, Vietnamese agriculture has been growing steadily, and this has been the foundation of Vietnamese reform. This growth trend has changed Vietnam's rural context, and rural infrastructure, such as houses, roads, schools, and hospitals, have subsequently been constructed. Numerous markets, industrial zones, urban zones, entertainment districts, and tourist facilities have been established and are now run in the countryside. However, due to the impacts of flooding, and changes in temperatures and precipitation, the combined damage cost estimates specifically for road infrastructure e during the period 2010-2050 is predicted to be between US$3.6 billion and US$7.2 billion (Chinowsky, Schweikert, Strzepek, & Strzepek, 2015). Chinowsky et al. (2015) also projected that 19,000 kilometres of national roads in Vietnam, which is equivalent to 12 percent of existing road stocks, would be destroyed during 2010-2050 because of sea level rises. Repairs to these damaged roads would cost approximately US$2.1 billion (Chinowsky et al., 2015). Housing is also often considered one of the most vulnerable sectors due to climate change in Vietnam. In Vietnam, houses in coastal communities were destroyed by floods and storms, the most common kind of disaster, due to limited financial capacity to strengthen houses (Tran, 2015). After a disaster, families with damaged houses become poorer due to the huge amount of expenditure required to repair or rebuild houses. Some of these households become indebted and unable to escape from poverty due to consequences of disasters (Tran, 2015; Tong, Shaw, & Takeuchi, 2012).

Human capital refers to the skills, education, experiences, and general abilities of individuals (Mendis et al., 2003). Various aspects of this resource in the community are necessary for building up resilience and adaptability to combat climate change. However, acquisition and dissemination of current climate change information is extremely important for successful recovery and adaptation (McDaniels, Axelrod, & Slovic, 1996; O'Connor & Bord, 1999; Marshall et al., 2013). Skilled and trained personnel also contribute to improving adaptation. Specific knowledge and skills are needed for makings decisions about the range of options for appropriate adaptation to

the potential impacts of climate change in the community (Mendis et al., 2003; Dang et al, 2014). The data obtained by the Gallup World Poll, conducted in 2007 and 2008 from nationally representative samples in 119 countries, reported that the majority of participants in developing countries, including Africa, the Middle East and Asia, had never heard of climate change (Pugliese & Ray, 2009). In a study of farmers' perceptions of the risks of climate change and its causal factors in Vietnam, the result indicated that interviewed farmers possessed a low overall perception of climate change risks (Dang et al., 2014). Similarly, Few & Tran (2010) suggested that many Vietnamese Mekong Delta farmers possessed a low level of perception of the specific health risks posed by climate change. Rubin (2014) also provided evidence that poor communities in Vietnam appear to suffer from a lack of access to and knowledge of formal institutions in times of crisis. Specifically, a survey in 2009 based on 25 communities in a central coastal province revealed that communities were often unaware of national policies and procedures related to disaster preparedness and planning that were formulated at the community or commune level (East Meets West, 2009 cited in Rubin, 2014). The results conclude that a low level of knowledge about climate change is one of the most important barriers to addressing climate change in rural Vietnam (Dang, 2014; USAID, 2011; Adger, 2005).

2.5 The relationship between human capital and adaptive capacity to cope with climate change

As discussed, adaptive capacity is the ability of a system to adjust to climate change in order to minimise potential damage, take advantage of opportunities or cope with the consequences of climate change impacts (IPCC, 2001). Adaptive capacity can be viewed as the specific application of a community's capacity to obtain a certain outcome, addressing the question: "What is the capacity needed to adapt to climate change?" (Mendis et al., 2003).

It is clear that building the ability to adapt to climate change requires specific attention to most aspects of a community's resources, including economic wealth, social capital, and human capital. While improvements to the economy and its infrastructure determine the capacity to prepare and undertake actions in households and communities in order to respond to climate change, these measures require significant time and financial capital (Hoffmann & Muttarak, 2017). By contrast, investing in human capital through the provision of information, skills and education is necessary for building adaptive capacity and is a cost-effective approach (UNICEF, 2012; Vo et al., 2013). As one important

component of community capacity, human capital contributes to enhancing adaptive capacity to cope with climate change for the following main reasons:

Firstly, a range of knowledge obtained from community residents is needed for making decisions on the potential impacts and consequences of climate change, as well as a range of options for adaptation, including strategies and methods to implement and assess their effectiveness.

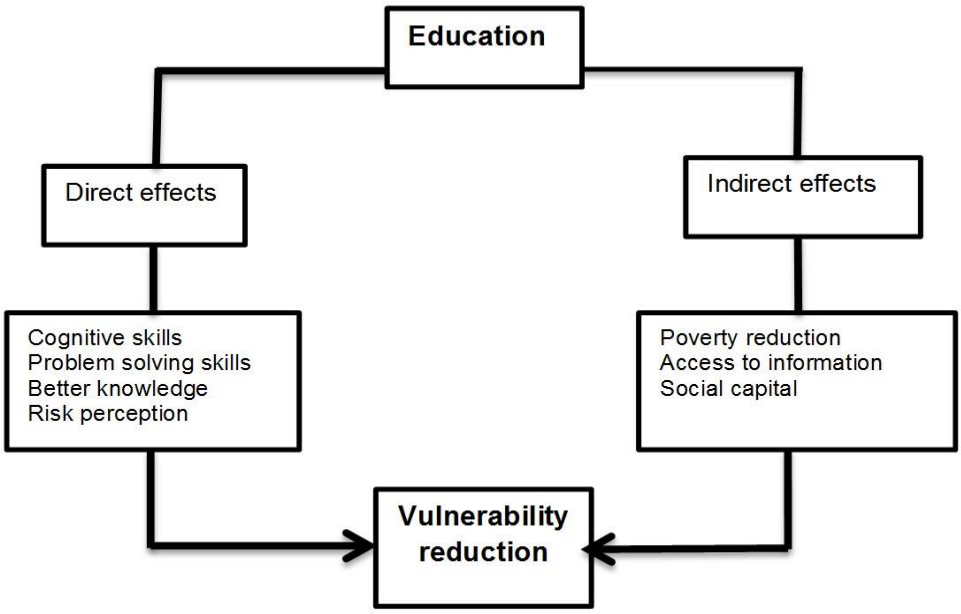
Secondly, a range of skilled and trained personnel also improves adaptive capacity due to the expertise held by community members. As discussed, the combination of a low level of awareness and poverty has been identified as a key determinant of low adaptive capacity in several Vietnamese rural communities (Mendis et al., 2003). Therefore, it is necessary from a diverse set of local people whose experience can contribute to greater understanding.

Thirdly, education (one of the key components of human capital) influences the ability of communities to address natural environmental change by enhancing the potential for livelihood diversification, as well as the basic knowledge to inform community preparation in coping with climate change (Tobin, 1999 cited in Mendis et al., 2003). Furthermore, transmission of knowledge between generations widens the ability of subsistence resource users to plan and implement adaptation strategies.

Finally, it is also crucial that all stakeholders and decision makers share information and ideas, so that education will better comprehend what climate change is, what adaptation measures are possible, and how to build and maintain the capacity to adapt to climate change (Mendis et al., 2003).

To sum up, human capital, including education and information, can not only provide people with knowledge, skills, attitudes and motivation, but can also help to reduce the harmful impacts of society on the environment and to preserve the planet for future generations (Cutler & Lleras-Muney, 2010; Melnychuk, Pidlisnyuk, & Stefanovska, 2003). Lutz, Muttarak, and Striessnig (2014) argued that public investment in education, especially in developing countries, should be seen as a priority for enhancing adaptation to climate change. Figure 1 shows how Muttarak and Lutz (2014) displayed the process through which education contributes to reducing the vulnerability of communities to the impacts of climate change.

Figure 1 Flowchart displaying the process through which education contributes to vulnerability reduction



Muttarak & Lutz (2014, p.42)

According to Muttarak and Lutz (2014), education plays a crucial role in decreasing the negative impacts of climate change in both direct and indirect ways. Formal education is considered primary among the direct ways by which people obtain skills, knowledge, and perceptions that can contribute to their adaptive capacity. High awareness of the risks of climate change associated with education may thereby contribute to implementing actions to help reduce vulnerability. Indirectly, education helps to increase socio-economic resources, improves the ability to access information and builds social capital. As a result, education can reduce the vulnerability and increase the adaptive capacity of a community (Muttarak & Lutz, 2014).

2.6 The roles of education in building adaptive capacity to cope with climate change?

Climate change is “undoubtedly the most serious environmental crisis Earth has ever witnessed” (Sujatha & Chella, 2009, p.134). Climate change affects almost all economies, societies and habitats, as well as threatening human life. Because of this fact, many nations conduct several strategies aimed at minimizing the impacts of climate change. Along with physical, technological, and financial solutions, education is a

strategy being employed worldwide. It is recognised as a crucial first step in increasing awareness, and plays a key role in a holistic response to climate change at local, national and global levels (Bonifacio, Takeuchi, & Shaw, 2010; UNFCCC, 1992). Education is identified to be a key global adaptation strategy to cope with climate change because of the following reasons:

a. *Raising awareness about climate change is a policy priority declared in the United Nations Framework Conventions on Climate Change (1992) and in the Convention's Kyoto Protocol (1998)*

By 1992, the United Nations Framework Convention on Climate Change (UNFCCC) acknowledged "that change in the Earth's climate and its adverse effects are a common concern of humankind" (p.1) and highlighted in the Article 6 and Article 10(e) in the Convention's Kyoto Protocol (1998) that the requirements of climate change education are as follows:

Article 6: Education, training and public awareness:

(i) The development and implementation of educational and public awareness programmes on climate change and its effects;

(ii) Public access to information on climate change and its effects;

(iii) Public participation in addressing climate change and its effects and developing adequate responses; and

(iv) The training of scientific, technical and managerial personnel.

(v) Cooperation and promotion at the international level, and, where appropriate, using existing bodies:

(vi) The development and exchange of educational and public awareness material on climate change and its effects; and

(vii) The development and implementation of education and training programmes, including the strengthening of national institutions and the exchange or secondment of personnel to train experts in this field, in particular for developing countries (UNFCCC, 1992, p16).

Article 10 (e): Kyoto protocol to the United Nations Framework convention on climate change

Cooperate in and promote at the international level, and, where appropriate, using existing bodies, the development and implementation of education and training programmes, including the strengthening of national capacity building, in particular human and institutional capacities and the exchange or secondment of personnel to train experts in this field, in particular for developing countries, and

> facilitate at the national level public awareness of, and public access to information on, climate change. Suitable modalities should be developed to implement these activities through the relevant bodies of the Convention, taking into account Article 6 of the Convention (UNFCCC, 1998, p.10).

It is clear that implementation of education projects to increase awareness of climate change, including formal and non-formal education channels is an urgent need in countries (UNFCCC, 2012). Climate change education should be a part of the official curriculum in developed countries and developing countries. Furthermore, climate change education in the community levels play an crucial role in developing capacity to cope with climate change for many countries.

b. Global technological, financial, and physical solutions are insufficient to respond to climate change

As discussed above, global climate change manifested by rising average temperature, melting of snow and ice, and rising sea levels affects all countries, but poor communities and nations are especially vulnerable to its negative effects (Kerr, 2007; Sharma, 2011). Societies around the world have discovered how to minimize and manage some impacts of climate change (Sharma, 2011). Several practical adaptation measures have been adopted including technological, financial, and physical strategies (Lutz et al., 2014; Sharma, 2011; Muttarak & Lutz, 2014). There is also a widespread belief in the ability of science and technology to develop solutions that will control climate change (Leiserowitz, 2007). However, many scientists and social scientists argue that, while technology, financial incentives, and physical solutions will help and continue to be required, it will take much more than these solutions to tackle climate change entirely (Sharma, 2011; Shaw & Rouhban, 2005; Lutz et al., 2014, Muttarak & Lutz, 2014). Despite the important role of technological and financial policies, wider structural, cultural, perceptual, behavioural and ideological shifts are also essential to help humans adapt to climate change. Transformative shifts in how people think and act, and how people relate to present and future generations are necessary to respond to climate change. This is where education plays a key role (Mochizuki & Bryan, 2015).

According to Sharma (2012), education is essential for any plan to meet the challenges of climate change. In other words, education is a critical element of the response to the challenges of climate change, both as formal and non-formal education and from primary through to tertiary and adult education (Bangay & Blum, 2010). This is also argued by

Amanchukwu, Amadi-Ali, and Ololube (2015), who state “education is an essential element of the global response to climate change. It helps young people understand and address the impact of global warming, encourages changes in their attitudes and behaviour, and helps them adapt to climate change-related trends” (p, 73). Further, education is one of the most common tools for sharing knowledge among children around the world, whereby it can be transformative. Through cultivating and shaping values and behaviours, education can contribute to building the resilience of the most vulnerable populations (The United Nations Children's Fund [UNICEF], n.d).

c. Education is a cost- effective approach

Another important reason why education should be undertaken as part of a climate change solution is because it is a cost-effective approach to dealing with climate change (UNICEF, 2012; Vo et al., 2013). It has been suggested that over the coming decades, enormous amounts of financial capital will likely be spent on climate change via technology and physical solutions to its challenges (Lutz et al., 2014; Muttarak & Lutz, 2014). In particular, during the period from 1991-2010, Vietnam received roughly $331,000 million in disaster risk reduction funding from the international community (http://www.give2asia.org/disaster-preparedness-and-resilience-myanmar-1-1). Despite large financial investments in many regions, people still face a high level of uncertainty about climate change impacts (Lutz et al., 2014). Therefore, scholars suggest that it may be more efficient and effective to spend part of this budget on education, rather than other solutions, to help respond to climate change (Lutz et al., 2014; Sharma, 2011; Mochizuki & Bryan, 2015; McNamanra, 2013; Wibeck, 2014). Further, it was argued that education in schools is an inexpensive and effective route to awareness and preparedness to cope with climate change (Finnis et al., 2004; Izadkha & Hosseini, 2005 cited in King & Cottrell, 2007).

2.7 The connection between awareness and behaviour change in terms of climate change adaptation

There is a link between awareness and actions to cope with climate change because “building capacities to cope with climate change required going beyond simply providing ‘more knowledge’ on climate impacts to policy makers” (Tabara et al., 2010, p.1). McNamara (2013) explained that raising the awareness of community members is an important component of climate change adaptation in guiding community decision making and planning, encouraging changes in attitudes and behaviours, as well as

enhancing adaptive capacity to cope with climate change. Further, raising climate change awareness can be conducted by several educational methods, such as workshops and training; communal storytelling; art, poetry and song competitions, as well as using books and movies (McNamara, 2013). Vize (2012) provided evidence of behaviour change through raising awareness in the Pacific Islands. It is evident that people living on the Pacific Island coast have faced the negative impacts of rising sea levels. However, improving knowledge for community members has contributed to increasing their capacity to be resistant to the risks and impacts posed by climate change. Moreover, climate change education is crucial to equipping today's students with the necessary knowledge and skills to face potential climate change impacts in the future (Vize, 2012).

Mochizuki and Bryan (2015) claimed that climate change education is a process aimed at enhancing "the degree to which an education system is prepared for, and is responsive to, the challenges of climate change" (p.5). As a result, a model of understanding the systemic effects of climate change (showing climate change trends, potential adverse effects on human life, and implications for children's rights) was designed and conducted in a pilot study. The model particularly emphasised when people acquire new knowledge and skills which primarily cause behavioural changes in order to help manage the risks and vulnerabilities related to climate change, thereby building adaptive capacity and resilience in societies (Mochizuki & Bryan, 2015; Paton & Johnston (2001). The model also recommended that there was an urgent need for policy makers to better understand this model in order to enhance climate change responses through education. Similarly, Anderson (2012) stated that new knowledge and skills play a crucial role in changing behaviour in order to reduce vulnerability, manage the risks of climate change, alter consumption, and build adaptive capacity and resilient societies. Anderson (2012) also emphasised that the promotion of multi-stakeholders in social learning, empowerment of communities and encouragement for citizens to change behaviour would create a future sustainable environment. Furthermore, the participation of communities, especially children and youth, was one of the most important components of climate change education (Anderson, 2012).

2.8 An educational provision is proposed as an approach to enhance adaptive capacity to cope with climate change in a coastal Vietnamese community

The literature review has revealed that education is an important strategy to help minimize and adapt to climate change worldwide. Climate change education has been adopted not only in many developed countries but also in developing countries (Lotz-

Sisitka, 2010; UNESCO, 2012, Ashtiany, 2005; UNESCO, 2015). Many researchers showed that although climate change information is now readily available, this nation does not appear willing to effectively address climate change due to “lack of public understanding of climate change issues and opportunities for effective responses” (Forrest & Feder, 2011, p1). Therefore, the need for climate change education can affect all society from broad societal action to the household level, especially effective education on human and behavioural dimensions of climate change (Gardner & Stern, 2008; Forrest & Feder, 2011). In developing countries, such as Nigeria, studies also showed that levels of awareness about climate change are low and are likely to remain without educational intervention (Akpomi & Vipene, 2016). Similar to Vietnam, a large percentage of Nigerian livelihoods depend on natural resources, which are particularly vulnerable to climate change (Akpomi & Vipene, 2016). However, Nigerians are unaware of what climate change is and its impacts (Akpomi & Vipene, 2016). Therefore, it was recommended that education is one sustainable way to build a community’s capacity for climate change mitigation and adaptation (Akpomi & Vipene, 2016).

Regarding Vietnam, education and training to enhance awareness and change behaviour to adapt to climate change is one of the priorities of policy (Socialist Republic of Vietnam, 2011). Recognizing the potential impacts of climate change, Vietnam “signed the UNFCCC in 1992 and ratified it in 1994; signed the Kyoto Protocol (KP) in 1998 and ratified it in 2002” (UNFCCC, 2017, p.1). In the report of the Second National Communication submitted to the UNFCCC Secretariat (2010), MONRE (2010) reported that Vietnam had yet to establish a national climate change education and training program at formal education levels. However, in terms of informal education levels, a series of short courses for climate change were held across the country at the national and local levels. Furthermore, MONRE (2010) confirmed that Vietnam would make an effort to increase education and raise public awareness in coming periods. To achieve this goal, the Ministry of Education and Training [MOET] combined with UNESCO and Samsung Company (2013) launched a $1 million for education system in response to the challenges of climate change. Ministry of Agriculture and Rural Development [MOARD] also declared in its action plan framework for mitigation and adaptation of climate change that training human resources and raising awareness are focused responsibilities to help climate change mitigation and adaptation during the period 2008-2020 (MOARD, 2008). According to UNESCO (2015), Vietnam is developing an innovative e-learning training course on CCE in line with the current teacher training strategy targeted at all teachers, lecturers, and school students. Moreover, Vietnam has approximately 40-50 non-government organizations [NGOs], which have been working in Vietnam to help educate community residents about climate change adaptation,

especially with regards to flood-related disasters (http://www.give2asia.org/disaster-preparedness-and-resilience-myanmar-1-1).

It is clear that the Vietnamese Government acknowledges the important role of climate change education, promulgated frameworks, and has undertaken initial actions to help awareness of climate change. However, education, training, and public-awareness raising about climate change in Vietnam involves several challenges, including:

- Climate change education, training and awareness-raising plans and programs are unavailable at the national level.
- Higher-education curricula and content remain in the pilot stage. There is no course material available at the primary and secondary education levels
- The dissemination of basic information on climate change relies on efforts by specialised bodies, NGOs and international collaborative projects. Public awareness raising has therefore been limited, reaching only select agencies and provinces.
- Awareness-raising activities remain campaign-like rather continuous projects and are yet to be permanent fixtures in mainstream media programs (MONRE, 2010, p.127).

In terms of gender context, climate change affects women's lives in many ways and its impact on women is worse than men (United Nations Vietnam [UNVN], 2009; Tran, et al., 2016). Vietnamese women and girls are disproportionately affected by the climate change impacts, potentially due to their greater dependence on the agricultural sector (UNVN, 2009; Tran et al., 2016). Many rural women in Vietnam are concentrated in the agricultural sector, which is highly affected by weather conditions, while men are able to migrate for work outside the agricultural sectors (UNVN, 2009). However, Vietnamese women and girls also have access to fewer opportunities than men to obtain jobs when they are away from farms (UNVN, 2009). Lower levels of education, limited access to warning information, and less decision-making power in the households are also important factors which exacerbate the vulnerability of Vietnamese women to climate change (Dankelman, 2010). The above review shows that in many parts of the world, including Vietnam, climate change has a greater impact on women than men (Dalton, Ong, Minh Hac, & Thanh Nghi (2002); World Bank, 2011). For this reason, education is needed to encourage the participation of women in these efforts in order to better understand and prepare for actions to cope with impacts of climate change, especially as Maddison (2007) has found that female farmers' awareness of climate change is important for their adaptive decision making.

Due to an urgent need of enhancing climate change adaptive capacity, an educational intervention for Vietnam coastal community members is proposed in this research. In order to conduct an effective educational intervention, it is virtually necessary to build a specific CCE curriculum, especially at a community level. The curriculum of the project was established based on current locals' knowledge and behaviour about climate change, which informed from the baseline data in the earlier step.

In terms of methodology, the CCE proposal project used constructivist teaching methods. Based on review nations' experience, climate change education has paid much attention to learners' participation by using various methods, such as media tools, colouring, sharing experience, discussion, posters, handprint materials, and group work. Constructivism proposes that learners build their own knowledge and understanding of the world through their experience and reflecting on that experience (O'Donnell, Dobozy, Bartlett, Bryer, Reeve, & Smith, 2012). In the classroom, the constructivist view means that learners are encouraged to use active ways to create knowledge and understanding, and then reflect upon their thoughts.

Additionally, the teachers ensure their students' preexisting concepts are examined and questioned; then they guide them to address and build their own new knowledge (O'Donnell et al., 2012). Under the teacher's encouragement, students use their previous experiences and then gradually develop their abilities to integrate new information. This method brings numerous benefits for learners. Firstly, learners learn more and enjoy learning more because they are actively involved, rather than passive listeners. Secondly, constructivism focuses on thinking and understanding, rather than memorization. Thirdly, by active learning and thinking, the students are more likely to maintain, transfer, and apply their knowledge to real life. Finally, constructivism enhances learners' cooperation and exchange of ideas, which is essential in making successes in real life (O'Donnell et al., 2012).

The constructive view of learning is an appropriate tool to apply in the educational intervention in the Vietnamese small coastal community due to the following reasons:

- The learners in this community are mostly adults: farmers, teachers, and local government staff members. Thus, they will be more interested in learning through the exchange of ideas and group work, rather than listening to lecturers, and focusing on textbooks.

- The main goal of this project is to enhance the knowledge and adaptation for local residents to address climate change through a community education program. Thus, strict adherence to a fixed curriculum is not appropriate because learners' questions must be pursued. An open-curriculum will encourage adult learners' active participation.
- In the study site community, many farmers might not have progressed beyond a primary level education and may be illiterate, so the teachers who try to seek correct answers to validate student learning may face difficulties. It is practical and necessary for the teacher to seek the learner's points of view in order to identify students' present understanding to use in subsequent lessons.
- Through application of constructivist teaching strategies, the teacher will guide and provide community members with the first bricks of climate change knowledge. Afterward, by cooperation, exchange of ideas, and active learning, community residents will obtain for themselves new knowledge and skills in order to retain and use in day-to-day life.

It is clear that an educational intervention using constructivist teaching methods must to be conducted in this study. However, an intervention alone is not enough. It is important assess whether as a result of the climate change education participants enhance their awareness and behaviour to adapt to climate change. Therefore, it is necessary to evaluate each stage of the intervention as a means to measure the success of the program in increasing awareness and knowledge and in bringing about behavioural change. This study proposes a three-phase research project, comprising of a baseline survey, an intervention, and an evaluation. A baseline survey will be conducted before undertaking an educational intervention aimed to measure current level of awareness and behaviour to address climate change from participants. The data obtained from the baseline survey will help to direct an appropriate intervention based on socio-economic demographics and local knowledge about climate change. The evaluation phase is critical to testing the effectiveness of the intervention program. It is anticipated that surveys, field observations, and semi-structured interviews will be employed in the three phases of the project.

It is proposed that the key purpose of intervention was to enhance perception and awareness as well as prepare actions to mitigate the causes of climate change and adapt to the consequences of climate change impacts for a targeted community. Thereby, this intervention stemmed from an overview of climate change consequences and the limitation of adaptive capacity, as well as the acquisition of previous educational

provision provided in the literature review. Further, findings from the baseline research were proposed to provide a knowledge foundation which would develop the intervention program. In alignment with theoretical frameworks, the development of this educational intervention was proposed, as below:

Enhancing climate change understanding for community participants by providing climate change science education to learners. The materials covered a range of topics including:

- What is climate change?
- What is the evidence of climate change in Vietnam and globally?
- What are the impacts of climate change?
- What are greenhouse gases?
- What are the “greenhouse effect” and “global warming”?
- What human activities cause climate change?

Enhancing awareness, attitudes, and ability to mitigate the human causes of climate change, which was predicted to facilitate adaptation. The climate change mitigation strategies focused on were those relevant to people who live in rural and coastal areas:

- Using effective cooking stoves
- Tree management
- Minimizing the carbon footprint of transportation
- Usage of sustainable shopping bags and avoidance of plastic disposable bags
- Electricity use
- Recycling
- Reducing meat consumption
- Waste water and livestock management
- Minimizing the carbon emissions of agricultural activities

Enhancing actions to adapt to specific climate events in the study site:

- Sea level rise
- Annual storms and floods
- Droughts and water shortages

The content of this proposed educational model illustrated the understanding and attentiveness aspects in creating a clear awareness to climate change. This was necessary because of the threats of climate change to large populations as well as widespread misconceptions about climate change. At the same time, the mitigation aspect was about identifying the causes of climate change and the development of knowledge, skills and actions for individuals and society. Finally, the adaptation aspect involved improving knowledge, skills and dispositions to better face looming climate

impacts. It is vital that adaptive education combined technical strategies and indigenous knowledge.

In terms of method, a constructivist approach to teaching was proposed to be applied in this educational program. This would meet the requirements of the educational level of participants as well as contribute to building knowledge and skills through self- social relationships.

Regarding the development of the evaluation survey, the post-intervention phase aimed to assess levels of community attendees' awareness, actions to mitigate the causes of climate change, as well as plans and actions to adapt to climate change after the educational intervention had been conducted. Thereby, evaluation questions were developed based on the content of the intervention program, which needed to meet the required standard as follows:

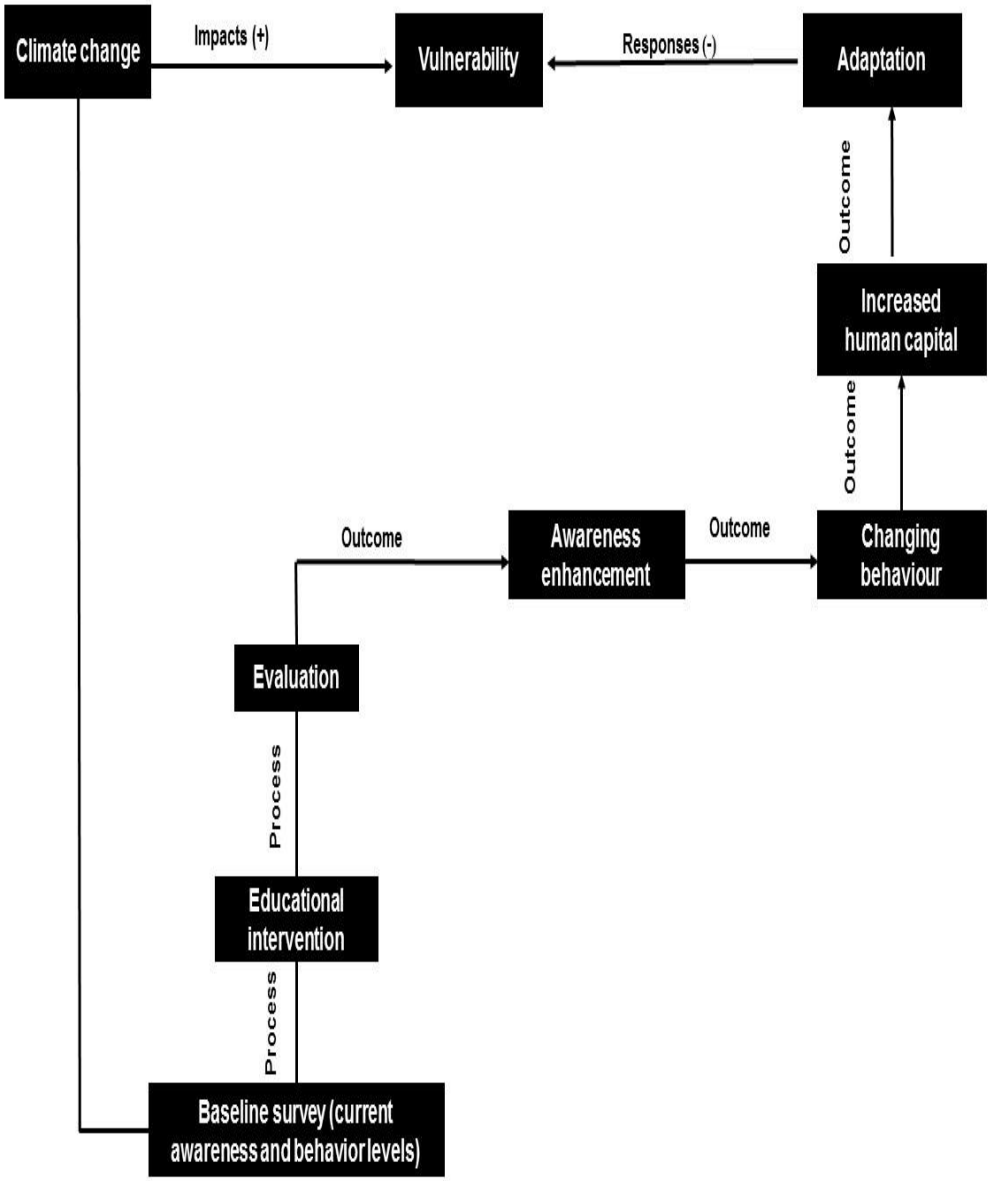
a. Identify any changes of perception in climate change knowledge
b. Identify attitudes and actions to mitigate climate change causes
c. Identify actions intended to adapt to climate change
d. Identify actions intended to broaden knowledge and actions to mitigate and adapt to climate change

2.9 Conclusion and research question

The scholarly literature demonstrates that climate change is a phenomenon spread across regions and time (Kagawa & Selby, 2010). We thus face a number of problems (including food safety, poverty, health, water shortage and so on), complicated by uncertainty about when and where the impacts of climate change will fall (Kagawa & Selby, 2010; Anbumozi et al, 2012; UNFCCC, 2008). Awareness of climate change is relevant to understanding the problem and plays a crucial role in the adaptation decision-making process (Ojomo & Bartram, 2016). Hamin and Gurran (2015) argued that by increasing awareness of climate change, policy-makers, the public, and other stakeholders become engage and allocate resources to find solutions for addressing climate change. Raising awareness is, thus, one of the foundational factors and central to discovering effective measures to adapt to climate change (Antwi-Agyei et al., 2012; Biesbroek et al., 2013; Moser et al., 2008; Glavocic, 2015). In other words, there is a need for educators and policy-makers across all nations to urgently and rationally think through the implications of responses to climate change (Kagawa & Sellby, 2010; Lutz et al., 2014). Wherever it takes place, climate change learning and action within school and community contexts are urgently needed to protect current and future generations

(Kagawa & Sellby, 2010). A framework that has emerged from this thesis aims to build climate change adaptation as shown in Figure 2. The impacts of climate change cause vulnerability within affected areas, and actions to respond to climate change and reduce these vulnerabilities urgently need to be implemented. An educational intervention will be employed and evaluated as an effective strategy to increase human capital, thereby enhancing climate change adaptation in the targeted community members

Figure 2 An education approach for enhancing climate change adaptation



The Thinh Loc community is located in Central Vietnam on the coast. Thinh Loc has poor economic conditions, and has suffered from climate change impact over recent decades (Nguyen, 2011). In other words, the Thinh Loc community's resources are insufficient and ineffective to address climate change. This literature releveled that while financial investment requires more time and money, raising awareness through an

education program is essential and cost-effective to help locals enhance their ability to adapt to climate change. Within Vietnamese rural communities in general, and Thinh Loc community in particular, family ties remain central to social networks for many individuals, and respect for parents is virtually universal (Dalton et al., 2002). Social connection through friendship and a network of neighbours is also strong within the Vietnamese rural community (Hoang, Castella, & Novosad, 2006). This indicates that community residents are likely to exchange, observe, and learn information from others within their community (Hoang et al., 2006). Therefore, the close relationship among individuals is one of the most important indicators for support broadening knowledge and adaptation within Thinh Loc community.

Raising awareness about climate change in coastal Vietnamese communities is urgently needed. This helps to reduce the impacts of climate change and to enhance the community's ability to adapt to climate change. The research questions arising from this review might be addressed by identifying the means to increase Thinh Loc community residents' capacity to adapt to climate change. The purpose of the study is encapsulated in the primary research question: *Can an educational program enhance Thinh Loc community members' adaptive capacity for the Thinh Loc community to cope with climate change?*

To address the key research question, two sub-research questions emerge:

- Question 1: What is the current level of awareness and ability to adapt to climate change in the Thinh Loc community?
- Question 2: Does evaluation of awareness and behavioural change indicate effectiveness of education as a strategy to increase climate change adaptive capacity of the Thinh Loc community members?
- Question 3: May this educational intervention become a model for replication in other Vietnamese coastal communities?

Chapter Three describes in detail the specific methodology that will be employed in addressing these research questions.

CHAPTER THREE: METHODOLOGY

3.1 Introduction

As mentioned in Chapter Two, there are various strategies for adapting to climate change worldwide. Climate change education has been identified as a strategy to help coastal Vietnamese communities to adapt to climate change. Several key climate change education programs worldwide have been reviewed, which can be used to guide this research and deal with the key research question being posed: Can an educational program enhance Thinh Loc community members' adaptive capacity for the Thinh Loc community to cope with climate change?

The two sub-questions emerging from the primary research question:

Question 1: What is the current level of awareness and ability to adapt to climate change in the Thinh Loc community?

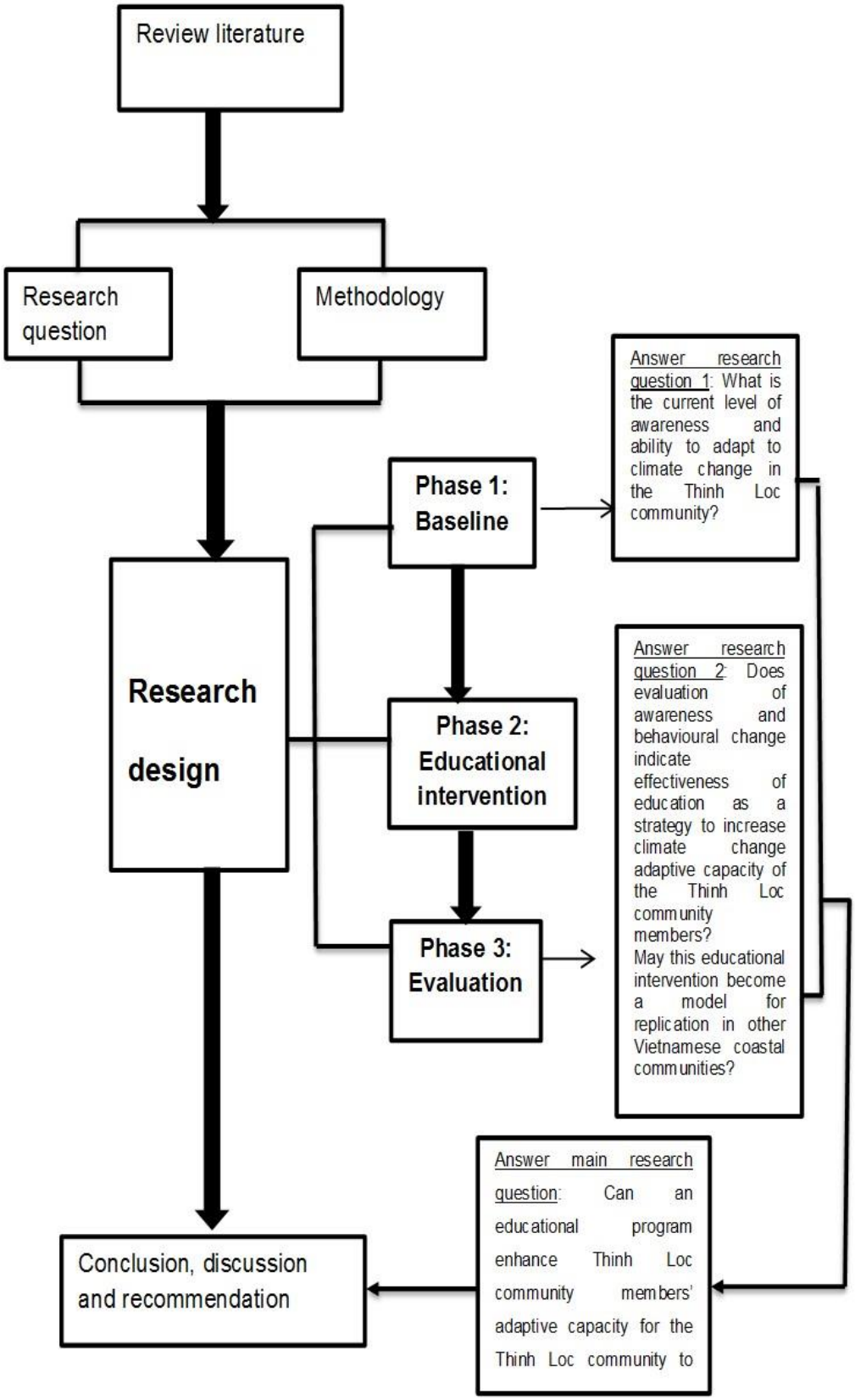
Question 2: Does evaluation of awareness and behavioural change indicate effectiveness of education as a strategy to increase climate change adaptive capacity of the Thinh Loc community members?

Question 3: May this educational intervention become a model for replication in other Vietnamese coastal communities?

In order to address these questions, the research design focused on utilising a survey after undertaking field observations and interviews in the village of Thinh Loc in order to identify Vietnamese coastal residents' awareness of climate change. After this process, an intervention program was employed that aimed to enhance the adaptive capacity of participants. Finally, an assessment phase was conducted six months after the educational intervention to examine whether there had been any changes in the adaptive capacity of the community to cope with climate change.

A mixed methods approach was applied in the research project, involving questionnaires, interviews, field-observations, and teaching. The overall research approach is illustrated in Figure 3:

Figure 3 Research process

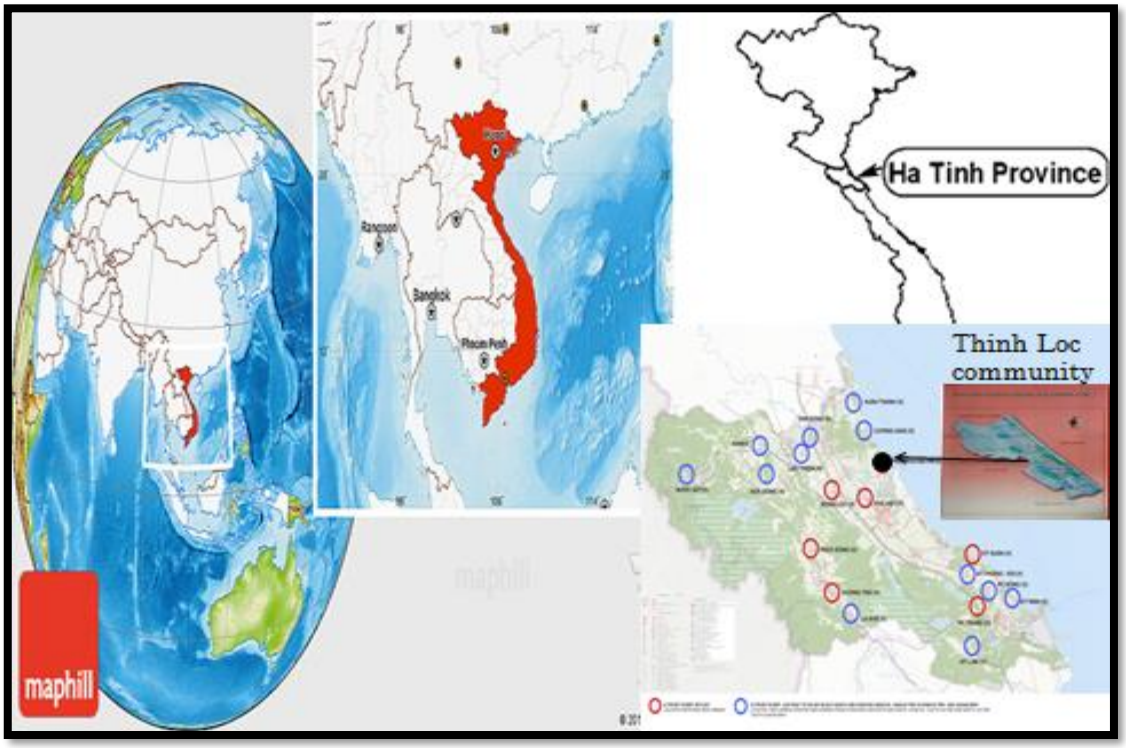


Chapter Three comprises five main sections: 3.2 Selection of case study site, 3.3 Methodological paradigm, 3.4 Research design, 3.5 Data analysis, and 3.6 Research ethics.

3.2 Selection of case study

Vietnam has 63 provinces with 28 of those located on the coastline. Ha Tinh, a central province of the coastal areas of Vietnam, is one of the poorest provinces due to low economic capacity as well as severe annual climatic events. The research literature has indicated that although suffering significantly from the effects of climate change, there were few projects conducted in this province to minimize the negative impacts of climate change. In addition, a previous researcher had implemented a project in this area addressing climate change impacts on local residents in 2011, so a subsequent project regarding climate change had been highly encouraged by the community. The following paragraphs describe a thorough overview of the study site.

Figure 4 Location of the study site (Thinh Loc community)



(Trinh 2005, p.1)

The basic topography of Ha Tinh is narrow and slopes from the West to the East. The average slope gradient is 1.2%, which creates three types of natural topography; high mountain zones, low mountain zones and narrow coastal strip zones (Action Aid, 2013). Ha Tinh is located in the monsoon and tropical area, which possesses two main seasons, with one being wet and the other dry. The dry season lasts six months, normally from

April to September with average temperatures of 21^0C to 29^0C (Department of Planning & Investment Ha Tinh province, 2011) [DOPIHTP].

In recent years, from May to August, Ha Tinh province has experienced irregularly hot spells with average temperatures of 39^0C-40^0C. The number of hot and sunny days now fluctuates from 100-200 days per year. After a prolonged hot and sunny period lasting 10-15 days, there is a high likelihood of a large rain event. Average yearly rainfall in Ha Tinh is the highest in the Northern and central areas of Vietnam, with 2000mm, but some areas in Ha Tinh can receive as much as 5,300mm. However, due to the fact that rivers in Ha Tinh are very short and have a high slope, significant amounts of rain often lead to flooding in the upper rivers and cause widespread inundation of the narrow coastal strip areas. At the same time, this means several rivers remain empty despite the rain (DOPIHTP, 2011).

Loc Ha district was established in 2007, located close to Ha Tinh city. Loc Ha district has many advantages because of the district's topography, which includes rivers, ocean mountains and deltas. This suggests there is a high degree of potential for developing the district's economic capacity. The district's topography is divided into two main types:

(1) Lower areas along the banks of rivers including Ho Do community, Mai Phu community, Thach Chau community where productive activities are salt production, agriculture and aquaculture. In general, the economy in these communities is stronger than other communities (Loc Ha Government Report, 2010).

(2) Higher areas such as Thinh Loc, Thach Bang, An Loc, Binh Loc community focus on agricultural and aquaculture activities (Loc Ha Government Report, 2010).

With a view to selecting a community for conducting this project, several communities located on the coastal areas of Loc Ha district, Ha Tinh province were visited. These included Thinh Loc, Thach Bang, An Loc, Thach Kim and Binh Loc among others. Thinh Loc has been subjected to the most serious impacts of annual climate change among these locations; a fact identified by conducting in-depth interviews and field observations. As a result, Thinh Loc was selected as a suitable site for the project. The main characteristics of the community are summarised below:

- Thinh Loc is located in the coastal zone of Vietnam and has 12km of coastline. The total area of the community is 1,536 ha; an area including 476ha of agricultural land, 564ha of forested land, 28ha of built environment and other areas totalling 468ha (TLCGR, 2014).

- In 2009, the population of the commune was 1,484 households with 6,700 people. The population growth rate in 2009 was 0.82 %. The number of high-income households was 371, about 25%; the number of medium income households was 552, equal to 37.2%; the number of households close to poverty was 223, approximately 15%; and the number of poor households was 338 equal to 22.8% (TLCGR, 2014).
- The community had 2,500 people who were of working age in 2009, including 2,200 labourers who had long-term employment and the rest who did not have long-term employment. Poor economic conditions and low household incomes combined with serious weather events have been acting to exacerbate the poverty issue in this commune (Nguyen, 2011).
- Thinh Loc village is in a tropical monsoon area with an average daily temperature of about 23.4^0C. The annual rainfall level is from 1,680 to 1,700mm. The weather in Thinh Loc is divided into dry and wet seasons as follows (Trinh, 2005):
  - ✓ Dry season: This mainly occurs from April to October, but can sometimes be earlier or later. In this season, the average temperature is above 25^0C. When the prevailing wind is blowing from Laos, the weather becomes extremely hot and dry and temperatures increase to above 40^0C. In Thinh Loc, drought conditions often occur from April to June, but in some years, the drought extends to 5-6 months, which causes many problems for local people.
  - ✓ Wet season: This tends to last from November to March. The average temperature in the cold season is 15-16^0C, but recently temperatures have dropped to as low as 5-7^0C. Storm clouds, prolonged rainy spells, and monsoons are common weather events during the cold season. Prolonged rain events and very cold weather severely affect local residents' life and agricultural production.
- The level of education among Thinh Loc community members is low, with less than half of the population only having attended secondary school or lower (Thinh Loc community government report, 2014).

Despite living in a location that experiences severe weather conditions in central Vietnam, having low economic capacity and a low level of education, Thinh Loc community residents have continually demonstrated cooperation, a strong work ethic, and a steadfast determination to overcome difficulties and obstacles brought on by both the weather and the war. Despite this fact, local residents still chose to live in Thinh Loc. From 1954-1975 and many young men from Thinh Loc went to Southern Vietnam to take

part in combat and save the motherland. Meanwhile, women, elderly people, and the remaining local residents worked extremely hard to increase agricultural production and provide farming products for soldiers. Today, with unyielding dedication, the Thinh Loc community works together and helps each other to deal with natural disasters and climate change (Trinh, 2005).

3.3 Methodological paradigm

In designing a theoretical framework for research, a variety of elements and concepts inform the selection of a methodological approach. Four main questions can be considered: what epistemology informs the study; what theoretical perspectives underpin the methodology; what methodology determines the choice and use of methods; and what methods are suggested to be applied? These can be conceptualised as the philosophical assumptions that create knowledge claims and strategies of inquiry and method approach.

3.3.1 Knowledge claims

There are several positions surrounding the development of knowledge claims, including positivism, constructivism and pragmatism.

Positivism reflects a deterministic philosophy (Cresswell, 2014) which suggests that causes may be influenced by outcomes. In terms of ontology, positivism has a single reality or truth and true knowledge is obtained through direct observation and the measurement of a phenomenon (Cresswell, 2014). Regarding epistemology, reality may be measured and therefore the focus is on reality and the valid tools to acquire it. Experimental research and survey research are the most common methodologies applied in the positivist paradigm, utilising mostly quantitative methods such as sampling, questionnaires, measurement and scaling, statistical analysis and so on (Cresswell, 2014).

Constructivist/ Interpretive method:

According to this method, there is no single reality or truth. Reality is created by people in their groups. Therefore, reality needs to be interpreted. It is used to discover the underlying meaning of events and activities. Ethnography, grounded theory, and action research are the main approaches. Qualitative methods include qualitative interview, observation, case study, narrative and so are often applied in the constructivist paradigm.

Pragmatism

This position focuses on the problem rather than the method of research. In this position, reality is constantly negotiated, renegotiated and interpreted in light of its usefulness in new and unpredictable situations. As a result, this paradigm focuses on the research problem itself; pluralistic approaches are applied to acquiring knowledge of the problem (Tashakkori & Teddie, 2003). Mixed method research, action research and designed based research are used as the most prevalent methodology. A combination of any of the quantitative and qualitative methods above is used to identify the problem.

3.3.2 Strategies of inquiry

Assumption of knowledge claims or methodological paradigms construct strategies of inquiry (Cresswell, 2014). There are four principal differences between quantitative and qualitative research. The first difference is ontology or the nature of reality. In the quantitative approach, research has a single objective reality, therefore it requires for testing. By contrast, the qualitative approach is holistic and cannot be dissected, as research involves multiple subjective dimensions. In terms of epistemology, while the relationship between the "known" and the "knower" in the quantitative approach is separate and objective, this relationship in qualitative research is inseparable and interactive. Thirdly, while the purpose of the quantitative approach focuses on prediction and generalisation, the purpose of qualitative research is contextualisation. Finally, the relation of cause to effect is possible in quantitative research, suggested by statistical association, while the possibility of causation is not considered relevant in qualitative research.

While each approach above uses particular and separate inquiry strategies, a mixture of these strategies of inquiry refers to the mixed method approach, which is combined in a single study as a multiple approach to all relevant aspects of the study. This approach creates pragmatic knowledge claims, whereby data collection comprises both numeric and textual information, and the meaning of the final database comprises both quantitative and qualitative information. According to Wheeldon (2010):

> Pragmatism allows for a more flexible, adductive approach. By focussing on solving practical problems, the debate about the existence of objective truth or the value of subjective perceptions can usually be side-stepped. As such, pragmatists have no problem with asserting both, that there is a single, real world and that all individuals have their own unique interpretations of that world (p.8).

3.3.3 Mixed methods

This project used both quantitative and qualitative research methods. A recent study has found that:

> Mixed methods research is the type of research in which a researcher or team of researchers combines elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis inference techniques) for the broad purposes of breadth and depth of understanding and corroborations (Johnson et al., 2007: 123 quoted in Best, 2012: 268).

Why used a mixed methods approach?

As discussed in the previous chapters, the main goal of the project was to enhance the knowledge of and ability to adapt to climate change for a coastal Vietnamese community. In order to achieve the key goal of the research, both quantitative and qualitative research methods were used: questionnaires, interviews, and observations. The mixed methods approach was necessary for this study because of several general reasons:

- Combining the two approaches enables the process of triangulation. This means the findings from one type of method can be checked against the findings detected from the other method. The significant aim of triangulation is to increase the validity of research results (Punch, 2001).
- Mixed methods approach helps the researcher to address research questions that might not be answered by using only quantitative or qualitative research (Best, 2012). For example, in this research, while questionnaires helped to identify individuals' awareness, and behaviour, interviews and observations helped obtain data from groups, organizations, and the whole community related to climate change mitigation and adaptation. In other words, quantitative and qualitative research was combined in order to help produce a more complete answer to the research question (Bryman, 1988).
- A mixed methods approach enhances the validity of the findings by using more data from a combination of quantitative and qualitative tools rather than using quantitative or qualitative method alone. This is true as findings of mixed methods research come from numbers and words in a meaningful way by using quantitative and quantitative data sets (Best, 2012).
- Qualitative methods may help to facilitate the interpretation of relationships between variables. While quantitative methods help to establish the relationships between variables, qualitative methods allow researchers to explore the reasons for those relationships (Punch, 2001).

Quantitative method: Questionnaire (Using for baseline and evaluation phase)

The questionnaire is most commonly employed in quantitative survey research: "questionnaires that are completed by respondents themselves are one of the main instruments for gathering data using a social survey design" (Bryman, 2001, p.128). In this study, a questionnaire was employed before and after intervention. They comprised baseline and evaluation surveys that were used to examine the knowledge, attitude, and adaptation behaviour of participants before and after the intervention. The questionnaires were delivered directly to respondents.

The base line questionnaire aimed to identify knowledge, attitudes, and the actions of community members to cope with climate change. The structure of the baseline was divided into five parts: Part 1: Demographic information; Part 2: Climate change knowledge; Part 3: Climate change attitudes; Part 4: Activities related to climate change, and Part 5: Source of information and requirement for a further climate change education. The survey is located in Appendix A.

The evaluation questionnaire aimed to measure any changes of knowledge, attitudes, and behaviours about climate change after the intervention program. The model of KAP survey (Knowledge, Attitude, and Practice) was applied in the evaluation survey in order to identify any change in the knowledge, attitude, and behaviour of community members about climate change. The structure of the evaluation survey was also divided into five parts: Part 1: Demographic information; Part 2: Climate change knowledge; Part 3: Climate change attitudes; Part 4: Climate change mitigation; and Part 5: Climate change adaptation. The survey is located in Appendix B. Both the baseline and evaluation questionnaires were designed in English, and then translated into Vietnamese before being delivered to participants. The findings of the baseline and evaluation questionnaires are presented in Chapter Four and Chapter Six, respectively.

Qualitative methods

<u>Semi- structured interviews</u>

An interview is simply is a conversation with a purpose to gather information (Berg, 2007). According to Cohen and Manion (1980), the research interview has been defined as a conversation between an interviewer and an interviewee with the purpose of obtaining relevant research information based on research objectives (Cohen & Manion, 1980). Bernard (2013) found that "the concept of interview covers a lot of ground, from

totally unstructured interaction, through semi structured situations, to highly formal interactions with respondents" (p.181).

According to Bryman (2001), the interview is probably the most prevalent method employed in qualitative research. There are two main types of qualitative interview: the unstructured interview and the semi- structured interview. While the structured interview is one in which the content and procedures are organised in advance, the unstructured interview is an open situation, having greater flexibility and freedom (Cohen & Manion, 1980). A semi-structured interview that mixes the structured and unstructured interview approaches was used in this research. With the semi- structured interview, the researcher has a list of questions or fairly specific topics to be covered, often referred to as an interview guide, but the interviewee has a great deal of leeway in how to reply; therefore questions may not follow the guidelines exactly (Bryman, 2008).

In this study, by using a semi-structured interview, a list of main open-ended questions for the interview was prepared. Qualitative interviews were also employed before and after the intervention. Interviews during the pre-intervention stage were used to gain a fuller understanding of participants' knowledge about climate change impacts as well as community residents' needs to address climate change. The interview used after the intervention helped to more thoroughly understand how learners had applied their knowledge and skills to mitigate and adapt to climate change, which post-test questionnaires could not explore. In particular, interviewees in the rural communities made suggestions to explain in more detail useful and appropriate ways for replicating climate change education in other communities.

All interviews were tape-recorded and transcribed. Heritage (1984:238 cited in Bryman, 2001) recommended that the recording and transcribing of interviews have the following benefits:

- Helps to correct the human limitation of memories;
- Allows more thorough examination of what people say;
- Repeats examination of the interviewees' answers as many times as required;
- Allows the data to be reused in other ways;
- Avoids researcher's values or biases;
- Opens up the data to public scrutiny by other researchers.

Field observations

Direct observation has been a key method in the history of the qualitative approach. Observation has been a formative tool in ethnography (Ritchie, Lewis, Nicholls, & Ormston 2014) to allow the researcher to systematically watch, listen, and record the phenomena of interest. By observation, the researcher seeks to understand the cultural norms, beliefs, behaviours, and potential abilities of members or communities.

Cohen and Manion (1980) stated the purpose of observation is to: "probe deeply and to analyse intensively the multifarious phenomena that constitute the life cycle of the unit with a view to establishing generalisations about the wider population to which that unit belongs" (Cohen & Manion, 1980, p. 99). There are also variations in the nature of observation depending on the purpose of the observer. Spradley (1980) cited in Ritchie at el. (2014) identified three steps of observations:

- Descriptive observation: the beginning step of data collection, it provides the researcher with an orientation to the field of study.
- Focused observation: the second step of data collection, it narrows the perspective and focuses on problems that are most necessary to the research questions.
- Selective observation: the final step of data collection, it focuses on finding further evidence and examples of practices that are found in the second step.

The observation method was used in this project during the pre-intervention and post-intervention phase. In the pre-intervention phase, the descriptive observation and focused observation techniques were used to obtain overviews of the study site and concentrate on the research problem, such as economic conditions and infrastructure development, attitudes and behaviours of locals to address climate change and so on. In this step, watching open settings (community infrastructure, locations, natural resources, local environments, etc.) and closed settings (households' property, domestic animals' behaviours, etc.) was aimed at deeply understanding the community's current environmental problems, attitudes and actions to respond to climate change. Through an observation of community settings during the field trip, a depiction of the Thinh Loc community could be obtained. This helped to identify and assess the level of community need for the conducting of a climate change education program. Selective observations were also used in the post-intervention phase to identify any actions undertaken by local residents to mitigate and adapt to climate change in the community. This post-observation was conducted after surveying in May 2016.

Recording observation data: Field notes are probably the most common form of recording observation data (Ritchie at el., 2014). By writing field notes, the investigator describes the setting interactions as well as the understanding and interpretation of what is going on. Field notes can include the following three elements (Berg & Lune, 2012; Merriam, 2009 cited in Ritchie at el., 2014):

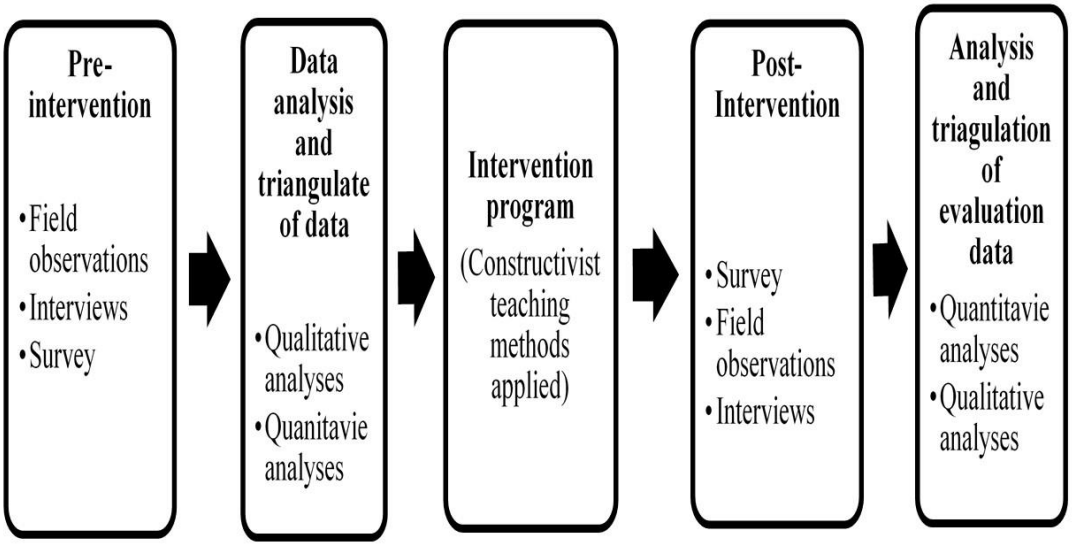
- Detailed descriptions: details may include information on what the observer watched and heard.
- Observer comments about the setting: these should be identified separately from the descriptive narrative, but include the ideas and views of the investigator.
- Subject reflections: about how the observer themselves felt.

Drawing a diagram or map, taking photos or making videos of the physical setting also help the observer to recall later. Filed notes and photos were used in this instance to record observational data in this project.

3.4 Research Design

In using a mixed methods approach, the study employed an inductive type of research design. It began with the collection of qualitative and then quantitative data in Phase One, followed by analysis of this qualitative data and quantitative data. The data obtained from Phase One directed the researcher to conduct the intervention in Phase Two. In this phase, three classes using constructivist methods were applied to 98 participants. After intervention, an evaluation was conducted in Phase Three, involving the collection of further quantitative data, followed by collection of further qualitative data. The aim of the evaluation phase was to assess the usefulness of the program and how to improve it, as well as how to modify it for duplication. The sequencing of the research is illustrated in the diagram below:

Figure 5 Sequencing of research



3.4.1 Pre- Intervention phase

3.4.1.1 Field observations

The first field observations were conducted from 02 November until 09 November 2014 at Thinh Loc community. At this stage, the field observations focused on the following settings:

a. Open settings (community)

- Public roads
  - ✓ Types and quality of roads
  - ✓ Road sanitation
- Coastline:
  - ✓ Sea-walls
  - ✓ Mangroves
  - ✓ Sea sanitation
  - ✓ Location
- Drainage system
  - ✓ Quantity of drainage system
  - ✓ Quality of drainage system
- Community facilities
  - ✓ Commune offices
  - ✓ Common houses

- ✓ Village markets
- ✓ Schools

- Infirmary centres
- Electricity system
- Environmental communication
  - ✓ Posters
  - ✓ Pictures
  - ✓ Slogans
- Types of transportation
- Aid centre
  - ✓ Police/army
  - ✓ Fire support
  - ✓ Medical resource
- Local ecology environment
  - ✓ Trees
  - ✓ Mountains
  - ✓ Rivers/ streams

b. Closed setting (households)

- Houses:
  - ✓ Type of buildings
  - ✓ Strength of buildings
- Garden:
  - ✓ Organization
  - ✓ Sanitary situation
- Breeding facilities:
  - ✓ Type of breeding facilities
  - ✓ Quality of breeding facilities
  - ✓ Sanitary management
- Sewage system:
  - ✓ Type of household toilets
  - ✓ Sanitary situation
  - ✓ Domestic sewage management
- Types of cookers
- Garbage disposal
- Media equipment such as Television, radio
- Fishing equipment

- Agricultural and aquaculture equipment

3.4.1.2 Interviews

Four semi-structured interviews were conducted during the pre-intervention stage that took place on November 2014. The interviews were conducted in Thinh Loc community, and undertaken in order to better understand climate change impacts faced by the community as well as the need for community residents to address climate change. Interviewees were a Thinh Loc community government president, a Thinh Loc secondary school Principal, a farmer, and a secondary school student.

In order to recruit participants for interview, snowball sampling was applied. Initial research was in the study site in 2011, and contact was maintained with local government staff members in Thinh Loc community. I visited one person who I worked with 3 years ago and asked him to put me in contact with the President of the Thinh Loc community government. He became my first interviewee. Then, the President of the Thinh Loc community government introduced me to the Principal of the Thinh Loc secondary school. She was my second interviewee. I asked the Thinh Loc secondary school Principal to introduce me to her student. This male student became the third interviewee. Then, he put me in contact with his parent – a farmer. I asked this farmer to introduce me to another female farmer who was willing to participate in the fourth interview.

These interviews asked the following questions:

1. Tell me how do you feel about the recent climatic impacts in the community?
2. Tell me how often do you talk about climatic impacts and what information do you talk about?
3. Tell me how has the climate affected your community, and what difficulties are you facing from climate change?
4. Tell me would a climate change education program be interest to you and to your community?
5. Tell me when is the most appropriate time to conduct a community education program in your community?
6. Tell me what sort of information do you wish to obtain from a climate change education program?

3.4.1.3 Survey (Baseline)

Questionnaire design

To ensure the validity and reliability of the survey, the researcher designed the questionnaire based on issues related to climate change established in the literature review, while referring to previous research involving perceptions of climate change, and in consultation with two academic supervisors working in the field of climate change adaptation and education. The baseline questionnaire was conducted in order to answer the research question: What is the current level of awareness and ability to adapt to climate change in the Thinh Loc community?

Before delivering the questionnaire, a pilot survey was conducted. Four local residents including one local government employee, one farmer, one secondary school student, and one teacher completed the pilot survey. As a consequence of the pilot survey some problems related to technical jargon were detected and resolved by translating into common language. Some matrix questions were also abbreviated to make questions clearer.

The baseline questionnaire was designed by referring to some existing survey questions about climate change awareness. After referring to the existing survey questions, a questionnaire was designed specifically for this project. The questionnaire was designed to include the following five parts:

- Part 1: Demographic information. This part aimed to collect the personal information of the participants such as age, gender, education level, occupation, and length of residence.
- Part 2: Climate change knowledge. This part aimed to examine the level of awareness the participants possessed regarding climate change terms, the existence of climate change, the causes of climate change, the impact of climate change, and of any current local government policy proposals to address climate change.
- Part 3: Climate change attitudes. This part aimed at determining the level of concern about climate change demonstrated by residents, and the importance of climate change issues to them.
- Part 4: Activities related to climate change. This part aimed at identifying relevant activities that mitigate or exacerbate climate change. It also aimed to as identify

activities undertaken by organizations, individuals, or communities that best to help reduce climate change and its impacts in the community.

- Part 5: Sources of information and requirements for more climate change knowledge. This part aimed to identify how participants obtain climate change information and whether they believed they needed more knowledge.

A rationale of questions used in the baseline survey

Interviews and field observations helped to explore community capacities such as economic wealth, social capital and human activities related to climate change causes, migratory activities and the current level of adaptive capacity to cope with climate change. Meanwhile, the baseline survey aimed to measure the current level of perception and attitudes to climate change, as well as the wants and needs of community residents in the process of developing actions to mitigate and adapt to climate change. Thus, the baseline questionnaire was developed to underpin the theoretical framework in order to guide an educational intervention. The table below illustrates a rationale for each question used in the baseline questionnaire:

Table 2. A rationale for each question used in the baseline questionnaire

Questions	Rationale
1. How old are you? 2. What is your gender? 3. What is your highest completed education level? 4. What is your main job? 5. How many years have you lived in Thinh Loc?	These questions were designed to collect demographic information about respondents. As a result, the research could explore the different experiences among stakeholders in relation to perceptions, attitudes and behaviours in coping with climate change. This would help to design appropriate content and teaching methods to each group in the climate change education intervention.
6. How familiar are you with the following concepts/terms: climate change, global warming, greenhouse gases, the greenhouse effect, and carbon dioxide)?	The purpose of this question was to measure the familiarity of community participants with basic terms related to climate change. Depending on the baseline level of familiarity with those concepts/terms, the educational

	intervention would be designed to explain and build appropriate knowledge levels of climate change science.
7. Do you think that climate change is happening?	This question was designed to examine whether respondents believe that climate change is happening. Understanding the existence of climate change would shape the later intervention with regards to providing current evidence of its validity.
8. In your opinion, what are the causes of climate change?	This question was designed to identify respondents' perception of climate change causes. The later intervention would provide and build knowledge to explain why climate change happens.
9. In terms of human activity, what do you think are the causes of climate change (tick as many as you think are important)	This question was designed to identify respondents' perception of climate change caused by human activities. This data would drive the later intervention by providing and building knowledge about daily activities which result in climate change, especially in rural and coastal areas, as well as discussing strategies to mitigate the causes of climate change.

10. If nothing is done to reduce climate change in the future, how serious a problem do you think it will be for the world, Vietnam, and your community? 11. When, if at all, do you think your community will begin to feel negative effects from climate change? 12. How much do you think climate change will harm you and your family; your community members; as well as your community's future generations? 13. If nothing is done to address climate change, what do you think will be observed in the next 20 years in your community?	These questions were designed to measure respondents' predictions about the time and level of the impacts of climate change worldwide, in Vietnam and the local community. This would help to identify community member respondents' understanding of the impacts of climate change and their consequences. The later intervention would then provide and build knowledge of the impacts of climate change at the international, national and especially the local community level.
14. Do you know any current policy proposals to address climate change?	This question was designed to test participants' perception of current policy proposals to manage climate change in the community. Later, this would guide discussions on the need to schedule and publish climate change adaptation policy in the pilot study.
15. How concerned are you about climate change? 16. How important is the issue of climate change to you personally?	These questions were designed to measure respondents' attitudes by identifying their concerns about the issue of climate change. This identified the wants and needs of community members

	in relation to the provision of education to deal with climate change.
17. How often do you implement the following activities? 18. What have you done to address climate change? (Tick as many as you done)? 19. Which of the following would best help reduce climate change? (Tick as many as you think are important)	These questions were designed to identify and measure current actions which not only exacerbate but also mitigate climate change consequences in the pilot study. This would help to evaluate the adaptive capacity of community residents as well as drive actions to mitigate and adapt to climate change in the later intervention.
20. From where do you get information about climate change? (Tick as many as applicable)	This question was designed to identify the most prevalent sources of climate change information acquired by respondents. This would help to identify the factors influencing awareness and the adoption of behaviour after intervention.
21. Do you think that a future climate change education program should be conducted in your community? If a climate change education program were conducted in your community, would you attend?	These questions were designed to examine whether community member respondents needed education provision in the future, as well as suggesting the timeframe required to conduct the intervention in the pilot study.

Sampling procedures

Participants in Phase One were local residents in the Thinh Loc community, comprising farmers, local government staff members, secondary school teachers, and secondary school students. The sample size was 115 people who were selected through simple random sampling and convenience sampling methods from approximately 7,000 local residents.

Simple random sampling methods

Simple random sample is “the most basic form of probability sample that has been selected using random selection so that each unit in the population has a known chance of being selected” (Bryman, 2008, p.168). With a random sample, each unit of the population has an equal probability of inclusion in the sample (Bryman, 2008). In this project, the researcher used the simple random sample to gather data from secondary school students. Using this method, 30 secondary school students and 11 secondary school teachers were chosen to participate in the survey:

- The key steps for simple random sampling of secondary school students were followed:
  - ✓ *Step 1:* The population in Thinh Loc secondary school was defined. The population in this school was 135 students, including Grade Six, Grade Seven, and Grade Eight students. The researcher had decided that the sample should be drawn from Grade Six and Grade Seven students because when the climate change education project was to be conducted the following year, the Grade Eight students would have transferred to another school in another community, so might not attend the project.
  - ✓ *Step 2:* A sampling frame was devised by accessing the students list from the Principal.
  - ✓ *Step 3:* The sample size was decided upon. The total number of students in the Grade Six and Seven classes was 90. The researcher decided that the sample was to be 30 students including 14 male and 16 female students.
  - ✓ *Step 4:* All the students in Grade Six and Seven were listed and assigned consecutive numbers from 1 to 90.
  - ✓ *Step 5*: 30 different random numbers were selected between 1 and 90.
  - ✓ *Step 6:* The Thinh Loc secondary school Principal was responsible for sending the information sheet to respondents’ parents before assembling 30 students.
  - ✓ *Step 7:* After receiving permission from parents to allow their children to participate in the survey, the random sample of 30 students was assembled in the main hall to answer the questionnaire.
- The key steps of simple random sampling for secondary school teachers were conducted as follows:
  - ✓ *Step 1:* The population of teachers in Thinh Loc secondary school was defined. There were 22 full-time teachers and 10 casual teachers. The researcher had decided that the sample should be made up of full-time

teachers because it would be more convenient for these teachers to attend a climate change program.

- ✓ *Step 2*: The researcher devised a sampling frame from the full-time teacher list.
- ✓ *Step 3*: A decision was made to choose 11 teachers from the 22 full-time teachers.
- ✓ *Step 4:* The researcher randomly selected 11 full-time teachers from the sampling frame.
- ✓ *Step 5:* The random sample of 11 teachers was assembled in the main hall to answer the questionnaire.
- ✓ *Step 6*: The information sheets were delivered to 11 teachers before they answered the questionnaire.

Convenience sampling methods

A convenience sample is "one that is simply available to the researcher by virtue of its accessibility" (Bryma, 2008), p183). Bryman (2008) also stated that the convenience sample method was appropriate to apply in a wide range of communities. With a population of approximately 7000 people and a scattered distribution of households, this method is very suitable for use in this research in the Thinh Loc community, particularly with regard to farmers. Questionnaires were opportunistically given out to local government staff and farmers when they attended community meetings. As a result, 74 questionnaires were collected as follows:

- Convenience sample 1: In the first community meeting, people came to choose the families who would become the best families in the community, 20 people including 11 local government staff members at hamlet level and 9 local government staff members at commune level were selected by convenience to answer the questionnaire.
- Convenience sample 2: In the second community meeting, people came to pay back annual interest to the Agricultural Bank; 20 farmers were selected by convenience to respond to the questionnaire.
- Convenience sample 3: In the third community meeting, people came to share information about harvest collection at one household; 15 farmers were selected by convenience to respond to the questionnaire.

- Convenience sample 4: In the fourth community meeting, people came to share information about daily news; 19 people were asked to respond to the questionnaire.

The information sheets were read to those participants who were selected and informed consent was obtained from them before conducting survey. Consequently, from two sampling methods, 115 local residents including secondary school students, teachers, local government staff members, and farmers participated in the survey.

Survey activities

In order to implement the survey for the pre- test, the research complied with the following survey process:

Table 3 Survey activates in the Thinh Loc community in the pre-intervention stage

Date	Place	Activities	Method
Week 1	Thinh Loc government office	The researcher introduced the aims and activities of the research to the Thinh Loc community government. Had a meeting with 3 local government staff to obtain their support for survey. Conducted field observations Conducted semi- structured interviews Prepared questionnaire copies, pens, recorder, and camera for questionnaire survey	Presentation Discussion
Week 2	Thinh Loc government office	Delivered questionnaire to 11 local government staff at hamlet level and 9 local government staff at commune level (in the "cultural families" meeting)	Presentation Supervision
Week 3	A resident's house	Conducted a pre- meeting with respondents' supporters Delivered questionnaires to participants (in the meeting of neighbours to share information about harvest collection)	Presentation Supervision
Week 4	Thinh Loc Secondary School	Had a meeting with the Principal of the secondary school Selected a sample of student and teachers Delivered questionnaires to students and teachers	Presentation Discussion Supervision

Week 5	Thinh Loc Community house	Delivered questionnaires to local community members (in the business meeting of paying back annual interest for the Agricultural Bank)	Presentation Supervision
Week 6	Thinh Loc Community house	Delivered questionnaires to local community members (in the meeting of neighbours to share information about daily news)	Presentation Supervision
Week 7	Government office & Thinh Loc Secondary School	Reviewed data collection Made a further plan with the local government for the second fieldtrip Made a further plan with the secondary school Principal for conducting a climate change education program in the next phase	Presentation Discussion

Figure 6 Some survey activities in the Thinh Loc community in 11/2014

For school students, teachers, and local government, the survey receivers themselves filled in the questionnaires. However, due to the limited literacy of many farmers, many surveys were face to face interviews in order to collect the complete information required from the questionnaires. The researcher directly undertook these face-to-face interviews.

3.4.2 Intervention phase

3.4.2.1 Why using constructivist teaching methods in the intervention

Although the literature review showed that a variety of educational material and tools are used to deliver interventions such as media, focus groups and so on, in this project a traditional teaching project approach was applied. Analysis of the data collection from Phase One showed that the respondents of Thinh Loc community exhibited a low level of knowledge about climate change. Moreover, participants stated they would like more climate change knowledge, so it was necessary and appropriate to conduct the intervention using constructivist classes to enhance understanding about climate change.

Constructivism states that learners build their own knowledge and understanding of the world through their experience and by reflecting on that experience (O'Donnell et al., 2012). In the classroom, the constructivist view means that learners are encouraged to use active ways to create knowledge and understanding, and then to reflect upon their thoughts. Constructivist teachers also ensure that their students' pre-existing concepts are examined and questioned; they then guide students to address and build upon their knowledge (O'Donnell et al., 2012). The following advantages were obtained by applying the constructivist class in the Thinh Loc community:

- In the classroom, participants could concentrate more on educational messages on climate change through actives and interactions. As a result, learners might better remember knowledge and skills, and start thinking and doing.
- The classroom setting was most familiar to both school students and teachers. In addition, a classroom was the most convenient location to engage with a focus group of local government staff and typical farmers.
- In the classroom, educational messages could be delivered more efficiently to learners by using video clips, pictures, and games.
- In a constructivist classroom, learners are encouraged to work in groups and exchange ideas, rather than only focusing on textbooks. Therefore, learners can

be more engaged with climate change knowledge and reflecting on this knowledge, as well as transferring it to others. Consequently, it was hoped that the aim of building a group of facilitators within the community after the education program could be more easily realised. This facilitator group may take responsibility for transferring climate change knowledge and adaptive activities to all community members.

3.4.2.2 Recruitment procedures for the intervention program

The program was delivered to three different class levels in the Thinh Loc during a one-month period. The sample of 98 people comprised 28 primary school students, 30 secondary school students, five primary school teachers, five secondary school teachers, 13 local government staff and 17 farmers. Participants were recruited as follows:

Class One: Secondary school students and teachers

The sample of class one was 35 participants, comprising 30 secondary school students who participated in the baseline survey in Phase One (the recruitment process for school students in the baseline survey is indicated above). Of 11 secondary school teachers who were participants in the baseline survey, five teachers were selected to participate in the intervention program based on their registrations. Thirty of these students and five of these teachers were also expected to become facilitators in order to duplicate climate change knowledge in all students and teachers at the Thinh Loc secondary school.

Class Two: Farmers and Thinh Loc government staff members

The sample of class two was 30 participants selected from original samples those who participated in the baseline survey. Of the 30 people, 17 farmers and 13 local government staff members were chosen to attend the intervention program and invited by the Thinh Loc Women's Association. Five local government staff members (mainly women) were expected to become facilitators to broaden climate change knowledge to whole community members.

Class Three: Primary school students (Grade Five) and primary teachers

The sample of class three included 33 participants, comprising 28 primary school students and five primary school teachers (volunteer class). A purposive sampling method was applied to recruit participants. By using this sampling method, one whole

class of Grade Five (28) students was nominated by the primary Principal to participate in the program. The selection of this class was based on the following reasons:

- Firstly, this Grade Five class contained the oldest students in primary school level; therefore, this group was old enough to approach and obtain the knowledge and skills included in the climate change education program.
- Secondly, the 28 students studied in the same regular class, so learners identified with the class structure and had established interpersonal relationships.
- Thirdly, the 28 students had been divided into seven regular groups, which was convenient for conducting group work activities in the climate change education class.

Regarding the teacher sample, five teachers were selected to attend the intervention program by the nomination of the Principal of the Thinh Loc primary school. These five teachers were Head Teachers of Grade Five and Four, and one vice Principal of the school. These teachers were expected to become facilitators for replicating this climate change education program.

3.4.3 Evaluation phase

The evaluation phase was designed and conducted to assess the intervention program after 6 months. Both quantitative and qualitative methods were used during this phase. Unlike the pre-intervention phase, an evaluation survey was employed first, while qualitative methods including the use of field observations and semi-structured interviews followed.

3.4.3.1 Evaluation survey

The evaluation survey was aimed to address the second research questions. The evaluation survey was designed to examine whether learners' knowledge was enhanced and whether they had actually applied adaptive strategies to mitigate and adapt to climate change. The evaluation survey was implemented six months after intervention (May 2016). The total sample of the evaluation survey was 98 people. All 98 participants in the intervention program were invited to answer the questionnaire. However, out of 98 participants in the intervention program, only 88 people were able to participate the evaluation phase including 26 primary school students, 30 high school students, five primary school teachers, four high school teachers, nine local government members, and 14 farmers.

Before delivering the questionnaire, a pilot survey was conducted. One student, one teacher, and one farmer were invited to complete the pilot survey. The evaluation survey used a Likert scale and closed questions. The questions were designed to assess the knowledge that was derived from the educational intervention program. The evaluation survey included five parts, focussed on the following:

- Parts 1: Demographic information. This part aimed to attain three aspects of personal information made up of age, gender, and occupation.
- Part 2: Climate change knowledge. This part aimed to test any change of awareness level of the participants on climate change concepts, climate change evidence, climate change causes, as well as climate change impacts.
- Part 3: Climate change attitudes. This part involved one question designed on a Likert Scale aiming to identify the attitude of participants about 17 indicators that relate to climate change predictions and daily activities enhancing climate change.
- Part 4: Climate change mitigation. This part comp aimed to examine whether participants applied strategies of climate change mitigation that were provided by the education intervention program in Phase Two.
- Part 5: Climate change adaptation. This part aimed to examine whether participants conducted activities to adapt to climate change and any plan for coping with the next flood/storm reason.

A rationale of questions used in the evaluation survey

As discussed, the evaluation questionnaire was designed to assess any improvements in the community participants' understanding of the scientific basis and knowledge of climate change, as well as adopting and changing actions to mitigate and adapt to climate change after the educational intervention. Therefore, most evaluation questions were developed based on the knowledge provided in the intervention program. A rationale of each question is illustrated in the table below:

Table 4. A rationale of each question in the evaluation questionnaire

Questions	Rationale
Age Gender Occupation	These questions were designed to collect the demographic information of different group stakeholders. As a result, the research would be able to ascertain different experience among

	cohorts/groups of climate change awareness, mitigation and adaptation.
1. How familiar are you with the following concepts or terms?	This question was reused in order to discover any increased familiarity with the concepts related to climate change after the intervention.
2. What are the clues of climate change? 3. What are the main sources of greenhouse gases? 4. Think about climate change causes. Show how strongly you agree or disagree with each the following statements.	These questions were designed to determine any improvement in the basic scientific knowledge of climate change evidence, the main sources of greenhouse gases and climate change causes after the intervention.
5. Think about climate change impacts on your community. Show how strongly you agree or disagree with each the following statements.	This question was designed to evaluate the attendees' understanding of the impacts of climate change in the community, which were discussed in the Intervention phase.
6. Think about each of the following statements. Does it sound like the kind of thing that you would think?	This question was designed to evaluate the attitudes of attendees regarding their regular actions which might contribute to the causes of climate change.
7. What kinds of cookers are used in your household? 8. Have you participated in planting and protecting trees in the past 6 months? 9. What modes of transportation do you use when you travel to the following places? 10. What shopping bags do you use?	The 11 questions were designed to assess whether community participants would adopt and change actions to mitigate the causes of climate change after an educational intervention had been delivered. Those activities were proposed to facilitate adaptation.

11. Have you ever reused nylon bags and plastic bottles? 12. Have you turned off electrical equipment before leaving the following places? 13. Have you carried out recycling? 14. Have you changed the proportion of meat in your meals in the past 6 months? 15. What have you or your family members fed your cattle in the last 6 months? 16. How often have you or your family members cleaned your cattle facilities in the past 6 months? 17. How often have you or your family members participated in cleaning public canals in the past 6 months?	
18. How often have you conducted the following activities in the coastline within the last 6 months? 19. What have you or your family members done to cope with water shortages or droughts in the past 6 months? (tick as many as apply) 20. How do you or your family members, school, community or workplace plan to prepare for the next flood/storm season?	These questions were designed to examine whether participants would implement and plan activities to adapt to climate change after intervention.
21. Have your school, workplace or community organised competitions, workshops or training relating to climate change within the last 6 months?	This question was designed to examine whether community organizations and targeted schools had conducted any educational activities to broaden the knowledge and skills provided in the educational intervention.

In order to implement the evaluation phase, the research involved the following activities:

Table 5 Research activities in the evaluation phase

Date	Place	Activities
Week 1	Households & Thinh Loc government office	Delivered questionnaires to farmers and local government staff members
Week 2	Thinh Loc secondary school & Thinh Loc primary school	Had meetings with Principals of Thinh Loc primary school and secondary school for a survey plan. Conducted delivering questionnaires to teachers and students
Week 3	Thinh Loc government office, Thinh Loc primary school and secondary school, and households	Conducted semi- structured interviews
Week 4	Thinh Loc community	Conducted field observations

3.4.3.2 Field observations

The second set of field observations was conducted one and half years after the first set of observations and six months after the intervention program. At this stage, the project continued to use the guidelines developed for the first observations by re-observing open and closed settings in order to detect any change of the settings following the intervention program (the observed settings of the first observation are provided above). The research also concentrated on mitigation and adaptation strategies to cope with climate change applying to households (cooking systems, animal and household facilities, waste-water and waste management, communication equipment, etc.), schools (electricity saving, waste management, school facilities, and tree planting and protection, etc.) and the Thinh Loc community (public road management, tree planting and protection, sea wall protection, coastline protection, etc.).

The second set of field observations were conducted by the researcher and recorded by photographs and notes.

Table 6 Guideline of post- observations

Observation activities	Place of observation	Time of observation	Quantity
Cooking system	Households		
Cattle' management	Households Public roads		
Electricity saving	Schools Workplaces		
Sea- wall protection	Coastline		
Collecting garbage	Coastline		
	Secondary school		
	Primary school		
	Community public road		
Public cleaning activities	Community roads		
	Community canals		
Instruments of climate change and environment campaigns	Thinh Loc community government office		
	Secondary school		
	Primary school		
	Public roads		
Planting trees	Coastline		
	Schools		
	Public roads		
Recycling	Schools		
	Thinh Loc government office		
	Households		

3.4.3.3 Interviews

In the post-intervention stage that took place in May 2016, the interviews gave participants more opportunities to discuss the intervention program as well as to offer any suggestions for improving and widening the education program. Four interviewees who participated in the education program at the intervention stage were selected to participate. Based upon a list of participants who attended the intervention program, four

people (comprising one local government staff member, one teacher, one student, and one farmer) were recruited to participate in the interviews. All interviews were conducted by the primary researcher and supported by a research assistant responsible for note taking, photos, and tape-recording. The discussions focused on the following main questions:

1. What do you think about the climate change education program which you were invited to attend 6 months ago at your school/ Thinh Loc government office?
2. Have you applied any suggestions to mitigate and adapt to climate change? If yes, could you please tell me observations when you applied suggestions from the program?
3. Have you coped with any difficulties when you applied those suggestions to address climate change in your community?
4. Is it possible to broaden the climate change education program to all residents in your community and other communities? If yes, could you advise the most appropriate ways to duplicate this program?

3.5 Data analysis

> Analysis is the search for patterns in data and for ideas that help explain why those patterns are there in the first place …. Most quantitative analysis in the social sciences involves reducing people (as observed directly or through their texts) to numbers; most qualitative analysis involves reducing people to words – your words about the meaning of their words or action or artifacts (Bernard, 2000, p.419).

3.5.1 Quantitative data analyses

The Statistical Package for the Social Sciences (SPSS) version 20.0 was employed to analyse the baseline and evaluation surveys.

In Phase One, descriptive statistics were employed to summarize the characteristics of participants including age, gender, occupation, educational level, and length of residence. Descriptive statistics, including mean, median, mode, and Std. deviation, were computed to examine participants' awareness of climate change knowledge, climate change attitudes and predictions, and their perceived need for an education program.

In Phase Three, descriptive statistics were computed to illustrate and compare changes in the knowledge and behaviour of respondents after intervention. To assess the associations between participants' characteristics (such as age and occupation) and awareness, attitude and behaviour about climate change, Chi square independent test, independent sample *t* test, an analysis of variance (ANOVA), and non-parametric analysis of the Mann-Whitney U and a Kruskal- Wallis were applied to the data. For all statistical tests, a significant level of at least $p<.05$ was employed.

3.5.2 Qualitative *data analysis*

> Qualitative research concentrates on the study of social life in natural settings. Its richness and complexity mean that there are different ways of looking at analysis social life and therefore multiple perspectives and practices in the analysis of qualitative data (Punch, 2001, p.199).

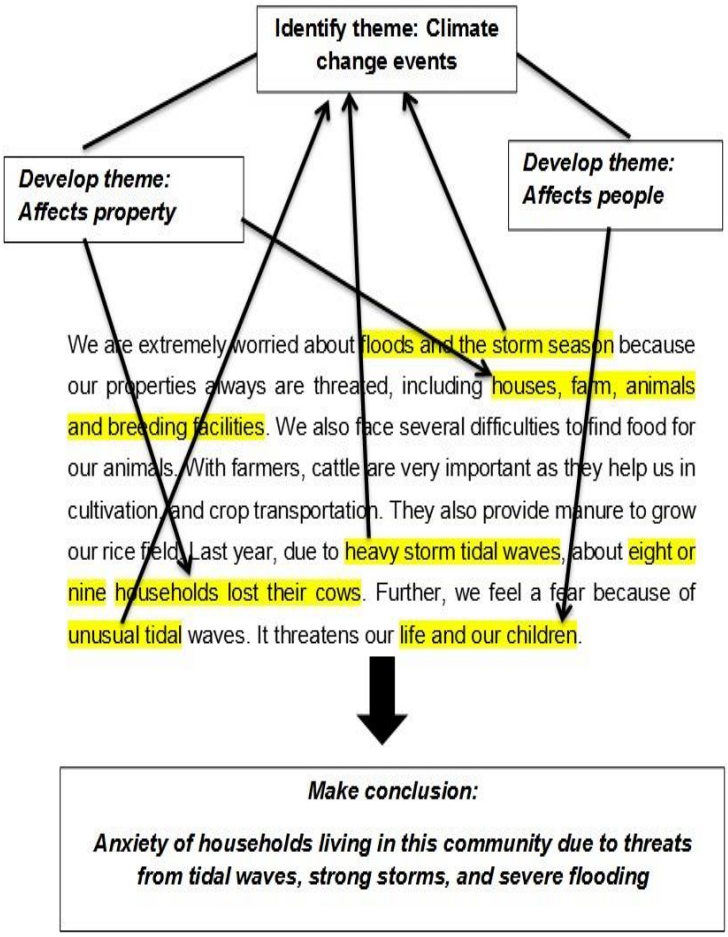
The purpose of qualitative data analysis is to discover meaning in the data, and this is done by systematically arranging and presenting the information (Burns, 2000). Consequently, comparisons, contrasts, and insights can be illustrated by qualitative analysis. Several techniques may be used in qualitative analysis such as narrative analysis, discourse analysis, ethnomethodology and conversation analysis, hermeneutics /interpretive analysis and so on. In this thesis, the researcher used the content analysis technique to analyse qualitative data collected from four interviews in the pre-intervention phase and four interviews in the post-intervention, evaluation phase. According to Hsieh and Shanon (2005), content analysis is "a research method for the subjective interpretation of the content of text data through the systematic classification process of coding and identifying themes or patterns" (p.1278). Webber (1985) also proposed that "content analysis is a research method that uses a set of procedures to make valid inferences from text" (Weber 1985, p.9). Researchers can use content analysis to analyse various types of data including interview transcripts in order to detect or model interviewees' information related to behaviours and thoughts. By using this method, content analysis in this project was employed as follows:

- Step 1: Defined the units/themes of analysis
- Step 2: Developed categories and a coding scheme that were derived from the interview transcripts.
- Step 3: Coded all the text by matching categories/themes with the texts in the transcripts.

- Step 4: Compared and contrasted texts demonstrating the same categories/themes.
- Step 5: Drew conclusions from the coded data
- Step 6: Reported finding by using typical quotations to justify conclusion.

Here is one example of the display of content analysis:

Figure 7 Example of interview content analysis



3.6 Ethical issues

This project is not a sensitive topic so it was not difficult to persuade respondents to answer questions in the questionnaires and interviews. However, the project complied with the following ethical rules:

- The Human Research Ethics Committee (at James Cook University) issued an ethics approval (Human Ethics Approval Number H 5878) from 15/10/2014 to 31/10/2016.
- A letter of approval was issued by Thinh Loc commune government, which allowed me to undertake formal research from 2014 to 2017.
- Climate change is an urgent problem in the Thinh Loc community, thus this topic attracted the local community's attention. However, while conducting interviews, the researcher was concerned for the welfare of the respondents, including mental and physical health and safety, and took all possible precautions to avoid distress. Further, questions that may cause embarrassment, guilt, discomfort, or risk to respondents were avoided (Bailey, 1982; Sproull, 1988; Vlahos, 1984 cited in Sarantakos, 1998). For example, when assessing climate change impacts, we avoided questions that emphasize loss and deaths of the respondent's family members from floods or typhoons.
- The research had to ensure that respondents participated in the research freely and were not pressured to do so or deceived in any way. The respondents had to be fully informed about the goals of the study before they were asked to take part in the project.
- We ensured that the project respected respondents' privacy when entering their private spheres and allowed respondents to leave questions unanswered if they did not wish to provide the information.
- The researcher has ensured that names and other forms of identification of respondents remain confidential during data collection and when publishing the report.
- The respondents have the right to confidentiality. Information offered by respondents was used by the researcher only and then only for the purpose of the study. It was not made available to other people for any reason or purpose.
- Finally, photos and recordings taken during this thesis were only taken with permission from participants and local government. In addition, local government provided photos of natural disasters, the natural environment, and human activities in the study site to inform findings of the research and to be included in this thesis.

Chapter Four presents Phase One results: Thinh Loc community awareness of, attitudes to, and behavior about climate change.

CHAPTER FOUR: RESULTS PHASE ONE – THINH LOC COMMUNITY'S AWARENESS OF CLIMATE CHANGE

Introduction

This chapter aims to identify awareness, attitudes, and behaviour demonstrated by Thinh Loc community residents in response to climate change in order to answer the first research question: *What is the current level of awareness and ability to adapt to climate change in the Thinh Loc community?*

The main research question has been divided into the following three sub-questions:

> Question 1: What is the Thinh Loc local residents' level of awareness, attitudes and behavior in response to climate change?
>
> Question 2: Do the demographic characteristics of Thinh Loc community members influence their awareness of climate change?
>
> Question 3: Do Thinh Loc community members and the Thinh Loc local government require more climate change education to sufficiently enhance their capacity to cope with climate change?

This chapter is organised into three main parts. Part one presents a pictorial overview about the Thinh Loc community. Part two documents statistical analyses showing climate change awareness of local residents. Part two is divided into five sections: section one describes the demographic characteristics of respondents; section two presents knowledge of respondents on climate change; section three illustrates respondents' attitudes towards climate change; section four describes the activities related to climate change that Thinh Loc community participants engage in, as well as their selection of initiatives to cope with climate change; section five reports on how respondents obtained information on climate change and the need for a climate change education program. Part three is a summary and brief discussion of results. Content analysis was used to analyse qualitative data. For all statistical tests, a significant level of at least $p<0.05$ was employed.

4.1 A pictorial overview of Thinh Loc community through qualitative analyses.

Chapter Three described that observations and semi-structured interviews were two qualitative methods employed in the first phase of the research. Qualitative analysis of field notes and photos from observations as well as content analysis of semi-structured interviews conveys a picture of the Thinh Loc community as one possessing the following significant traits:

4.1.1 Economic condition:

Thinh Loc is a rural community in Vietnam with low levels of infrastructure and economic development. According to the Thinh Loc community Government Report (2014), Thinh Loc is located in the coastal zone and has 12km of coastline. The total area of the community is 1,536 ha, including 476 hectares of agricultural land, 564ha of forested land, 28ha of built environment, and other areas totalling some 468ha. The most common livelihood in the village is agriculture, represented primarily by rice cultivation and supplemented by fishing. Agriculture in the region is completely dependent on climate conditions and natural resources. Over recent decades, income from agricultural production has fallen due to the failure of crops caused by severe floods, storms, inundation and prolonged droughts (Nguyen, 2011). A small percentage of residents is involved in business outside of the agricultural sector, and makes their living from the local flea market and business conducted in their own houses. The major trading services provided in the Thinh Loc community are the sale of seafood and groceries. Currently, the Thinh Loc community remains economically self-sufficient. Local residents consume their own produce and fish. Exchange of goods with outside communities is limited, with the exception of selling seafood.

Climate change and poverty are connected. While climate change exacerbates poverty, poor economic conditions reduce the capacity of communities to respond and adapt to the demands of climate change. Residents living in low socio-economic conditions tend to have a lower level of awareness and a reduced ability to mitigate and adapt to climate change. Figure 8 shows the main livelihoods of the Thinh Loc community locals, including growing rice, fishing and seafood trade. It also shows that women participate in all economic activities in order to generate incomes for their families.

Figure 8 Main livelihoods in the Thinh Loc community

4.1.2 Household location

Many households in the Thinh Loc community are located along the coastal zone. The nearest distance between the beach and residents' houses is about 5 meters without a sea wall. Pine trees and mangroves that protect the coastline from the sea are scattered, with only a few lines of trees. Because of the community's location and lack of infrastructure, Thinh Loc village has been seriously affected by annual natural disasters. A female farmer talked about the anxiety experienced by households living in this area due to the threats posed by tidal waves, strong storms and severe flooding: *"We are extremely worried about annual floods and the storm season because our properties are*

always threated, including houses, farm, animals and breeding facilities. We also face several difficulties to find food for our animals. With farmers, cattle are very important as they help us in cultivation, and crop transportation. They also provide manure to grow our rice. Last year, due to heavy storm tidal waves, about eight or nine households lost their cows. Further, we are nervous because of unusual tidal waves. It threatens our life and our children".

Figure 9 Many households are located along the coast without sea-walls

4.1.3 Households and husbandry's facility

In terms of households' facilities, it was observed that many houses seem vulnerable, lacking strong doors and surrounding walls, which are necessary for coping with heavy annual storms and cyclones. The toilet areas of many households are unhygienic and are set up as compost pits within the garden, which causes serious problems when there are floods. Regarding animal husbandry facilities, one hundred percent of breeding facilities for cattle (including cows, buffalos and pigs) are built inside households' gardens and are close to people's houses. Cattle are often tethered to the front doors of household gardens or are free to wander on the village roads. Such poor household facilities render the Thinh Loc residents at significant risk of severe impacts from of climate change and natural disasters. Furthermore, a limited awareness of sustainable animal waste management and the presence of a poor sewage system contribute to greenhouse gas emissions as well as more general environmental pollution. A farmer presented reasons for using the poor sewage system in the Thinh Loc community "*From my grandfather's generation, they did use a compost pit toilet, so we are familiar with our old traditional toilet. I did not feel comfortable with a new modern toilet as I used it in my relative's house in Ha Tinh city (*laughing)" (A female farmer).

Figure 10 Typical houses in the Thinh Loc community (without doors and /or surrounding walls) illustrated a limitation in addressing climate change and disasters

Figure 11 Inappropriate domestic animal management and animal waste management are prevalent in the Thinh Loc community that contributed to enhancing GHG emissions and environmental problems

Figure 12 Poor sewage system is common in the Thinh Loc community, which contributed to enhancing GHG emissions and environmental problems

4.1.4 Management of wastewater

Several ditches in the village were untidy. These ditches were unlikely to be tidied up regularly. These ditches accounted for the presence of dirty water, bad odours, and

insects, all of which affect human health while the ditches themselves increase methane emissions. Methane (CH_4), which is one of the most prevalent greenhouse gasses emitted as a result of human activities, contributes to global warming and climate change. Methane is generated in wastewater such as dirty ditches and domestic livestock such as cattle, buffalo, sheep, goats and camels, which produce large amounts of CH_4 as part of their normal digestive process (United Nations Environmental Protection Agency [US EPA], 2015). Dredging public ditches and canals in Thinh Loc community was not conducted frequently, as a Thinh Loc local government President said: *"We have an occasional environmental protection activity, but it happens once or twice per year. To conduct this environmental protection activity, all households assemble to clean public roads and facilities, as you witnessed a couple of days ago. But normally, public hygienic issues are ignored, so environmental pollution is a serious problem*".

Figure 13 Uncleaned ditches within the community and a poor wastewater management within households affect residents' heath and contribute to enhancing GHG emissions and environmental problems

4.1.5 Inefficient cookers

Traditional biomass cookers were the most prevalent cookers in the Thinh Loc community. Thinh Loc community members took full advantage of agricultural waste, such as hay, rice hulls and animal dung to help make open fires or inefficient stoves for daily cooking and heating. This practice not only causes health risks from smoke inhalation but also releases carbon dioxide, methane and other gas emissions. Thinh Loc community residents also conducted unsustainably harvested wood from the forest, which contributed to deforestation and reduced carbon uptake.

Figure 14 Biomass cookers are common in the Thinh Loc community which effect human health and enhance GHG emissions

4.1.6 Other factors related to adaptation capacity to cope with climate change in the Thinh Loc community

The sand dyke, which plays a crucial role in protecting rice farms for not only the Thinh Loc community but also other adjacent villages when floods, storms and cyclones occur, was seriously damaged. It was reported that local residents removed sand from this dyke in order to build houses and conduct business. A Thinh Loc local government President said: "*In recent years, people have used trucks, wagons, and even rickshaws to remove sand. All houses are built from that sand dyke. Look at our sand dyke, what do you see? (*Pause-a long breath). *A lot a lot, a lot of sand was removed. Compared to the previous sand dyke, the height of this sand dyke is now just around a half. Imagine if this sand dyke disappears, how many risks from the sea we will face?"*

Figure 15 The sand dyke has been exploited, which causes damage to crops and residents' lives

The Thinh Loc community does not have an emergency centre to help rescue or support people during emergency situations such as unpredicted storms, floods, or tidal flow. There is a village medical centre with only one doctor, two nurses and one accountant. Lack of rescue resources and medical support affects their capacity to adapt to climate change

Figure 16 Thinh Loc community medical centre has a poorly supported facilities and human resources, which affects the adaptive capacity to address climate change

The Thinh Loc community is a coastal village, which has been impacted by climate change disasters over several decades. However, as with other undeveloped Vietnamese coastal communities, there was not a sea wall to help address climate change and disasters in the Thinh Loc community. Since 2013, the government have paid attention to Thinh Loc by building a sea wall to aid local residents in facing sea level rise and floods. This sea wall certainly plays a crucial role in helping the Thinh Loc community to mitigate the risks and severe impacts of floods and sea level rise. A Thinh Loc local government President reported that "*External organizations fund the building the sea of the sea-wall. Our local government and community members are not involved in this project. Although it is clear that our community will get huge benefits from the sea wall, we do not know when this project will be completed. It seems quite slow. We are waiting for a completed sea wall to minimize the serious impacts from severe weather*".

Figure 17 Sea-wall is being built

In general, results from qualitative analyses show that:

- The Thinh Loc community is vulnerable due to poverty and climate change impacts.
- Awareness, attitudes and behaviours to cope with climate change are limited.
- Infrastructure, economic conditions and human resources are not enough to help mitigate and adapt to climate change.

The following part will report quantitative analysis awareness of Thinh Loc community participants of climate change.

4.2 Climate change awareness of Thinh Loc community residents

4.2.1 Demographic characteristics

In order to examine Vietnamese coastal residents' awareness of climate change, aside from interviews and field observations, a survey was considered necessary, by which to better understand participants' climate change attitudes and knowledge. Before delivering the survey, a pilot study was conducted. Consequently, any problems with terminology were identified and these terms converted to local languages. The survey used is found in Appendix A. According to the Thinh Loc community government report (2015), the population of the Thinh Loc community was 6,763 people with 3,376 males and 3,387 females. The proportion of working age people (age 18-60) accounted for 41.6%. The proportion of under 18s was 50% and the percentage of over 60s was 8.4%. The sample for this study was 115 local residents using the selection procedure described in Chapter Three. Of 115 people who received the survey, only 108 completed the questionnaire fully. Seven surveys recipients did not complete the questionnaire; therefore, they were not used to analyse results. Out of 108 people, there were 47

farmers, 20 local government staff, 11 secondary school teachers and 30 secondary school students[4] who were selected through simple random and convenience sampling methods. Sample characteristics are illustrated as below:

Figure 18 Age sample

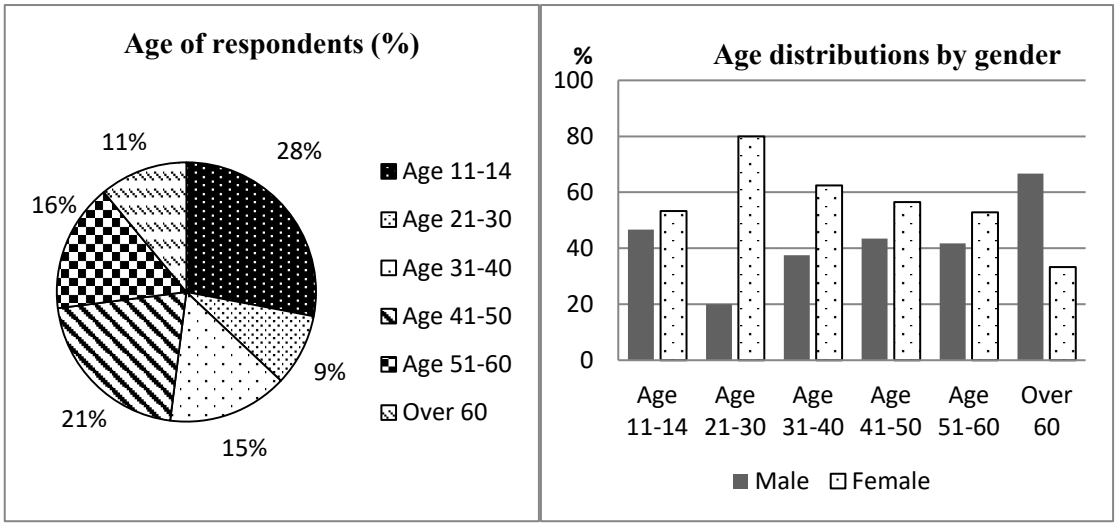


Figure 18 shows age of the sample. The age of respondents was distributed as follows: 28% were aged 11-14; 9% were aged 21-30; 15% were aged 31-40; 21% were aged 41-50; 16% were aged 51- 60 and 11% were aged 60 and over. Out of 108 samples, there were 60 females and 48 males corresponding to 55.6% and 44.4%, respectively. As a result, there were more females than males in almost all of the age categories except the category of age over 60: 66.7% of males compared with 33.3% of females.

Educational level of respondents

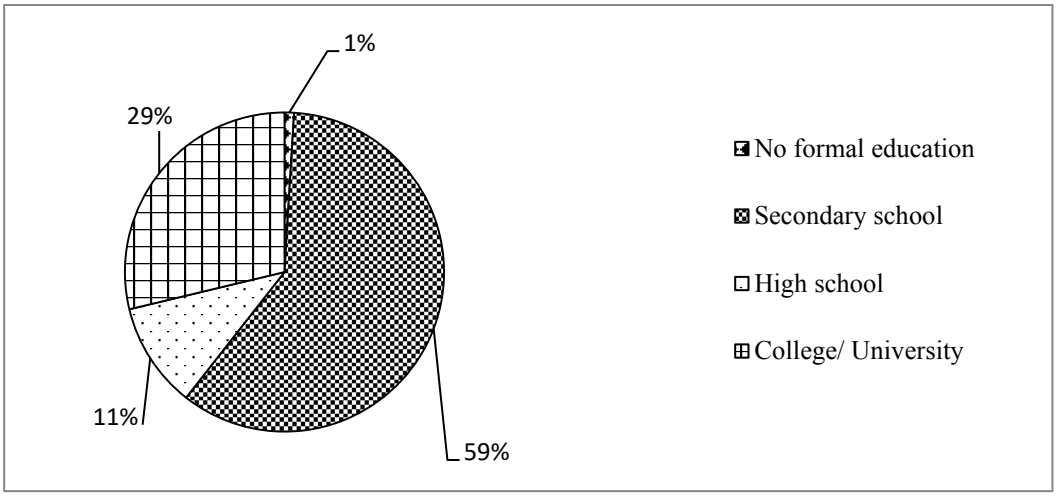
According to the Thinh Loc community government report (2015), out of approximately 7,000 residents in this community, 4.6% was illiterate, 15.2% obtained primary school education, 28.5% achieved secondary school education, 31.7% completed high school education, and 20% of population graduated in vocational, college and university studies.

The questionnaire was designed to classify the education levels of respondents into five categories: no formal education; elementary school (grades1, 2, 3, 4, and 5); secondary school (grades 6, 7, 8, and 9); high school (grades 10, 11, and 12); and

[4] In Vietnam there are three levels of schools: primary school (grade 1-5), secondary school (grade 6-9), and high school (grade 10-12).

vocational/college/university. Figure 19 presents the sample's education levels. Data on education indicated that 1% received no education, 59% received only secondary school education, 11% attended high school and 29% received vocational/bachelor or higher education.

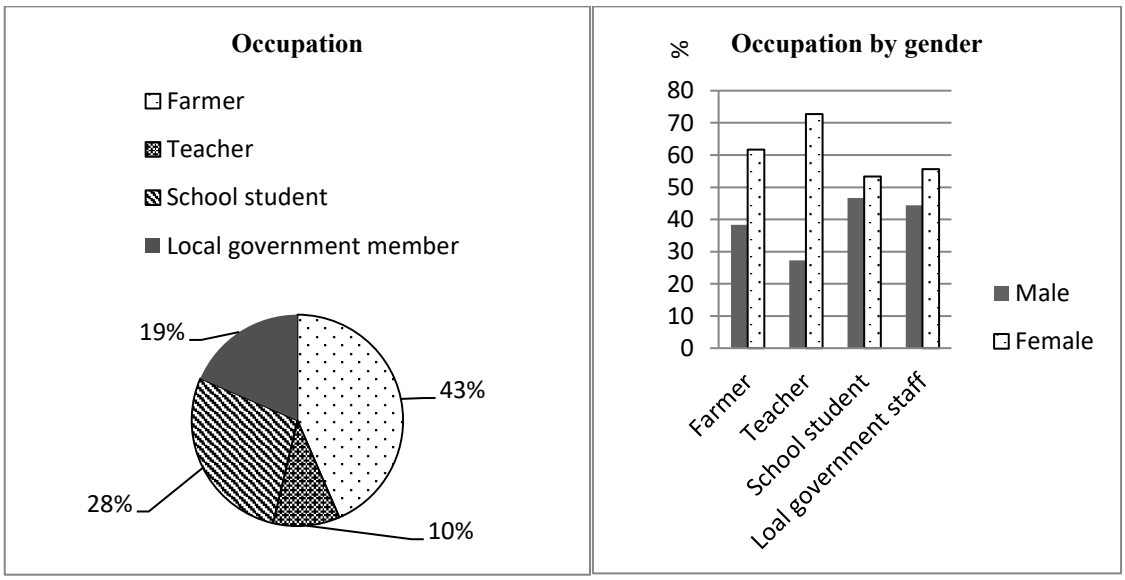
Figure 19 Highest education level (N=108)



Main occupation of respondents

Figure 20 displays the occupations of participants. Farmers, teachers, secondary school students, and local government staff members were the main occupation of 43%, 10%, 28%, and 19% of respondents, respectively. Further, there was an unequal distribution between males and females in all occupational categories, as the number of females was higher than the number of males in all occupational categories.

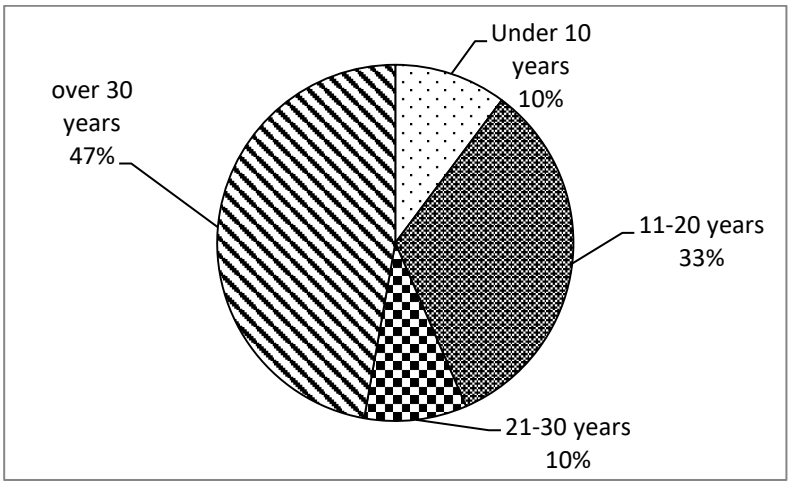
Figure 20 Occupation (N=108)



Length of residence in Thinh Loc community

Figure 21 presents the participants' length of residence in the Thinh Loc community. The number of respondents who lived in Thinh Loc over 30 years made up the largest proportion at 47%, followed by people who lived in the village from 11-20 years at 33%. Lengths of residence from 0-10 years and 21-30 years were identical at 10%.

Figure 21 Length of residence in Thinh Loc community (N=108)



4.2.2 The Thinh Loc community participants' awareness of climate change

In order to identify respondents' climate change awareness, they were asked about their familiarity with five basic terms related to climate change, their knowledge about climate change causes, their belief in the existence of climate change as well as their predictions about climate change impacts.

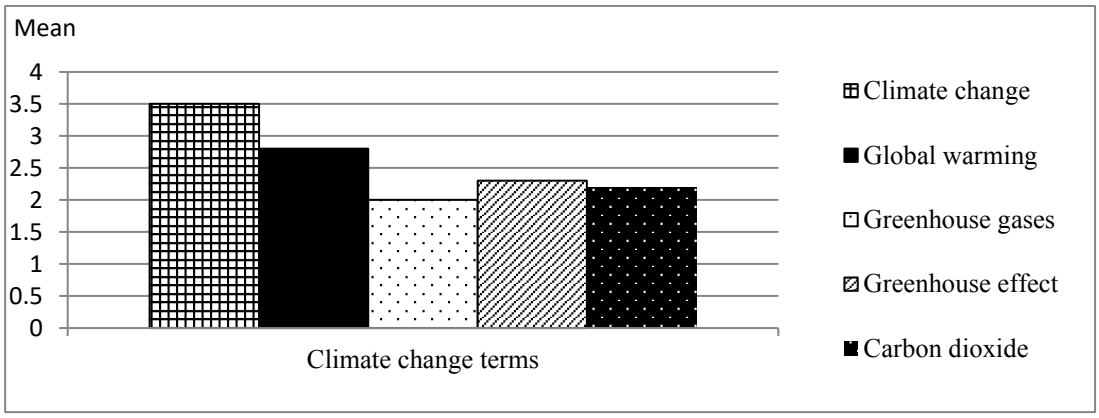
4.2.2.1 Familiarity with the terms related to climate change and significant associations between familiarity and respondents' characteristics

a. Analysis of familiarity with the terms related to climate change

The first survey question was "How familiar are you with the following terms?" The terms, which were used, included Climate change, Global warming, Greenhouse gases, Greenhouse effect, and Carbon dioxide.

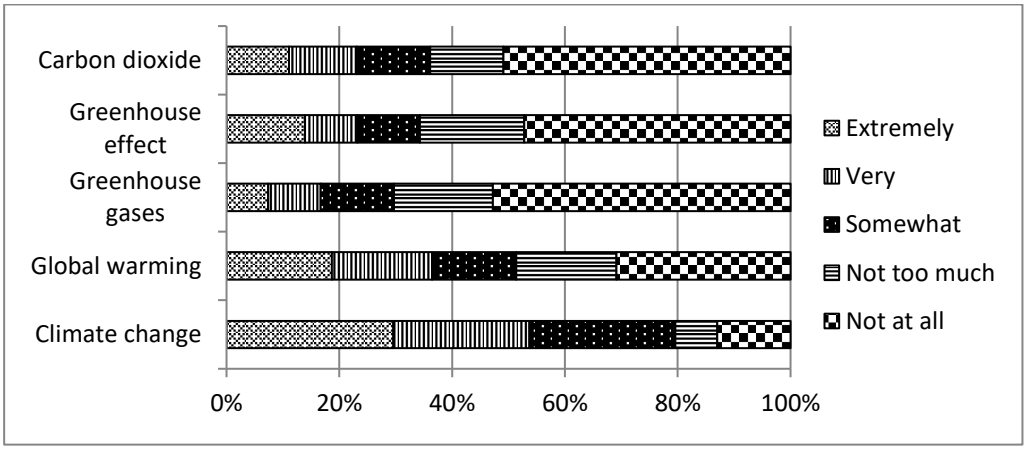
Figure 22 and 23 show the familiarity of respondents with terms related to climate change. Overall, familiarity of respondents with climate change terms were below 3 (somewhat scale) except Climate change term (3.5). Respondents' familiarity with Carbon dioxide was 2 ("not too much").

Figure 22 Mean rating of familiarity with climate change terms (N= 108)



Responses were coded: 1 = "Not at all", 2 = "Not much", 3 = "Somewhat", 4 = "Very familiar", 5 = "Extremely familiar"

Figure 23 Percentage of familiarity with the terms related to climate change (N= 108)



Out of 108 respondents, about 30% respondents perceived that they were "extremely" familiar with the term Climate change and 24% were very familiar with it, while 26% were "somewhat familiar", 7% were "not too familiar", and 13% were "not at all". Regarding the term Global warming, respondents' familiarity was quite low as only 19% of respondents were "extremely" familiar with this term and 17.6% were "very" familiar, while "somewhat" familiar accounted for 15%, "not too much" were 17.6%, and the highest proportion of people chose "not at all" (30.8%).

The familiarity of respondents with the term “Greenhouse gases” was very low. It was indicated that 7.5%, 9.3%, 13%, 17.6%, and 52.8% of respondents were “extremely”, “very”, “somewhat”, “not too much”, and “not at all”, respectively. This trend was true with respondents’ familiarity with the terms Greenhouse effect and Carbon dioxide. Familiarity of respondents with the term Greenhouse effect was found to be: extremely familiarity (13.9%), very familiarity (9.3%), somewhat familiarity (11.1%), not too much familiarity (18.5%), and not at all familiarity (47.2%). It was also found that only about 11% of respondents in Thinh Loc were very familiar with Carbon dioxide, 12 % were “very”, 13 % were “somewhat”, 13% were “not too much”, and 60 % were “not at all”.

b. Significant associations between familiarity of terms of climate change and respondents’ occupation

A one-way analysis of variance (ANOVA) was used to examine if occupation influenced respondents’ familiarity with the climate change terms. Significant associations were found between main occupation and respondents’ familiarity with all five terms:

1. With Climate change term: $F(3,104) = 9.270$, $p<0.05$, η^2_p [5] = 0.21, showing a large size effect

2. With Global warming term: $F(3,103) = 14.617$, $p<0.05$, $\eta^2_p = 0.3$, showings a large-size effect

3. With Greenhouse gases term: $F(3,104) = 3.977$, $p<0.05$, $\eta^2_p = 0.1$, showing a medium-size effect

4. With Greenhouse effect term: $F(3,104) = 6.679$, $p<0.05$, $\eta^2_p = 0.16$, showing a large-size effect

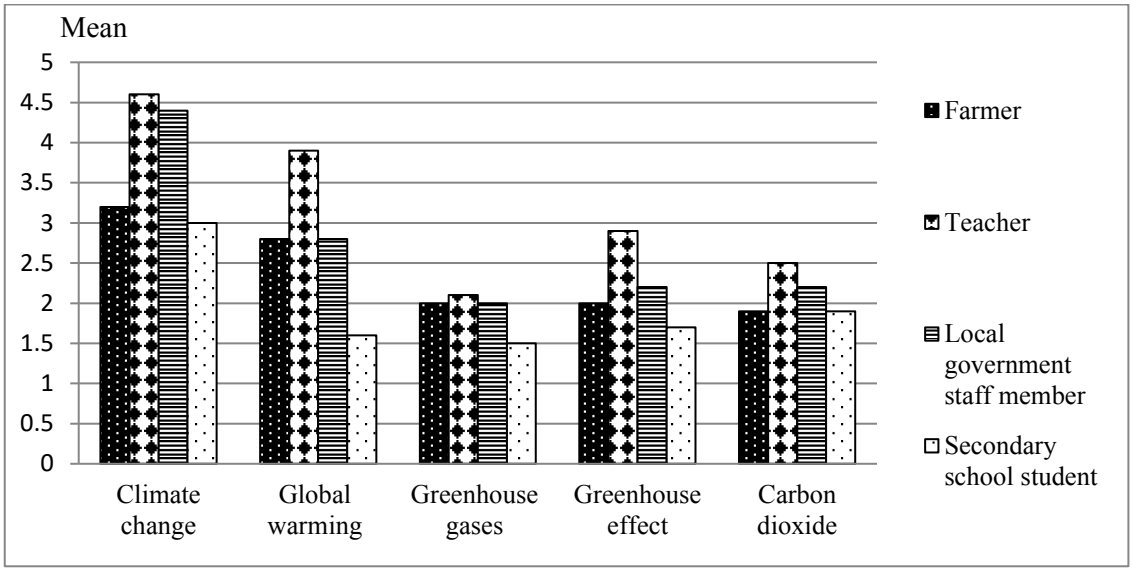
5. With Carbon dioxide term: $F(3,104) = 3.708$, $p<0.05$, $\eta^2_p = 0.1$, showing a medium-size effect.

Figure 24 displays mean scores of the levels of familiarity with five terms related to climate change knowledge among farmers, teachers, secondary school students and local government officers. In general, local government officers demonstrated the highest familiarity with almost all five terms, followed by teachers. Farmers ranked in the

[5] Partial Eta Squared (η^2_p) measures the proportion of the total variance in a dependent variable that is associated with the membership of different groups defined by an independent variable (Richardson, 2011). The values of .01, .06, and .14 to indicate small, medium, or large size effects for Eta squared (Richardson, 2011).

third position and secondary school students exhibited the lowest familiarity with all five terms.

Figure 24 Mean scores of familiarity with 5 terms related to climate change knowledge by occupation (N= 108)



Responses were coded: 1 = "Not at all", 2 = "Not much", 3 = "Somewhat", 4 = "Very familiar", 5 = "Extremely familiar"

c. Association between respondent's age and familiarity with the terms related to climate change

In order to examine if age was associated with awareness of climate change, a chi-square analysis was conducted. The analysis showed a significant effect of age with familiarity with the first two terms: Climate change and Global warming.

- *Climate change*: a significant association between age and familiarity with the Climate change term was detected, with a model of χ^2= 53.109, df = 20, p<0.05. The measured value of Cramer's V[6] = 0.35 showed a large-size effect of age upon familiarity with climate change.
- *Global warming*: the age of respondents also affected familiarity with the term Global warming since χ^2 = 28.529, df = 12, p< 0.05, and this association produced a large-size effect, Cramer's V = 0.3.

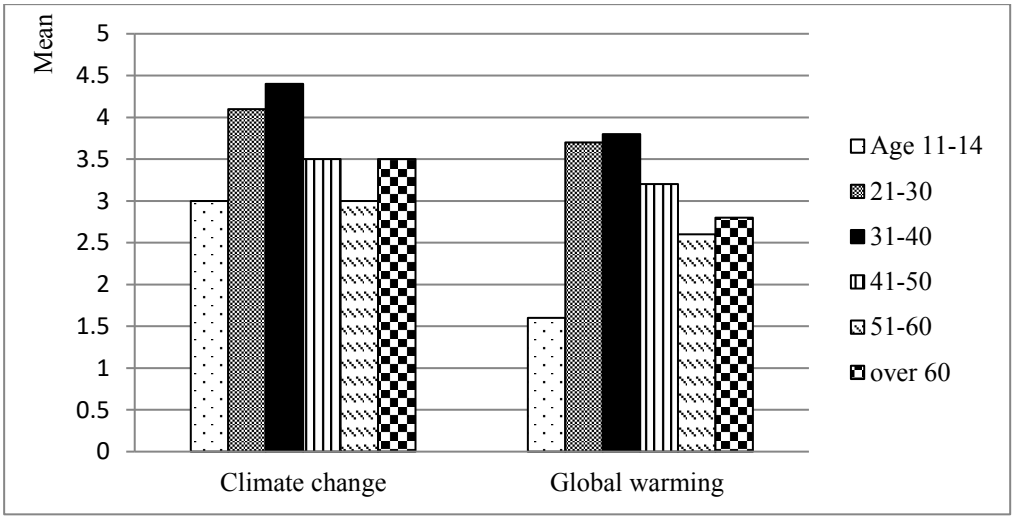
Other chi-square analyses showed no effect between age and familiarity with

[6] Cramer's V is frequently used to find out the strength of association between two variables for tables larger than 2 by 2. Cramer's V ranges between 0 and 1, with O representing no association and 1 a perfect association. (Miller, Acton, Fullerton, & Maltby, 2002)

greenhouse gases, greenhouse effect, and carbon dioxide as $p>0.05$. This is not a surprising result because overall result showed that familiarity of respondents with these three terms was low.

Figure 25 displays the mean scores of respondents' familiarity with two terms: Climate change and Global warming by age group. It was shown that familiarity with both terms in the youngest aged group 11-14 was the lowest. By contrast, the age 31-40 obtained the highest familiarity with Climate change and Global warming.

Figure 25 Mean scores of familiarity with the terms of Climate change and Global warming by age (N = 108)



Responses were coded: 1 = "Not at all", 2 = "Not much", 3 = "Somewhat", 4 = "Very familiar", 5 = "Extremely familiar".

e. Association between gender and familiarity with the terms related to climate change knowledge

In order to detect associations between gender and familiarity with the terms related to climate change knowledge, chi-square analyses were performed. Results showed there was only a significant relationship between gender and familiarity with Greenhouse gases. This was demonstrated when a 2 x 5 contingency table (Table 7) analysis was performed for gender and familiarity with Greenhouse gases, and a statistically significant relationship emerged, with χ^2= 10.238, df = 4, $p<0.05$. Crammer's V= 0.38 showed a strong association between these factors. Table 7 shows a significant difference between males and females in familiarity with Greenhouse gases. It was found that more males were familiar with the Greenhouse gas term than females.

Table 7 Chi-Squared (χ^2) independence test between gender and familiarity with greenhouse gases (N=108)

Familiarity with greenhouse gases		Male	Female	χ^2	df	*p*	% variance Crammer's V
				10.238	4	*0.37*	0.38
Extremely	N	6	2				
	%	75	25				
Very	N	8	2				
	%	80	20				
Somewhat	N	5	9				
	%	36	64				
Not too	N	6	13				
	%	32	68				
Not at all	N	23	34				
	%	40	60				

f. Association between education level and familiarity with the terms related to climate change knowledge

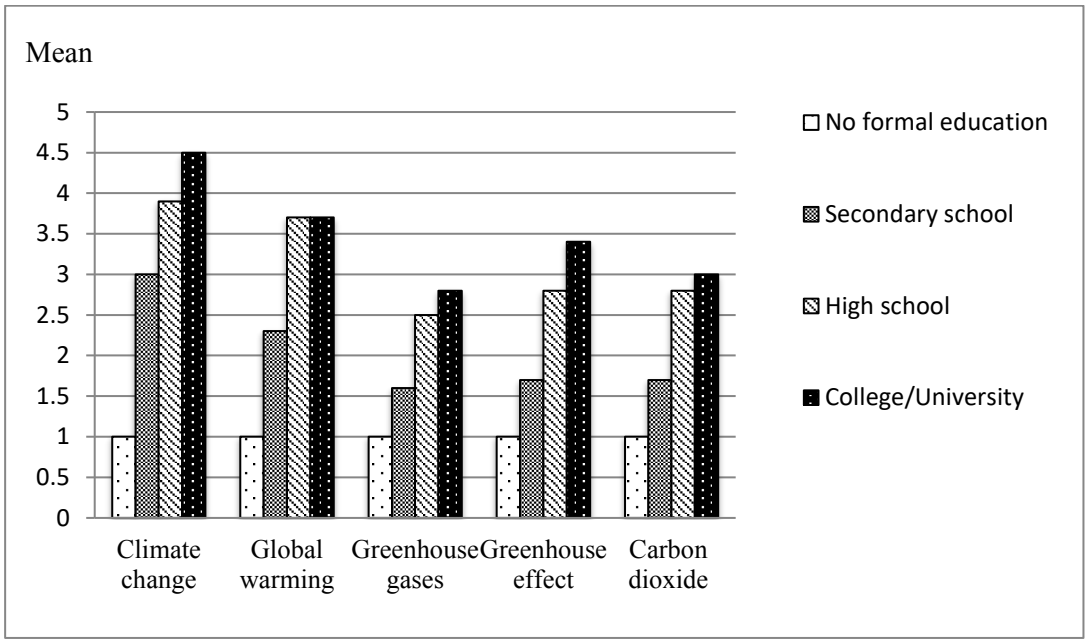
A univariate analysis of variance (ANOVA) was conducted to examine effects between education levels and familiarity to the terms related to climate change knowledge. It was found that education levels were linked to familiarity for all five terms*:*

1. Climate change: a statistically significant effect was found from the model F (3,104) = 11.429, $p<0.05$, partial eta squared (η^2_p) = 0.25, showing a large size effect.
2. Global warming: a statistically significant effect was found from the model F (3,103) = 8.88, $p<0.05$, partial eta squared (η^2_p) = 0.21, showing a large size effect.
3. Greenhouse gases: a statistically significant effect was found from the model F (3,104) = 6.317, $p<0.05$, partial eta squared (η^2_p) = 0.15, showing a large size effect.
4. Greenhouse effect: a statistically significant effect was found from the model F (3,104) = 12.448, $p<0.05$, partial eta squared (η^2_p) = 0.26, showing a large size effect.

5. Carbon dioxide: a statistically significant effect was found from the model F (3,104) = 7.408, p<0.05, partial eta squared (η^2_p) = 0.18, showing a large size effect.

Figure 26 compares the mean rating of respondents' familiarity with all terms related to climate change by education levels. It is clear that people who achieved higher levels in education were more familiar with the terms related to climate change. For example, respondents who had completed vocational/college/university achieved the highest familiarity with all terms, followed by respondents who completed high school, secondary school, and had no formal education.

Figure 26 Mean scores of familiarity with the terms related to climate change by education level (N=108)



(Note: a higher mean equal to more familiarity with terms of climate change)
Responses were coded: 1 = "Not at all", 2 = "Not much", 3 = "Somewhat", 4 = "Very familiar", 5 = "Extremely familiar"

g. Associations between length of residence in the Thinh Loc community and familiarity with the concepts related to climate change knowledge

A univariate analysis of variance (ANOVA) was also used to examine influences of length of residence on familiarity with the terms related to climate change. As a result, length of residence affected respondents' familiarity with two terms: Global warming and Greenhouse effect. However, significant associations between length of residence and familiarity with the terms of Global warming and Greenhouse effect were medium size

effect with the models of F (3,103) = 5.243, p<0.05, η^2_p = 0.13 and F (3,104) = 3.563, p<0.05, η^2_p = 0.09, respectively.

Table 8 displays a comparison of means and Standard Deviations (SD) of familiarity with global warming and greenhouse effect by length of residence. It was found that respondents who lived in the community from 11-20 years obtained the lowest familiarity to both terms as the value of means was 2 and 1.8, respectively. By contrast, people living from 21-30 years obtained the highest familiarity with the terms of Global warming and Greenhouse effect as shown from the value of mean at 3.4 and 3.2, respectively.

Table 8 Mean and SD of familiarity with global warming and greenhouse effect by length of residence

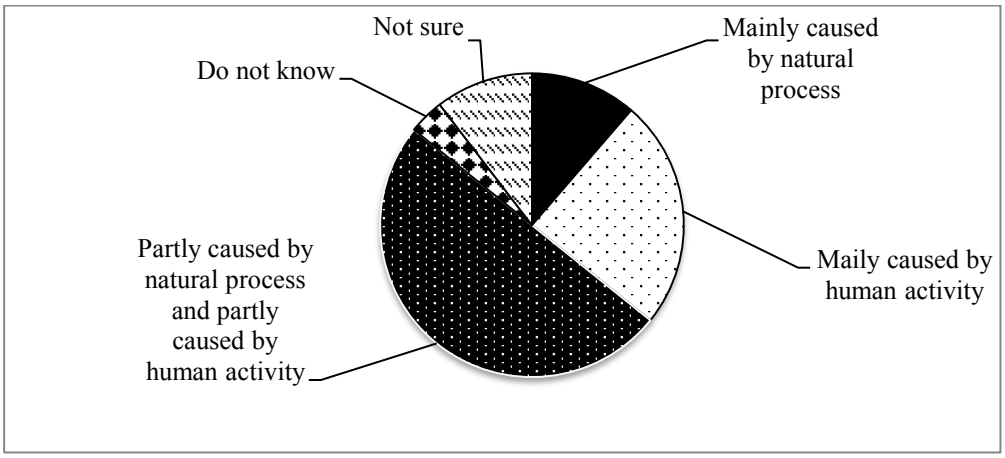
Length of residence	Global warming (n= 107)			Greenhouse effect (N= 108)		
	Mean	S.D	N	Mean	S.D	N
0-10 years	3.3	1.6	11	2.8	1.4	11
11-20 years	2	1.1	36	1.8	1.2	36
21-30 years	3.4	1.4	10	3.2	1.7	10
Over 30 years	3.1	1.6	50	2.3	1.5	51

(Note: a higher mean equal to more familiarity with terms of climate change)

4.2.2.2 Perception of climate change causes

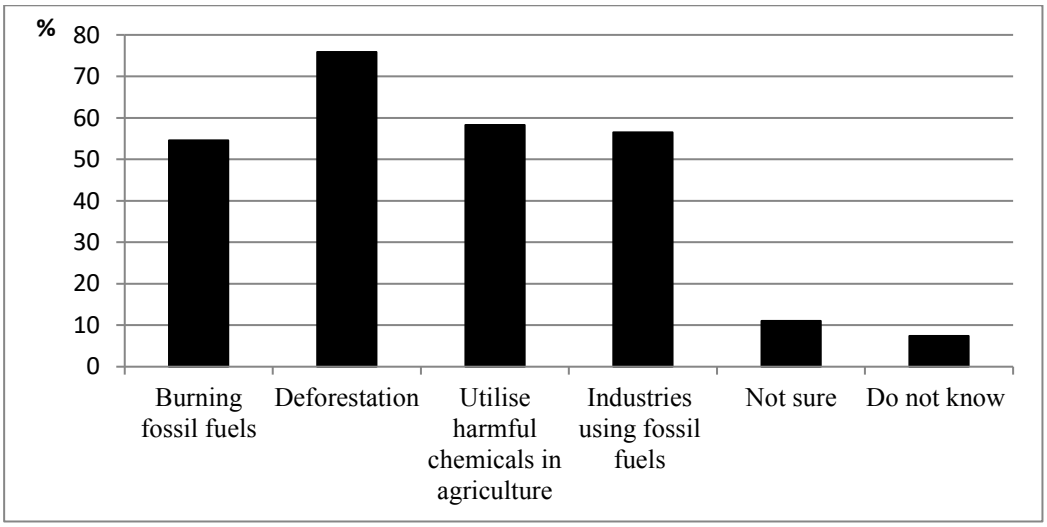
The proportion of people who attributed the cause of climate change to human activity was 24% while 11% of respondents said climate change was mainly or entirely due to natural causes. The largest proportion of respondents (over 50%) thought climate change is a mixture of natural and human cause. Nearly 4% of population samples did not know the causes of climate change while over 10% of respondents were not sure about climate change causes (Figure 27).

Figure 27 Perception of respondents on climate change causes (N= 108)



In relation to human causes (Figure 28), the largest percentage of people thought deforestation activity such as cutting down trees and burning forest contributed to climate change (75.9%). Other explanations included utilizing harmful chemicals in agriculture (58.3%), industries using fossil fuels for manufacturing (56.5%), and burning fossil fuels such as coal oil, gas, and petrol at 54.6%. Moreover, respondents who were not sure and did not know the causes of climate change were 11% and 7.4%, respectively.

Figure 28 Perception of human activity causes climate change (N=108)



Chi-square tests did not show any associations with age, education level, occupation, and length of residence, on what causes climate change. However, a significant association was found between gender and participants' awareness on the causes of climate change, with χ^2= 10.831, df = 4, p<0.05. Crammer's V= 0.317 showed a strong association between these factors. Table 9 shows a significant difference between males and females in identifying the causes of climate change. It was found that more females

than males believed that climate change is mainly caused by natural process: 75% and 25% respectively. By contrast, more men than women perceived that climate change is mainly caused by human activity: 64%, and 36%, respectively. Noticeably, while no male selected the category "do not know," four females answered that they did not know what causes climate change. Furthermore, the percentages of females not sure about the causes of climate change were also higher than males: 73% compared with 27%.

Table 9 Chi-square (χ^2) independence test between gender and the causes of climate change (N=108)

Causes of climate change		Male	Female	χ^2	df	*p*	% variance Crammer's V
				10.831	4	*0.03*	0.317
Mainly caused by natural processes	N	3	9				
	%	25	75				
Mainly caused by human activity	N	18	10				
	%	64	36				
Partly caused by natural processes and partly caused by human activity	N	24	29				
	%	45	55				
Do not know	N	0	4				
	%	0	100				
Not sure	N	3	8				
	%	27	73				

4.2.2.3 Awareness of the existence of climate change

The results showed that a large proportion of people (75%) thought climate change is happening, while only 2.8 % did not agree with this statement. However, a significant percentage of respondents were not sure whether climate change existed (22.2%).

a. Association between gender and perception of climate change existence

In order to examine a relationship between gender and the belief whether climate change is happening; a chi-square analysis was conducted. It was found that there was a significant association between gender and perception of the existence of climate change with χ^2= 9.900, df =2, p<0.05. Crammer's V= 0.3 showed a strong association between these factors. Table 10 shows that there were more males than females

believing that climate change is happening. Moreover, the number of females who were "not sure" was much higher than males, 83% and 17%, respectively.

Table 10 Chi-square (χ^2) test between gender and whether climate change existence (N=108)

Is climate change happening?		Male	Female	χ^2	df	*p*	% variance Crammer's V
				9.900	2	*0.007*	0.3
Yes	N	42	39				
	%	52	48				
No	N	2	1				
	%	67	33				
Not sure	N	4	20				
	%	17	83				

b. Association between age and perception of climate change existence

A chi-square analysis was also employed to find out the relationship between age and whether or not climate change is happening. A significant association also was detected, χ^2= 23.672, df = 10, p<0.05, Crammer's V = 0.331, showing a strong relationship between two these factors. Table 11 illustrates a significant difference between age groups and participants' consideration. It presents the fact that the amount of young people aged 11-14 who were unsure whether climate change is happening was higher than other age groups.

Table 11 Chi- square (χ^2) independence test between age and perception of climate change existence (N=108)

Age		**11-14**	**21-30**	**31-40**	**41-50**	**51-60**	**over 60**
Yes	N	14	8	13	22	13	11
	%	47	80	81	96	77	92
No	N	2	1	0	0	0	0
	%	7	10	0	0	0	0
Not sure	N	14	1	3	1	4	1
	%	47	10	19	4	24	8

4.*2.2.4 Prediction of climate change impacts*

a. Analysis of prediction of climate change impacts

Regarding perceptions of climate change impacts, most respondents were aware of the negative future impacts of climate change. In their opinions, if nothing was done to

address climate change, the issue of climate change will be “very serious” worldwide, in Vietnam, and in the Thinh Loc community (92%, 80%, and 79% respectively). Respondents also believed that there will be “a great deal” of “harmfulness of climate change” on individuals and their family members, community members, and future generation (over 65%, 60% and nearly 80%, respectively) (see Figure 29 & Figure 30).

Figure 29 Perceptions of harmfulness of climate change for the world, Vietnam, and Thinh Loc village if nothing is done to reduce this problem (N=108)

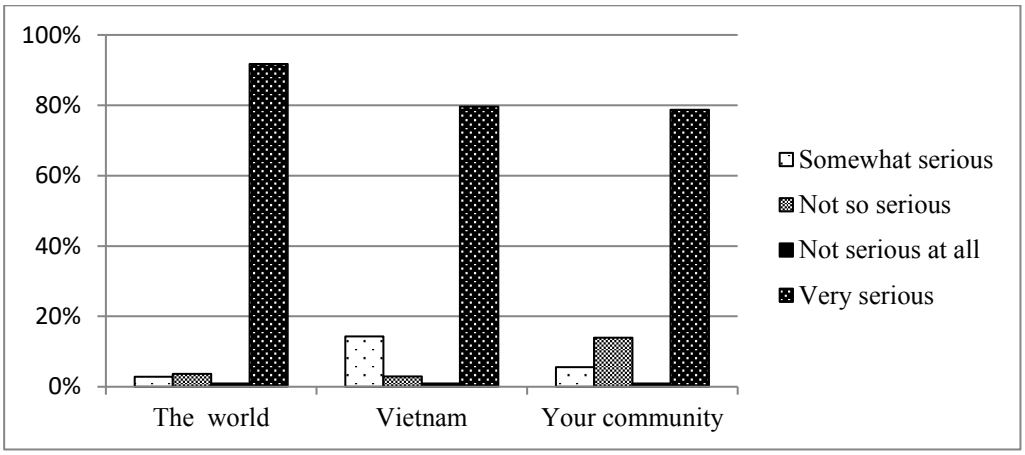
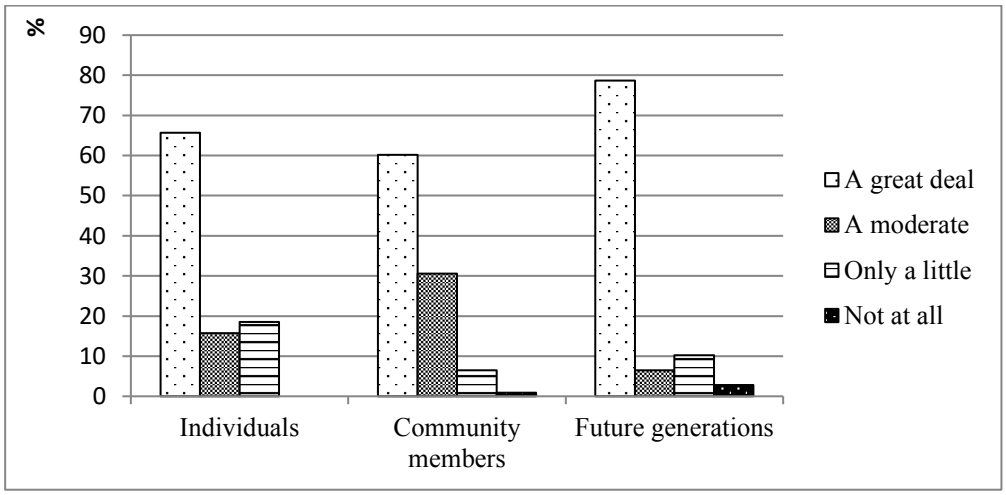
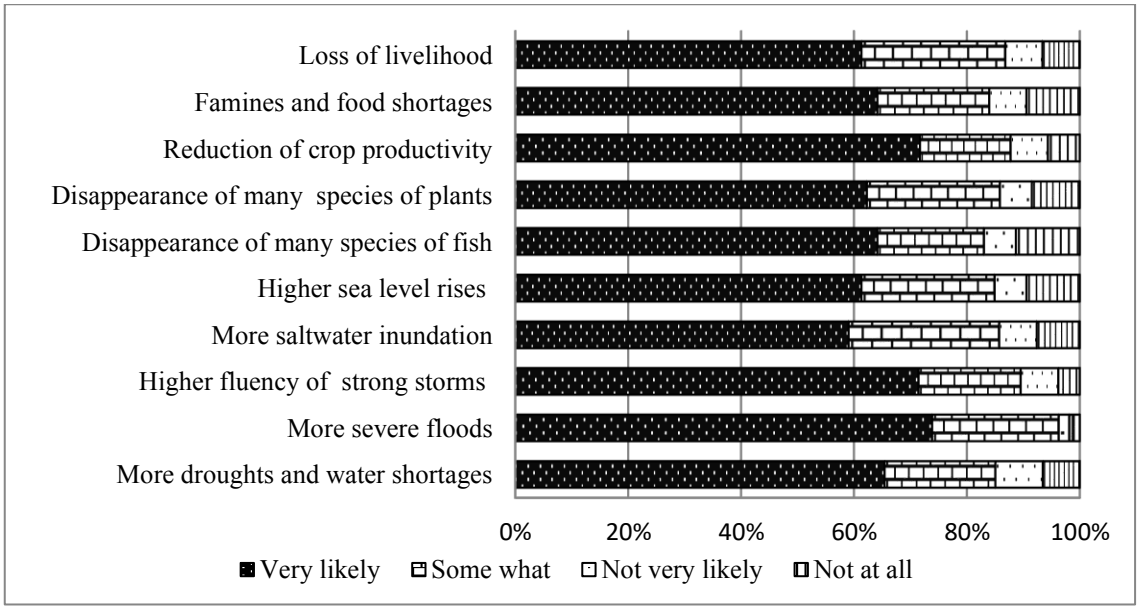


Figure 30 Perception of harmfulness of climate change for the individuals and his family, community members, and future generations (N= 108)



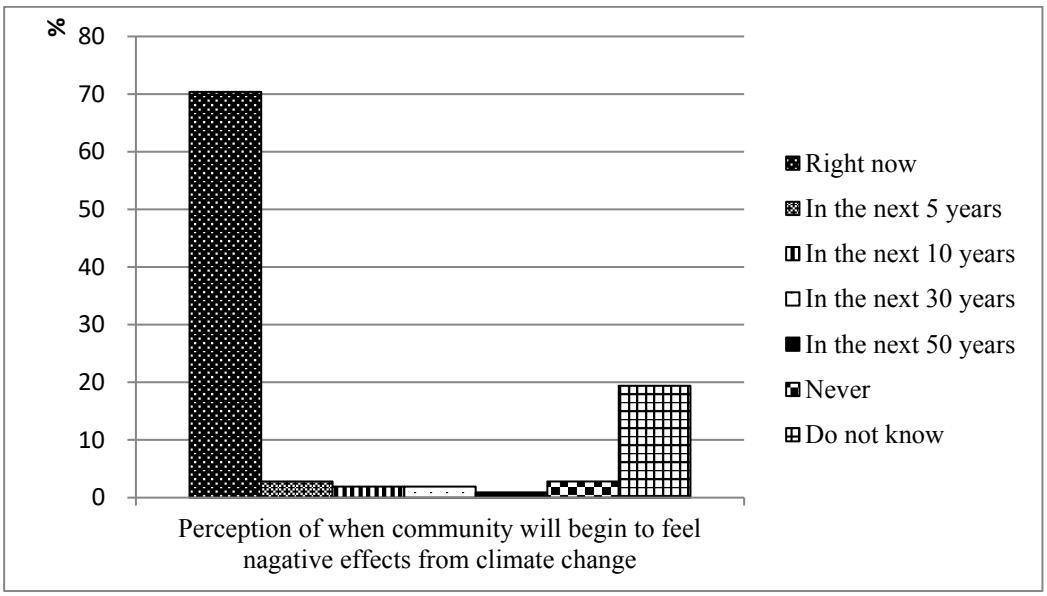
The participants also predicted severe impacts of climate change for the Thinh Loc community in the next 20 years. Figure 31 shows that more than 70% of respondents forecast that reduction of crop productivity, higher frequency of strong storms and more severe floods will be “very likely” in the next 20 years. Other phenomena such as famines and food shortages; disappearance of many species of plants and fish; more droughts and water shortages; higher sea level rise; and loss of livelihood will “very likely” appear in the next 20 years, as predicted by over 60% of respondents.

Figure 31 Prediction of phenomena likely to be observed in the next 20 years in Thinh Loc (N=108)



Regarding when the local community is likely to feel negative impacts from climate change, around 70% of the sample thought that Thinh Loc village is being affected "right now". However, up to 20% of survey recipients who could not perceive when their community would begin to feel negative effects from climate change, accounted for approximately 20%. Those who believed that their village would "never" be affected by climate change were just less than 3% (see Figure 32).

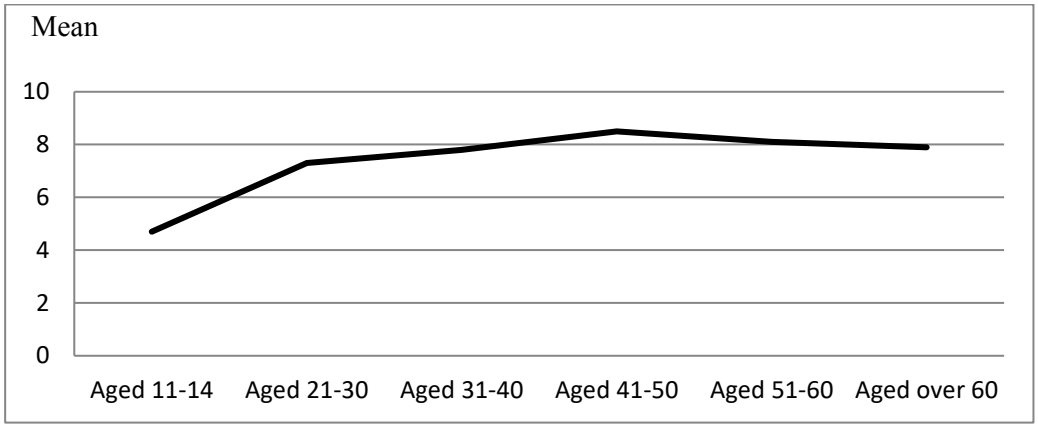
Figure 32 Perception of when Thinh Loc community will begin to feel negative impacts from climate change (N=108)



b. Association between age and respondents' prediction about when the Thinh Loc community will begin to feel negative effects from climate change.

In order to examine any significant relationship between age and respondents' predictions about when the Thinh Loc community will begin to feel negative impacts from climate change, an ANOVA test was conducted. A significant association was shown by model F (5,102) = 5.914, $p<0.05$. The measure of association of $\eta^2_p = 0.23$ represents a large-size effect of age on the respondents' forecast. Mean comparison of prediction amongst age groups in Figure 33 shows that there was a significant difference among all age groups, especially in the 11-14 and 41-50 age groups. A majority of respondents in the 41-50 age group believed that their community is being affected negatively "right now" by climate change. By contrast, a majority of people in the 11-14 age group felt that negative effects of climate change on the Thinh Loc community would happen in the "next 50 years".

Figure 33 Prediction of climate change impacts' time by age (N=108)



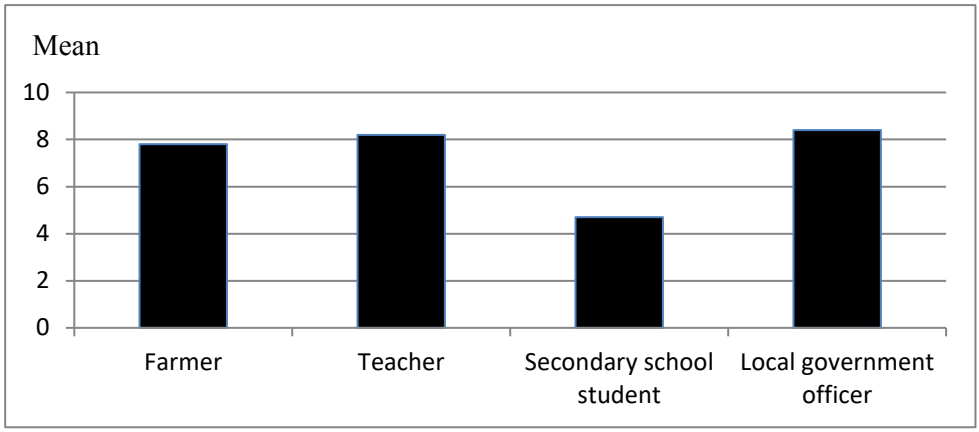
Responses were coded: 1 = "Do not know", 2 = "Never", 3 = "Over 100 years", 4= "In the next 100", 5= "In the 50 years", 6 = "In the next 30 years", 7 = "In the next 10 years", 8 = "In the next 5 years", 9= "Right now".

c. Association between occupation and prediction about when Thinh Loc community will begin to feel negative effects from climate change

An ANOVA analysis also was employed to test the effect of occupation on respondents' forecast about when the Thinh Loc community will begin to feel negative effects from climate change. As a result, a significant association emerged as F (3,104) = 9.712, $p<0.05$, $\eta^2_p = 0.2$ showing a large size effect of occupation upon respondents' prediction. A significant difference in prediction amongst the occupational groups is illustrated in

Figure 34 It is clear that while farmers, teachers, and local government staff believed that Thinh Loc village is being affected “right now” by climate change, a majority of high school students predicted a future happening time that will occur in the “next 50 years”.

Figure 34 Mean scores of predictions of climate change impacts’ time by occupation (N=108)



Responses were coded: 1 = “Do not know”, 2 = “Never”, 3 = “Over 100 years”, 4= “In the next 100”, 5= “In the 50 years”, 6 = “In the next 30 years”, 7 = “In the next 10 years”, 8 = “In the next 5 years”, 9= “Right now”.

4.2.2.5 Awareness of current local policy proposals to address climate change

Table 12 provides respondents’ awareness of current policy proposals to deal with climate change. Around 15% of respondents were aware of many current policy proposals to cope with climate change. Further, more than 30% of those sampled believed that they knew “quite a few”, while 28.7 % of respondents knew “some” current policy proposals in the local area. The remainder knew “not very many” and “nothing”: 15.47% and 9.28%, respectively.

Table 12 Awareness on current policy proposals to address climate change (N=108)

Awareness of current policy proposals to address climate change	N	%
A lot	16	14.8
Quite a few	34	31.5
Some	31	28.7
Not very many	10	9.3
None	17	15.7

Table 13 presents a chi square analysis of gender and awareness level of respondents of current local policy proposals to overcome climate change. When a 2 x 5 contingency table was performed for gender and level of awareness of policy proposals, a statistically significant relationship was detected, with χ^2= 10.020, df = 4, p<0.05. Crammer's V= 0.31 showed a strong association between these factors. It was found that more males knew current policy proposals to deal with climate change than females.

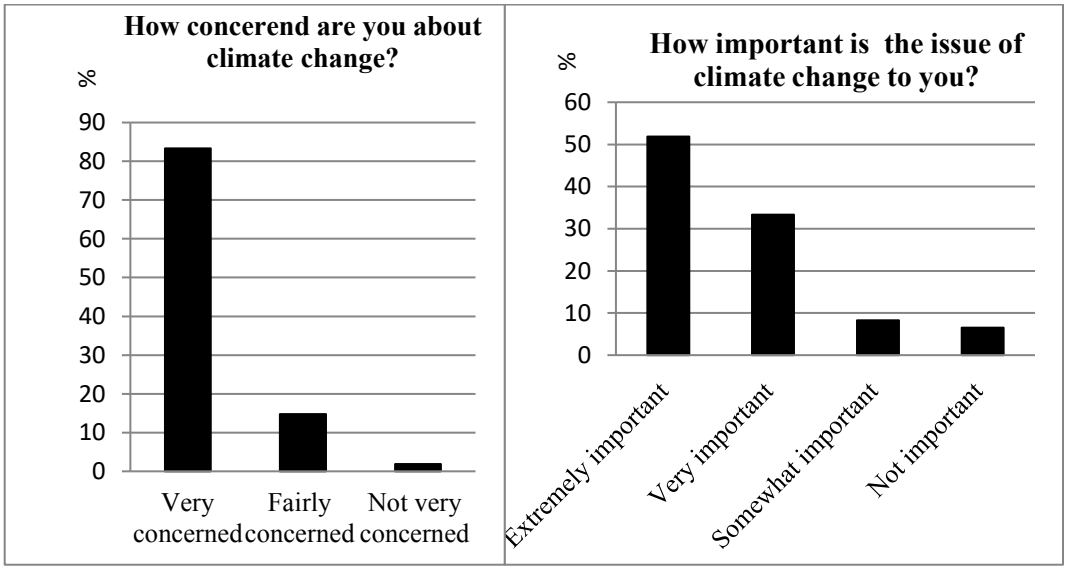
Table 13 Chi square (χ^2) test between gender and awareness of current policy proposals to address climate change (N=108)

Gender		A lot	Quite a few	Some	Not very many	Nothing
Male	N	10	14	18	2	4
	%	21	29	38	4	8
Female	N	6	20	13	8	13
	%	10	33	22	13	22

4.2.3 Attitudes of Thinh Loc community residents towards climate change

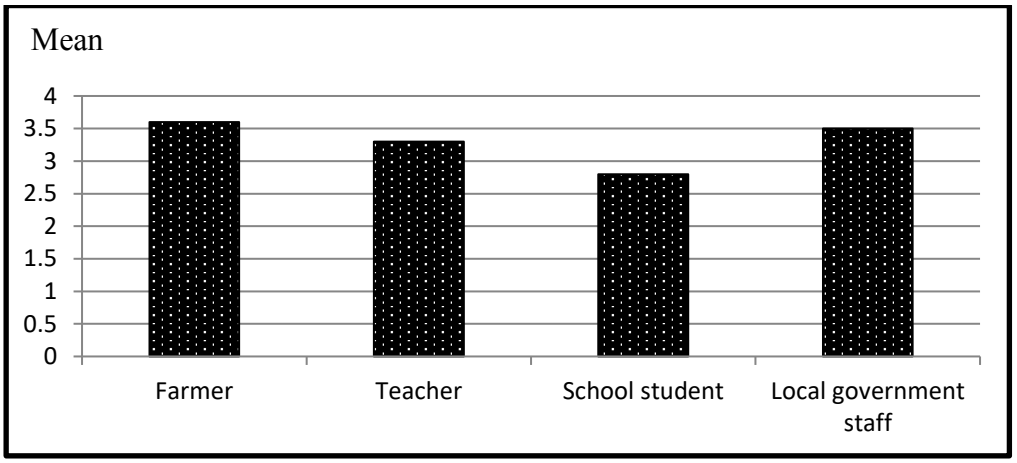
Residents' attitudes to climate change play a crucial role in their efforts to implement adaptive strategies. Results showed that respondents were very concerned about climate change. It is evident (see Figure 35) that a majority of respondents were very concerned about climate change (83.3%) while a huge proportion of people believed that climate change was "extremely" (51.9%) and "very" important (33.3%) to their personal lives.

Figure 35 Attitudes to climate change (N= 108)



In order to examine if occupation of respondents affected attitudes to climate, a chi square independence analysis was employed. Results showed that the importance of climate change to farmers was highest, followed by local government staff members, teachers and secondary school students with mean scores of 3.6, 3.5, 3.3, and 2.8 respectively (Figure 36). A significant association was detected as χ^2 = 19.189, df = 9, p<0.05, and the value of Crammer's V= 0.24 showed a large size effect of occupation upon importance of climate change to participants.

Figure 36 Mean scores of importance of climate change to respondents by occupation (N=108)



Responses were coded: 1 = "Not important", 2 = "Somewhat important", 3 = "Very important" and 4 = "Extremely important".

An ANOVA analysis also showed that the effect of length of residence and attitudes towards climate change was significant overall F (3,104) = 9.697, p<0.05, with a large-size effect of η^2_p = 0.2. A post- host test indicated that more people who have been in the Thinh Loc community for over 30 years acknowledged the importance of the climate change issue to themselves than those who have been living in the community under 30 years. Table 14 compares mean and Standard Deviation (SD) of perception of the importance of the climate change issue to locals by length of residence. It confirms that the importance of the climate change issue to people who have lived in the Thinh Loc community for over 30 years was higher than other people, with Mean at 3.7 and SD at 0.53.

Table 14 Mean scores and SD of the importance of the climate change issue to locals by length of residence (N=108)

Length of residence	N	Mean	SD
0-10 years	11	3.2	.98
11-20 years	36	2.8	.97
21-30 years	10	3.0	.94
over 30 years	51	3.7	.53

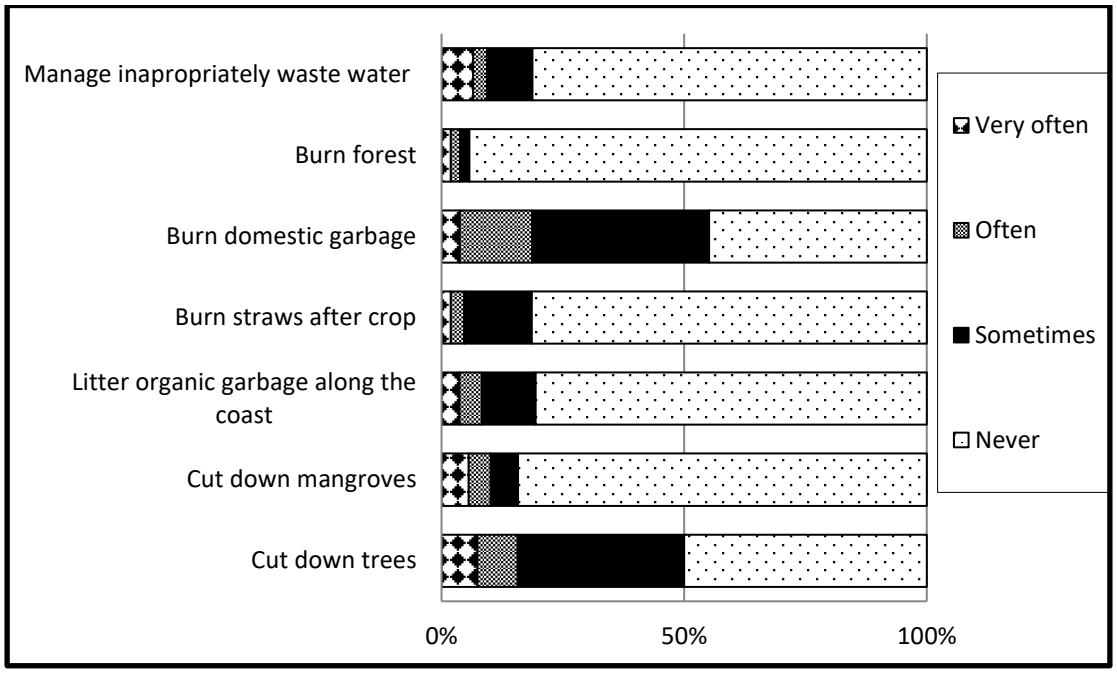
4.2.4 Thinh Loc community residents' actions involving climate change and their suggestions of initiatives to cope with climate change.

This part reports local residents' activities that aggravate climate change. Respondents' selection of initiatives to help the Thinh Loc community to adapt to climate change is also presented in this part.

4.2.4.1 Thinh Loc community residents' activities contribute to exacerbating climate change

Before examining adaptive capacity to cope with climate change, respondents were asked about their behaviours. This was done in order to understand their climate change exacerbating actions. The question was asked "How often do you implement the following activities?" The result showed that burning domestic garbage was conducted the largest proportion (60%). This was followed by cutting down trees (around 50%). Noticeably, approximately 10% of participants undertook cutting down trees at the "very often" level. There were around 20% of survey recipients who acknowledged that they had littered organic garbage along the coastal zone, burning straw after crop, and conducting inappropriate wastewater management. Burning forests and cutting down mangroves were undertaken by fewer people: about 16% or less.

Figure 37 Locals' activities contribute to enhancing GHG emissions (N=108)



4.2.4.2 Suggestion of initiatives to address climate change

Results showed that there was a high requirement for cooperative initiatives amongst individuals and public organizations to deal with climate change in the Thinh Loc community, as respondents selected multiple responses to the question: "Which of the following would best help reduce climate change? (Tick as many as you think are important)". Yet, most people (81%) chose community action. The following choices were local government initiatives (77%) and central government initiatives (75%). The actions of international community initiatives and environmental groups were recommended by more than 70%. The number of respondents, who suggested individual and family action, and voluntary action, was similar at 69%. Those recommending initiatives from industry or companies were the lowest, 69 out of 108 people (64%). Finally, less than 6% of respondents selected "did not know" or other initiatives.

Table 15 Initiatives to address climate change (N=108)

Initiatives	%
Central government initiatives	75
Local government initiatives	77
Community action	81
Individual and family action	69
Voluntary action	69
Environmental groups	70
Industry/Companies Initiatives	64
International community Initiatives	72
Do not know	4
Other	2

4.2.5 Sources of climate change information and a requirement for more climate change education in Thinh Loc community

This part reports results of the examination of how Thinh Loc community participants acquired climate change information. In addition, results of an examination of Thinh Loc community members' need more climate change education to enhance their adaptive capacity in dealing with climate change is reported.

4.2.5.1 Main source of climate change information

Examination of communication tools which local residents used to obtain climate change information is extremely important to help design the most effective methods to enhance the community's ability to deal with climate change.

Table 16 displays respondents' main sources of information about climatic problems and climate change. An approximately 100% of respondents obtained climate change information from television. Radio was second with 70%. Nearly 60% of the population sampled acquired climate change information from newspapers and the Internet. Local government staff members and books were also common source of climate change information to residents with 47% and 44%, respectively. More than 30% of survey recipients believed that they obtained climate change information from teachers. Climate change information provided from family members, friends, relatives and neighbors was reported by fewer than 30% of respondents.

Table 16 Prevalence of sources of climate change information reported by community members (N=108)

Sources of climate change information	%
Television	96
Radio	70
Newspapers	58
Books	44
Internet	58
Local government staff members	47
Neighbours	23
Relatives	21
Friends	22
Teachers	32
Family members	28
Community education programs	41
Others	4

4.2.5.2 Perception of a requirement for a climate change education program

Table 17 showed that 41% of respondents obtained climate change information from a community education programs. However, Thinh Loc community residents reported that climate change was only one topic in the comprehensive programs delivered to community members. Therefore, most respondents expressed their desire to participate in a further climate change education program. Table 17 showed that there was a high demand for a community education project. Importantly, 97% of the sample expressed their willingness to attend a proposed climate change education if it was implemented in their local area.

Table 17 Responses to questions about a climate change education program (N=108)

Questions	Yes		No	
	N	*%*	*N*	*%*
Question 1: Do you think that a future climate change education program should be conducted in your community?	102	94	6	6
Question 2: If a climate change education program is conducted in your community, will you attend?	105	97	3	3

One local resident emphasized the necessity of a climate change education program in Thinh Loc village that "*I have been a teacher for 30 years and now I am a high school principal. I strongly understand the issue of climate change in our area but we almost do not have any educational activity to deal with this problem. If you conduct a climate change education program in Thinh Loc, I will encourage our teachers and students attend this program (smile). We greatly lack climate change knowledge to design an external curriculum for students. It will be great if our staff can attend your project and then we will be able to establish a group of facilitator to transfer your climate change project to our students and other organizations"* (A secondary school principal, female, 54 years old).

4.3 Summary and discussion

Before proceeding to summarize the primary findings, it is a priority to find out the limitations of the first phase of study. Identifying the level of climate change awareness of Thinh Loc community residents was affected by several factors including education levels, the fact that climate change is a complex topic, and poor living conditions.

Firstly, a majority of obtained samples indicated low education levels. Out of 108 samples 69 had only completed secondary school or lower, which is equivalent to grade 9/12 for those residents under 45, and grade 7/10 for ages of above 45. This suggests the literacy level of many respondents was limited, especially in older females. The researcher spent several hours supervising respondents' answers.

Secondly, climate change has become an urgent concern in recent years, but it is a complex and abstract concept that is not easy to understand. Consequently, information provided by respondents was not always consistent.

Third, because the research was conducted during harvest time, data collection from 47 farmers (of 108 samples) was done mostly at night. This posed a significant challenge because the electricity system in Thinh Loc village is extremely poor. As a result, in some cases, respondents listened to questions asked by researchers and then dictated their responses about preferred categories in the questionnaire.

Despite these limitations, the study was able to answer the research questions:
Question 1: What is the Thinh Loc local residents' level of awareness, attitudes, and behaviors to cope with climate change?
A low-level awareness of the terms related to climate change knowledge was demonstrated by respondents. Excluding the term of Climate change, terms such as Global warming, Carbon dioxide, Greenhouse gases, and Greenhouse effect were not familiar to local residents. Compared to the previous research conducted in India by Suhatharahima, Gurugnanam, and Dharanirajan (2013), familiarity with the terms related to climate change was lower for Thinh Loc community residents than Indian survey recipients. For example, 59.5% of Madurai respondents in India were familiar with the term of Climate change, and 72% of those respondents were familiar with Global warming.

Regarding the cause of climate change, only one quarter of participants in the Thinh Loc community believed that climate change was caused by human activity. Compared with the survey in the UK (2015), awareness of human activity as a driver of climate change in the study site was lower, given that in the UK this figure was 40% **(**Roz, 2015).
In terms of the causes of climate change, more respondents believed that deforestation, which is witnessed more directly and easily than other activities, causes climate change. Within their local environment, community members conducted several exacerbating activities; cutting down trees, burning domestic garbage and so on were implemented more often rather than other damaging activities. Furthermore, not many survey recipients were aware of current climate change policy proposals in their community.

In contrast to their low levels of familiarity with climate change terms and causes, Thinh Loc community respondents' perceptions of climate change existence were high, reflecting similar results as those reported in Australia, where roughly three quarters of Australian respondents believed climate change was happening (Leviston & Walker, 2011).

Furthermore, almost all participants demonstrated that they had a high level of concern about the issue of climate change as well as acknowledging the importance of the issue of climate change to their lives. In addition, local residents were very aware of the seriousness of climate change globally, in Vietnam, and in Thinh Loc. Concern over the issue of climate change in the Thinh Loc community was significantly higher than even that found in the general population in Asian countries such as India (76%), the Philippines (72%) and Vietnam in general (69%) (Bruce, Richard, & Jill, 2015).

Almost all respondents predicted severe impacts of climate change to their community and personal lives. They predicted more severe floods, storms, and a reduction in crop productivity to be strongly negative impacts of climate change in their village, compared to other phenomena in the next 20 years. To deal with climate change, local residents conducted positive activities such as planting and maintaining more mangroves, trees and bushes, and participating in building the sea wall, etc. Residents also followed and updated climate change information through a variety of communication methods, of which television became the most important tool to convey climate change information for many Thinh Loc community residents. Furthermore, most people suggested community action to address climate change.

Question 2: Are there influences of Thinh Loc community members' demographic characteristics on their awareness of climate change?

There were significant associations between Thinh Loc community members' characteristics and their awareness of climate change. It was shown that in terms of climate change knowledge, males were better informed than females; local government officers and teachers were better informed than farmers and secondary school students; and respondents who completed vocational/college/university were better informed than people who had only completed high school, secondary school, or received no formal education. Furthermore, the 41-50 age group was most concerned about the issue of climate change. The farmer group acknowledged the importance of the climate change issue more than other occupational groups. In addition, males knew more current local policy proposals relating to climate change than females.

Question 3: Do Thinh Loc community members need more climate change education to enhance their capacity to cope with climate change?

Qualitative analyses showed that the Thinh Loc community was vulnerable to climate change due to poverty and climate change impacts. It is evident that the Thinh Loc community residents were limited in their adaptive capacity to cope with climate change due to factors including poor infrastructure, economic conditions, and a low level of

education. In addition, statistical analyses showed there was a high requirement for more climate change education in the Thinh Loc community. A majority of respondents also expressed their willingness to participate in any climate change education program that was to be conducted in the village. Furthermore, local residents recommended a timetable for implementing an education project, thereby possibly encouraging community members to attend and obtain the best benefits from the project.

Based on the literature review and preliminary analyses, a climate change education program in the Thinh Loc community was proposed to be beneficial. It would be based on the following principles:

1. Designing curriculum based on:
    - Using global climate change knowledge obtained from literature review.
    - Using local knowledge obtained from Chapter IV analyses:
        - Thinh Loc community local residents' climate change awareness and attitudes to climate change
        - Thinh Loc community locals' environmental issues
        - Thinh Loc community locals' economic and livelihood conditions
        - Thinh Loc community locals' educational levels
2. Teaching method: Applying constructivism teaching methods in the classrooms.
3. Participants: The educational intervention proposed to deliver to diversified learners including farmers, school students, teachers, and local government staff members.

Chapter Five will present how a climate change education program was designed and delivered to Thinh Loc community residents.

CHAPTER FIVE: INTERVENTION PROGRAM

Education to enhance capacity of the Vietnamese coastal residents to adapt to climate change (A case study on Thinh Loc community)

Chapter Four concluded that Thinh Loc community is a vulnerable community with poor economic conditions, a low-level of education, limited infrastructure, and significant exposure to the impacts of climate change. Moreover, Thinh Loc community survey recipients demonstrated a low level of awareness about and ability to cope with climate change, especially in the case of farmers and secondary school students, and female participants. However, Thinh Loc community residents were very concerned about climate change and desired climate change education to be conducted in the community. Based on the demand of local residents as well as analysis of the knowledge gap, an intervention needed to be conducted in this community. Consequently, a climate change education program was designed and delivered to 98 community members in the Thinh Loc community strategy to help them mitigate and adapt to climate change. Chapter Five describes how the intervention program was designed and deployed in the study site, as well as the feedback received from learners.

5.1 Curriculum design

Based on the current level of participants' awareness of climate change obtained from baseline data, a curriculum was designed that focused on the three main components below:

<u>Part 1: Climate change understanding.</u>

This part provided climate change science education to learners. The purpose of this part was to help participants to bridge any gaps relating to climate change science in their understanding. The teaching materials covered a range of topics including:

1. What is climate change?
2. What are evidence of climate change in Vietnam and globally?
3. What are climate change impacts?
4. What are greenhouse gases?
5. What are the "greenhouse effect" and "global warming"?
6. What are human activities causing climate change?

Part 2: Climate change mitigation.

This part of the program described measures to mitigate greenhouse gas emissions in rural and coastal areas. Climate change mitigation strategies focused on were those relevant to people who live in rural and coastal areas:

1. Using effective cook- stoves
2. Tree management
3. Minimizing carbon footprint of transportation
4. Usage of sustainable shopping bags and avoidance of plastic disposable bags
5. Electricity use
6. Recycling
7. Reducing meat consumption
8. Waste water and livestock management
9. Minimizing the carbon emissions of agricultural activities

Part 3: Climate change adaptation.

This part of the program focused on educating local residents about adaptive strategies for their community by building upon local knowledge and experience to adapt to climate change in the coastal community. As a result, climate change adaptation part of the program focused on helping residents to adapt to climatic events common in the study site:

- Sea level rise
- Annual storms and floods
- Droughts and water shortages

5.2 Constructivist principles

In order to deliver the climate change curriculum, constructivist principles were employed in the classroom aimed at enhancing deep learning (Howlett, Ferreira, & Blomfield, 2016). The main ideas of constructivist theories of learning suppose that “learners learn best when they are actively engaged in constructing knowledge within a framework of their own experiences, rather than passively receiving information transmitted to them by textbooks or teachers” (Leder, 1993, pp. 12-17 cited in Howlett et al., 2016, p.308). Therefore, “students construct their knowledge via already existing interpretative frameworks” (Leder, 1993, pp. 12-17 cited in Howlett et al., 2015, p.308). By using constructivist principles, interactions between learners (including farmers, school students, school teachers, and local government staff members) were promoted while

the teacher (the researcher) scaffolded ideas allowing the students to construct their understanding.

5.3 Participants

The program was delivered to three different classes during a one-month period. The 98 participants comprised 28 primary school students, 30 secondary school students, five primary school teachers, five secondary school teachers, 13 local government staff employees, and 17 farmers (see Chapter Three: Participants' recruitment for the intervention class). These three classes were divided as follows:

- Class One: 35 participants comprised 30 secondary school students and five secondary school teachers, conducted at Thinh Loc primary school
- Class Two: 30 participants comprised 17 farmers and 13 local government staff members, conducted at Thinh Loc community government office
- Class Three: 33 participants comprised 28 primary school students and 5 school primary teachers, conducted at Thinh Loc secondary school

5.4 Unit plan: Climate change education intervention in Thinh Loc community

Unit description:

This subject was designed to help school students, teachers, farmers, and local government staff members in the Thinh Loc community to raise their awareness and ability to respond to climate change. The subject aimed to provide students with an understanding of climate concepts related to climate change, climate change perspectives in Vietnam and globally, impacts and causes of climate change, and strategies for climate change mitigation and adaptation. Through a constructivist lens, teaching used content and methods to actively involve learners and promoted actions.

Objectives: At the end of this unit, students would be able to:

- Understand meanings of concepts associated with climate change
- Identify causes and impacts of climate change
- Acquire the ability to undertake and develop actions to mitigate and adapt to climate change

Teaching and learning strategies: The unit used a combination of strategies. In order to assist teachers in implementing a participatory or student centred approach, aside from

formal lectures, students were engaged in a variety of learning activities to seek and build knowledge, skills, and the ability to critically analyse and discuss climate change topics. Educational games, group-work, and student presentations accounted for the majority of activities.

Unit resources: The resources of this subject comprised:

- A climate change education curriculum designed by the researcher
- Videos related to climate change education
- Games related to climate change education

5.5 Unit calendar

Date	Class	Session	Detail content	Methods
15/10/16 23/10/16 01/11/16 Time: 120 minutes (2:00 pm- 4:00 pm)	Class 1 Class 2 Class 3	Session 1: Climate change overview	1. What is climate change? 2. What is evidence of climate change in Vietnam and globally? 3. What are main impacts of climate change in the coastal communities in Vietnam?	Group discussion Group presentations Games Evaluation
16/10/16 24/10/16 01/11/16 Time: 180 minutes (2:00pm- 5:00 pm)	Class 1 Class 2 Class 3	Session 2: Climate change causes	1. What are greenhouse gases? 2. What are the greenhouse effect and global warming? 3. What are the human activities causing climate change (focus on Vietnamese coastal communities)?	Group discussion Group presentations Games Evaluation
18/10/16 26/10/16 04/11/16 Time 150 minutes (2:00pm - 4:30pm)	Class 1 Class 2 Class 3	Session 3: Climate change mitigation and adaptation	1. What are actions to help reduce greenhouse gas emission and mitigate climate change in the Vietnamese coastal communities? 2. What are strategies to respond to climate change in the Vietnamese coastal communities?	Games Group discussion Group presentations Evaluation Feedback

5.6 Example of teaching and learning sessions

5.6.1 Session 1: Climate change overview

Learning outcomes: At the end of this session, students will be able to

- Understand the climate change terms
- Identify evidence of climate change in Vietnam and worldwide
- Understand the main impacts of climate change

Time: 120 minutes

Supporting materials:

- Student's handouts: 1 & 2
- Teacher' fact sheet 1,2,3
- Clips: 1 and 2
- Educational game: Sea level rise

Activities	**Teacher**	**Student**
1. Group discussion Time:  20 minutes Aim: To critically distinguish between weather and climate change via learners' existing knowledge	- The teacher (researcher) divided students in to groups of 5-6 students; each group was named in relation to climate change causes such as: Cow, Transportation, Deforestation, Inefficient cooker, Waste and plastic, Industry and electricity, and Agriculture - The teacher asked a question to the whole class: "What do weather and climate change mean to you?"	- Each group discussed, wrote, and drew their ideas on the paper provided by the teacher. - Each group presented their understanding of weather and climate change
	- The teacher listed students' ideas on the blackboard - The teacher summarized key points which led to an explanation and distinction associated with weather and climate change	
2. Problem scenario Time:  20 minutes	- The teacher gave handout 1 to all students. - The teacher explained and distinguished weather and climate change terms (Used teacher' fact sheet 1 & Student's handout 1)	- Reading handout 1: *Climate change overview and evidence in Vietnam and worldwide* - Critical thinking - Asking questions
	The teacher showed clip 1: *Climate change in Vietnam*	Students watched clip 1: *Climate change in Vietnam*

Aim: To identify climate change concepts and evidence of climate change in Vietnam and globally		https://www.youtube.com/watch?v=whSUr-fT9FM
	- The teacher showed evidence of climate change in Vietnam and worldwide such as: (Used teacher' fact sheet 2 & Student's handout 1) • Temperature rise • Sea level rise • Greater intensity and frequency of floods and storms • Greater intensity and frequency of droughts and bushfires • Hotter in summer and colder in winter • Greater intensity and frequency of natural disasters	- Continued reading handout 1: *Climate change overview and evidence in Vietnam and worldwide* - Critical thinking - Asking questions
3. Break 10 minutes 	- The teacher instructed a facilitator (school teachers/local government staff members had been selected prior to the next session) how to organize a game related to climate change impacts	- Students had a 10 minute break
4. Game: Sea level rise game Time:	- The teacher explained that climate change results in melting ice and sea level rise. This causes loss of land, human shelter, agriculture, as well as animal's habitat and so on.	- Four or five students were invited to become judges. They observed and decided which team would stay alive while their land shrank because of sea level rise.

 20 minutes <u>Aim:</u> To identify impacts of sea level rise on the life and community via playing game	- The teacher asked the facilitator to organize the "sea level rise" game - The facilitator asked students to stay with their group and gave each group a piece of large paper - The facilitator explained the rules of the game: "The paper is the land where we live, outside of the paper is the ocean. To stay safe, you should have enough space for all members to stay on the paper. If any feet touch the sea you will lose the game."	- When the facilitator shouted: "The ice is melting causing sea level rise that is flooding a quarter of the land," all teams folded their papers and reduced their land by a quarter. - The judges observed the groups standing in their reduced area. - When the facilitator continued: "The sea is still rising, flooding a quarter of the land," the groups folded their papers again and the game continued until only one team was left.
	To conclude, the teacher explained the link between the game and reality that sea level rise caused by climate change can lead to the loss of habitats of millions people and animals as well.	
5. Group discussion <u>Time:</u>  20 minutes	The teacher asked each group to describe the impacts of climate change in the Thinh Loc community	Each group worked with their topic as follows: • Group 1: Discussion of impacts of climate change on schools and students • Group 2: Discussion of climate change impacts on livelihoods

Aim: To enable students to identify the negative impacts of climate change in their community via their existing knowledge and experience		• Group 3: Discuss of climate change impacts on health problems • Group 4: Discussion of climate change impacts on local environmental problems • Group 5: Discussion of climate change impacts on migration • Group 6: Discussion of climate change impacts on the coastline and aquaculture sector • Group 7: Discussion of climate change impacts on forest and water use
		Each group discussed their topic, drew the pictures and presented to the whole class
	The teacher summarised ideas of each group which lead to an explanation of climate change impacts	
6. Problem scenario Time:	- The teacher delivered handout 2 to all students	• Reading handout 2: *Climate change impacts* • Critical thinking

 25 minutes <u>Aim:</u> To identify key negative impacts of climate change	- The teacher presented and explained key climate change impacts, for example: (Used teacher' fact 3 & Student's handout 2) • Ocean creature damage due to temperature rise • Arctic creature loss due to ice melt • Forests more prone to deadly infestation • Rising temperature, weather extremes, and rising sea level causing human diseases. • Climate change causing failure of crops, poverty, animal diseases, agricultural infrastructure damage, and water shortage etc. • Unemployment unexpected migration increase due to droughts, floods, and sea level rise	• Asking questions
	The teacher showed clip 2	Students watched clip 2: *The effect of climate change short film* https://www.youtube.com/watch?v=1vl2atXGjt8 Asking questions

7. Evaluation and closure Time:  5 minutes Aim: To help students reinforce knowledge obtained from the lesson	The teacher asked questions to test students understanding about the session. A range of questions was asked. Below are some examples: *Question 1*: Choose the most appropriate answer for the following question: a…… the meteorological state of the atmosphere at a specific place and time, possibly for an hour, a day or several weeks. For example, yesterday it was sunny at home. a. Climate b. Climate change c. Weather d. Disaster Answer: c b…… is the common, average weather conditions at a particular place over a long period. a. Climate change b. Weather c. Climate d. Disaster Answer: c c……. refers to any significant change in the measures of climate lasting for an extended period. a. Weather b. Climate c. Climate change d. Disaster Answer: c	

	Question 2: Which of the following are phenomena associated with climate change? a. Volcano b. Ice melt c. Average temperature reduction d. Sea level rise Answers: b & d
	Question 3: Climate change will make all parts of the Earth hotter. True False Answer: False
	Question 4: Choose the two most appropriate answers for the following question: Climate change is likely to reduce: a. The number of fauna and flora species on the Earth b. The average global surface temperature c. The number of storms d. The land mass of inland areas Answer: a & d

5.6.2 Session 2: Climate change cause

Learning outcomes: At the end of this session, students will be able to

- Identify the main source of greenhouse gases and human activity resulting in greenhouse gas emissions
- Explain the greenhouse effect and global warming
- Understand individual and community activities contributing to enhancing climate change in the coastal – rural areas

Time: 180 minutes

Supporting materials:

- Student's handouts: 3,4, 5
- Teacher's fact sheet 4
- Clips: 3,4, and 5
- Educational game: Greenhouse gas emissions

Activities	**Teacher**	**Student**
1. Group discussion Time:  20 minutes Aim: To learn about greenhouse gases via learners' experience	- The teacher asked all students a question: "Have you heard about greenhouse gases and what greenhouse gases are?" - The teacher asked students to work in groups to explore their knowledge about greenhouse gases.	- Each group discussed and wrote down individuals understanding about greenhouse gases - Each group presented their understanding about greenhouse gases to the whole class
	- The teacher listed students' ideas on the blackboard - The teacher summarized key points which lead to an explanation of greenhouse gases	

2. Problem scenario Time:  20 minutes Aim: To identify main sources of greenhouse gases and human activity results in the emissions of GHGs	- The teacher gave handout 3 to all students - Teacher explained what greenhouse gases mean (Used Student's handout 3) - The teacher introduced the main sources of greenhouse gases ($C0_2$, CH_4, N_20, CFC_S, and water vapour, etc.,) and human activity resulting in greenhouse gas emissions.	- Reading handout 3: *Greenhouse gases* - Critical thinking - Asking questions
3. Game: "*Greenhouse gas emissions"* Time:  20 minutes Aim: To enable students to identify human activity cause GHG emmisions via playing game	- The teacher prepared colour cards on which the names of different GHGs were written comprising $C0_2$, CH_4, N_20, CFC_S (Red for $C0_2$, Green for CH_4, Yellow for N_20, and Black for CFCs etc.) - The teacher asked students to work within group	- When the teacher helps up a card of a specific colour, each groups had to introduce one human activity that causes the emission of that GHGs

4. Film show: Time:  15 minutes Aim: To help students understand carbon cycle, and the water vapour cycle	The teacher showed clip 3 and clip 4	- Students watched clip 3: Carbon cycle https://www.youtube.com/watch?v=4vJ_1ojjlxw - Students watched clip 4: Water vapour cycle https://www.youtube.com/watch?v=9pqh6tlEOhs
4. Break  10 minutes		
5. Group discussion Time:  20 minutes Aim: To encourage students to explain why climate change is happening via existing knowledge	- The teacher asked students a question and asked students to work with groups: "Why is climate change happening?"	- Each group spent about 5 minutes discussing and writing down their ideas to explain why climate change is happening - Each group spent 3 minutes presenting their work
	- The teacher summarised ideas of each group and leading to explanations of global warming and the greenhouse effect	
6. Problem scenario Time:  30 minutes	- The teacher explained to all students (Used Student's handout 4) • What is global warming? • What is the greenhouse effect? - The teacher showed clip 5	- Reading handout 4: *Global warming and the greenhouse effect* - Critical thinking - Asking questions

Aim: To understand the greenhouse effect and global warming		- Student watched clip 5 : *The greenhouse effect* at https://www.youtube.com/watch?v=x_sJzVe9P_8
7. Group discussion Time:  20 minutes Aim: To help reinforce knowledge of the greenhouse effect and global warming	- The teacher asked each group to draw a picture describing how the greenhouse effect works	- Each group discussed and drew a picture to illustrate the greenhouse effect - Each group presented their work to the whole class
	- The teacher gave comments to each group after all groups had finished presentation and asked students to vote for the best one.	
8. Problem scenario Time:  20 minutes Aim: To identify individual and community activities contribute to enhancing climate change	- The teacher delivered handout 5 to all students - The teacher introduced and explained human activities causing climate change (Used teacher's fact sheet 4 & Student's handout 5)	- Reading handout 5: *Human activities cause greenhouse gas emissions and climate change* - Critical thinking - Asking questions
9. Evaluation and closure Time:	The teacher asked questions to test students' understanding about the session. A range of questions was asked. Below are some examples:	

<table>
<tr>
<td> 
5 minutes</td>
<td><u>Question 1</u>: What are the main sources of GHGs?
……
<u>Question 2</u>: Chose the most suitable word for the following sentences:
a……. has always been a natural part of the atmosphere. They absorb and radiate the Sun’s warmth and maintain the Earth’s temperature at a level necessary to support life.
Answer: Greenhouse gases
b……..refers to the recent and ongoing rise in global average temperature near the Earth’s surface. It is caused mostly by increased concentrations of greenhouse gases in the atmosphere.
Answer: Global warming
<u>Question 3</u>: Are the following statements true (T) or false (F)? Tick the right box
<table>
<tr><td></td><td>T</td><td>F</td></tr>
<tr><td>Livestock produces GHG emissions</td><td></td><td></td></tr>
<tr><td>Animal husbandry does not cause GHG emissions</td><td></td><td></td></tr>
<tr><td>Deforestation causes GHG emissions</td><td></td><td></td></tr>
<tr><td>Transportation does not cause GHG emissions</td><td></td><td></td></tr>
<tr><td>Flooded paddy fields produce GHG emission</td><td></td><td></td></tr>
<tr><td>Using fertilizers for crops does not cause GHG emissions</td><td></td><td></td></tr>
<tr><td>Burning straw causes GHG emissions</td><td></td><td></td></tr>
<tr><td>Waste water and landfills do not cause GHG emissions</td><td></td><td></td></tr>
<tr><td>Using nylon bags contributes to GHG emission</td><td></td><td></td></tr>
<tr><td>Eating more meat helps mitigate climate change</td><td></td><td></td></tr>
<tr><td>Energy supply causes GHG emissions</td><td></td><td></td></tr>
<tr><td>Industrial activities do not cause GHG emissions</td><td></td><td></td></tr>
</table>
</td>
</tr>
</table>

5.6.3 Session 3: Climate change mitigation and adaptation

Learning outcomes: At the end of this session, students will be able to

- Understand individual and community activities which help to reduce impacts of climate change
- Acquire the ability to undertake and develop actions to mitigate and adapt to climate change

Time: 150 minutes

Supporting materials:

- Student's handouts: 6 & 7
- Teacher's fact sheet 5 & 6
- Clips: 6 & 7
- Educational games: Fighting climate change

Activities	Teacher	Student
1. Game: *"Fighting climate change game"* Time:  10 minutes Aim: To identify different activities that increase greenhouse gas emissions and activities that help respond to climate change	- The teacher asked all students to stand in a circle. - The teacher named different activities that increase greenhouse gas emissions (using biomass cookers, using motorbikes for travel, burning straw after crops, landfill etc.) and activities that help respond to climate change (using solar cookers, using bicycle and walking for travel, eating less meat etc.).	- When the teacher shouted activities that increase GHG emissions, students had to bend their bodies - When the teacher shouted activities that help respond to climate change, students had to stand up and put their arms over each other's shoulders.
2. Problem scenario Time:  25 minutes Aim: To Identify actions mitigating climate change	- The teacher explained a two pronged approach to cope with climate change: mitigation and adaptation - The teacher explained the strategies to mitigate climate change, focusing on (Used teacher's fact sheet 5 & Student's handout 6) • Using effective cookers • Planting and protecting trees and forest • Minimizing carbon footprint for transportation	- Reading handout 6: *Climate change mitigation* - Critical thinking - Asking questions

	• Using beneficial shopping bags • Saving electricity • Recycling • Reducing of meat consumption • Waste and rubbish management Changing behaviour in agricultural sectors - The teacher showed clip 6	- Students watched clip 6: *Changing daily behaviour to protect environment* at https://www.youtube.com/watch?v=tmhiglxga-4
3. Group discussion Time:  20 minutes Aim: To reinforce mitigation strategies	- The teacher asked students to work within groups - Each group discussed and drew a map illustrating how to mitigate greenhouse gas emissions	- Each group produced a climate change mitigation map - Each group presented and stuck their maps on the blackboard
4. Film show Time:  10 minutes	- The teacher showed clip 7	- Students watched a clip 7 : *Usage of energy in Vietnam* https://www.youtube.com/watch?v=K92k1UALWwc

Aim: To identify the rapid exhaustion of fossil coal resources in Vietnam and plan for using solar and wind resources etc.		
5. Break  10 minutes		
6. Group discussion Time:  25 minutes Aim: To identify actions to help adapt to climate change by learners' experience and knowledge	- The teacher prepared three paper sheets and hung in three corners of the class with three discussion topics. • Topic 1: Actions to respond to climate change carried out by individuals • Topic 2: Actions to respond to climate change carried out at family/ school/workplace level • Topic 3: Actions to respond to climate change carried out in the community	- Students were divided into 6 groups - Two groups discussed one topic - The group wrote each action on one colour card provided by the teacher - After 10 minutes, all groups stuck their cards on the paper sheets accordingly. - Cards with the same ideas or actions were combined by the teacher
	- The teacher summarised key ideas which led to an explanation of climate change adaptation	
7. Problem scenario Time:	- The teacher delivered handout 7 to all students - The teacher provided effective adaptation strategies to cope with climate change in the	- Reading handout 7: *Climate change adaptation* - Critical thinking - Asking questions

 20 minutes <u>Aim</u>: To identify adaptation strategies to cope with climate change	coastal area, comprising (Used teacher's fact sheet 6 & Student's handout 7): • Strategies to cope with sea level rise and inundation • Strategies to cope with droughts and water shortage • Strategies to cope with floods and storms	
8. Evaluation <u>Time</u>:  10 minutes <u>Aim</u>: To reinforce the lesson	The teacher asked questions to test students' understanding. A range of questions was asked. Below are some examples*:* <u>*Question 1*</u>*:* Choose the most suitable word for the following sentences: a……. refers to any actions taken to reduce greenhouse gas emissions and their impacts on the global climate system Answer: Climate change mitigation b……. refers to any adjustments to human activities that make us less vulnerable to actual or expected climate change and associated climate variability, or actions that take advantage of opportunities presented by climate change. Answer: Climate change adaptation <u>*Question 2*</u>: Out of the following actions, which one does not help to mitigate climate change? a. Reducing the amount of motorbikes on the road b. Using nylon bags c. Riding a bicycle instead of a motorbike d. Saving electricity	

Answer: b

Question 3: Among the following, which activities mitigate climate change?

a. Leaving electricity equipment on when going out
b. Planting vegetable
c. Eating more meat
d. Planting more trees

Answer: b, d

Question 4: Which actions to help respond to climate change?

a. Strengthen house before storms and floods

b. Do not store food before storms and floods

c. Do not plan for migration before storms and floods

d. Do not buy a life vest before storms and floods

Answer: a

Question 5: Are the following statements True (T) or False (F)? Tick the right box

Statements	T	F
Building more water tanks and water jars helps to adapt to droughts		
Digging wells and build/dredge more irrigation canals does not help to adapt to droughts		
Applying short day crops to avoid prolonging drought season does not help to response to climate change		
Applying polyculture to avoid prolonging drought seasons helps to adapt to droughts		

	Strengthening house and animal facilities help to adapt to storms and floods			
	Strengthening dykes does not help to adapt to floods/storms			
	Trimming branches of big trees help to adapt to floods/storms			
	Storing medicine and food does not help to adapt to floods/storms			
9. Feedback Time:  10 minutes Aim: To help the teacher obtain learners' assessments about the educational intervention program in Thinh Loc community	- Delivered feedback questionnaire to all students		- Students self-answered a feedback questionnaire and returned it to the teacher	
10. Closure	Thank you, questions, and taking photos			

5.7 Feedback from learners about the climate change education program

At the end of the program, the researcher gave a questionnaire to each student in order to obtain students' feedback about the education program. The questionnaire used a Likert scale response format to evaluate students' opinions about the content of the curriculum, teaching methods, and other activities in the class. Feedback from students was important as it assisted the researcher to adjust and improve the program for the future use. In general, participants in all three classes positively endorsed the educational messages, teaching methods, and other activities in the class. Results are illustrated as follows:

Table 18 Feedback from the primary school students (N= 28)

Strongly agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly disagree (SD)

	How much do you agree with the statements following	**SA** (%)	**A** (%)	**U** (%)	**D** (%)	**SD** (%)
1.	Contents provided in the climate change education program were appropriate to my educational level	93	7			
2.	Contents provided in the climate change education program were useful	89	7	4		
3.	Content of the curriculum was easy to remember	86	14			
4.	Content of the curriculum was easy to apply in real life	71	29			
5.	I liked the methods of teaching	100				
6.	Videos presented in the program were useful to help me pay more attention to climate change issues.	96	4			
7.	Duration of the program was reasonable	89			11	
8.	The number of students in the class was reasonable	100				
9.	The program should be delivered to all students and teachers in my school	100				
10	I have the ability to become a climate change educator	54	46			

Table 19 Feedback from secondary school students (N= 30)

Strongly agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly disagree (SD)

	How much do you agree with the following statements	**SA** (%)	**A** (%)	**U** (%)	**D** (%)	**SD** (%)
1	Contents provided in the climate change education program were appropriate to my educational level	59	41			
2	Contents provided in the climate change education program were useful	87	13			
3	Content of the curriculum was easy to remember	37	63			
4	Content of the curriculum was easy to apply in real life	25	67	6		
5	I liked the methods of teaching	50	50	0		
6	Videos presented in the program were useful to help me pay more attention to climate change issues.	88	2	9		
7	Duration of the program was reasonable	37	63			
8	The number of students in the class was reasonable	50	50			
9	The program should be delivered to all students and teachers in my school	63	37			
10	I have the ability to become a climate change educator	59	41			

Table 20 Feedback from local residents (N= 30)

Strongly agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly disagree (SD)

	How much do you agree with the following statements	**SA** (%)	**A** (%)	**U** (%)	**D** (%)	**SD** (%)
1	Contents provided in the climate change education program were appropriate to my educational level	83	17			
2	Contents provided in the climate change education program were useful	93	7			
3	Content of the curriculum was easy to remember	47	53			
4	Content of the curriculum was easy to apply in real life	80	20			
5	I liked the methods of teaching	100				
6	Videos presented in the program were useful to help me pay more attention to climate change issues.	100				
7	Duration of the program was reasonable	100				
8	The number of students in the class was reasonable	43	57			
9	The program should be delivered to all students and teachers in my school	100				
10	I have the ability to become a climate change educator	50	50			

Table 21 Feedback from teachers (N=10)

Strongly agree (SA), Agree (A), Undecided (U), Disagree (D), and Strongly disagree (SD)

	How much do you agree with the following statements	SA (%)	A (%)	U (%)	D (%)	SD (%)
1	Contents provided in the climate change education program were appropriate to my educational level	100				
2	Contents provided in the climate change education program were useful	100				
3	Content of the curriculum was easy to remember	100				
4	Content of the curriculum was easy to apply in real life	100				
5	I liked the methods of teaching	100				
6	Videos presented in the program were useful to help me pay more attention to climate change issues.	100				
7	Duration of the program was reasonable	100				
8	The number of students in the class was reasonable	100				
9	The program should be delivered to all students and teachers in my school	100				
10	I have the ability to become a climate change educator	100				

Conclusion

Due to limitations of time and finance, the education program was only conducted for 98 participants in three classes in the Thinh Loc community. However, most learners actively engaged and interested in the program. They expressed a high degree of satisfaction with it, demonstrated in the results of feedback. The aim of the three classes was to provide skills and teaching materials as well as an understanding of climate change to learners with a low level of climate change knowledge in rural and coastal

areas. School teachers, the Women's Association staff members, and some local government staff employees were expected to take responsibility for the plan to duplicate the climate change education program in their workplaces and the wider community. For this reason, teachers were invited to attend the same class with their own students, as well as local government members and farmers. The researcher shared the curriculum, all teaching materials, as well as teaching methods to expected educators before and after each session. In the next chapter, an analysis of the evaluation will be presented in order to examine whether or not the intervention program was useful, and to identify how the program can be improved, as well as to confirm if it is possible to be used elsewhere.

CHAPTER 6: RESULTS PHASE THREE - EVALUATION OF THE EDUCATIONAL INTERVENTION PROGRAM

Introduction

This chapter reports the findings of analyses that aimed to assess any changes in Thinh Loc community residents' awareness and adaptive capacity to cope with climate change six months after an educational intervention was put in place. The aim was to answer the second research question: Does evaluation of awareness and behavioral change indicate effectiveness of education as a strategy to increase climate change adaptive capacity of the Thinh Loc community members? May this educational intervention become a model for replication in other Vietnamese coastal communities?

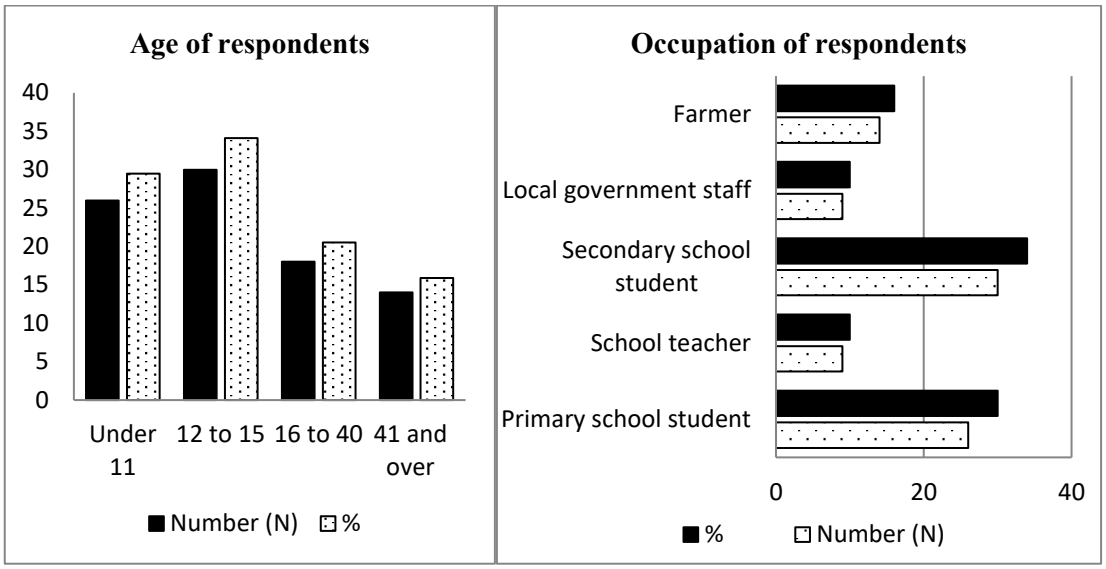
In order to answer the research questions above, mixed methods were employed comprising a questionnaire, interviews, and field observations. Chapter Six is organized into two main parts: Part 1 presents statistical analyses, and Part 2 describes qualitative analyses.

6.1 Quantitative analysis

6.1.1 Demographic characteristics

Before conducting the survey, the researcher intended to invite 98 people who participated in the intervention program to answer a questionnaire. However, 10 people were unable to participate for the following reasons: two students were sick, one teacher was on maternity leave, three farmers migrated to save their families' livelihood, and four local government staff members were attending long-term training courses in other provinces. Consequently, a sample of 88 people undertook the survey and all 88 survey recipients were used in the analysis. Of the 88 respondents, 51% were males and 49% were females. The age and occupation of respondents are displayed in Figure 38:

Figure 38 Age and occupation of respondents



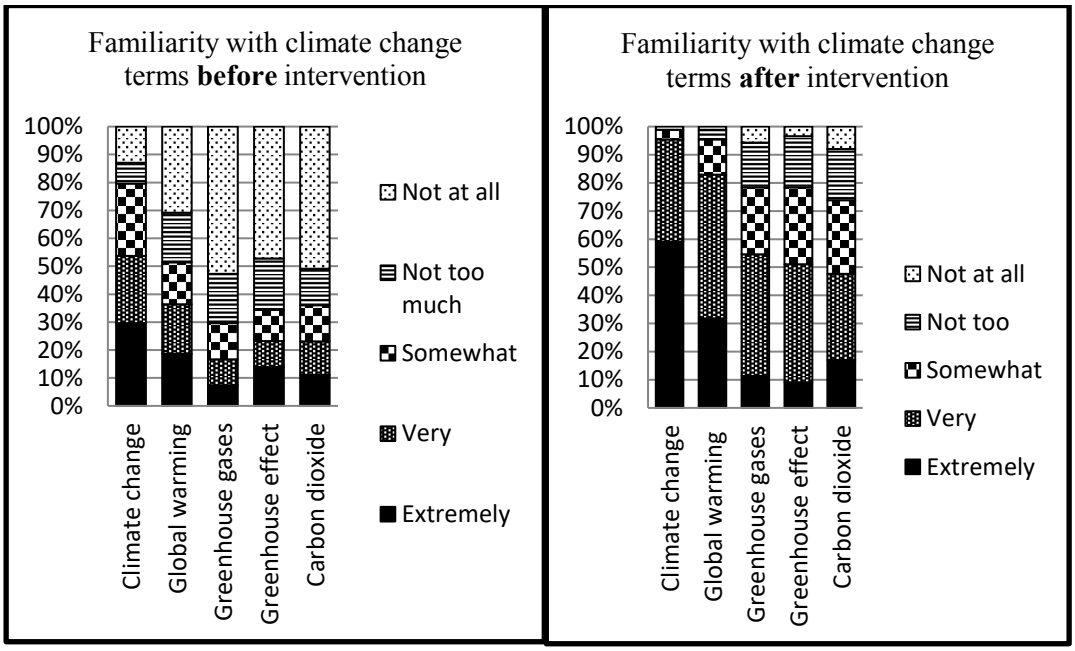
6.1.2 Evaluation of awareness and attitudes to climate change six months after the intervention

In order to evaluate any changes in climate change awareness from 88 participants 6 months after the educational intervention, three closed and two open-ended questions were used. They examined the perception of basic terms related to climate change, climate change evidence, and knowledge main sources of greenhouse gases, climate change causes, as well as climate change impacts.

6.1.2.1 Assessment of familiarity with climate change terms

A question from the initial survey was used to examine if participants had experienced any changes in familiarity with the five terms being tested. These terms were Climate change, Global warming, Greenhouse gases, Greenhouse effect, and Carbon dioxide. The results showed an increase in respondents' familiarity with those five terms (see Figure 39).

Figure 39 Familiarity with climate change terms after and before intervention



In general, there was a considerable increase in familiarity with climate change terms six months after intervention. In particular, the proportion of people who were extremely and very familiar with the Climate change term increased from just over 50% before intervention to around 95% after intervention. Also demonstrated was an enhancement of people who had high familiarity with Global warming, above 80% in 2016 compared to just fewer than 40% in 2014. The number of people who were extremely and very familiar with Greenhouse gases, Greenhouse effect, and Carbon dioxide also grew from around 20% to around 50%.

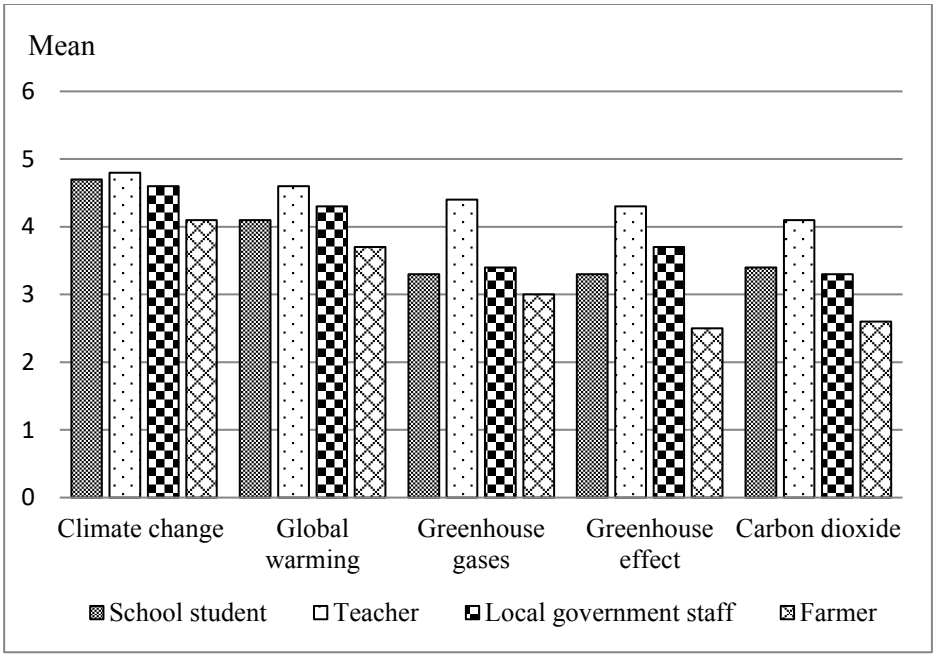
A univariate analysis of variance (ANOVA) was used to examine if respondents' occupation and gender affected their familiarity with the terms related to climate change. While the results indicate that there was not a difference between males and females in familiarity to all five terms related to climate change, significant associations were found between occupation and familiarity with almost all terms except global warming:

1. Climate change: The effect of respondents' occupation with familiarity to the term of climate change was significant overall ($F(4, 83) = 3.683$, $p<0.05$), with a strong effect size of $\eta^2_p = 0.15$.
2. Greenhouse gases: ANOVA also showed that the effect of respondents' occupation with familiarity with greenhouse gases was significant overall ($F(4,83) = 3.041$, $p<0.05$), with a medium effect size of $\eta^2_p = 0.12$.

3. Greenhouse effect: ANOVA found a significant effect among occupational groups ($F(4,83) = 4.829$, $p<0.05$) with a large effect size of $\eta^2_p = 0.189$.
4. Carbon dioxide: ANOVA test also showed that the effect of respondents' ocupation on familiarity with the term, carbon dioxide, was significant general ($F(4,83) = 10.584$, $p<0.05$), with a large effect size of $\eta^2_p = 0.338$.

However, post hoc tests indicated that there was only a significant difference between teachers and farmers. This suggested that teachers had the highest level of familarity with almost all climate change terms while the group of farmers ranked at the lowest level.

Figure 40 Mean scores of familiarity with climate change terms by occupation (N= 88)



Responses were coded: 5 = "Extremely familiar", 4 = "Very familiar", 3 = "Somewhat familiar", 2 = "Not too much familiar" and 1 = "Not at all".

Statistical analysis showed that although farmers still had the lowest awareness of climate change terminology after intervention, compared to baseline levels, farmers demonstrated a large improvement (Figure 41). Further, awareness of climate change terms of secondary school students was enhanced considerably (Figure 42).

Figure 41 Familiarity with climate change terms before and after intervention by farmer

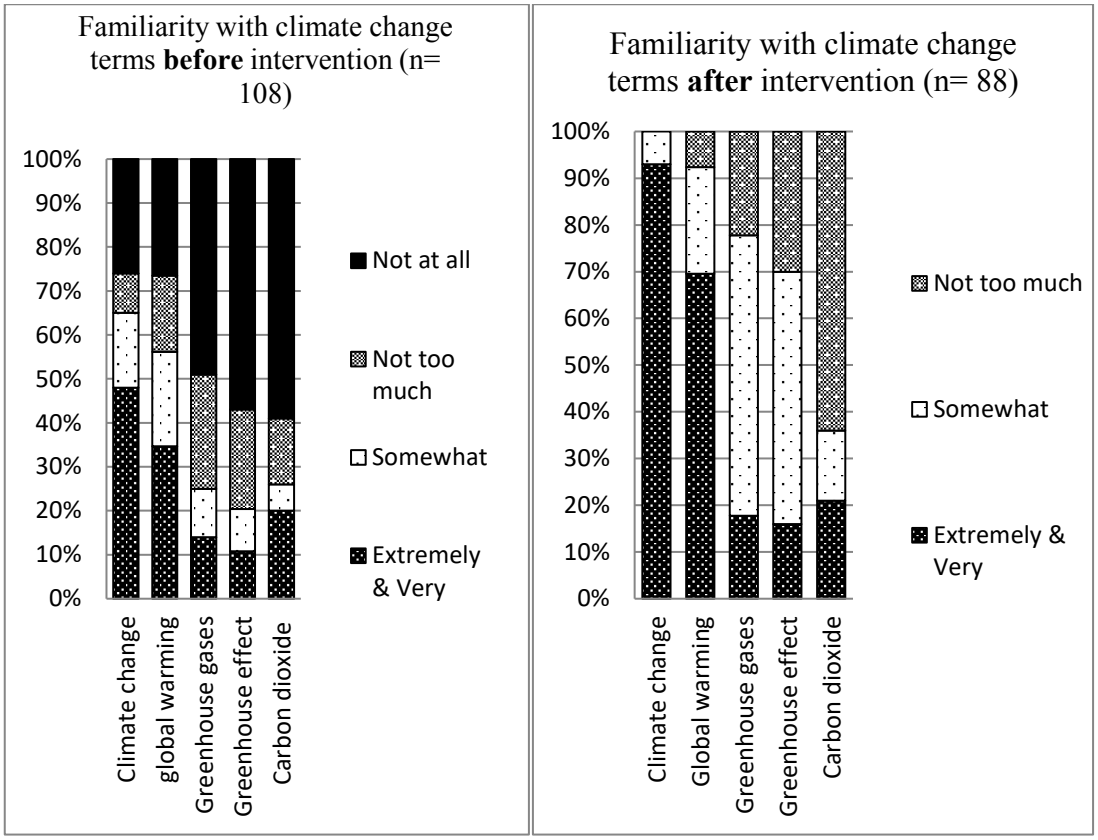
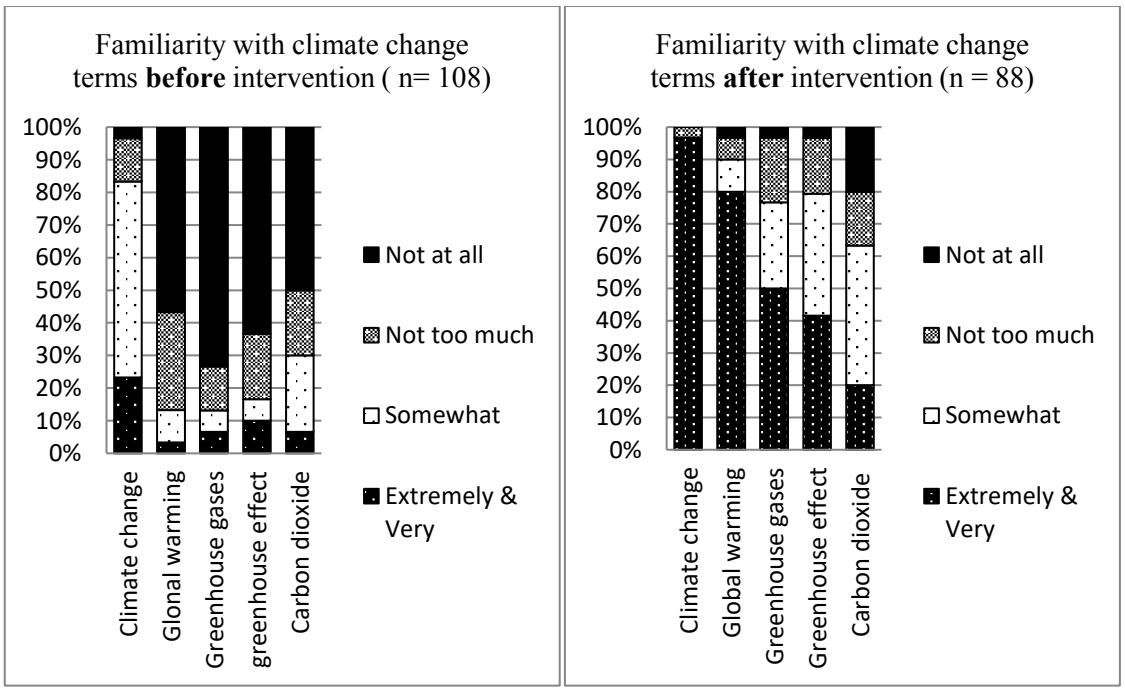


Figure 42 Familiarity with climate change terms before and after intervention by secondary school student



6.1.2.2 Assessment of knowledge on climate change evidence and greenhouse gas

The educational intervention program presented evidence of global climate change including changing rain and snow patterns, stronger storms, higher temperatures, more heat waves, rising sea levels, warmer oceans, less snow and ice, changes in animal migration and life cycles, damaged corals, changing in life cycles, more droughts and wildfires, and thawing permafrost (US EPA, 2015).

In order to examine respondents' memory of climate change evidence, an open question was used: "Could you write down any evidence of climate change?" The content analysis showed that many participants were able to recall climate change evidence such as temperature rise, sea level rise, prolonged droughts, ice melting, winter coming late and lasting longer, high intensity and frequency of storms and floods, and serious salt inundation. Interestingly, along with teacher and local government groups, the proportion of secondary school students who were able to recall climate change evidence was high. Furthermore, a small percentage of respondents thought that climate change evidence included natural disasters such as earthquake, tsunami, volcano, and bush fire. The responses are presented in Table 22.

Table 22 Open response question addressing recall of evidence for climate change

Climate change evidence	Primary school student (n=26) %	Secondary school student (n=30) %	Teacher (n=9) %	Farmer (n=14) %	Local government officer (n=9) %
Temperature rise	58	63	78	50	67
Sea level rise	76	83	89	71	78
Ice melt	15	40	67	29	22
Prolonged droughts	38	40	44	38	56
Salt inundation	57	57	89	43	67
Winter coming late and lasting longer	-	16	44	36	44
Greater intensity and frequency of storms and floods	58	77	67	50	56
Bushfire	12	-	-	14	22
Earthquake	19	17	22	-	-
Tsunami	30	17	-	-	-
No answer	4	0	-	-	-
Wrong answer	0	6	-	-	-

In order to examine respondents' memory about the main sources of greenhouse gases, another open-ended question was asked "What are the main sources of greenhouse gases?" In the educational intervention, learners were taught about five sources of greenhouse gases: carbon dioxide, methane, water vapour, nitrous dioxide, and CFCs. After 6 months, through content analysis of this question, the result showed that people were able to recall carbon dioxide, methane, and nitrous dioxide better than other greenhouse gases. Results showed that among adult groups, teachers and local government staff members were able to recall the main sources of GHGs better than farmers; secondary school students were able to recall main source of GHGs better than primary school students. The responses are tabulated in Table 23:

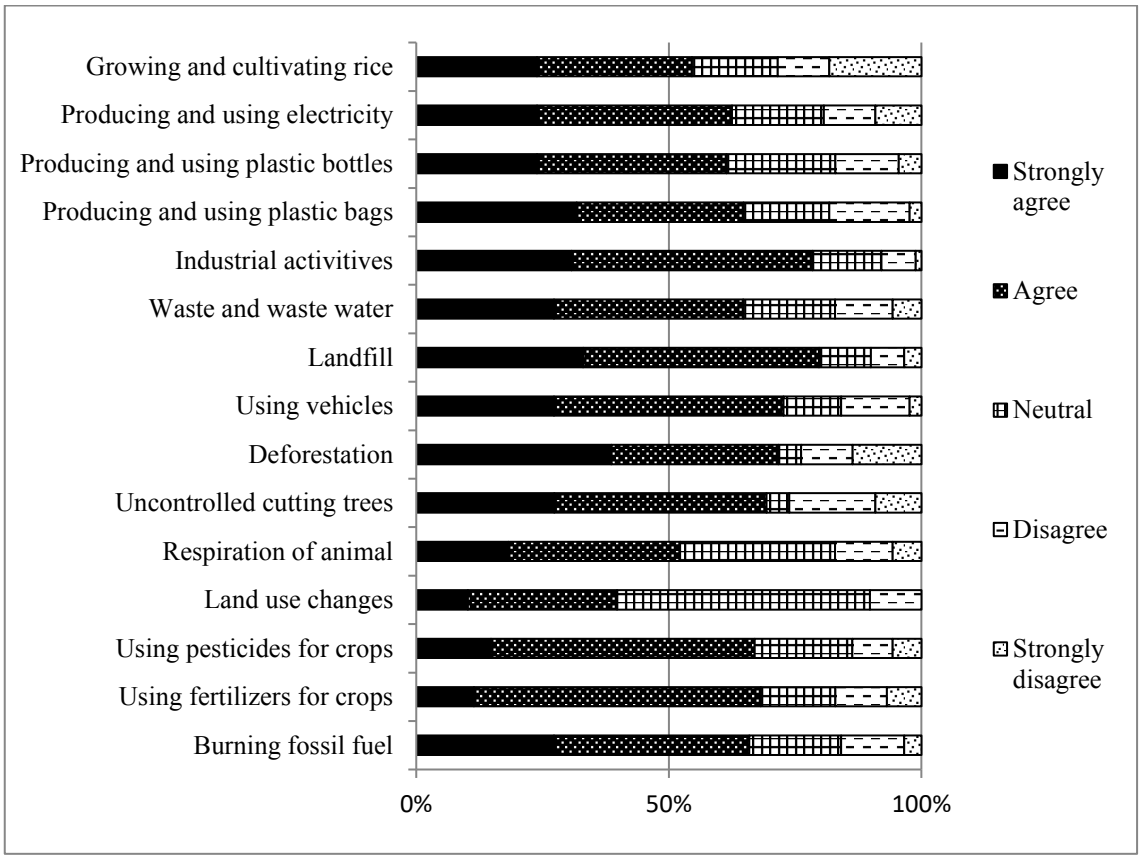
Table 23 Open response question addressing recall of greenhouse gases

Main source of GHGs	Primary school student (n=26) %	Secondary school student (n=30) %	Teacher (n=9) %	Farmer (n=14) %	Local G. officer (n=9) %
Carbon dioxide	62	67	67	57	67
Methane	46	58	78	43	56
Water vapour	38	43	56	21	33
Nitrous dioxide	54	58	78	50	67
No answer	30	30	0	0	0
Wrong answer	12	0	0	14	0

6.1.2.3 Assessment of perceptions of climate change causes

As discussed, in the baseline survey only a quarter of survey recipients thought that climate change is mainly caused by human activities and deforestation was considered to be the main reason. To assess perceptions of climate change causes, a Likert scale question based upon knowledge and information provided during the intervention program was used. The question was: “Think about climate change causes. How strongly do you agree or disagree with each the following statements?” Results showed a high agreement of respondents with 15 climate change causes (Figure 43).

Figure 43 Agreement of respondents about climate change causes (N=88)



Overall, industrial activities and landfill were identified by over 80% people. Next, more than 65% of the sample strongly agreed or agreed that human activities, such as burning fossil fuel, using fertilizers and pesticides for crops, deforestation, uncontrolled cutting trees, and using vehicles caused climate change. The other causes included land use changes, respiration of animals, as well as growing and cultivating rice, which reached a lower agreement rate of around 40%, 50%, 45%, and 55%, respectively.

An independent sample *t* test was conducted to examine the hypothesis that males and females differ significantly in perception about with climate change causes. The results did not show difference between females and males, except deforestation and uncontrolled tree cutting. The significant statistics are presented as follows:

1. The cause of uncontrolled tree cutting, the mean agreement score of males (M = 3.29, SD = 1.35) was statistically significantly different (t= -2.468, df= 86, two tailed p<0.05) from that of females (M = 3.95, SD = 1.15).
2. The deforestation cause, the mean agreement of males (M = 3.4, SD = 1.54) was statistically significantly different (t= -2.263, df= 86, two tailed p<0.05) from that of females (M = 4.06, SD = 1.2). More females agreed with both causes

(uncontrolled tree cutting and deforestation) leading to climate change than males.

A univariate analysis of variance (ANOVA) was used to examine if respondents' occupation affects agreement with climate change causes. Significant associations were found between occupation and respondents' agreement with most reasons of climate change (See Table 24).

Table 24 ANOVA result of agreement about climate change causes by occupation (N=88)

Cause	F statistic	df	Probability (*p*)	Size effect (η^2_p)
Burning fossil fuel	3.3	(5,82)	.009	0.17
Using fertilizers for crops	2.6	(5,82)	.031	0.14
Using pesticides for crops	3.5	(5,82)	.007	0.18
Land use changes	7.1	(5,82)	.001	0.3
Respiration of plants	2.7	(5,82)	.029	0.13
Uncontrolled cutting trees	4.1	(5,82)	.002	0.2
Deforestation	3.3	(5,82)	.009	0.17
Using vehicles	3.4	(5,82)	.008	0.17
Landfill	2.5	(5,82)	.039	0.13
Waste and waste water	6.8	(5,82)	.001	0.23
Industrial activities	4.1	(5,82)	.002	0.2
Producing and using plastic bags	6.6	(5,82)	.001	0.29
Producing and using plastic bottles	7.9	(5,82)	.001	0.33
Producing and using electricity	7.2	(5,82)	.001	0.31
Growing and cultivating rice	3.6	(5,82)	.006	0.18

Table 25 below presents Mean and Standard Deviations (SD) of respondents' occupation with their agreement level with the causes of climate change. It is evident that the agreement in almost all climate change causes from adults was higher than that from children.

Table 25 Mean scores of agreement with climate change cause by occupation (N=88)

(M: mean, N: sample number, SD: Standard Deviations)

Climate change cause	Primary students			Secondary student			Secondary teacher			LG staff member			Farmer		
	M	N	SD	**M**	N	SD	**M**	N	SD	**M**	N	SD	**M**	N	SD
Burning fossil fuel	**3.2**	26	1.4	**3.7**	30	1	**4.6**	9	0.5	**4.1**	9	0.6	**4.1**	14	0.5
Using fertilizers	**3.1**	26	1.4	**3.5**	30	0.9	**4.3**	9	0.5	**4.1**	9	0.6	**3.7**	14	0.5
Using pesticides	**3.1**	26	1.2	**3.6**	30	1	**4.3**	9	0.5	**4.3**	9	0.5	**3.8**	14	0.6
Land use changes	**3.3**	26	0.6	**3**	30	0.7	**3.5**	9	1	**4.4**	9	0.7	**3.6**	14	0.6
Respiration of animal	**3.6**	26	1.1	**3.1**	30	1.2	**3.7**	9	1.3	**3.9**	9	0.9	**3.7**	14	0.6
Uncontrolled tree cutting	**2.8**	26	1.6	**3.7**	30	1.2	**4.2**	9	1.4	**4.1**	9	0.8	**4.3**	14	0.5
Deforestation	**3**	26	1.7	**3.6**	30	1.5	**4.7**	9	0.5	**4.3**	9	0.7	**4.3**	14	0.5
Using vehicles	**3.3**	26	1.3	**3.8**	30	0.9	**4.3**	9	1.4	**4.3**	9	0,7	**4.3**	14	0.5
Landfill	**3.8**	26	1.1	**3.7**	30	1.2	**4.8**	9	0.5	**4.7**	9	0.5	**4.3**	14	0.5
Waste and waste water	**2.9**	26	1.1	**3.6**	30	1.2	**4.6**	9	0.5	**4.4**	9	0.7	**4.3**	14	0.6
Industry activity	**4**	26	0.9	**3.5**	30	1	**4.3**	9	0.6	**4.7**	9	0.5	**4.4**	14	0.5
Nylon bags	**3.2**	26	1.2	**3.5**	30	1.1	**4.3**	9	0.6	**4.8**	9	0.4	**4.5**	14	0.6
Plastic bottles	**3.2**	26	1.2	**3.2**	30	1.1	**4.5**	9	0.6	**4.6**	9	0.5	**4.5**	14	0.5
Electricity	**3.8**	26	0.9	**2.7**	30	1.3	**3.8**	9	1.3	**4.6**	9	0.5	**4.2**	14	0.7
Cultivating rice	**3.5**	26	1.5	**2.6**	30	1.5	**3.5**	9	1	**4.3**	9	0.7	**3.9**	14	0.8

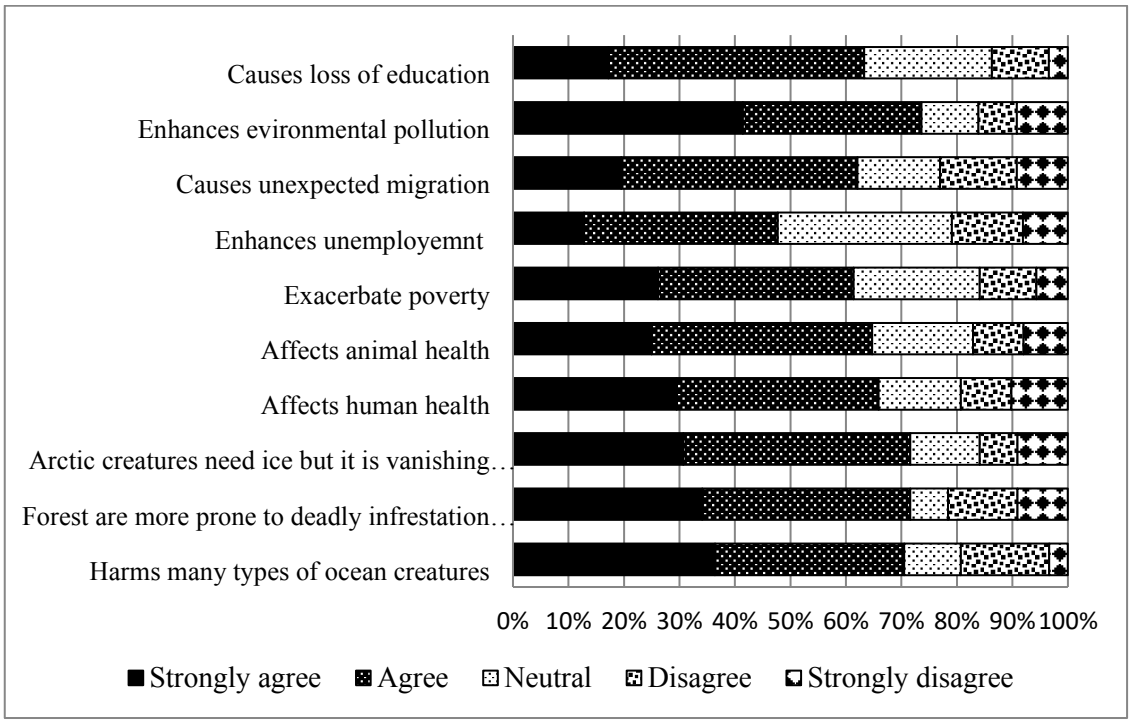
Responses were coded: 1 = “Strongly agree”, 2 = “Agree”, 3 = “Neutral”, 4 = “Disagree”, 5 = “Strongly disagree”.

6.1.2.4 Evaluation of perceptions of climate change impacts

Perceptions of climate change impacts were assessed through respondents’ agreement with 10 statements of climate change impact, which were discussed in the educational intervention program (Figure 44). Overall, respondents expressed a high agreement with all impacts of climate change. For example, above 70% of respondents strongly agreed or agreed that climate change enhances environmental pollution (73.5%), climate

change harms many types of ocean creatures (70.5%), or forests are more prone to deadly infestation due to climate change (71.6%) and so on.

Figure 44 Agreement with climate change impacts (N=88)



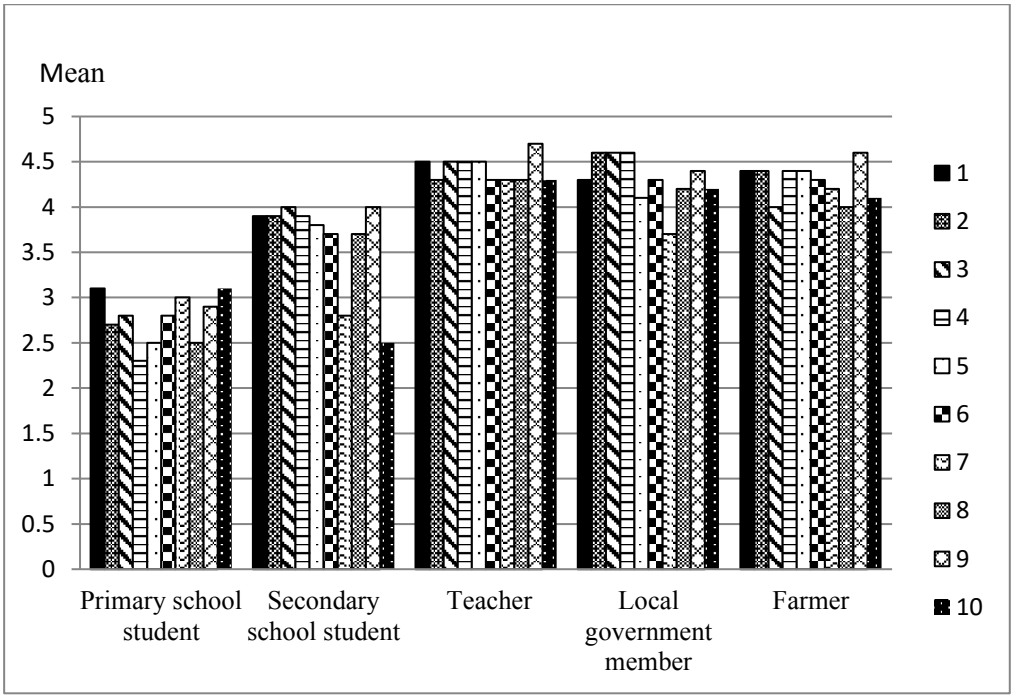
The non-parametric analysis of the Mann-Whitney U[7] test was used to test for differences between gender and their agreement about climate change impacts, which did not find any association among these variables. However, Mann-Whitney U test analysis showed that there was a significant difference between the group of school students and the other groups in terms of their agreement level with climate change impacts. Among them, the agreement level with 10 statements of climate change impacts from primary school students was lower than other groups in almost all statements. In addition, the lowest level of agreement with the statement of "climate change contributes to enhancing the unemployment rate" was endorsed by secondary school students. Significant statistics are presented in Table 26 and Figure 45:

[7] SPSS does not report an effect size index for the Mann- Whitney U test, but simple indices can be computed to communicate the size of the effect. For example, the difference in mean ranks between the two groups can serve as an effect size index. Critical values of the Mann- Whitney U for a one- tailed test at 0.005, two tailed test at 0.01 (Burns, 2000, p 192).

Table 26 Mann-Witney U test of agreement level with climate change impacts by occupation (N = 88)

Climate change impacts	U statistic	Probability *(p)*	Primary school students (mean rank)	Other groups (mean rank)
1. Climate change harms many types of ocean creatures	446.5	0.001	31	49
2. Our Arctic creatures need ice, but it is vanishing because of global warming	331.5	0.001	26	52
3. Forests are more prone to deadly infestation due to climate change	335.5	0.001	27	52
4. Climate change affects human health	203	0.001	21	54
5. Climate change affects animal health	245	0.001	23	54
6. Climate change exacerbates poverty	363.5	0.001	27	52
7. Climate change causes unexpected migration	345	0.001	27	51
8. Climate change enhances environmental pollution	361	0.001	27	51
9. Climate change causes loss of education	498	0.004	32	49
10. Climate change contributes to higher unemployment rates	465	0.001	Secondary school student (mean rank) 31	Other groups (mean rank) 50

Figure 45 Mean scores of agreement with climate change impacts by occupation (N=88)



Responses were coded: 1 = "Strongly disagree", 2 = "Disagree", 3 = "Neutral", 4 = "Agree" and 5 = "Strongly agree".

Explanations comprised:

1. Climate change harms many types of ocean creatures
2. Forests are more prone to deadly infestation because of climate change
3. Our Artic creatures need ice, but it is vanishing due to global warming
4. Climate change affects human health
5. Climate change affects animal health
6. Climate change exacerbates poverty
7. Climate change contributes to higher unemployment rates
8. Climate change causes unexpected migration
9. Climate change enhances environmental pollution
10. Climate change causes loss of education

6.1.2.5 Assessment of attitudes towards climate change

In the baseline survey, Thinh Loc community respondents said they were concerned about climate change as well as identifying impacts of climate change on their lives. In the assessment phase, in order to evaluate attitudes towards climate change, a Likert attitude scale question was designed to ask respondents' attitudes towards 17 statements related to activities that contribute to enhancing climate change. The

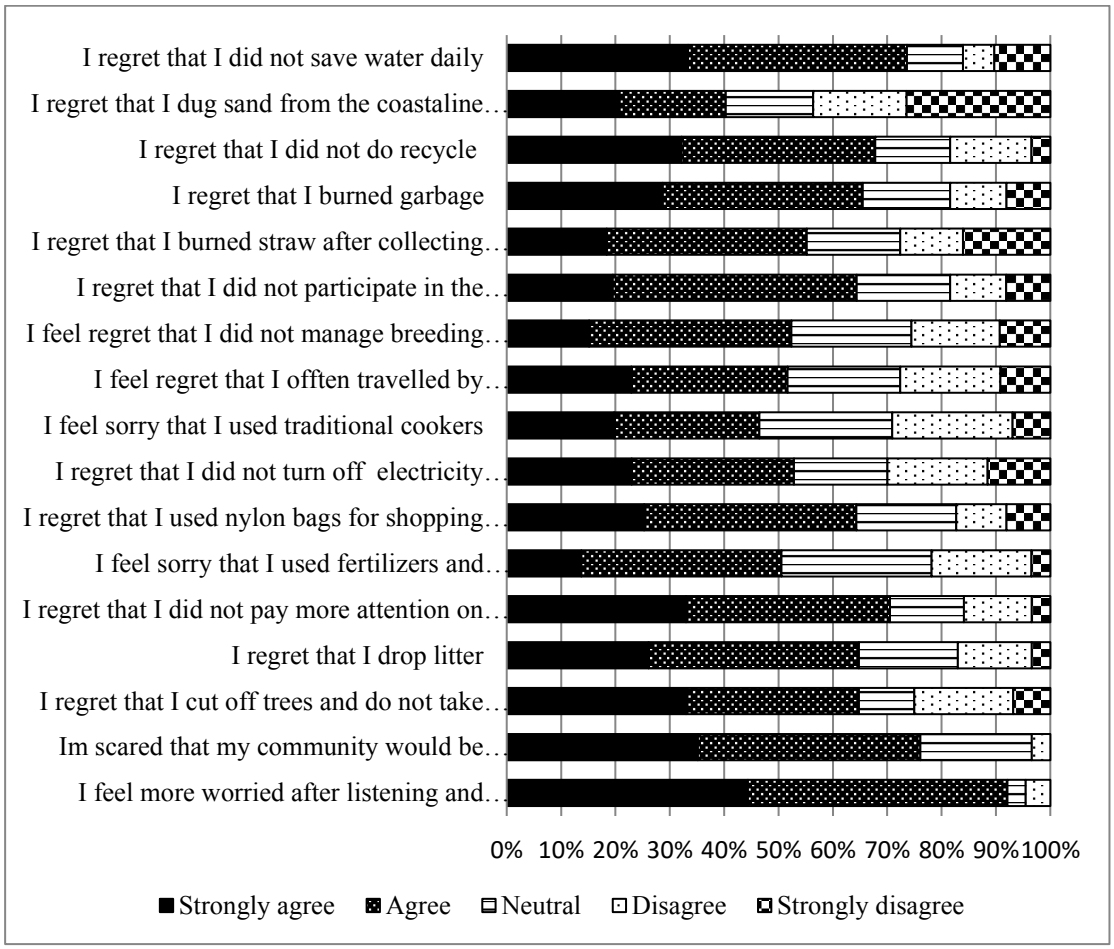
question was delivered to survey recipients: “Think about each of the following statements. Does it sound like the kind of thing that you would think? Tick (√) the box matching the most correct answer”? Seventeen statements were released comprising:

1. I feel more worried after listening and watching warnings about climate change in the intervention program
2. I am scared that my community could disappear due to sea level rise
3. I regret that I cut down trees and did not take care of trees
4. I regret that I drop litter
5. I regret that I did not pay more attention to the climate change issue
6. I feel sorry that I used fertilizers and pesticides for crops
7. I regret that I used nylon bags for shopping
8. I regret that I did not turn off electrical equipment after leaving school/ workplace/home
9. I feel sorry that I used traditional cookers
10. I feel sorry that I used motorbikes/cars for my travelling instead of walking or riding bicycles
11. I feel regret that I did not manage my cattle’s’ facilities well
12. I regret that I did not participate in the environmental campaigns in the community or schools
13. I regret that I burned straw after crops
14. I regret that I burned garbage
15. I regret that I did not conduct the recycling
16. I regret that I dug sand from coastline or sand dyke
17. I regret that I did not save water daily

Overall, respondents demonstrated a high-level agreement with the 17 statements related to human activities which contributing to enhancing greenhouse gas emissions. Results showed that approximately 95% of samples strongly agreed or agreed that they were worried after listening to and watching climate change warnings in the intervention program (44.3% for strongly agree and 47.7% for agree). A large proportion of people answered that they strongly agree or agree that they were afraid that their community would disappear due to sea level rise (35.2% for strongly agree and 40.9% for agree); 72.8% of respondents strongly agreed and agreed regretted not saving water daily (33% for strongly agree and 39.8% for agree). Other (70%) felt regret for not paying more attention to climate change issues (33% for strongly agree and 37.5% for agree). Around 65% felt regret because of uncontrolled tree cutting and not taking care of trees, dropping

litter, using nylon bags for shopping instead of traditional bags, not doing recycling, and not participating in the environmental protection campaigns.

Figure 46 Attitudes towards climate change (N=88)



Responses were coded: 1 = “Strongly agree”, 2 = “Agree”, 3 = “Neutral”, 4 = “Disagree”, 5 = “Strongly disagree”.

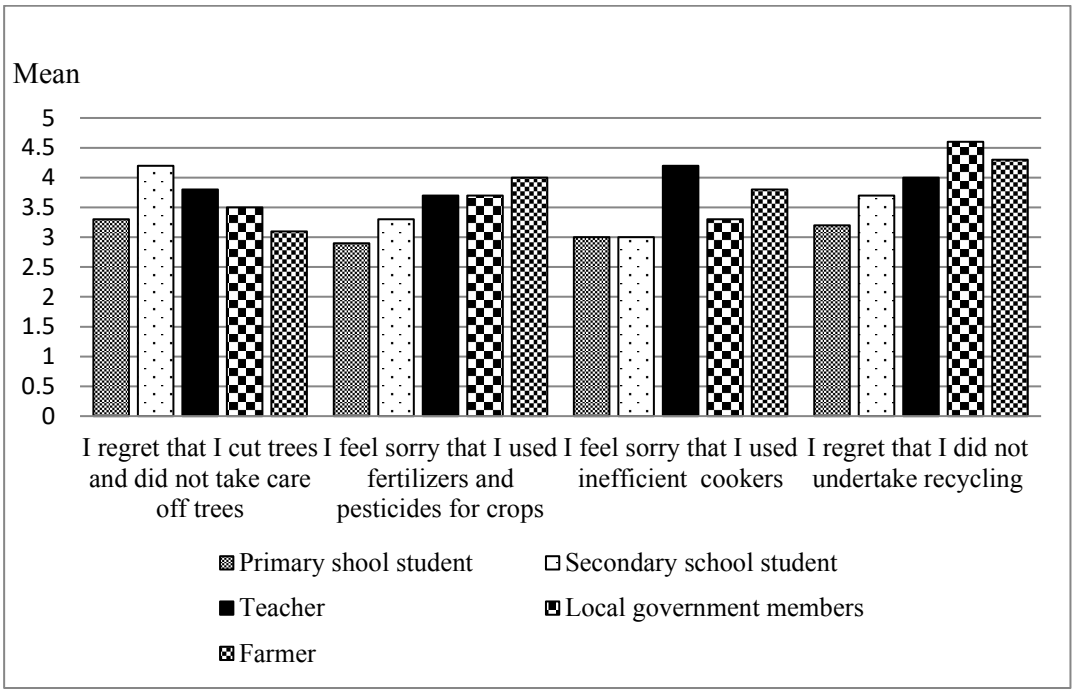
An analysis of variance (ANOVA) was used to examine if respondents’ occupation affects attitudes to climate change. Significant associations were found between occupation and respondents’ agreement with four statements. Significant statistics are presented as follows:

1. I regret that I cut down trees and did not take care of trees: $F(5, 82) = 2.332$, $p<0.05$, $\eta^2_p = 0.13$, showing a medium-size effect
2. I feel sorry that I used fertilizers and pesticides for crops: $F(5, 81) = 2.408$, $p<0.05$, $\eta^2_p = 0.13$, showing a medium-size effect
3. I feel sorry that I used traditional cookers: $F(5,81)= 2.469$, $p<0.05$, $\eta^2_p = 0.13$, showing a medium-size effect

4. I regret that I did not conduct recycling: F (5, 81) = 3.129, p<0.05, η^2_p = 0.16, showing a large-size effect.

Figure 47 shows secondary school students felt more regret than the other groups for cutting down trees and not looking after trees. Furthermore, farmers felt more sorry than the other groups for using fertilizers and pesticides for crops. Teachers felt more sorry than the others for using traditional cookers, and the group of local government staff members felt more regret than the others because they had not undertaken recycling.

Figure 47 Mean scores of attitudes to climate change by occupation (N=88)



Responses were coded: 1 = “Strongly agree”, 2 = “Agree”, 3 = “Neutral”, 4 = “Disagree”, 5 = “Strongly disagree”.

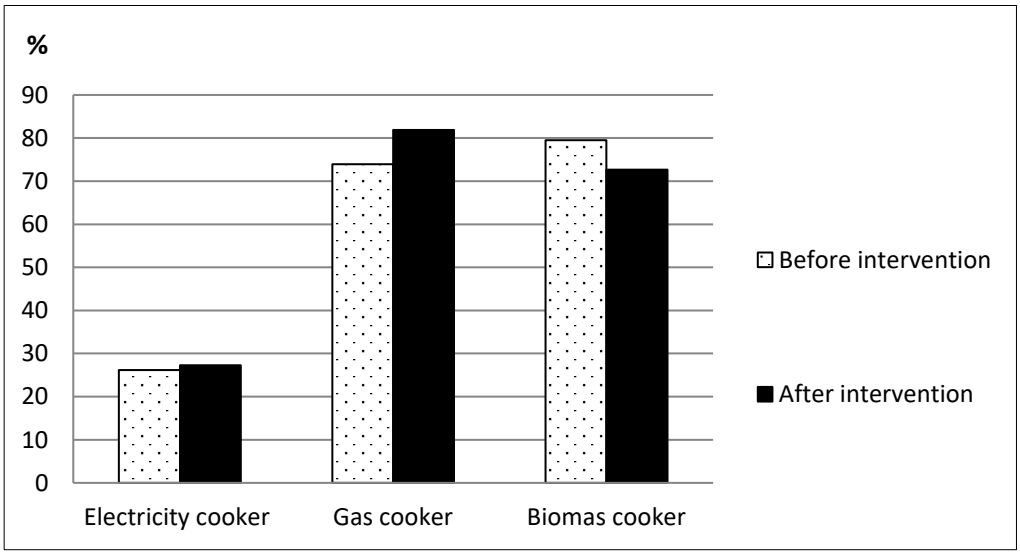
6.1.3 Applying actions to mitigate climate change

The Thinh Loc community is an undeveloped village community. Livelihood completely depends on agricultural activities including growing rice and fishing. Therefore, in the educational intervention program, the information about climate change mitigation that was provided related directly to locals’ agricultural activities and daily habits in the rural and coastal areas.

6.1.3.1 Using cookers

Using traditional cookers, such as hay and wood cookers, contributes to enhancing climate change, especially in rural Vietnamese areas. This was mentioned and discussed in the intervention program to all attendants. Figure 48 shows gas cookers and biomass cookers were the most prevalent cooking stoves in the Thinh Loc community, while no participants used efficient cookers, such as infrared and solar cookers. In general, six months after intervention, there was a decrease in using biomass cookers (6.8%). However, this improvement was due to an increase in the use of gas cookers, rather than replacing with more effective cookers. This is probably explained by the limits of households' finances, culture in this community and the limits of the study period and length, as the evaluation phase was undertaken only six months after intervention.

Figure 48 Usage cookers before and after intervention (N=88)

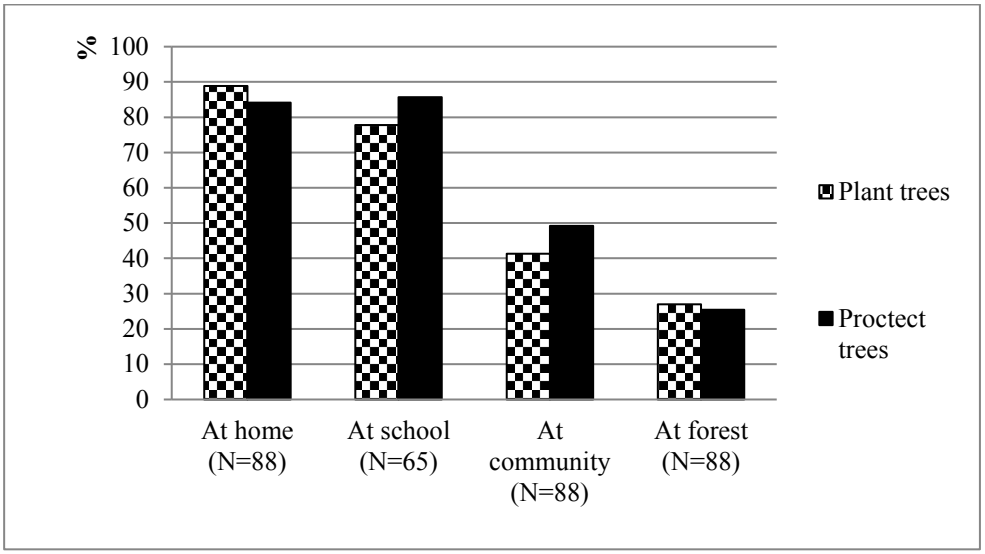


6.1.3.2 Planting and protecting trees

Planting and protecting trees is one of the most effective solutions to help mitigate climate change. Before intervention, 50% of respondents reported that they had conducted cutting down trees (see baseline result in Chapter Four). However, after intervention many participants undertook to plant and protect trees. The figure illustrated that those who attended the intervention preferred to grow and protect trees in their homes and schools, rather than in the wider community and forests. Specifically, while more than 80% of respondents stated that they had planted and protected trees at home

and at school after intervention, planting and protecting trees in the broader Thinh Loc community was approximately 50% and in the case of forests was and under 30%.

Figure 49 Planting and protecting trees at home, school, community, and forest after intervention



6.1.3.3 Using modes of transport in daily life

In general, respondents used motorbikes and bicycles as the main modes of transportation in the Thinh Loc community, but there was an increase in the use of bicycles after intervention. A majority of local government members and teachers travelled to work by motorbike (83%) and this figure remained stable after intervention. Out of 80 people going to markets, 38% of the sample travelled by motorbike and bicycle before intervention, but after intervention use of motorbikes decreased significantly to 23%, while use of bicycles surged dramatically (59%). Bicycle was also the most preferred mode of transport when travelling to farms in both pre-intervention and post-intervention. In addition, using bicycles increased after intervention (from 38% to 54%). This was due to a slight reduction in the use of motorbikes (25% previous year to 24% in the following year) and walking to travel to farms after intervention (from 37% in the previous year to 22% in the following year). Bicycle was also the most common mode of transportation to school (66% before intervention and 80% after intervention), while use of motorbikes and walking were reduced. Furthermore, there was a plunge in the use of motorbikes to travel among hamlets after intervention (20% compared to 33%), because of an increase in the use of bicycles from 33% to 54%.

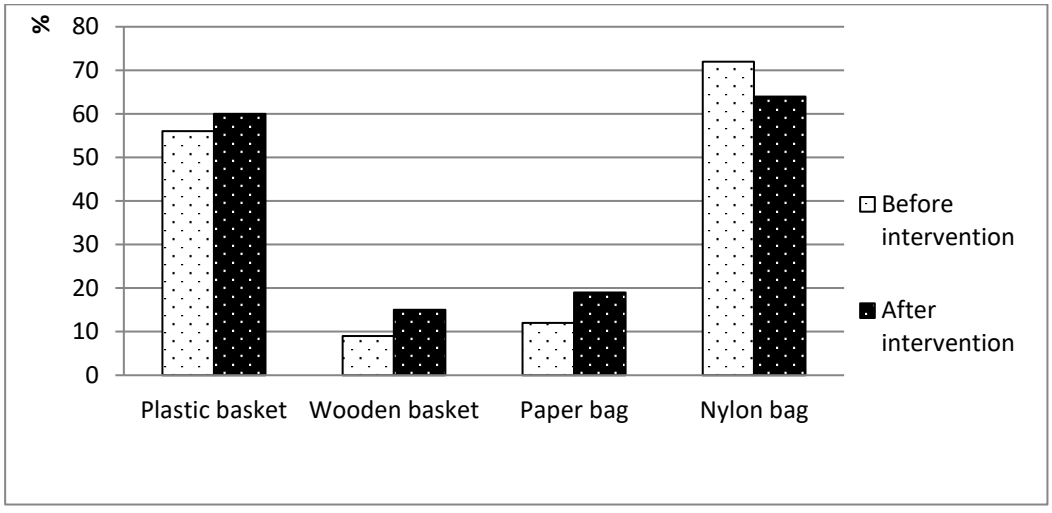
Table 27 Using modes of transportation

Place	Car (%)		Motorbike (%)		Bicycle (%)		Walking (%)	
	Before	After	Before	After	Before	After	Before	After
Workplace (N= 18)	6	6	83	83	6	6	6	6
Market (N= 80)	0	0	38	23	38	59	25	19
Farm (N= 68)	0	0	25	24	38	54	37	22
School (N= 56)	0	0	7	5	66	80	27	14
Among hamlets (N= 86)	0	0	33	20	33	54	33	27

6.1.3.4 Using shopping bags

Out of 88 survey recipients, 86 people answered the question relating to shopping bag usage. Overall, there was an enhancement in the usage of shopping bags 6 months after intervention as they reduced using nylon bags for shopping. Specifically, while the use of effective shopping bags, including wooden baskets, plastic baskets (can be reused and recommended to be used for shopping), and paper bags increased; the use of nylon bags decreased.

Figure 50 Percentage of people using shopping bags before and after intervention (N=86)

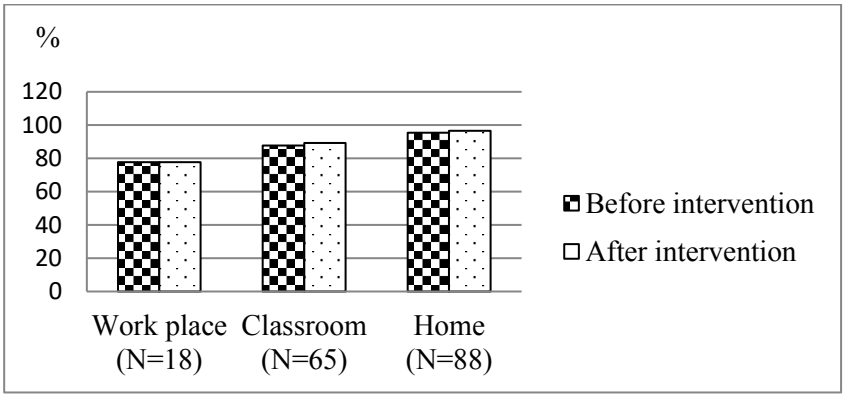


6.1.3.5 Energy saving

Figure 51 presents changes in saving energy before and after intervention at home, school, and workplace. A majority of people confirmed that they always had turned off electrical equipment before leaving home, class, and workplace in both pre intervention and post intervention. In addition, the proportion of people undertaking daily energy

saving increased slightly after intervention especially in the classrooms (3%) and at home (2%).

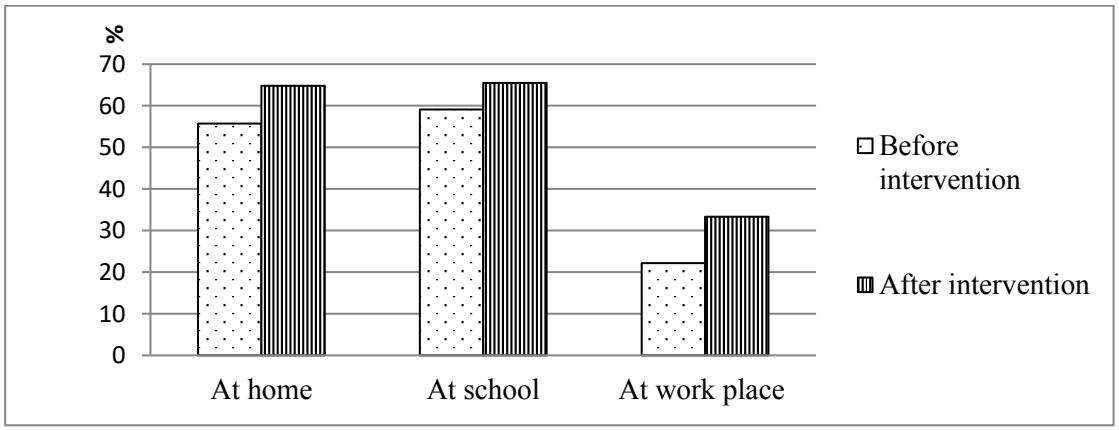
Figure 51 Percentage of people turning off electrical equipment after leaving home, school, and workplace before and after intervention



6.1.3.6 Recycling

Figure 52 demonstrated that there was an improvement in recycling behaviour after intervention. There was a considerable increase in recycling at home (55.7% before and 64.8% after intervention) and the workplace (22.2% before to 33.3% after intervention); and at schools from 59.1% before intervention to 65.5% after intervention. The analyses of independence Chi square tests (contingency table 4x4) were conducted to determine whether there were associations between occupation and recycling behaviour at home, school, and workplace. The only statistically significant result revealed that more students conducted recycling at home after intervention, than any other occupation, with *Fisher's exact test = 15.667, df = 9, p<0.05.* The effect size was 0.26 indicating a medium size effect.

Figure 52 Percentage of people reporting recycling before and after intervention at home, school, and workplace (N=88)



6.1.3.7 Meat consumption

There was an important change in the proportion of meat consumed by people who participated in the intervention program. Out of 88 respondents, 53.2% reduced meat consumption, while only 10.2% increased meat consumption and 37.5% remained stable. A 3x4 contingency table analysis showed a significant association between occupation and meat consumption. A significant relationship was presented with Fisher's exact test = 12.7, $df = 6$, $p < 0.05$, in that more teachers reduced their meat consumption, while more students increased eating meat. The effect size was 0.28, showing a medium size effect.

Table 28 Meat consumption by occupation (N= 88)

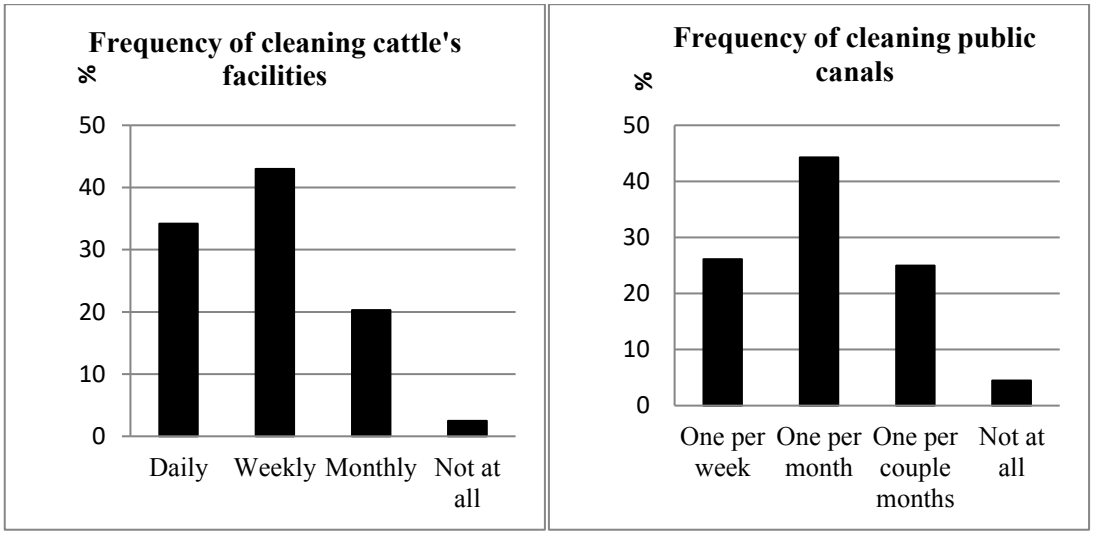
Occupation		Increase	Remain	Decrease	Fisher's exact test	df	*p*	Cramer's V
					12.7	*6*	*.03*	*.28*
School	N	8	19	29				
student	%	14	34	52				
Teacher	N	1	0	8				
	%	11	0	89				
Local G.	N	0	6	3				
officer	%	0	67	33				
Farmer	N	0	8	6				
	%	0	57	43				

6.1.3.8 Public canal and livestock manure management

Analyses of observations from Chapter IV showed that the Thinh Loc community had dirty public canals because domestic waste water and animal manure were not being managed effectively (and were released into canals). Further, these canals were not dredged frequently by community residents (dredging was only conducted one or twice per year as reported by Thinh Loc community local government). These dirty canals release methane into the air that contributes to enhancing global warming and climate change. Therefore, waste water and manure management, dredging canals and cleaning cattle's' facilities, were discussed in the intervention program as ways to help mitigate climate change. An assessment of the cleaning behaviour of respondents in the last six months was necessary to supplement a hypothesis that there was an enhancement in their ability to mitigate climate change after conducting intervention.

Figure 53 shows that the majority of people said that they had cleaned their cattle facility and participated in cleaning public canals. In terms of cattle facilities, 43% of respondents asserted that their family had cleaned weekly, 34% daily, and 20% monthly. Regarding public canals, approximately 45% of people confirmed that they participated in cleaning once per month, 26% once per week, 25% once per couple of months, and only 5% of those were not involved in this activity.

Figure 53 Frequency of cleaning cattle facilities and public canals (N=79)



Chi square independent tests (3x4 contingency tables) were conducted to examine whether there were significant associations between the occupation of respondents and frequency of cleaning cattle facilities and public canals. The analysis showed no difference among school students, farmers, and local government staff members in frequency of cleaning their household cattle facilities (Fisher's exact test = 4.6, *df* =6, *p*> 0.05). By contrast, a significant relationship was detected between respondents' occupation and frequency of cleaning public canals within 6 months with Fisher's exact test = 18.5, *df* = 9, $p < 0.05$; school students' families conducted cleaning of their cattle facilities more often than other groups. The effect size was 0.29, showing a medium-size effect.

Table 29 Frequency of cleaning households' cattle facilities and pubic canals by occupation

Frequency of cleaning	School student	LG staff member	Farmer	Fisher's exact test	df	*p*	% variance (Cramer's V)
Cattle's facilities *(N=79)*				*4.6*	*6*	*0.58*	*0.17*
Daily	N 21	4	2				
	% 38	44	14				
Weekly	N 23	3	8				
	% 41	33	57				
Monthly	N 10	2	4				
	% 18	22	29				
Not at all	N 2	0	0				
	% 4	0	0				
Frequency of cleaning public canals *(N=88)*				*18.5*	*9*	*0.01*	*0.29*
One per week	N 18	2	1				
	% 32	22	7				
One per month	N 26	5	3				
	% 46	56	21				
One per couple of months	N 10	1	10				
	% 18	11	71				
Not at all	N 2	1	0				
	% 4	11	0				

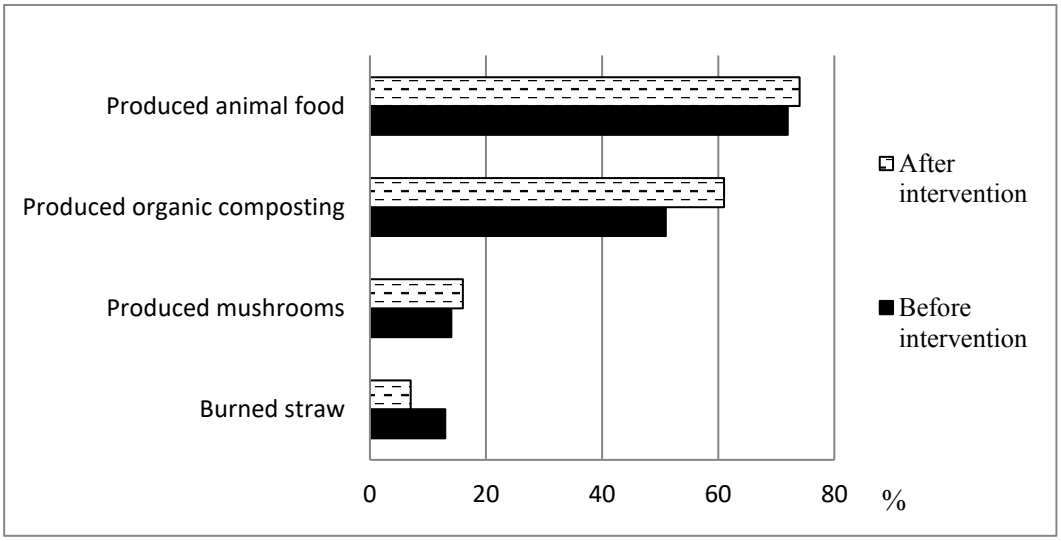
6.1.3.9 Mitigation activities in the agricultural sector

a. Dealing with straw after crops

In Thinh Loc community, the livelihood of the majority of residents is cultivating rice. Therefore, during the intervention program, it was suggested that farmers use the remaining straw after harvest to produce mushrooms, organic composting, and animal food, rather than burning it in the field or as fuel for inefficient cookers, which contributes to exacerbating climate change. Out of 88 survey recipients, nine teachers did not have farms; therefore, only 79 respondents answered the questions related to agricultural activities. The results showed that animal fodder (mainly cows and buffalos) was the most common use of straw both before and after intervention, and this increased slightly after intervention (around 2%). Using straw for organic composting was the second most common use before and after intervention, which also increased following the program (10%). Meanwhile, using straw to produce mushrooms was conducted by less people.

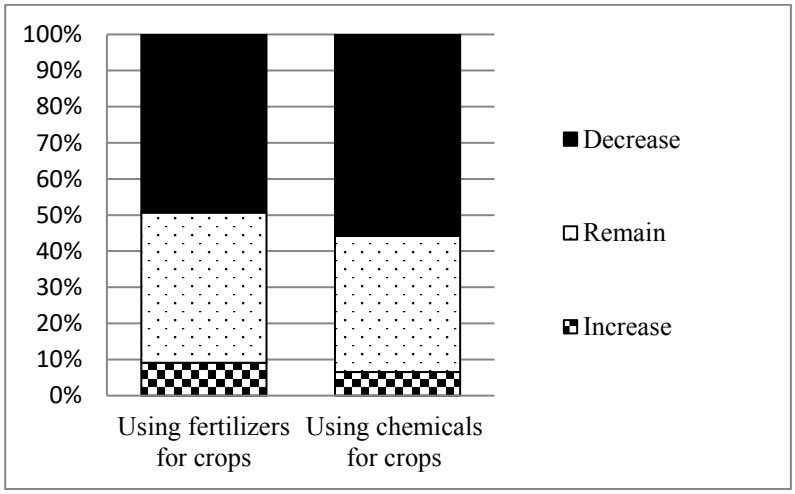
However, this activity also witnessed a slight increase from 14% before intervention to 16% after intervention. The figure also showed that very few people reported that they had burned straw after harvest and this behaviour decreased from 8% to 3% after the intervention program.

Figure 54 The prevalent ways of using straw after crops (N=79)



b. Using fertilizers and chemicals for crops

Figure 55 Comparison of using fertilizers and chemicals for crops before and after intervention (N=79)



Of the 79 people who answered this question, 49% and 56% believed that their family decreased their use of fertilizers and chemicals in their crops. Meanwhile, the percentage of people using fertilizers and chemicals for crops was just under 10% (9% for fertilizers and 7% for chemicals). The rest believed that their family did not change the quantity of fertilizers and chemicals for growing crops, 42% and 38% respectively.

Chi-square independent tests between occupation (farmer, school student, and local government staff member) and their use of fertilizers and chemicals for growing crops did not show any relationship between the two variables.

6.1.4 Applying strategies to adapt to climate change

The Thinh Loc community has been faced three key impacts from climate change: sea level rise, droughts, floods and storms. Therefore, adaptation strategies were discussed and suggested in order to protect the coastline, deal with water shortages, and address monsoon seasons. This section will evaluate to what extent locals applied activities to adapt to sea level rise and droughts, as well as any planning of how to deal with the upcoming flood/storms seasons at the end of year.

6.1.4.1 Protecting coastline

Protecting the Thinh Loc community's coastline plays a crucial role in adapting to sea level rise by undertaking activities such as collecting garbage, planting trees, and looking after the new sea wall. Nearly two thirds of survey recipients said that they participated in protecting their coastline in the last 6 months, with over 30% of people collecting garbage on the seashore daily, while planting trees and looking after the new sea wall was predominantly conducted monthly.

Analysis of chi square tests found that there was a significant association between respondents' occupation and frequency of collecting garbage and planting trees on the coast. Statistical significances are presented:

1. Colleting garbage: With Fisher's exact test = 15.5, df = 9, $p<0.05$, in that school students conducting this activity after intervention, more than any other groups The effect size was at 0.23 showing a medium effect
2. Planting trees: With Fisher's exact test = 16.4, df = 9, $p<0.05$, in that more school students conducted this activity after intervention. The effect size was at 0.27 showing a medium effect.

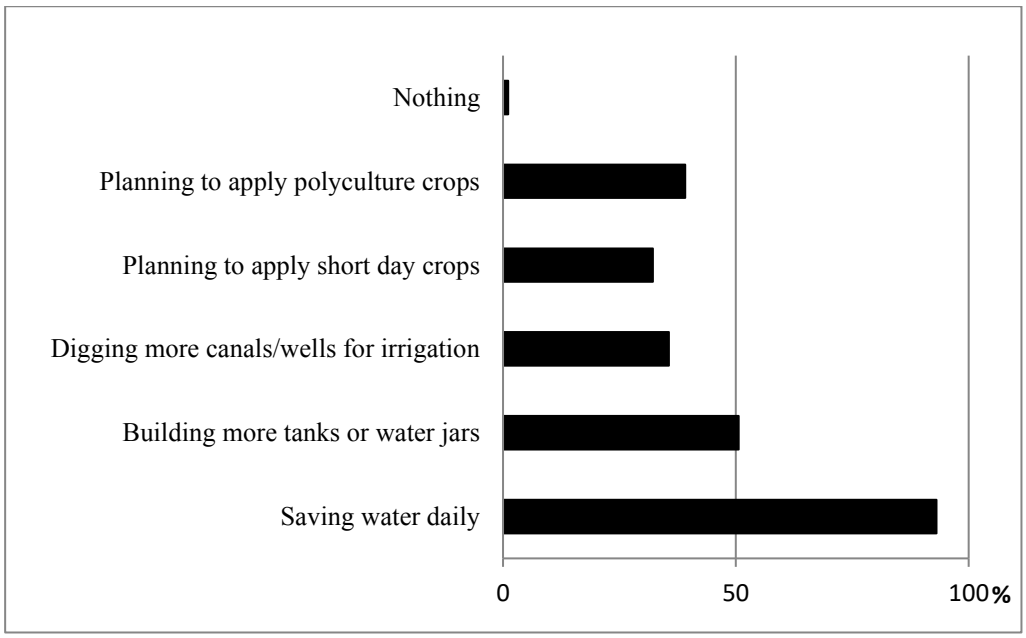
Table 30 Protecting coastline activities by occupation (N=88)

		School student	Teacher	Government staff member	Farmer	Fisher's exact test	df	*p*	% variance (Cramer's V)
1. Collecting garbage in the coastline						15.5	9	0.04	0.23
Yes	N	42	6	6	6				
	%	75	67	67	43				
No	N	14	3	3	8				
	%	25	33	33	57				
2. Planting trees in the coastline						16.4	9	0.03	0.27
Yes	N	40	8	6	7				
	%	71	87	67	50				
No	N	16	1	3	7				
	%	29	13	33	50				

6.1.4.2 Actions to adapt to prolonged droughts and water shortage

In order to cope with annual droughts and water shortage, most Thinh Loc community residents saved water daily (over 90%). Around half the people built more water tanks or jars to store fresh water, while above 35% of respondents planned to apply techniques of poly-culture and short-term crops, and dug more canals or wells for irrigation safety.

Figure 56 Main activities reported to adapt with drought and water shortage (N=88)



Kruskal-Wallis tests were conducted to examine differences between respondents' occupation on their adaptive strategies to cope with droughts and water shortage. Statistic significances are demonstrated as follows:

1. The test, which was corrected for tied ranks of planning to apply short-term crops, was significant, chi-square (N=88) = 11.2, p<.05. Post hoc pairwise comparison using Mann- -Whitney demonstrated a significant difference between the group of farmers and the teacher group. The number of farmers who planted short-term crops to adapt to drought and water shortage was greater for other groups, especially for the teacher group.

2. The test, which was corrected for tied ranks of planning to apply poly-culture crops, was significant, chi-square (N=88) = 15.8, p <.05. Post hoc pairwise comparison using Mann-Whitney also demonstrated a significant difference between the farmer group and the teacher group. The number of famers who planned to apply poly-culture crops to adapt to drought and water shortage was greater for the other groups, especially for teachers.

Table 31 Main activities to adapt to droughts and water shortage by occupation (N=88)

Adaptation to cope with droughts and water shortage after intervention		School student	Teacher	Government staff member	Farmer
Saving water daily	N	49	9	9	14
	%	37	82	31	31
Building more tanks or water jars	N	28	2	6	8
	%	21	18	21	18
Digging irrigation canals/wells	N	23	0	3	5
	%	17	0	10	11
Planning to apply short-day crops	N	15	0	5	8
	%	11	0	17	18
Planning to apply poly-culture crops	N	18	0	6	10
	%	13	0	21	22
Nothing	N	1	0	0	0
	%	1	0	0	0

6.1.4.3 Actions to adapt to the forthcoming flood and storm seasons

To assess the community's ability to cope with the upcoming flood and storm season from September to December after the intervention, an open-ended question was used; "What do you do to plan for the upcoming flood and storm season?" The results showed

that almost all respondents demonstrated a high level of preparation. Students, teachers, farmers and local government staff members planned to cut off big trees' branches; to plant more pine trees to prevent big waves; to store food; to tidy up houses and gardens; to dredge canals; to build temporary dykes by using jute sand bags; to build more water tanks to store fresh water in the drought season; to strengthen houses and cattle facilities; to buy life vests and simple boats; to plan for people and animals' migration. The responses are presented as below:

Table 32 Open response question preparing for the upcoming storm and flood season

Prepared actions	Primary school student (n=26) %	Secondary school student (n= 30) %	Teacher (n=9) %	Farmer (n=14) %	Government staff member (n=9) %
Trimming trees	54	83	78	85	82
Plant more pine trees to prevent big waves	50	67	55	64	67
Store food for family	62	50	89	80	73
Store food for animals	30	50	33	74	62
Tidy up house and garden	58	87	100	93	78
Dredge canals	0	17	33	57	44
Build temporary dykes using jute sand bags	19	33	55	79	78
Strengthen houses and cattle facilities	65	73	100	86	78
Buy life vests and simple boats	7	17	44	21	22
Plan for people and animals' migration	62	87	100	86	89
Follow weather forecast	75	80	100	92	100
No preparation	15	0	0	0	0
No answer	0	10	0	0	0

6.1.5 Undertaking communication and educational activities help to mitigate and adapt to climate change in the Thinh Loc community

Communication and education are considered key methods to help mitigate and adapt to climate change through transmitting knowledge and strategies, as discussed in the intervention program. Within the last six months, nearly 70% of intervention attendees confirmed that they had talked about the climate change issue at a different frequency. Out of 88 people, 23% confirmed that they had talked about climate change issues daily, 19% weekly, and 25% monthly. Analysis of chi square independent tests did not find any difference among occupational groups in relation to frequency in communicating about the climate change issue.

Involving climate change education, 61% of respondents asserted that their organizations, comprising the schools, Thinh Loc local government, and Thinh Loc community, implemented training, workshops or competitive role-playing performances related to the climate change issue after the educational intervention. The attendees also confirmed that workshops and performances were mainly undertaken in the schools.

6.2 Qualitative analyses

6.2.1 Field observations

In order to triangulate the results, observations and semi-structured interviews were conducted. The main goal of field observations was to find whether there was any change in the behaviour of local residents in the Thinh Loc community to mitigate and adapt to climate change. Meanwhile, semi-structured interviews were undertaken to ascertain the opinions of locals on the benefits of the intervention program, advantages and barriers to applying climate change mitigation and adaptation, as well as recommendations for broadening the program.

The post intervention observations showed key changes in the Thinh Loc community aimed at addressing climate change. The post-observation was undertaken as follows:

Table 33 Field observation in the post- intervention phase

Observation activities	Place of observation	Time of observation	Quantity
Cooking system	Households	20 minutes/household	4
Cattle' management	Households	20 minutes/household	4
	Public roads	2 hours	1
Sea- wall protection	Coastline	1 hour	1
Collecting garbage	Coastline	2 hours	1
	Secondary school	1 hour	1
	Primary school	1 hour	1
	Community public road	2 hours	1
Public cleaning activities	Community roads	2 hour	1
	Community canals	2 hour	1
Instrument of climate change and environment campaigns	Thinh Loc community government office	1 hour	1
	Secondary school	1 hour	1
	Primary school	1 hour	1
	Public roads	2 hours	1
Planting trees	Coastline	1 hours	1
	Schools	1 hour	1
	Public roads	2 hours	1
Recycling	Schools	1hour	1
	Thinh Loc government office	1 hour	1
	Households	15 minutes/households	4
Electricity saving	Secondary school	1 hour	1
	Primary school	1 hour	1
	Thinh Loc government office	1 hour	1

In particular, garbage on the coastline was collected more often. Furthermore, the sea wall along Thinh Loc community coastline was completely rebuilt, which plays an extremely important role in preventing danger from sea level rise and floods for all Thinh Loc residents, especially for households located next to the coast. The public roads

seemed to be cleaner because of weekly public road cleaning. In addition, several activities to address environmental protection and climate change mitigation were undertaken in the schools and by Thinh Loc local government. This included planting more trees, organizing and attending competitions on climate change by performing on stage, or publishing posters to educate residents about environmental protection. The following pictures illustrate improvements in environmental sanitation in the Thinh Loc community after the intervention program provided by field observations.

Figure 57 The coastline is cleaner

Figure 58 Seawall is completely re-built and used

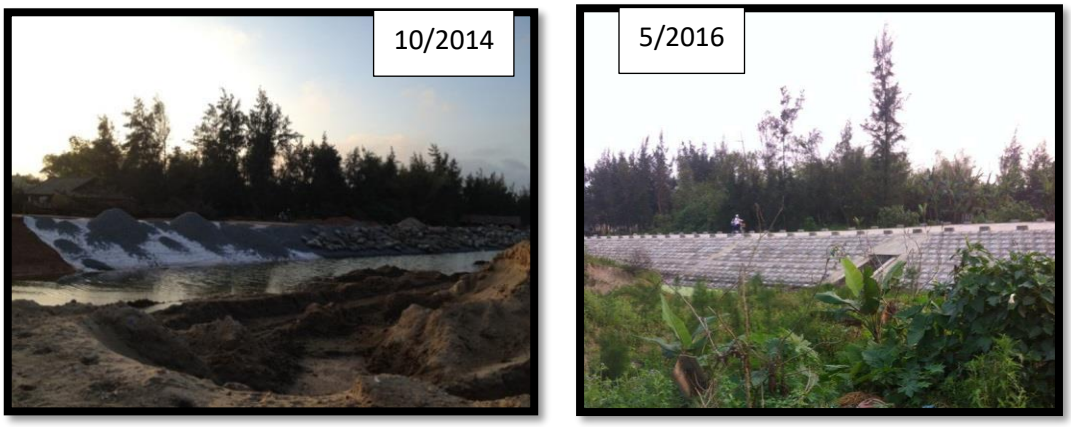


Figure 59 Enhancing environmental protection campaigns at schools and local government

6.2.2 Interviews

Besides observation, semi-structured interviews were undertaken to discover interviewee's opinions about the benefits of the educational intervention program, advantages and barriers in applying climate change education program, and recommendations for broadening the program. Four interviews comprised one teacher, one secondary school student, one farmer, and one local government staff member who were invited to answer semi-structured interviews. These interviewees were randomly selected from the 98 people who attended the intervention program 6 months previously based on their agreement and availability. Each interview lasted around 30 to 45 minutes. The interview focused on four main questions:

1. What do you think about the climate change education program which you were invited to attend 6 months ago at your school/ Thinh Loc government office?

2. Have you applied any suggestions to mitigate and adapt to climate change? If yes, could you please tell me observations when you applied suggestions from the program?
3. Have you coped with any difficulties when you applied those suggestions to address climate change in your community?
4. Is it possible to broaden the climate change education program to all residents in your community and other communities? If yes, could you advise the most appropriate ways to duplicate this program?

In order to undertake the interviews, the researcher was responsible for interviewing, while a research assistant was responsible for taking notes. Interview transcripts were coded in Vietnamese, and then translated into English for analysis. The content analysis technique was used for analysing the qualitative interviews. Results from content analysis were presented as follows:

6.2.2.1 Qualitative analysis of the usefulness and the necessity of the climate change education program

Analysis from interview transcripts showed that the intervention program was highly appreciated by interviewers because the program provided information and knowledge, which met the requirements of locals: "*Thinh Loc is a very poor community compared to An Loc, Binh Loc, and Thach Bang etc. In addition, we are next to the coast. Your program satisfied our needs. I found that information provided in the class warned us about impacts of sea level rise. The contents of the program were easy to get and matched with our condition, coastline and rural area"* (A local government staff member, male, 30 years old).

Furthermore, the program provided good compiled material on climate change education, which would be useful and effective for teachers who use this document for climate change education: "*Well, I have been a teacher for over 30 years and next year I will retire. However, I still really love my teaching and my young students. I notice that Thinh Loc community has been changing a lot; especially there have been more natural disasters recently. But we do not have any good compiled material on climate change to educate our students. After three days of your class, I strongly appreciate the information and data provided by the program. Especially, I feel very scared and worried about the warnings of sea level rise, which would affect my future generation [*stop and deep breath*]. I also couldn't believe that our cows' breath contributes to climate change. Do you know that almost all households in my community own at least one to two cows and*

Thinh Loc community is quite large with nearly 7000 people? I start feeling worried about our cows and what happens if we don't raise cows that would help farmers to do rice farming? Ok, back to your climate change education program, that was great. It seems to bring to light a story about climate change in Thinh Loc and open our eyes at environmental protection. My children liked the videos and exercises very much. So did I. For me, I like the way the program provided information in order from concepts, warnings, facts, evidence, and exercises until strategies etc." (A teacher, female, 54 years old).

Besides, the intervention program created a source of inspiration to students by using visual materials and strong interaction between the teachers and students as well as amongst the students themselves: "*I like the program because it was fun, interactive, there were tea breaks, and there was no homework* [smile]*. I also learnt more things from the program such as 10% of Vietnamese land would be underwater if the sea level rises in next 100 years or that burning straw increases greenhouse gases and global warming. The videos and exercises about the greenhouse effect are useful for me and my friends because before that I did not know how the greenhouse effect works. Now I can show my sister about the greenhouse effect and global warming if she asks me"* (A secondary school student, male, 15 years old).

Finally, the program provided basic knowledge on climate change directly related to their own rural and coastal community. Therefore, locals could identify how their behaviour contributes to enhancing climate change: "*Last year, I still remember that it rained and was really windy but my son still took me to your class. I was a bit shy because I haven't gone to a public class for years, but I liked it very much. I felt it was easy to understand and remember* [a small cough]*. I still use a straw cooker even though I know it's not good for my health or the environment. You said straw cookers contribute to global warming and harm people's health, didn't you? But I can't afford a gas or an electric cooker now. May be I will try to buy an efficient cooker next year"* (A farmer, female, 45 years old).

6.2.2.2 Advantages in applying strategies to mitigate climate change

Attendants who participated in the intervention program saw advantages when they applied measures to mitigate and adapt to climate change. For example, the teachers received agreement and strong support from the school principal to undertake recycling or implement competitions related to climate change for students and teachers: "*I eat less beef, more fish, vegetables, and tofu. I also pursued my principal to conduct*

recycling at school. Before that we burned garbage in the school dump, but now we have many bins around the school thereby students and teachers have to recycle. We also organized competitions about climate change or environmental protection by performing, which attracted teachers and students to participate" (A teacher, female, 54 years old). Meanwhile, students and farmers had cooperation from their family to apply activities to contribute to minimizing climate change: "*I applied some of them. For example, I asked my mum and dad buy a new cooker instead of a straw cooker. We also planted more small trees in the garden and some big trees behind my house. My brother and my sister also helped me to plant our trees. Sometimes we collected garbage on the coast, next to my house* (A secondary school student, male, 15 years old) and a farmer said: "*I often tell my sons, my husband, and my daughters not to ride a motorbike if they are not in a hurry because motorbikes affect the environment. My children asked me to learn how to ride motorbikes but I am a bit scared. However, it's good now because I just walk and ride a bicycle. We also save water use and electricity daily. My husband and my children listened to me and don't travel by motorbike too much"* (A farmer, female, 45 years old).

Finally, Thinh Loc local government is always willing to help in conducting any activities to enhance benefits for their community on climate change mitigation and adaptation as well as environmental protection: "*Well, we displayed a slogan of environmental protection in the Thinh Loc government office so everyone can see it and pay more attention to it. . . The Thinh Loc president supports activities related to climate change and environmental protection. In the future, we may organize a group to advertise climate change mitigation and adaptation based on your program. Besides, in the next summer, we will also organize a volunteer group to collect garbage on the coast and plant more trees. Many households agreed with our plans and will volunteer to participate in it"* (A local government staff member, male, 30 years old).

6.2.2.3 Some difficulties in applying strategies to mitigate climate change

By contrast, people in Thinh Loc community faced some difficulties when they implemented actions to protect the environment and help to minimize climate change. The locals' income totally depended on growing rice in the small farms; therefore, poor economic conditions proved to be the largest barrier to Thinh Loc community members applying the strategies to protect the environment. For example, locals could not afford efficient cookers to replace traditional cookers and had difficulty in reducing the use of fertilizers and chemicals. Schools could not afford more computers for their students who needed to gain more knowledge about climate change: "*As you know, Thinh Loc*

community is an undeveloped village and our main income depends on farming. Therefore, using straw or wood cookers is quite hard to replace because we want to take full advantage of our agricultural resources. I think we have to implement a lot of education for them about impacts of climate change, and then they may change to efficient cookers" (A local government staff member, male, 30 years old) and a teacher said: "*The provision of computers and internet in school is limited; therefore, students still don't have many opportunities to work with computers and the internet in the school, so they can learn more about climate change. Of course, very few student own computers or laptops at home* (A teacher, female, 54 years old). Meanwhile a student emphasized his family's barrier if reducing the use of chemicals and fertilizers for crop*: "I think my mum and dad don't want to reduce chemicals or fertilizers for crops because it may reduce our crop's productivity. All our family's income just depends on a little rice farm"* (A secondary school student, male, 15 years old).

Recycling was not easy to apply because many Vietnamese rural communities did not have a garbage disposal system: "*Recycling is also hard to undertake because we don't have any garbage collection to support this" (*A local government staff member, male, 30 years old*).*

Also, reducing the use nylon bags for shopping was another challenge because traditional baskets were not very convenient and paper bags were not free: "*I know nylon bags aren't good for environmental protection but more convenient because they allow things to be separated* (A teacher, female, 54 years old) and *a secondary school student said: "Moreover, my mum can't afford paper bags when she goes to buy food at the market everyday (we don't have fridge and freezer) whereas using a nylon bag is free"* (A secondary school student, male, 15 years old).

The severe weather conditions were also a big challenge for locals who wanted to take action to mitigate and deal with climate change in Thinh Loc community. The teacher talked about her idea to change the mode of vehicles: "*I also want to go work by bike or on foot but it is always hot in the summer and too cold in the winter, so finally I decided to travel by motorbike* (A teacher, female, 54 years old). In addition, the farmer expressed her concern about adaptive strategies to address annual storms*: "The flood and storm seasons in Thinh Loc will come soon, normally in August. Two years ago, a bad storm destroyed all my cattle's facilities. We often strengthen and cover our house and cattle facilities but they aren't strong enough to deal with annual floods and storms when we live next to the coastline. If we don't have money to build a very strong house, all our*

solutions to deal with big storms won't be effective. I am very concerned about the upcoming storm" (A farmer, female, 45 years old).

6.2.2.4 Possibility of broadening the educational intervention program on climate change to schools and all locals in the community

All interviewees definitely agreed about the idea of duplicating the climate change education program. In order to broaden the knowledge and application of the educational program, interviewees gave important advice to effectively conduct program for all locals as follows:

In the school:

- The teachers in the schools can be trainers for delivering the program to their students. The climate change classes can be conducted in sequence for 40 classes with a total of 1500 students in the secondary school. The primary school is also committed to replicate the program for all students.
- The climate change classes should be organized after 4 pm when students and teachers are free.

A teacher's recommendation*: "We should do it at every class at school so all students will know about this program and then they may tell their parents and siblings about climate change knowledge. We don't have many projectors, just two for nearly 40 classes. This can be a big problem. However, if the Principal is willing to broaden knowledge to all students, we can do it in order; probably it takes a year to undertake for all classes. And I assure our teachers are willing to participate in this program to help better their students' on climate change".*

A student's recommendation: *"I think all students will like and participate in this program. The program is interesting and easy to understand and apply. I prefer to watch videos and do exercise with the group. Last year, only 30 students were invited to attend the class so many students stayed outside and watched through windows. They asked me about the class and they wanted to attend too. If the class is organized in the afternoon, it should be perfect because we are free after 4pm".*

In the community:

- The classes should be organized at night time in every hamlet so everyone can have more opportunities to attend.
- The Thinh Loc local government will supply a projector, computers, venue, and conduct recruitment for organizing classes.

A farmer's recommendation: "*I think it's very beneficial for us. I did think that climate change was caused by God and natural processes. I don't think we contribute to enhancing climate change through using nylon bags, burning straw, or raising cows and rice etc.* [stop] *Um and riding motorbikes. My husband and neighbours also want to attend the program. The class is better to organize in the hamlets, so many people can participate in it, but you should teach at night-time because everyone works on the farm during the day."*

A local government staff member's recommendation: "If *the program can be delivered to all locals at Thinh Loc community, it will be the best measure to improve knowledge and the ability to cope with climate change, and our government will support it completely by supplying a projector, computers, recruitment, and classrooms but we don't think we can supply tea".*

Conclusion

Chapter Four showed that Thinh Loc is an undeveloped village, where livelihoods and economic development were strongly dependent on weather and climate conditions. Thereby, development towards adaptation still faced potentially significant challenges. For example, many Thinh Loc farmers were unable to afford efficient cookers and they would take full advantage of agricultural waste products. In addition, only a few households were able to buy life vests and simple boats for emergencies in the flood season due to financial restrictions.

Along with poor economic conditions, cultural habits probably affected the adoption of mitigation and adaptation strategies. For instance, burning straw and cutting down trees for cooking, dropping litter and a lack of recycling seem to be innate in the rural culture of most Vietnamese rural communities. Therefore, it requires much more time to educate and convince farmers to conduct adaptive change.

Additionally, a lack of publicity regarding local policies associated with climate change mitigation and adaptation was one of the hardest barriers influencing the development of positive action in the study site. Undertaking recycling is an example of this, as not all coastal provinces have built an effective and compulsory recycling plant in Vietnam.

Thus, although education may enhance the knowledge of respondents in managing recycling, the processing of recycled materials depends totally on district and provincial governments, where officers have not been involved in any climate change education programs. This is a limit to the application of information from the intervention program as well as designing measuring equipment to evaluate recycling. Furthermore, any punishment of tree cutting and deforestation or litter dropping on the coast has not yet been applied. Those activities therefore require time and propaganda in order to broaden the participation of local community members.

Despite the challenges above, the intervention has achieved improvements in awareness and behaviour by almost all participants in responding to climate change in the Thinh Loc community. This could be due to the intervention's design being based on local knowledge, the needs and capacity of the community. Therefore, the content of educational provision focused only on the proposal's adaptive activities which were appropriate to the abilities and possibilities of the local people and the community. Further, duplicating educational activities to a variety of stakeholders would have been one of the most useful solutions to bring opportunity and change to the adaptation process. Finally, the participation of local government authorities would have expedited the process of publishing a system of climate change mitigation and adaptation policy.

The effectiveness of the educational intervention are summarised as below:

a. Awareness of climate change improvement:

- Six months after the intervention, there was an improvement among people who attended the intervention program in familiarity with terms such as climate change, global warming, greenhouse gases, greenhouse effect, and carbon dioxide. Among them, the proportion of people who were familiar with all five terms was much higher than the baseline survey (Pre- intervention phase), especially school students (See Chapter 6). While in the previous survey, participants were less familiar with the term greenhouse gases and carbon dioxide, in the post intervention phase, many respondents were able to recall the main sources of greenhouse gases, such as carbon dioxide, methane, and nitrous dioxide. In addition, over half of the intervention attendees could express evidence of climate change though answering the opened-ended question in the post intervention survey.
- With reference to climate change causes, a high rate of respondents strongly agreed or agreed with the cause of climate change including burning fossil fuels, using fertilizers and pesticides for crops, deforestation and uncontrolled cutting down of trees, landfill, industrial activities and using inefficient vehicles.

Interestingly, more females agreed with the causes of deforestation and uncontrolled tree felling than males.

- Concerning climate change impacts, a majority of participants strongly agreed or agreed that climate change resulted in negative consequences, especially for ocean creatures, forests, and environmental pollution.
- Attitudes towards climate change were evaluated by the respondent's opinion of certain activities which contribute to enhancing climate change. The result showed a very high rate of people who agreed that they felt scared since they became aware climate change warnings and predictions during the intervention program, followed by concerns about their community disappearing due to rising sea levels. A large percentage of respondents also agreed that they felt regret for not saving water daily, not paying more attention to climate change issues, dropping litter, using nylon bags, not recycling and so on.

b. Behaviour changing:

- Six months after the intervention, a large number of attendees ensured that they participated in planting and looking after trees at home and at school. In addition, interventional attendees were certain to participate in planting and taking care of trees at their community and forest.
- There was considerable decrease in the use of motorbikes for traveling to the markets and other hamlets in the village. Bicycles became the most prevalent mode of transport, replacing inefficient vehicles such as motorbikes and cars.
- The results showed a remarkable improvement in changing the use of shopping bags. Among them, use of nylon bags was reduced after intervention, while use of wooden baskets, paper bags, and reusable plastic baskets was increased. Interestingly, the improvement was demonstrated more by farmers than by other groups.
- For energy saving behaviour, almost all participants ensured that they turned off electrical equipment before leaving home, school, or workplace both pre and post intervention. Furthermore, the number of respondents conducting energy saving measures rose after intervention.
- Undertaking recycling was also enhanced remarkably six months after intervention.
- In terms of meat consumption, results demonstrated that there was a decrease in eating meat by farmers, teachers, local government staff members, and school students after the intervention program. Among these occupational groups, the

rate of teachers reducing the proportion of meat consumption was higher than others.

- There was a change in using straw after collecting crops in Thinh Loc community respondents. While burning straw after harvests dropped, using straw to produce organic composting and mushrooms had gone up. This improvement of using straw in effective ways instead of burning helps to mitigate greenhouse gas emissions.
- Close to half of the respondents whose livelihoods depend on agricultural activities asserted that they reduced the quantity of fertilizer and pesticide usage for their farm after intervention.
- Cattle facilities and public canal management was improved; over forty percent of respondents said that they undertook cleaning of cattle facilities weekly and cleaning of public canals monthly. Importantly, more school students believed that their families participated in cleaning public canals than other occupational groups after the 6-month intervention.
- Regarding adaptive capacity, many respondents reported that they participated in protecting the coastline by means of collecting garbage, planting more protective trees, and protecting the new sea wall. It also was illustrated that more school students participated in activities to adapt to sea level rise than other occupational groups.
- In order to adapt to droughts and water shortage, almost all respondents undertook daily water saving measures. A large number of respondents built more water tanks or planned to transfer from long-term crops into short-term crops, as well as applied poly - culture for their farms.
- In order to address the upcoming flood and storm season, most respondents prepared adaptive plans, such as trimming of large tree branches, which may harm people and property during severe floods and storms; planting more pine trees to mitigate big waves; storing food for people and animals; strengthening houses and cattle facilities as well as migration plans and so on. Regarding this issue, adults had a better plan for the next coming flood and storm season than school children as might be expected.
- After 6 months, schools and the Thinh Loc local government also implemented actions related to climate change education such as organizing performances related to climate change and environmental problems and advertising posters about environmental protection in the Thinh Loc community.

Upon quantitative and qualitative analysis, there was a significant improvement in attendants' awareness and ability to cope with climate change. Therefore, it can be concluded that an evaluation of awareness and behavioural change indicate effectiveness of education as a strategy to increase climate change adaptive capacity of the Thinh Loc community members. In other words, education involving evaluation in the last steps brings improvement of human capital, therefore, it may help to reduce the vulnerability and increase the adaptive capacity of a community (Muttarak & Lutz, 2014). Further, an improvement of awareness and behavioural changing of community respondents who attended the educational program concluded that this educational intervention program is an urgent need and suitable to lower education level laymen. Therefore, it would be possible to replicate it to other Vietnamese coastal community members.

Chapter Seven will summarise main findings of the project, discuss limitations, direct further research and conclude the thesis.

CHAPTER SEVEN: DISCUSSION AND CONCLUSION

The purpose of this chapter is to provide an overview of the thesis, to report and discuss its major findings, to propose future research possibilities and to acknowledge the limitations of the research.

7.1 Overview

Chapter One outlined the issues of concern to this thesis, namely, the effectiveness of education in helping Vietnamese coastal communities to adapt to climate change. The project also investigated the question of whether a climate change education program should be undertaken in Vietnamese coastal communities in order to enhance their residents' knowledge and adaptive capacity to cope with climate change. This line of inquiry was pursued because it had been shown in previous studies that education is crucial to building human capacity to adapt to climate change. Constructivist principles were used to help to build effective classroom strategies by encouraging social interactions and building upon learners' own knowledge and experience.

Chapter Two delineated the scope of the study by presenting previous research undertaken in the field of climate change mitigation and adaptation. This literature review also showed the role of climate change education in the response to climate change. A climate change education program was identified as a proposed approach which was able to apply constructivist teaching processes to help enhance the community's ability to adapt to climate change in the study site. The specific research questions formulated in the project were refined as a result of this review.
Methodological issues associated with the project were addressed in Chapter Three. A mixed methods approach was adopted as the methodology most suited to answering the project's research questions.

Baseline data about participants' awareness and attitudes with regards to climate change were presented in Chapter Four. Here both qualitative and quantitative analyses of the research data were described. Results showed that participants possessed a low level of climate change knowledge, especially in the case of school students and farmers. However, participants' level of concern about climate change was high, and they expressed the need for an education program addressing climate change.

Chapter Five outlined how a climate change education program was designed and delivered at the study site. At the end of the education intervention, participants were

highly appreciative of the quality and methods associated with the program and they also expressed a desire to duplicate the program for the whole community.

An evaluation of the education intervention after six months was delineated in Chapter Six. Analyses of both qualitative and quantitative surveys showed an improvement in awareness of climate change among people who attended the education intervention 6 months previously. Additionally, a high-level of concern about climate change warnings was demonstrated by almost all participants as well as a high level of agreement that they regretted the fact that certain prior behaviours they had engaged in had contributed to accelerating climate change. Results also showed that respondents were actively applying mitigation and adaptation strategies to minimize and address climate change.

This chapter concludes with the contributions made by the project, recommendations for application of the research, the limitations of the research, and some possible areas for future study.

7.2 Summary and discussion of main findings

Chapters Four and Six described in detail the results of the various analyses carried out. The key findings from both analyses are integrated below.

a. *Thinh Loc community members demonstrated a low level of awareness and ability to adapt to climate change before intervention. Evidence is provided as below:*

- A significant proportion of survey recipients were not familiar with terms related to climate change, such as climate change, global warming, greenhouse gases, greenhouse effect, and carbon dioxide.
- A small percentage of survey participants perceived that climate change is caused by human activity.
- One quarter of respondents were still not sure about the existence of climate change.
- With regard to activities associated with climate change, many respondents reported that they had undertaken activities that contributed to accelerating climate change, such as burning domestic garbage, deforestation, cutting down trees, dropping organic garbage on the coast, burning straw after harvest and so

on. Although these activities were not conducted frequently, they still created environmental problems and enhanced greenhouse gas emissions.

- Existing efforts related to environmental protection and climate change adaptation appeared ineffective from first observations and interviews.

b. *Demographic characteristics of survey participants affected awareness and adaptive capacity to cope with climate change in Thinh Loc community. They include:*

- Male participants demonstrated a greater understanding of climate change than female participants in this study. For example, male participants demonstrated more familiarity with climate change terms than female ones, and more male participants perceived that climate change is happening than female ones.
- Teachers and local government staff members demonstrated a greater awareness of climate change than school students and farmers.
- Participants with higher levels of education showed higher familiarity with climate change terms than those with lower levels of education.
- Most of the participants aged between 41 and 50 responded that they believed climate change was already negatively affecting their community. In contrast, children aged between 11 and 14 were more likely to respond that they believed climate change would affect the community in the next 50 years.

c. *Factors influencing Thinh Loc community members' adaptive capacity to cope with climate change*

- Climate change awareness is associated with adaptive capacity (Marshall, Park, Howden, Dowd, & Jakku, 2013). Marshall et al. (2013) showed that people who demonstrated a higher level of climate change awareness tended to have higher levels of adaptive capacity, while those who had limited climate change awareness were restricted in their ability to cope with climate change. Within the Thinh Loc community, the baseline result demonstrated that Thinh Loc community members had a low level of climate change awareness. Therefore, it is evident that adaptive capacity to address climate change in this community was also limited.
- As discussed earlier, community capacity affects climate change adaptation capacity (Mendis et al., 2003; Anbumozhi et al., 2012). Among kinds of community capital, economic capital emerges as one of the most important in determining adaptation capacity (Mendis et al., 2003; Adger, 2003; Adger et al.,

2004). Results showed that Thinh Loc community is a poor and undeveloped village, where the most common livelihoods involve rice farming and fishing. Thinh Loc community was determined to lack the economic capital to support community infrastructure and human security in response to climate change impacts. Poor economic conditions and poverty resulted in a low level of adaptive capacity in Thinh Loc community to cope with climate change.

- In addition to a low level of awareness and unfavourable economic conditions, limited access to sources of information about climate change may be considered as an important factor limiting the adaptive capacity of Thinh Loc community members. In this regard:
    - ✓ Most respondents in the Thinh Loc community suggested that they received climatic information through the medium of television, which is widely available in the community. However, programs on television mainly present weather information, environmental events and the effects of disasters, rather than providing basic information about climate change, its impacts and causes.
    - ✓ The use of reading materials in the community was also neglected. Similar to other communities in the rural Vietnamese areas, Thinh Loc community owns one Traditional House where a community library room provides books and newspapers to all locals. Despite this, local government and community residents did not focus on reading and using information in the library in the rural areas. The trend of urbanisation entices rural labourers who have good health and education levels to move to the cities in order to seek jobs to support their families and secure their pensions. This trend may also have reduced the number of people who prefer reading in rural areas. Furthermore, due to farming schedules, farmers are usually busy with their crops and do not have time to read. Importantly, books and documents provided in the community library are of poor quality and documents relating to climate change are almost non-existent in the community library.
    - ✓ In terms of local government services, Thinh Loc did not have any organizations running activities related to environmental issues. For this reason, local government staff members were not able to organize training, seminars or workshops on climate change education for local residents.
    - ✓ In terms of educational institutions, the primary and secondary school students in Da Nang province (a coastal province in Vietnam) believed

that climate change related to concepts and terminologies occurring in some subjects such as Geography, Science and Nature and Society at a primary level and Geography, Biology and Civic Education at a secondary level (Vo et al., 2013). The study also found that although school students expressed a high level of perception of climate change impacts in the survey, information provided in the school program was insufficient. All students suggested that they wanted to learn more about climate change in their regular and extracurricular programs (Vo et al., 2013). At Thinh Loc primary school and secondary school, students were taught based upon the Vietnamese national curriculum, and were provided with climate change information like other students. However, a survey conducted with the principal of Thinh Loc secondary school showed that information relating to climate change in those subjects was presented on an ad hoc basis. This indicated that both teachers and students did not possess comprehensive knowledge of climate change along with a clear understanding about the causes of climate change. As a result, the ability of Thinh Loc students to cope with climate change was not able to be enhanced.

d. Thinh Loc community members expressed more climate change education to help adapt to climate change

Despite the fact that Thinh Loc community participants' awareness of climate change was low, their level of concern about climate change was very high. Compared to average Vietnamese and global concern about climate change, Thinh Loc community participants' concern was much higher. While 83% of Thinh Loc participants believed that they were very concerned about climate change, the Vietnamese average was 69% and the worldwide average only 54% (Pew Research Centre, 2015). Concern over climate change is especially high in the Thinh Loc community and was similar to Latin America nations such as Brazil (86%), Chile (77%), and Peru (75%) (Bruce at el., 2015). This might be explained by the fact that the Thinh Loc community, Chile, and Peru have suffered from recent severe weather phenomena such as floods, and storms, while Brazil is considered to be home to one of the world's largest carbon sinks (Pew Research Centre, 2015). Along with a very strong level of concern about climate change, almost all Thinh Loc community research participants expressed the need for more climate change education to enhance their knowledge about climate change and capacity to mitigate and adapt to climate change. Halady & Rao (2009) argued that enhancing

climate change awareness would lead to behavioural change: “Awareness does in fact impact behavioural change towards strengthening the environment and alleviating the potential and existing threads of the climate change phenomenon” (p.20). The main research question of the project asked if an educational intervention including an evaluation in its later stage could become a strategy to increase the capacity of Thinh Loc community members to adapt to climate change. The research found that this strategy appears to be well founded. The main findings of the evaluation six months after the intervention support this proposal.

e. *An evaluation of the educational intervention in the final step indicated that there was an improvement in awareness of climate change as well as behavioural changes among people attending the intervention program.*

In particular, the proportion of people who were familiar with all five terms of climate change, including climate change, global warming, greenhouse gases, greenhouse effect and carbon dioxide, was much higher than before intervention. Furthermore, many intervention attendees were able to identify main sources of greenhouse gases, evidence of climate change, and the causes of climate change. Importantly, an evaluation of educational intervention illustrated that many Thinh Loc community participants were aware of human activities that contribute to enhancing climate change, and applied strategies to help mitigate and adapt to climate change within their community. Furthermore, farmers and high school students demonstrated the most significant enhancement of awareness and changes in behaviour after the intervention. The effectiveness of climate change education can be explained by the following two reasons:

- The curriculum used was designed based on local knowledge and conditions. According to Nguyen (2011), Thinh Loc community residents have been witnessing a greater frequency and stronger intensity of floods, storms, and droughts, as well as sea level rises (the residents realized this by noting that the place where their fishing boats made landfall is now closer to the mangroves) and temperature change (apparent to residents because it is hotter in summer and colder in winter). Nguyen (2011) also concluded that over the decades, due to climate change, Thinh Loc community locals have faced several difficulties such as a lack of food; diseases; a lack of education; loss of livelihoods, shelters, and livestock; water shortage; and infrastructure and property damage. Although they were aware of the existence and impacts of climate change as well as their resilience to cope with social problems (Trinh, 2005), Thinh Loc community

residents did not have enough opportunities to access information resources about climate change mitigation and adaptation. Identifying knowledge gaps and demands of Thinh Loc community members, the intervention focused on explaining the human activities leading to climate change, providing warnings and predictions of climate change based on evidence, and building strategies to mitigate and adapt to climate change, especially in regions that are both rural and coastal. Designing an appropriate curriculum was an important aspect of the intervention, which resulted in improvement in and application of newly acquired knowledge by learners. This is a theory that was also proved by previous projects. For instance, in the Republic of Korea, the climate change education program conducted in primary and secondary schools achieved beneficial results by helping students and teachers to better understand the causes of climate change (UNESCO, 2012). Climate change education in Sri Lanka was also beneficial because the program focused on teaching learners in the rural communities about major problems, such as drought risk reduction, better land use, and water management (UNESCO, 2012). The success of the CCE program in Japan (2005) was demonstrated by developing children's understanding of the impact of human activity on the nature of climate change as well as explaining how to minimize the negative effects of disasters and climate change (Kawata, 2005; Suwa, 2005). The intervention met the demands and knowledge gaps of the climate change issue for Thinh Loc community residents. It was designed based upon the preliminary results of the baseline survey of Thinh Loc community participants' perception of, attitudes to, and behaviour towards climate change as well as field observations involving environmental and climate change issues in the community. In other words, the Thinh Loc community intervention combined local knowledge and global perspectives, which resulted in an appropriate curriculum for almost all the participants.

- Using constructivist-teaching methods: Another factor, which may have contributed to the improvement of learners' awareness and ability to cope with climate change, was the application of constructivist teaching methods in the class. Within a constructivist class, a variety of teaching methods such as video graphics, drawing, games, group discussions, group presentations, and direct instruction are used. This was the case in the Thinh Loc community project. In fact, many previous programs worldwide have achieved success due to using a combination of strategies in teaching and learning. For instance, the "Transfer Live Lesson" program, in Japan, used films, cartoons, and videos to gain more attention from students (Kawata, 2005). The climate change program in Costa

Rica used colouring books as a key method to teach students in order to help improve awareness of climate change for both learners and their parents (Vaughan et al., 2003). It is clear that using diversified methods or by grounding learning activities in a real-world context, students are stimulated and engaged in learning activities and apply the lessons to the world around them.

7.3 Contribution of thesis

Results showed that Thinh Loc community residents - especially school students and farmers -demonstrated a low baseline awareness of and ability to cope with climate change. Despite this, their concern about climate change and their demand for climate change education was high. Therefore, an educational intervention was designed and delivered to a diverse sample of Thinh Loc community members. Six months after the intervention, an evaluation of the intervention was conducted using a questionnaire, observations and interviews. This evaluation indicated that there was an enhancement in awareness of climate change and an improvement in actions to respond to climate change among Thinh Loc community participants. The success of this project contributes to developing climate change adaptation in both empirical and methodological aspects:

a. The effectiveness of education indicates that education with an evaluation in the final step is a strategy to increase climate change adaptation.

The literature review revealed that many nations have become more vulnerable due to climate change impacts (Jung, 2012; Nair, 2009; Pathmarajah, 2012; Collier et al., 2008; Anbumozhi et al., 2012). Acknowledging severe impacts of climate change, many governments, scholars, policy makers, educational institutions and communities have employed several global strategies of adaptation to respond to climate change. They include: investing in infrastructure, irrigation, technology; and changing crops (Ford et al., 2011; Wang et al., 2014; Mc Leman & Smit, 2006; Socialist Republic of Vietnam, 2011; Royal Government of Cambodia, 2006). However, it was argued that although a huge amount of money was spent on adaptation to climate change, changes in climate in several regions were still highly uncertain, and as a result difficult to effectively adapt to. For this reason, it might be more efficient and effective to give part of this fund to education rather than other adaptation strategies (Lutz et al., 2014). In fact, climate

change education projects have been employed in both developed and developing countries at both school and community levels. For example, CCE programs reached 400 teachers in 18 regions in the Domincan Republic (UNESCO, 2015) and CCE was delivered through Geography subjects in Ethiopia (Dalelo, 2011), along with programs designed to enhance climate change awareness and actions through educational interventions in several other communities (UNESCO, 2012; Vaughan et al., 2003; Ashtiany, 2005; Lotz-Sisitka, 2010). Vietnam also has applied education as an effective tool to address climate change at both a school and community level (Vo et al., 2013; MONRE, 2010; USAID, 2011). Nevertheless, many of these global educational interventions, including those in Vietnam, have not been measured to measure their effectiveness. This project established and implemented an educational intervention and measured its impact in a subsequent step, and has obtained effective results for targeted participants in the Thinh Loc community. The effectiveness of the program was measured using an evaluation phase 6-months after the intervention. It can be concluded from the research that when using any strategy to enhance climate change adaptation is always necessary to be test its effectiveness in later stages. By doing this, the researcher can determine whether the intervention has been beneficial to its targeted participants. This project contributes to enhancing climate change adaptation strategies worldwide by proposing an educational intervention which is tested in later stages.

b. The project designed an appropriate CCE curriculum for the community learners who have a lower education level in Vietnam

Reviewing climate change education in Vietnam and globally showed that, aside from adaptation strategies in relation to infrastructure and migration, education was considered as an important method for enhancing adaptive capacity (Vo et al., 2013; Mochizuki & Bryan, 2015; Anderson, 2012; Wibeck, 2014; Sharma, 2011). However, climate change education seems to have been deployed as a part of general environmental education, and there is a lack of national CCE curriculum in many countries such as the Dominican Republic, the Philippines, South Korea and Vietnam (UNESCO, 2012; UNESCO, 2015; Dalelo, 2011). The educational project deployed in the Thinh Loc community used a CCE curriculum that was designed based on local knowledge and behaviours around climate change, determined by a baseline investigation. This educational project used a visual, simple, and brief curriculum catering to residents with a low level of climate change awareness, combined with constructivist teaching methods. Together, these contributing factors resulted in a successful project. The outcome is that, by using a CCE curriculum catered to a local

context and involving teaching methods suitable for a lay audience, this program is considered as innovative at a community level, as it is developed for a variety of participants including farmers, school students, teachers, and local government staff members. Such a model is likely to be important when applied to the context of poor and developing countries which face a high risk of vulnerability to climate change impacts and are limited by lower budget spending on climate change adaptation.

c. The educational intervention identified the most beneficial targeted groups, which helps widening climate change knowledge

Results from before and after the intervention showed that the climate change education program in the Thinh Loc community helped to improve many participants' awareness of climate change and adaptive capacity to cope with it, especially in the case of secondary school students. The education project in the Thinh Loc community highlighted the school students group achieving the most benefit. This helps this group in improving their ability in coping with climate change and broadening practices to others in their community. The improvement of school students is due to the fact that they often consolidate knowledge through integrated subjects and activities related to environmental protection in schools. Furthermore, school students are at an age when they are engaged in study; this may help to foster a greater understanding and acceptance of knowledge provided in a school context (Brown, Jimerson, & Comerchero, 2015). Good teaching of climate change information results in interest in children, which in turn means knowledge may be absorbed by children for life (King & Cottrell 2007). Children may communicate with others about climate change knowledge they have obtained through the process of doing homework, projects, and explanation. The improvement of this group is a crucial to broadening the knowledge of the whole community through strong relationships with parents, relatives, friends and siblings (Dalton et al., 2002; Hoang et al., 2006).

Along with school students, teachers and local government staff members also play a crucial role in developing the adaptation process. On the one hand, local government staff members may contribute to constructing proposal policies and promoting practical measures. On the other hand, teachers become the best facilitator resource to help train and broaden knowledge and skills in the educational intervention to thousands of students through teaching and organising environmental protection and climate change adaptation.

d. Education helps to build community capacity through increasing human capital, thereby enhancing ability to adapt to climate change for community members

The literature review revealed that community capacity affects climate change adaptation capacity (Mendis et al., 2003). In the context of Vietnam, limited economic capacity and infrastructure as well as a low level of climate change awareness influence the ability of communities to adapt to climate change (Tran, 2015; Fortier, 2010; Adger, 2005). It is undoubtable that enhancing economic capital will continue to help and be required, as it will take time and finance to deal with climate change (Sharma, 2011; Shaw & Rouhban, 2005; Lutz et al., 2014). The educational intervention project undertaken in the Thinh Loc community propagated climate change knowledge and responsive actions among community members. As a result, there was an improvement in awareness and a change in behaviour among community members to address climate change that presented an increase in human capital. As a component of community capacity, an increase in human capital contributes to enhancing climate change adaption capacity for targeted community members and locals making better decisions regarding the climate change issue.

e. The project discovered gender issues in relation to climate change adaptation

Another significant contribution of the Thinh Loc community intervention is that it paid attention to the relationship between climate change adaptation and gender. The baseline survey results illustrated that female participants' awareness of climate change in the Thinh Loc community was lower than males, specifically regarding perception of climate change terms, climate change causes, and existence of climate change itself (see Chapter Four).

Although the position of Vietnamese women has improved since 1950, gender inequality remains (Oxfam, 2009). A majority of women take responsibility for domestic tasks, while men still hold much of public life (Oxfam, 2009). For example, men are responsible for finishing early during agricultural seasons, allowing them to migrate casually in order to raise finance and assert their strong position in the household. Meanwhile women keep caring for crops until harvest time, bearing and raising children, caring for other family members including parents-in- law, as well as conducting common household tasks such as collecting water, fuel wood, cooking, and looking after livestock (Oxfam 2009; Teerawichitchinan et al., 2010). Recent overviews indicated that there is a disproportionate burden of unpaid or low paid work for Vietnamese women, large salary

gaps between men and women, as well as women's occupation being restricted to the agricultural sectors. Furthermore, the number of women participating in decision-making and policy is small compared to men, while improvement in women' participation in policy and decision-making, and especially in rural Vietnamese communities is slow (Oxfam, 2009). The limitation in women in decision-making is illustrated by the following: "Women's participation in daily expenses has improved over the last decade in Hai Ba and Dai Nghia, but men make most of the final decisions on large expenses. In Avao men still male nearly all of the decisions control most of the cash income and have much greater mobility than women" (Oxfam 2009, p.28).

In many Vietnamese rural communities, climate change affects women's lives in many ways and its impact on women is worse than men (UNVN, 2009; Tran et al., 2016; Dalton et al., 2002; World Bank, 2011). Scholars show that like in other developing countries, Vietnamese women and girls are disproportionately affected by the climate change impacts, possibly due to their greater dependence on the agricultural sector (UNVN, 2009; Tran et al., 2016; Nguyen et al., 2015). In order to address climate change impacts on agriculture, migration is one livelihood strategy that many vulnerably Vietnamese households pursue to sustain their income sources and to overcome adverse welfare effects of social, economic, and institutional barriers in their hometown (Nguyen et al., 2015). However, due to gender division of labour in the household, a greater number of men migrate and have better opportunities to obtain employment off-farm than women (World Bank, 2011). For traditional agricultural tasks, men take responsibilities for ploughing, spraying pesticides, transporting and irrigating plants while women tend to do weeding, fertilizing, and selling products (Trung, 2013; World Bank, 2011). When men migrate to secure the family income, women left behind must undertake all agricultural tasks (World Bank, 2011; Trung, 2013). Aside from agricultural full-time works, a larger percentage of rural wives take responsibilities doing common household chores while a fewer number of husbands participate in domestic tasks (Teerawichitchinan et al., 2010). Furthermore, a large majority of wives deal with childcare tasks, both preschool childcare and early school age childcare, while few husbands are involved in childcare responsibilities (Teerawichitchinan et al., 2010). Moreover, women take on unexpected tasks from males such as disaster preparation or recovery during periods of male migration (World Bank, 2011). As a result, while male migration as a livelihood support strategy reduces vulnerability, it places more strain on women left behind, giving them more work in agricultural sectors, domestic tasks, as well as disaster preparation and recovery (World Bank, 2011; UNVN, 2009).

Rural Vietnamese women who have not been displaced as refugees not only experience workload due to male migration but also more severely affected by exacerbation of rainfall variability. There is evidence that a majority of women face water shortages, accessing unsafe drinking water and diseases because of more frequent floods and droughts (Ojomo & Bartram, 2016; Tuyet-Hanh et al., 2016; Trinh et al., 2013). Currently, most Vietnamese rural residents do not have access to a safe water supply. Some pilot communities have benefitted from piped water projects, but thirty percent of the population still cannot access this type of relief (World Bank, 2015). It is clear that in many parts of the world, including Vietnam, climate change has a great impact on females (Dalton et al., 2002; World Bank, 2011). Gender-related problems are clearly observed in Vietnam (Tran et al., 2016), but not many studies have analysed the climate change awareness and adaptation of rural women sufficiently.

Terry (2009) emphasised "there are powerful arguments for addressing gender issues in both these policy areas, both to prevent climate change from exacerbating existing gender inequalities, and to make sure that public policy on both curbing and adapting to climate change is as effective as possible" (p.6). Therefore, it is clear that attention to the gendered impacts of climate change is a crucial in relation to developing policy and strategies for minimizing greenhouse gas emissions as well as preparing actions to respond to climate change impacts. However, due to "gender-blindness", it is often difficult to discern the many and complex links as well as resulting barriers in policy making involved in climate change adaptation (Terry, 2009).

Acknowledging the role of gender in response to climate change, in the Thinh Loc intervention course, women were encouraged to participate in the program. Encouraging women's participation in the Thinh Loc climate change education project took advantage of the potential to broaden knowledge and the ability to address climate change through the role of the Thinh Loc Women's Association. The Women's Association in the Thinh Loc community has demonstrated its capacity to work effectively, a fact proven by its involvement in the Credit Program, the Domestic Violence Project and other activities (TLCGR, 2014). Focusing on educating women to help them adapt to climate change in the Thinh Loc community project contributes to the urgent need to integrate gender equity in adaptation responding to climate change. Several previous projects worldwide have suggested the importance of educating women in the process of climate change adaptation (Nelson, Meadows, Cannon, Morton & Martin, 2010; Dupont, 2012; Cannon, 2010; Sultana, 2011).

7.4 Limitations

The climate change intervention resulted in improvements for learners who participated in the Thinh Loc education program, and importantly, it illustrated contributions to supplement and develop the adaptation framework in a global context as discussed above. However, it cannot be denied that there are several limitations related to methodology that may affect the research results.

First, the sample used in the quantitative method was small, with 108 respondents in the pre-intervention phase, 98 in the intervention phase, and 88 in the post-intervention phase. However, accessing Thinh Loc community residents to attend the survey and education program was sometimes difficult, especially farmers. Farmers in the Thinh Loc community were always busy looking after crops and managing cattle during the daytime. At night, they were only free after 8 pm but were very tired. Furthermore, the electricity system in the Thinh Loc community was very poor; therefore, in some survey sessions, torches replaced electricity. While collecting surveys from school students and teachers was relatively straightforward, conducting a survey questionnaire with 54 farmers took much more time and effort. In the intervention phase, 17 farmers out of 98 respondents were invited to participate in the climate change education class. Compared to 58 school students, the number of farmers attending the program was much smaller. This could influence significant association analyses among occupations as well as the ability to broaden the knowledge of local residents. However, attending a three-day class without payment was a large effort from farmers. Furthermore, due to finance and timing restrictions, the researcher was not able to organize more than three climate change educational classes in the Thinh Loc community.

Another limitation that may affect the research results is that the Thinh Loc community possessed a poor system of data management resulting in difficultly accessing available data. The Thinh Loc community lacked electronic documents and books that would provide and update important data such as population, employment, poverty, history, and geography. Although the local government staff members were willing to provide population, cultural, social, economic, and other related information for the researcher, the data provided was mainly based upon local staff members' memory or note-taking. This was one of the largest obstacles at the beginning of the research. However, the researcher believed that the information provided was reliable because the researcher spent a lot of time meeting and talking to both residents and many local government staff members to verify information before designing and delivering the research.

Climate change is not a new topic, but climate change education has not emerged as an independent field (UNESCO, 2012). Climate change education has been integrated into Environment Education and Education for Sustainable Development. Climate change has been considered an infancy field and has only gradually developed since 2006 (Lessoe et al., 2009 cited UNESCO, 2012). As a result, a lack of prior research studies on climate change education was another barrier of the research, especially literature in Vietnam and Vietnamese coastal regions. Due to a lack of previous research on this topic in Vietnam, the researcher had to construct survey measures and a climate change curriculum for learners with a low educational level. The researcher had to spend a lot of time preparing the pilot survey and modifying the questionnaire. However, this limitation did not seriously affect the research results. By contrast, due to a lack of prior research, more opportunities to develop new literatures for climate change education may have been provided.

Another limitation that may influence the research result is the time restriction. As presented in Chapter Three, the project has been undertaken over a 3-year period with three phases comprising pre-intervention, intervention, and post-intervention. It should be more effective if the evaluation phase is conducted at least one year after the intervention. Therefore, the research could examine in greater depth changes in knowledge, attitude, and behaviour of the Thinh Loc community residents to mitigate and adapt to climate change within a one-year cycle. Due to deadlines for this thesis, evaluation of the climate change interventional program was implemented after 6 months. This early evaluation was unable to measure adaptive capacity of participants to cope with the upcoming flood and storm seasons. Therefore, the research was limited to examining respondents' adaptive plans to address future severe climate events rather than actual capacity and actions to deal with climate change. However, it is not known how or if this sample will pass their knowledge on to other community members. Further surveys of other community members would be necessary to check if the intervention has been propagated to others.

Furthermore, the improvement of the educational intervention program was mainly examined through participants' responses to the questionnaire and field observations 6 months after intervention. Therefore, data may not be completely reliable since the respondents could wish to satisfy the researcher although it was expected that 100% respondents would answer truly all questionnaires. If the researcher has a further opportunity to conduct further observation, the data could be further validated.

Due to the literacy levels of respondents (mainly farmers), many questionnaires took the form of face-to-face interviews. On the one hand, the face-to-face interviews could result in a higher rate of survey completion. However, this might give rise to invisible pressure for respondents while answering questionnaires. For oral administration, the researcher and her research assistant took unbiased notes on each question. However, due to the potential invisible pressure on interviewees, the information provided by face-to-face interviews might be biased, whereas self-response questionnaires could contain missing data, especially open–ended questions.

Finally, an inefficient analysis of the separation of the stakeholder groups was a limitation influencing the findings of the thesis. While the questionnaires were delivered to the same stakeholder groups including teachers, secondary school students, farmers and local government staff members, in both the baseline and the evaluation, the volunteer participation of primary school students in the evaluation could affect the reality of the findings. Further, the thesis did not carry out separate analyses for each group, thereby resulting in a lost opportunity to compare and contrast findings before presenting a combination of results. However, as discussed in Chapters Five and Six, recruiting intervention participation faced significant challenges, specifically in the farmer group. As a result, there was a significant inequality of participants among each group. Thereby, the validity of compared findings was potentially diminished. Moreover, it was expected that conducting separate analyses with a variety of indicators in both baseline and evaluation surveys would exceed the word limitation of a PhD thesis. By contrast, qualitative analyses of interviews and observations in Chapter Four and especially Chapter Six provided evidence about adopting and changing behaviour in different groups. It showed that school students and teachers were the most beneficially targeted groups with regard to changing adaptive activities. The qualitative findings helped to triangulate some insights in the quantitative findings.

7.5 Recommendation and application for practices

Despite the limitations above, this study brings recommendations and potential application for practices as below.

Climate change is happening and rural communities whose livelihoods depend on agriculture are one of the worst sufferers of the climate change (Shaw, 2006; Yu et al., 2010; Oxfam, 2009; Shrestha et al., 2016). Adaptation to climate change helps to minimize many of the severe impacts and increase resilience (Shaw, 2006; Ojomo &

Bartram, 2016; Nguyen et al., 2017; Social Republic of Vietnam, 2011). While scholars have discussed about climate change adaptation over the decades through global, national, and organizational strategy levels, adaptation at community level has been yet developed (Shaw, 2006; Jung, 2012). It can be denied that international, national, and organizational level interventions play a very important role, however, it is essetial to undertake interventions at community level to tackle climate change (Mendis et al., 2003; Shaw, 2006). Indentifying and increasing climate change adapation at community level need to follow the particluar procedure as displayed in this project, including:

- Identify and analyse impacts of climate change on the community, espically in livelihood, water security, infrastructure, natural resource, and human well-being. Through identify climate change impacts, community vulnerability is exposed, thereby, appropriate adaptive responses will be recommended and conducted based on particular vulnerability within the targeted commuity.
- Identify community resouces, including economic, social, ecological, and human capital which influence adaptive capacity to address climate chang. In many contexts, climate change adapative capacity depends on community capacity (Mendis et al., 2003). Afterwards, buidling community capacity is one of the key strategy to enhance climate change adaptation.
- Identify current level of awareness and behaviour of community members to address climate change. Obtaining local knowlegde and ability of community in response to climate change play a crucial role in directing effective interventions within community.
- Monitor and evaluate interventions. An evaluational step helps to indicate effectiveness and limitations of interventions. Thereby, further applications will be adjusted in order to enhance benificial aspects while reducing barriers in applying adaptive strategies.

In terms of potential application of the educational intervention program, it is expected that the climate change education program for Thinh Loc community residents could be applied to other regions in Vietnam and across the world. According to Shaw (2006), the coastal central region of Vietnam includes 14 provinces with a population of around 18 million (2001). These provinces have faced adverse climatic hazards comprising typhoons, floods, storms, droughts, and bush fires (Shaw, 2006). Climate change has led to these hazards becoming worse recently, especially in the coastal zone (Shaw,

2006). Thinh Loc community is an example of a coastal community[8], which has suffered from impacts of climate change, has a low level of education and economic conditions, as well as inefficient knowledge of climate change and the adaptive capacity to cope with it. The climate change education program can be applied in the following ways:

a. At the primary school level: The program is recommended to be delivered to students who are in Grade 3, Grade 4 and Grade 5, while Grade 1 and Grade 2 students should only acquire climate change information through integral subjects. For primary school students, the program focuses on basic climate change, causes of climate change, as well as climate change mitigation and adaptation. The head teachers of classes need to be trained because afterwards they will be responsible for running their own climate change education classes. The course needs to combine a variety of teaching and studying methods such as games, group work, drawing, competitions, and presentations and so on. All teaching materials including the climate change curriculum and videos should be delivered to primary students.
b. At the secondary school level: For secondary school students, it is suggested that the program be delivered to all students from Grade 6 to Grade 9. A head teacher of each class should be trained to take responsibility for delivering the program to their students. Similar to primary school students, the course needs to combine a variety of teaching and studying methods such as games, group work, drawing, competitions, presentations, and performances. Alike the program used for primary school students, all teaching materials including climate change curriculum and videos should be delivered to all secondary students. For both primary and secondary school students, the course should be undertaken as an extra subject that would be organized after school time.
c. At the community level: For community residents, it is necessary that the program be delivered to all coastal residents who are impacted by climatic hazards and climate change. The Women's Association Organization in the commune-government level is the best organization, which takes a responsibility for delivering the program to all residents. As discussed, among many commune government organizations such as Youth Association, Elderly Association, Farmer Association etc., the Women's Association undertakes their activities more often and more beneficially than others do. Furthermore, children, disabled

[8] Vietnam has 64 provinces. Each province consists several districts. Each district consists of several communes like Thinh Loc community. The commune population may vary from 3000 to around 20000 residents. Each commune has several villages; usually from four to 10 communes has its own government structure and it is Peoples' Committee, which reports to the district level government (Shaw, 2006).

people, elderly people, and women were identified as vulnerable to climate hazards in the Thinh Loc community. Therefore, the Women Association staff members should be the best facilitators to deliver the climate change educational program to households. The courses should be undertaken after harvest time (recommended from July until August each year) and at night-time if possible. For local residents, the program should focus on: predictions and warnings about climate change, especially in the coastal region; explanation of human activity which causes climate change; the solutions for climate change mitigation; and possible strategies to cope with severe heat, storms, floods, and sea level rise. With regard to teaching strategies, the program should use constructivist methods such as group discussions, and individual and group presentations and games.

d. At the international level: It is suggested that the climate change education program be applied in other similar regions which have poor economies, low education levels, and agricultural livelihoods as well as along coastline such as Africa, South East Asia, and South Asia with small adjustments for the local environments and local people's knowledge.

In conclusion, the literature review shows several strategies to help people cope with climate change. However, education has been considered a key to improve the human ability to address not only climate change but also other global issues. The climate change educational program achieved positive results in the Thinh Loc community. It is possible to suggest that the primary schools, secondary schools, and the Commune Women's Associations are the most appropriate organizations to conduct the climate change educational programs to coastal residents along the Central Vietnamese region. The curriculum, methods, and goals of the Thinh Loc community education program are suitable to enhance awareness and adaptive capacity for coastal community residents in Vietnam. Therefore, although facing unavoidable limitations in methodology, the climate change educational project in the Thinh Loc community can be successfully duplicated in other communities in order to meet the requirements for adapting to climate change in Vietnamese coastal areas and other coastal regions in Africa, South East Asia, and South Asia.

7.6 Direction of further research

Climate change education is still a young field, especially in Vietnam, which has sustained impacts of climate change. However, this would open both opportunities and

responsibilities for researchers, teachers, policy makers, and environmental practice professionals to fill gaps in the knowledge of climate change issues across the world. It is clear that the Thinh Loc climate change educational program, which was undertaken in a pre-intervention, intervention, and post- intervention sequence, has brought benefits for local residents in improving their knowledge and adaptive capacity to address climate change. However, limitations were unavoidable. These research limitations will direct further studies.

Further possible research questions include:

- Does the climate change education need to be conducted in different regions such as mountainous and urban areas in order to enhance awareness and adaptive capacity to cope with climate change?
- Which is the best theoretical framework to use in conducting climate change education?
- Which is the most effective way to implement climate change education?
- To which age groups or occupations should a climate change educational program be delivered for maximum community benefits?
- Which are the best measures to identify and evaluate awareness and behaviour of respondents to cope with climate change?
- Is it better to conduct the cooperation project between locals and researchers rather than the independent project in order to enhance knowledge and adaptive capacity for residents to cope with climate change?

The further research questions above may widen the scope of new research approaches. As a result, new climate change educational projects might obtain more advantages and reduce limitations of the Thinh Loc project. The studies will then fill the knowledge gap and contribute to solving one of the most serious global issues: climate change.

7.7 Conclusion

This project to enhance awareness and adaptive capacity to cope with climate change in the Thinh Loc community was undertaken over a three-year period through three phases comprising pre intervention, intervention, and e post intervention. The project identified a low level of climate change knowledge from local residents, and then delivered a climate change educational program in order to meet the need of residents in mitigating and adapting to it. Six months after conducting the intervention, there was

an improvement in awareness and a change in behaviour of local residents to mitigate and adapt to climate change. The climate change educational program was delivered to four types of demographics, comprising farmers, school students, teachers, and local government staff members. It was expected to be duplicated to almost all Thinh Loc community locals as well as to other similar communities through training and transferring teaching documents to facilitators.

The project contributed to filling the gap of knowledge in order to create more solutions for the climate change issue. The study provided reliable information about climate change education field, both theoretical and practical. Although there were some limitations of methodology, the study was based upon the logical research design of three steps: baseline phase, intervention phase, and evaluation phase. Improvement in awareness and actions of participants was suggested by comparing and contrasting the results before and after conducting the intervention. Furthermore, combining quantitative and qualitative methods in research helped to improve reliability and contributed to reducing limitations of the research by triangulating results. The study also directed new opportunities for further research in similar communities in developing countries. Finally, the success of the project contributed to strengthening framework of climate change adaptation in a vulnerable, climate change impacted community. In other words, education is an important strategy to address climate change in venerable small communities.

REFERENCE

Abery, W. N., Nguyen, V. H., Nguyen, V. H., Truong. H. M., Nguyen, T. P., Jumnongsong, .S, ... De Silva, S. S. (2009). *Perception of climate change impacts and adaptation of shrimp farming in Ca Mau and Bac Lieu, Vietnam: Farmer focus group discussions and stakeholder workshop report*. Retrieved from www.library.enaca.org/emerging_issues/climate_change/2010/aquaclimate-report-2010-annex10.pdf

ActionAid. (2013). *ActionAid program in Ha Tinh: 17 years of development*. Retrieved from http://www.actionaid.org/sites/files/actionaid/ky_yeu_chuong_trinh_actionaid_tai_ha_tinh.pdf

Adger, W. N. (1999). Social vulnerability to climate change and extremes in coastal Vietnam. *World Development, 27*(2), 249-269. doi:10.1016/S0305-750X(98)00136-3

Adger, W. N. (2003). Social capital, collective action, and adaptation to climate change. *Economic Geography, 79*(4), 387– 404.

Adger, W. N., Arnell, W. N., & Tompkins, L. E. (2005). Successful adaptation to climate change across scales. *Global Environmental Change, 15*(2), 77-86. doi: 10.1016/j.gloenvcha.2004.12.005.

Adger, W. N., Huq, S., Brown, K., Conway, D., & Hulme, M. (2003). Adaptation to climate change in the developing world. *Progress in Development Studies, 3*(3), 179–195.

Adger, W.N., N. Brooks, G. Bentham, M. Agnew, S. Eriksen. (2004). New Indicators of Vulnerability and Adaptive Capacity. *Tyndall Centre for Climate Research, Technical Report Number 7*, Tyndall, UK. Retrieved from www.researchgate.net/publication/257343107_New_Indicators_of_Vulnerability_and_Adaptive_Capacity

AONTAS (The Irish National Association of Adult Education. (2004). Community education 2004. Retrieved from: http://www.aontas.com/pubsandlinks/publications/community-education-2004/

Akpomi, M. E., & Vipene, J. (2016). Promoting Knowledge of Climate Change (CC) amongst Nigerians: Implications for Education Managers. *Journal of Education and Practice, 7*(32), 132-138. Retrieved from www.iiste.org/Journals/index.php/JEP/article/view/34113

Amanchukwu, R. N., Amadi-Ali, T. G., & Ololube, N. P. (2015). Climate Change Education in Nigeria: The Role of Curriculum Review. *Education, 5*(3), 71-79. doi: 10.5923/j.edu.20150503.01

Anbumozhi, V., Breiling, M., Pathmarajah, S., & Reddy, R. V. (Eds). (2012). *Climate change in Asia and the Pacific: How can countries Adapt?* India, USA, UK: SAGE.

Anderson, A. (2012). Climate Change Education for Mitigation and Adaptation. *Journal of Education for Sustainable Development, 6(2),* 191-206. doi: 10.1177/0973408212475199

Antwi-Agyei, P., Fraser, E. D., Dougill, A. J., Stringer, L.C., & Simelton, E. (2012). Mapping the vulnerability of crop production to drought in Ghana using rainfall, yield and socioeconomic data. *Applied Geography, 32*(2), 324–334. doi: 10.1016/j.apgeog.2011.06.010

Arouri, M., Nguyen, C., & Ben Youssef, A. (2015). Natural disasters, household welfare, and resilience: Evidence from rural Vietnam. *World Development, 70*, 59-77. doi:10.1016/j.worlddev.2014.12.017

Arpino, B., & Aassve, A. (2014). The role of villages in households' poverty exit: Evidence from a multilevel model for rural Vietnam. *Quality & Quantity, 48*(4), 2175-2189. doi:10.1007/s11135-013-9885-6

Ashtiany, M. G. (2005). *Educational aspects of disaster management*. Paper presented at the World Conference on Disaster: Reduction Proceeding of the Thematic session on Education for sustainable development, Japan. Retrieved from www.unesdoc.unesco.org/images/0015/001590/159067eo.pdf

Babel, M. S., & Turyatunga, E. (2014). Evaluation of climate change impacts and adaptation measures for maize cultivation in the western Uganda agro-ecological zone. *Theoretical and Applied Climatology, 119*(1), 239-254. doi:10.1007/s00704-014-1097-z

Bangay, C., & Blum, N. (2010). Education Responses to Climate Change and Quality: Two Parts of the Same Agenda? *International Journal of Educational Development, 30*(4); 335-450.

Beniston, M. (2010). Climate change and its impacts: Growing stress factors for human societies. *International Review of the Red Cross, 92*(879), 557-568. doi:10.1017/S1816383110000342

Berg, B. L. (2007). *Qualitative Research Methods for the Social Sciences* (6th ed.). United States of America: Pearson Education, Inc.

Bernard, H. R. (2000). *Social research methods: Qualitative and quantitative approaches*. California, London, & New Delhi: Sage Publications, Inc.

Bernard, H. R. (2013). *Social research methods: qualitative and quantitative approaches* (Second Ed). United States of America: Vicki Knight.

Best, S. (2012). *Understanding & Doing successful research: Data collection and analysis for the social science.* England: Pearson Education Limited.

Biesbroek, G., Termeer, C., Klostermann, J., & Kabat, P. (2013) On the nature of barriers to climate change adaptation. Regional Environmental Change*, 13*(5), 1119–1129. doi:10.1007/s10113-013-0421-y

Boateng, I. (2012). GIS assessment of coastal vulnerability to climate change and coastal adaption planning in Vietnam. *Journal of Coastal Conservation, 16* (1), 25-36. doi:10.1007/s11852-011-0165-0

Boateng, I. (2009). *Spatial planning and climate change adaption in coastal regions: the case of Vietnam.* Paper presented at the 7th Regional Conference 2009, Spatial Data Serving People: Land Governance and the Environment - Building the Capacity, Hanoi, Vietnam. Retrieved from www.fig.net/resources/proceedings/fig_proceedings/vietnam/papers/ts04d/ts04d_boateng_3574.pdf

Bonifacio, A. C., Takeuchi, Y., & Shaw, R. (2010). Mainstreaming climate change adaptation and disaster risk reduction through school education: Perspectives and challenges. *Community, Environment and Disaster Risk Management, 4*, 143-169. doi: 10.1108/S2040-7262(2010)0000004013

Bowles, S., & Gintis, H. (2002). Social capital and community governance. *The Economic Journal, 112*(483), 419-436. doi:10.1111/1468-0297.00077

Brounwer, R., Akter, S., Brander, L., & Haque, E. (2007). Socioeconomic vulnerability and adaptation to environment risk: a case study of climate change and flooding in Bangladesh. Journal of Risk Analysis, 27(2), 313-326. doi: 10.1111/j.1539-6924.2007.00884.x

Brown, J.A., Jimerson, S.R. & Comerchero, V.A. (2015). Cognitive Development Considerations to Support Bereaved Students: Practical Applications for School Psychologists. *Contemporary School Psychology, 19*(3), 103–111. doi: 10.1007/s40688-014-0018-6

Brown, S., Grais, A., Ambagis, S., & Pearson, T. (2012). Agricultural GHGs in East and West Africa: Baseline Emissions and Mitigation Potential. Working paper No.13. Consultative Group on International Agricultural Research, Montpellier. Retrieved from

https://assets.publishing.service.gov.uk/media/57a08a8ced915d3cfd00080c/ccafs-wp-13-baseline_ghg_ag-web.pdf

Brown, T. J., Hall, B. L., & Westerling, A. L. (2004). The Impact of Twenty-First Century Climate Change on Wildland Fire Danger in the Western United States: An Applications Perspective. *Journal of Climatic Change, 62*(1), 365-388. doi:10.1023/B:CLIM.0000013680.07783.de

Bruce, S., Richard, W., & Jill, C. (2015, November 5). Global concern about climate change, broad support for limiting emissions. Retrieved from http://www.climateaccess.org/sites/default/files/Pew_climate%20change%20report%20.pdf

Bruun, O., & Casse, T. (2013). *On the Frontiers of Climate and Environmental Change*. Berlin: Springer Berlin Heidelberg. Retrieved from http://link.springer.com/book/10.1007%2F978-3-642-35804-3

Bryman, A. (1988). *Quantity and quality in Social Research*. London, Boston, Sydney, & Wellington: Unwin Hyman Ltd.

Bryman, A. (2001). *Social Research*. Oxford: Oxford University Press.

Bryman, A. (2008). *Social Research Methods* (3rd Ed). Oxford: Oxford University Press.

Bunce, A., Ford, J., Harper, S., Edge, V., IHACC Res Team, & IHACC Research Team. (2016). Vulnerability and adaptive capacity of Inuit women to climate change: A case study from Iqaluit, Nunavut. *Natural Hazards, 83*(3), 1419-1441. doi:10.1007/s11069-016-2398-6

Burns, B. R. (2000). *Introduction to research method.* Sydney, NSW, Pearson Education Australia.

Cannon, T. (2010). Gender and climate change hazards in Bangladesh. *Gender & Development, 10*(2), 45-50. doi: 10.1080/13552070215906

Chinowsky, P. S., Schweikert, A. E., Strzepek, N., & Strzepek, K. (2015). Road infrastructure and climate change in Vietnam. *Sustainability, 7*(5), 5452-5470. doi:10.3390/su7055452

Cohen, L., & Manion, L. (1980). *Research Methods in Education*. Great Britain: British Library.

Collier, P., Conway, G., & Venables, T. (2008). Climate change and Africa. *Oxford Review of Economic Policy, 24*(2): 337-353. doi: 10.1093/oxrep/grn019

Cutler, D. M., & Lleras-Muney, A. (2010). Understanding differences in health behaviours by education. *Journal of Health Economics, 29*(1), 1–28. doi: 10.1016/j.jhealeco.2009.10.003

Creswell, W., J. (2014). Research Design. Retrieved from file:///C:/Users/taisw/Desktop/David%20&%20Helen%20Submision/Creswell-ResearchDesign.pdf

Dalelo, A. (2011). Global climate change in geography curricula for Ethiopian secondary and preparatory schools, *International research in Geographical and Environmental Education, 2*(3), 227-246.

Dalton, R., Ong, N., Minh Hac, P., & Thanh Nghi, P. (2002). Social relations and social capital in Vietnam: Findings from the 2001 world values survey. *Comparative Sociology, 1*(3-4), 369-386. doi:10.1163/156913302100418646

Dang, H. (2014). *Adaptation to Climate Change: The Attitude and Behaviour of Rice Farmers in the Mekong Delta, Vietnam*. PhD thesis, The University of Adelaide, Australia.

Dang, H., Li, E., Nuberg, I., & Bruwer, J. (2014). Farmers' assessments of private adaptive measures to climate change and influential factors: A study in the Mekong Delta, Vietnam. *Natural Hazards, 71*(1), 385-401. doi:10.1007/s11069-013-0931-4.

Dang, H., Li, E., Nuberg, I., & Bruwer, J. (2014). Farmers' perceived risks of climate change and influencing factors: A study in the Mekong delta, Vietnam. *Environmental Management*, *54*(2), 331-345. doi:10.1007/s00267-014-0299-6

Dankelman, I. (Ed). (2010). *Gender and Climate change: An introduction*. London, Sterling & VA: Earthscan.

Deb, P., Tran, D. A., & Udmale, P. D. (2016). Assessment of the impacts of climate change and brackish irrigation water on rice productivity and evaluation of adaptation measures in Ca Mau province, Vietnam. *Theoretical and Applied Climatology, 125*(3), 641-656. doi:10.1007/s00704-015-1525-8

Denton, F. (2010). Climate change vulnerability, impacts, and adaptation: Why does gender matter? *Gender and Development, 10*(2), 10-20. doi: 10.1080/13552070215903

Depaepe, M., & Smeyers, P. (2008). Educationalization as an ongoing modernization process. *Educational theory, 58*(4), 379-389.

Department of Planning and Investment Ha Tinh province. (2011). *Natural conditions in Ha Tinh province*. Retrieved from http://dpihatinh.gov.vn/?url=detail&id=555&language=1

Dharmarathna, W R. S. S, Herath, S., & Weerakoon, S. B. (2014). Changing the planting date as a climate change adaptation strategy for rice production in

Kurunegala district, Sri Lanka. *Sustainability Science, 9*(1), 103-111. doi:10.1007/s11625-012-0192-2

Dimento, J. F. C., & Doughman, P. (Eds). (2007). *Climate change: What it means for Us, Our children, and our grandchildren*. London, England: The MIT press.

Doss, C. R. (2002). Men's crops? Women's crops? The gender patterns of cropping in Ghana. *World Development, 30*(11), 1987-2000. doi:10.1016/S0305-750X(02)00109-2

Dupont, C. (2012). Gender and climate change: An introduction. *Global Environmental Politics, 12*(1), 128-129. doi:10.1162/GLEP_r_00103

EPA [United Stated Environmental Protection Agency]. (2015). *Overview of greenhouse gases*. Retrieved March 7, 2015, from https://www.epa.gov/ghgemissions/overview-greenhouse-gases

FAO [Food and Agriculture Organization]. (2016). *Integrating Agriculture in National Adaptation Plans NAP-Ag: Vietnam*. Retrieved from http://www.fao.org/documents/card/en/c/c4b55105-664b-42ea-8df6-3e94a1c4c6b3/

FAO. (2011). *Climate Change Impacts on Agriculture in Vietnam: Strengthening Capacities to Enhance Coordinated and Integrated Disaster Risk Reduction Actions and Adaptation to Climate Change in Agriculture in the Northern Mountain Regions of Viet Nam*. Retrieved from http://www.fao.org/climatechange/34068-0d42acdf5fb7c4d80f3013c038ab92ce6.pdf

Fendler, L. (2008). New and improved educationalising: Faster, more powerful and longer lasting. *Ethics and Education, 3*(1), 15-26. doi:10.1080/17449640802018701

Few, R., & Tran, P. G. (2010). Climatic hazards, health risk and response in Vietnam: Case studies on social dimensions of vulnerability. *Global Environmental Change, 20*(3), 529-538. doi:10.1016/j.gloenvcha.2010.02.004

Few, R., Pham, G., & Bui, T. (2004). *Living with floods: health risks and coping strategies of the urban poor in Vietnam*. Research Report, University of East Anglia, Norwich, UK

Ford, D.J., Lea Berrang, L., & Paterson, J. (2011). A systematic review of observed climate change adaptation in developed nations. *Climatic Change, 106*(2), 327–336. doi: 10.1007/s10584-011-0045-5.

Forrest, S., Feder, M. A., National Research Council (U.S.). Board on Science Education, National Research Council (U.S.). Committee on the Human

Dimensions of Global Change, National Research Council (U.S.). Division of Behavioral and Social Sciences and Education, & National Research Council (U.S.). Division on Earth and Life Studies. (2011). *Climate change education: Goals, audiences, and strategies: A workshop summary*. Washington, D.C: National Academies Press. Retrieved from http://ebookcentral.proquest.com.elibrary.jcu.edu.au/lib/jcu/detail.action?docID=3378927

Fortier, F. (2010). Taking a climate chance: A procedural critique of Vietnam's climate change strategy, *Asia Pacific Viewpoint, 51*(3), 229–247.

Gardner, G. T., & Stern, P. C. (2008). *The short list: The most effective actions U.S. households can take to curb climate change*. Washington: Heldref. doi:10.3200/ENVT.50.5.12-25

GFDRR. (2011). *Vulnerability, risk reduction and adaptation to climate change Vietnam*. Retrieved from http://sdwebx.worldbank.org/climateportalb/doc/GFDRRCountryProfiles/wb_gfdrr_climate_change_country_profile_for_VNM.pdf

Glavovic, B. C. (2015). *On the frontline in the Anthropocene: adapting to climate change through deliberative coastal governance*. Retrieved from http://www.crcnetbase.com/doi/abs/10.1201/b18053-5

Goh, A. (2012). A literature review of the gender-differentiated impacts of climate change on women's and men's assets and well-being in developing countries (CAPRi Working Paper No. 106. Washington, DC: CGIAR System wide Program on Collective Action and Property Rights (CAPRi). Retrieved from http://www.capri.cgiar.org/wp/capriwp106.Asp

Giorgi, A & Giorgi, B. (2003). *Phenomenology* In: Smith JA, editor. Qualitative psychology. London: Sage

Government of India. (2009). India's National Capacity Needs Self-assessment Report and Action Plan. Retrieved from http://www.undp.org/mainstreaming/docs/ncsa/ncsa-reports/finalreportsandplan/ncsa-india-fr-ap.pdf

H. Djoudi & M. Brockhaus. (2011). Is adaptation to climate change gender neutral? Lessons from communities dependent on livestock and forests in northern Mali. *International Forestry Review, 13*(2011), 123–135.

Halady, I., & Rao, P. (2009). Does awareness to climate change lead to behavioural change? *International Journal of Climate Change Strategies and Management, 2*(1), 6-22.

Hamin, E., Gurran, N. (2015). Climbing the Adaptation Planning Ladder: Barriers and Enablers in Municipal Planning. In Walter Leal Filho (Eds.), *Handbook of Climate Change Adaptation*, (pp. 839-860). Berlin: Springer-Verlag.

Healey, J. (2009). The changing climate, *Issues in society*, 290. N.S.W: The spinney press.

Hien, H. N., Hoang, B. H., Huong, T. T., Than, T. T., Ha, P. T. T., Toan, T. D., & Son, N. M. (2016). Study of the climate change impacts on water quality in the upstream portion of the Cau river basin, Vietnam. *Environmental Modeling & Assessment, 21*(2), 261-277. doi:10.1007/s10666-015-9476-0

Hoa, N. T., Hasegawa, T., & Matsuoka, Y. (2012, 2014). Climate change mitigation strategies in agriculture, forestry and other land use sectors in Vietnam. *Mitigation and Adaptation Strategies for Global Change, 19*(1), 15-32. doi:10.1007/s11027-012-9424-0

Hoang, L. A., Castella, J., & Novosad, P. (2006). Social networks and information access: Implications for agricultural extension in a rice farming community in northern Vietnam. *Agriculture and Human Values, 23*(4), 513-527. doi:10.1007/s10460-006-9013-5

Hoffmann, R., & Muttarak, R. (2017). Learn from the past, prepare for the future: Impacts of education and experience on disaster preparedness in the Philippines and Thailand. *World Development, 96*, 32–51. doi: org/10.1016/j.worlddev.2017.02.016

Howlett, C, Ferreira, J & Blomfield, J. (2016). Teaching sustainable development in higher education: Building critical, reflective thinkers through an interdisciplinary approach. *International Journal of Sustainability in Higher Education, 17*(3), 305-321. doi: 10.1108/IJSHE-07-2014-0102

Hsieh, H. F., & Shannon, S. E. (2005). Three approaches to qualitative content analysis. *Qualitative Health Research, 15*(9), 1277-1288. doi: 10.1177/1049732305276687

Huan, N. H., Thiet, L. V., Chien, H. V., & Heong, K. L. (2005). Farmers' participatory evaluation of reducing pesticides, fertilizers and seed rates in rice farming in the Mekong delta, Vietnam. *Crop Protection, 24*(5), 457-464. doi:10.1016/j.cropro.2004.09.013

Hulme, M. (2002). *What is adaptation?* personal-communication. Norwich, UK, Tyndall Centre for Climate Research, University of East Anglia.

Huong, H. T. L., & Pathirana, A. (2013). Urbanization and climate change impacts on future urban flooding in Can Tho city, Vietnam. *Hydrology and Earth System Sciences, 17*(1), 379-394. doi:10.5194/hess-17-379-2013

Iizumi, T., Yokozawa, M., & Nishimori, M. (2011). Probabilistic evaluation of climate change impacts on paddy rice productivity in Japan. *Climatic Change, 107*(3), 391-415. doi:10.1007/s10584-010-9990-7

IMHEN [Vietnam Institute of Meteorology, Hydrology and Climate Change]. (2010). *Climate change and impacts in Vietnam*. Retrieved July 1, 2014, from http://www.imh.ac.vn/home/search.aspx?q=Bien+doi+khi+hau+va+tac+dong+o+vietnam

International Labor Organization. (2011). *Vietnam Employment Trends 2010*. Retrieved from http://www.ilo.org/wcmsp5/groups/public/---asia/---ro-bangkok/---ilo-hanoi/documents/publication/wcms_151318.pdf

IPCC. (2007). Climate Change 2007: Impacts, Adaptation and Vulnerability. *Working Group II Contribution to the Intergovernmental Panel on Climate Change Fourth Assessment Report*. Retrieved from http://www.meteotrentino.it/clima/pdf/rapporti_meteo/IPCC_Impacts_Adaptation_and_Vulnerability.pdf

IPCC. (2014). *Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change.* Retrieved from https://www.ipcc.ch/report/ar5/syr/

ISDR [International Strategy for Disaster Reduction]. (2008). *Climate change and Disaster Risk Reduction*. Retrieved from http://www.unisdr.org/files/4146_ClimateChangeDRR.pdf

ISPONRE [Institute of Strategy and Policy on Natural Resources and Environment]. (2009). *Vietnam assessment report on climate change.* Retrieved July 2, 2014, from http://www.unep.org/pdf/dtie/VTN_ASS_REP_CC.pdf

JICA [Japan International Cooperation Agency]. (2014). *JICA's Support for Climate Change Adaptation in Indonesia*. Retrieved from https://unfccc.int/files/adaptation/application/pdf/jica_sato_chiro_on_indonesia.pdf

Jost, C., Kyazze, F., Naab, J., Neelormi, S., Kinyangi, J., Zougmore, R.… Kristjanson, P. (2016). Understanding gender dimensions of agriculture and climate change in smallholder farming communities. *Climate and Development, 8*(2), 133–144. doi: 10.1080/17565529.2015.1050978

Jung, T. (2012). Review of the Economics of Climate Change on Southeast Asia. In Anbumozhi, V., Breiling, M., Pathmarajah, S., & Reddy, R. V. (Eds), *Climate change in Asia and the Pacific: How can countries Adapt?* (pp. 9-16). India, the USA, the UK: Sage.

Kagawa, F., Selby, D. (Eds). (2010). *Education and Climate Change: Living and Learning in Interesting Times*. New York: Routledge.

Kais, S., & Islam, M. (2016). Community capitals as community resilience to climate change: Conceptual connections. *International Journal of Environmental Research and Public Health, 13*(12), 1211. doi:10.3390/ijerph13121211

Kakota, T., Nyariki, D., Mkwambisi, D., & Kogi-Makau, W. (2011). Gender vulnerability to climate variability and food insecurity. *Climate and Development, 3*, 298–309.

Kang, W., & Imai, K. S. (2012). Pro-poor growth, poverty and inequality in rural Vietnam. *Journal of Asian Economics, 23*(5), 527-539. doi:10.1016/j.asieco.2012.04.004

Kawata, Y. (2005). *Transfer Live Lessons of Catastrophic Disaster*. Paper presented at the World conference on disaster reduction: Proceedings of the thematic session on education for sustainable development, Japan. Retrieved from http://unesdoc.unesco.org/images/0015/001590/159067eo.pdf

Keil, A., Zeller, M., Wida, A., Sanim, B., & Birner, R. (2008). What determines farmers' resilience towards ENSO-related drought? An empirical assessment in central Sulawesi, Indonesia. *Climatic Change, 86*(3), 291-307. doi:10.1007/s10584-007-9326-4

Kerr, R. A. (2007). Climate change. Global warming is changing the world. *Science (New York, N.Y.), 316*(5822), 188-190. doi:10.1126/science.316.5822.188

Kevane, M. (2012). Gendered production and consumption in rural Africa. *Proceedings of the National Academy of Sciences of the United States of America, 109*(31), 12350-12355. doi:10.1073/pnas.1003162108

King, D., & Cottrell, A. (Eds). (2007). *Community living with hazards. Queensland, Australia*. Centre for Disaster studies, James Cook University.

Know Climate. (2017, 38). Retrieved from http://know.climateofconcern.org/index.php?option=com_content&task=article&id=70

Kwon, S., Heflin, C., & Ruef, M. (2013). Community social capital and entrepreneurship. *American Sociological Review, 78*(6), 980-1008. doi:10.1177/0003122413506440

Lam, S., Tran, B., & Le, N. (2006). *Livelihood, vulnerability and local adaptation strategies to natural disasters in Huong river basin*. Retrieved May 6, 2014, from http://webcache.googleusercontent.com/search?q=cache:Wu3gPhAtYHAJ:www.nlcap.net/fileadmin/NCAP/Countries/Vietnam/032135.0503xx.VN.CON-01.Output6.v1.pdf+&cd=1&hl=en&ct=clnk&gl=vn

Lasco, R., Pulhin, J., Cruz, R., Pulhin, F., Roy, S., Boer, R… Parhan, A. (2006). *An Integrated Assessment of Climate Change Impacts, Adaptations and Vulnerability in Watershed Areas and Communities in Southeast Asia*. Retrieved from http://sedac.ciesin.columbia.edu/aiacc/progress/AS21_Jan04.pdf

Leiserowitz, A. (2007). *Human development report 2007/2008: International public opinion, perception and understanding of global climate change*. Retrieved May 9, 2014 from https://core.ac.uk/download/pdf/6248846.pdf

Levina, E., & Tirpak, D. (2006). *Adaptation to climate change: Key terms.* Retrieved May 9, 2014, from http://www.oecd.org/env/cc/36736773.pdf

Levistion, Z., & Walker, I. (2011). *Second annual survey of Australian attitudes to climate change: Interim report.* Retrieved from https://publications.csiro.au/rpr/download?pid=csiro:EP116224&dsid=DS2

Loc Ha Government Report. (2010). Ha Tinh.

Locatelli, B., Pavageau, C., Pramova, E., & Di Gregorio, M. (2015). Integrating climate change mitigation and adaptation in agriculture and forestry: Opportunities and trade-offs. Wiley Interdisciplinary Reviews: *Climate Change, 6*(6), 585-598. doi:10.1002/wcc.357

Lope-Alzina, D. G. (2007). Gendered production spaces and crop varietal selection: case study in Yucatán, Mexico. *Singapore Journal of Tropical Geography 28* (1), 21–38.

Lotz-Sisitka, H. (2010). Education and Climate Change: Living and Learning in Interesting Times. In F. Kagawa & D. Selby (Eds), *Climate Injustice: How should education respond?* (pp. 71-88). New York: Routledge.

Lucia-Casademunt, A. M., Ariza-Montes, J. A., & Morales-Gutiérrez, A. C. (2013). Determinants of occupational well-being among executive women/Determinates del bienestar laboral entre mujeres directivas. *Academia, 26*(2), 229.

Luo, Y., Jiang, Y., Peng, S., Cui, Y., Khan, S., Li, Y., & Wang, W. (2013). Hindcasting the effects of climate change on rice yields, irrigation requirements, and water

productivity. *Paddy and Water Environment, 13*(1), 81-89. doi:10.1007/s10333-013-0409-8

Lutz, W., Muttarak, R., & Striessnig, E. (2014). Universal education is key to enhanced climate change adaptation. *Science, 346*(6213), 1061-1062. doi: 10.1126/science.1257975.

Maddison, D. (2007). *The perception of and adaptation to climate change in Africa*. Retrieved from http://documents.worldbank.org/curated/en/479641468193774164/pdf/wps4308.pdf

Marshall, N. A., Park, S., Howden, S. M., Dowd, A. B., & Jakku, E. S. (2013). Climate change awareness is associated with enhanced adaptive capacity. *Agricultural Systems, 117*, 30-34. doi:10.1016/j.agsy.2013.01.003

Mcdaniels, T., Axelrod, L., Slovic, P. (1996). Perceived ecological risks of global change 1A psychometric comparison of causes and consequences. *Global Environmental Change, 6*(2), 159-171. doi:10.1016/0959-3780(96)00006-4

McLeman, R., & Smit, B. (2006). Migration as an adaptation to climate change. *Journal of Climatic Change*, *76*(1-2), 31-53. doi: 10.1007/s10584-005-9000-7

McLoghlin, L. (2004). *The role of community education in developing environmentally sustainable cities.* Retrieved August 1, 2014, from https://www.google.com.au/#q=the+role+of+community+education+in+developing+environmentally+sustainable+cities.

McNamara, K. E. (2013). Raising awareness about climate change in pacific communities. *Environmental Education Research, 19*(6), 864-871. doi:10.1080/13504622.2013.769046

Melnychuk, D. O.; Pidlisnyuk, V. V., & Stefanovska, T. R. (2003*). Key Questions about Sustainable Development: What Everyone Needs to Know?* Kyiv: Hopak Publisher House.

Mendis, S., Mills, S., & Yantz, J. (2003). *Building community adaptive to adapt to climate change in resource-based communities*. Retrieved from http://www.climateaccess.org/sites/default/files/Mendis_Building%20Community%20Capacity.pdf

Miller, R. L., Acton, C., Fullerton, D. A., & Maltby, J. (2002). *SPSS for social scientists*. Great Britain: Palgrave Macmillan.

MOARD [Ministry of Agriculture and Rural Development]. (2008). *Action Plan Framework for Adaptation and Mitigation of Climate Change of the Agriculture and Rural Development Sector Period 2008-2020*. Retrieved from

http://theredddesk.org/sites/default/files/10517_actionplanframeworkadaptationmitiga.pdf

Mochizuki, Y., Bryan, A. (2015). Climate change education in the content of education for sustainable development: rationale and principles. *Journal of Education for Sustainable development, 9*(1), 4-26.

MOET [Ministry of Education and Training Vietnam]. (2012). *Teaching manual on climate change education.* Retrieved July 7, 2015, from http://www.livelearn.org/resources/teacher-manual-climate-change-education

MONRE [Ministry of Natural Resource and Environment]. (2008). *National targeted program respond to climate change*. Hanoi: MONRE.

MONRE. (2010). *Vietnam's second national communication to the United Nations Framework Convention on Climate Change*. Retrieved 23 March, 2017 from http://www4.unfccc.int/ndcregistry/PublishedDocuments/Viet%20Nam%20First/VIETNAM'S%20INDC.pdf

MONRE. (2016). *Climate change and sea level rise scenario for Vietnam*. Retrieved from http://www.imh.ac.vn/files/doc/KichbanBDKH/CCS_SPM_2016.pdf

Moser, S. C., Kasperson, R. E., Yohe, G., & Agyeman, J. (2008). Adaptation to climate change in the northeast united states: Opportunities, processes, constraints. *Mitigation and Adaptation Strategies for Global Change, 13*(5), 643-659. doi:10.1007/s11027-007-9132-3

Muller A, Jawtusch J and Gattinger A. (2011). *Mitigating greenhouse gases in Agriculture. A challenge and opportunity for agricultural policies. Germany*. Retrieved from http://www.brot-fuer-die-welt.de/downloads/fachinformationen/greenhouse-gases.pdf

Muttarak, R. & Lutz, W. (2014). Is education a key to reducing vulnerability to natural disasters and hence unavoidable climate change? *Ecology and Society, 19*(1), 42. doi: 10.5751/ES-06476-190142.

Nair, S. (2009). Climate change: Societal impacts and current policies and adaptation strategies in India. *IOP Conference Series: Earth and Environmental Science, 6*(29), 292050. doi:10.1088/1755-1307/6/29/292050

Nellemann, C., Verma, R., & Hislop, L. (2011). *Women at the frontline of climate change: Gender risks and hopes: A rapid response assessment*. United Nations Environment Program, GRID-Arendal. Retrieved from https://www.academia.edu/25647625/Women_at_the_Frontline_of_Climate_Change_Gender_Risks_and_Hopes

Nelson, V., Meadows, K., Cannon, T., & Martin, A. (2010). Uncertain predictions, invisible impacts, and the need to mainstream gender in climate change adaptations. *Gender and Development, 10*(2), 51-59. doi: 10.1080/13552070215911

Nguyen, L. A., Dang, V. H., Bosma, R. H., Verreth, J. A. J., Leemans, R., & Silva, D., S.S. (2014). Simulated impacts of climate change on current farming locations of striped catfish (pangasianodon hypophthalmus; sauvage) in the Mekong delta, Vietnam. *Ambio, 43*(8), 1059-1068. doi:10.1007/s13280-014-0519-6

Nguyen, L. D., Raabe, K., Grote, U. (2015). Rural–Urban migration, household vulnerability, and welfare in Vietnam. *World Development, 71*, 79-93. doi:10.1016/j.worlddev.2013.11.002

Nguyen, Q. A., Miller, F., Bowen, K., & Tan Sinh, B. (2017). Evaluating capacity for climate change adaptation in the health and water sectors in Vietnam: Constraints and opportunities. *Climate and Development, 9*(3), 258-16. doi:10.1080/17565529.2016.1146118

Nguyen, Q. T. (Ed). (2008). *Contemporary Vietnam and Republic of Korea: A Glimpse from both sides*. Hanoi: Vietnam National University Publishers.

Nguyen, T. (2009). Jobs for labourers during the transfer of agricultural land use purpose. *Journal of Communist, 786*, 72-75.

Nguyen, T. A., Vu, D. A., Vu, P. V., Nguyen, T. N., Pham, T. M., Hang Thi Thuy Nguyen . . . Hens, L. (2017). Human ecological effects of tropical storms in the coastal area of Ky Anh (Ha Tinh, Vietnam). *Environment, Development and Sustainability, 19*(2), 745. doi:10.1007/s10668-016-9761-3

Nguyen, T. H. T. (2011). *Climate change impacts and adaptation strategies for farmers in the coastal zones in Vietnam: A case study in Thinh Loc commune, Loc Ha district, Ha Tinh province*. (Master thesis), James Cook, James Cook University.

O'Connor, R. E., Bard, R. J., & Fisher, A. (1999). Risk perceptions, general environmental beliefs, and willingness to address climate change. *Risk Analysis, 19*(3), 461-471. doi:10.1111/j.1539-6924.1999.tb00421.x

O'Donnell, Dobozy, Bafrtlett, Bryer, Reeve, & Smith. (2012). *Educational Psychology*. Australia: John Wiley & Sons Australia, Ltd.

Ojomo, E., & Bartram, J. (2016). Adapting drinking-water systems to coastal climate change: Evidence from Vietnam and the Philippines. *Regional Environmental Change, 16*(8), 2409-2418. doi:10.1007/s10113-016-0965-8

Oxfam [Oxford Committee for Famine Relief]. (2009). *Vietnam: Climate change, adaptation and poor people*. Retrieved June 8, 2014, from https://www.scribd.com/document/52828866/Vietnam-Climate-change-adaptation-and-poor-people

Padmanabhan, M. A. (2007). The making and unmaking of gendered crops in Northern Ghana. *Singapore Journal of Tropical Geography, 28* (1), 57–70.

Pathmarajah, S. (2012). Water Management Practices and Climate Change Adaptation: South Asian Experiences. In Anbumozhi, V., Breiling, M., Pathmarajah, S., & Reddy, R. V. (Eds), *Climate change in Asia and the Pacific: How can countries Adapt?* (pp.104-124). India, the USA, and the UK: Sage.

Paton, D. (2005). Community resilience: integrating hazard management and community engagement. In: *Paper presented at the international conference on engaging communities*, Brisbane, 14–17 Aug 2005

Paton, D., & Johnston, D. (2001). Disasters and communities: Vulnerability, resilience and preparedness. *Disaster Prevention and Management: An International Journal, 10*(4), 270-277. doi:10.1108/EUM0000000005930

Pew Research Centre. (2015). *Global Attitudes and Trends*. Retrieved September 5, 2015, from http://www.pewglobal.org/2015/11/05/1-concern-about-climate-change-and-its-consequences/

Phung, D., Huang, C., Rutherford, S., Chu, C., Wang, X., Nguyen, M. . . . Nguyen, T. H. (2015). Association between climate factors and diarrhoea in a Mekong delta area. *International Journal of Biometeorology, 59*(9), 1321-1331. doi:10.1007/s00484-014-0942-1

Phung, D., Rutherford, S., Chu, C., Wang, X., Nguyen, M., Nguyen, N. H. . . . Huang, C. (2015). Temperature as a risk factor for hospitalisations among young children in the Mekong delta area, Vietnam. *Occupational and Environmental Medicine, 72*(7), 529-535. doi:10.1136/oemed-2014-102629

Pitzer, K. A., & Streeter, C. L. (2016). Mapping community capitals: A potential tool for social work. *Advances in Social Work, 16*(2), 358-371. doi:10.18060/17470

Poudel, S., & Kotani, K. (2013). Climatic impacts on crop yield and its variability in Nepal: Do they vary across seasons and altitudes? *Climatic Change, 116*(2), 327-355. doi:10.1007/s10584-012-0491-8

Poster, C., & Kruger, A. (1990). Community education in the western world. New York: Routledge.

Pugliese, A., & Ray, J. (2009). A heated debate: Global attitudes toward climate change. *Harvard International Review, 31*(3), 64-68.

Punch, F. K. (2001). *Introduction to Social Research: Quantitative & Qualitative Approaches.* Great Britain: SAGA Publication Inc., London.

Resurreccion, B. P., Sajor, E. E., & Fajber, E. (2008). *Climate adaptation in Asia: Knowledge gaps and research issues in Southeast Asia*. Retrieved from http://www.preventionweb.net/files/8126_ClimateAdaptationSEASept081.pdf

Richardson, J. T. E. (2011). Eta squared and partial eta squared as measures of effect size in educational research. *Educational Research Review, 6*(2), 135-147. doi: 10.1016/j.edurev.2010.12.001

Rickards, L., & Howden, M. S. (2012). Transformational adaptation: agriculture and climate change. *Crop & Paster Science, 63*(3), 240-250. doi: 10.1071/CP11172

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (2014). *Qualitative research practice: A guide for social science students and researchers* (2nd ed). London: SAGE

Rocklöv, J., Giang, K. B., Minh, H. V., Ebi, K., Nilsson, M., Sahlen, K., & Weinehall, L. (2014). Special issue: Climate change and health in Vietnam. *Global Health Action, 7*, 1-84. doi:10.3402/gha.v7.26572

Rossing, T., O. Rubin & I. Brisson. (2010). Building short-term coping capacity and longer-term resilience through asset-based adaptation. In D. Verner (ed.), *Reducing poverty, protecting livelihoods, and building assets in a changing climate*, (pp. 267–303). Washington: World Bank Publication.

Royal Government of Cambodia. (2006). *National adaptation programme of action to climate change (NAPA)*. Retrieved from http://unfccc.int/resource/docs/napa/khm01.pdf

Roz, P. (2015, April 30). What the UK thinks about climate change and energy- in seven charts. C*arbon Brief Clear on Climate*. Retrieved from http://www.carbonbrief.org/what-the-uk-public-thinks-about-climate-change-and-energy-in-seven-charts

Rubin, O. (2014). Social vulnerability to climate-induced natural disasters: Cross-provincial evidence from Vietnam. *Asia Pacific Viewpoint, 55*(1), 67-80. doi:10.1111/apv.12037

Sales, R. F. M. (2009). Vulnerability and adaptation of coastal communities to climate variability and sea-level rise: Their implications for integrated coastal

management in Cavite city, Philippines. *Ocean and Coastal Management, 52*(7), 395-404. doi:10.1016/j.ocecoaman.2009.04.007

Sarantakos, S. (1998). *Social research (2nd ed.)*. South Yarra [Vic.]: Macmillan Education Australia.

Schipper, E .L. F. (2007). Climate Change Adaptation and Development: Exploring the Linkages. *Tyndall Centre Working Paper No.107* July 2007.

Schmidt-Thomé, P., Nguyen, T. H., & Pham, T. L. (2014, 2015). *Climate change adaptation measures in Vietnam development and implementation (2015th ed.)*. S.l.: Springer International Publishing. doi:10.1007/978-3-319-12346-2

Sharma, A. (2011). Global climate change: What has science education got to do with it? *Science & Education, 21*(1), 33-53. doi:10.1007/s11191-011-9372-1

Shaw, R. (2006). Community-based climate change adaptation in Vietnam: inter-linkages of environment, disaster, and human security. In S. Sonak (Ed,), *Multiple Dimension of Global Environmental Changes*, 521-547. New Delhi, TERI publication. Retrieved from https://www.researchgate.net/publication/237124109_Community-based_climate_change_adaptation_in_Vietnam_inter-linkages_of_environment_disaster_and_human_security

Shaw, R., & Rouhban, B. (Eds) (2005). Education for ssustainable ddevelopment: Towards effective disaster reduction and enhancing human security. *World conference on disaster reduction*: Retrieved from http://unesdoc.unesco.org/images/0015/001590/159067eo.pdf

Shrestha, S., & SpringerLink (Online service). (2014). *Climate change impacts and adaptation in water resources and water use sectors case studies from southeast asia* (1;2014; ed.). S.l.: Springer International Publishing. doi:10.1007/978-3-319-09746-6

Shrestha, S., & Trang, B. T. T. (2015). Assessment of the climate-change impacts and evaluation of adaptation measures for paddy productivity in Quang Nam province, Vietnam. *Paddy and Water Environment, 13*(3), 241-253. doi:10.1007/s10333-014-0434-2

Shrestha, S., Deb, P., & Bui, T. T. T. (2016). Adaptation strategies for rice cultivation under climate change in central Vietnam. *Mitigation and Adaptation Strategies for Global Change, 21*(1), 15-37. doi:10.1007/s11027-014-9567-2

Simelton, E., Dam, B. V., & Catacutan, D. (2015). Trees and agroforestry for coping with extreme weather events: Experiences from northern and central Vietnam. *Agroforestry Systems, 89*(6), 1065-1082. doi:10.1007/s10457-015-9835-5

Simelton, E., Viet Dam, B., Linköpings universitet, Institutionen för tema, Centrum för klimatpolitisk forskning, & Filosofiska fakulteten. (2014). Farmers in Vietnam rank values of ecosystems from seven land uses. *Ecosystem Services, 9*, 133-138. doi:10.1016/j.ecoser.2014.04.008

Simoes, F. A, Kligerman, C. D., Rovere, L. E., Maroun, R. M., Barata, M., & Obermaier, M. (2010). Enhancing adaptive capacity to climate change: The case of smallholder farmers in the Braxillian semi-arid region. *Environmental science & Policy, 13*(8), 801-808. doi: 10.1016/j.envsci.2010.08.005

Singh, A., Svensson, J., & Kalyanpur, A., (2010). The state of sex-disaggregated data for assessing the impact of climate change. *Procedia Environmental Sciences, 1*, 395–404. doi: 10.1016/j.proenv.2010.09.027

Smit, B., & Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global Environmental Change, 16(3)*, 282-292. doi: 10.1016/j.gloenvcha.2006.03.008

Socialist Republic of Vietnam. (2011). *National strategy on climate change*. Retrieved from http://www.chinhphu.vn/portal/page/portal/English/strategies/strategiesdetails?categoryId=30&articleId=10051283

Sovacool, B. K., D'Agostino, A. L., Rawlani, A., & Meenawat, H. (2012). Improving climate change adaptation in least developed Asia. *Journal of Environmental Science and Policy, 21*, 112. doi: 10.1016/j.envsci.2012.04.009

Srinivasan, J., & Hunt, J. (2011). Climate change in Asia. *Journal of Current Science (Bangalore), 101*(10), 1269-1270. Retrieved from http://eprints.iisc.ernet.in/id/eprint/43869

Suhatharahima, S., Gurugnanam, B., & Dhaaranirajan, K. (2013). Climate change concept familiarity in urban area, Madurai, 2013- A field study. *International Journal of Science, Environment, and Technology, 2*(6), 1238-1244. Retrieved from https://www.researchgate.net/publication/269993347_04_CLIMATE_CHANGE_CONCEPT_FAMILIARITY_IN_URBAN_AREA_MADURAI_2013-A_FIELD_STUDY

Sujatha, B., & Chella, S. S. (2009). The social impacts of climate change in South Asia. *Journal of Migration and Refugee Issues, 5*(3), 134-147. Retrieved from http://search.informit.com.au.elibrary.jcu.edu.au/documentSummary;dn=345884827079987;res=IELHSS

Sultana, F. (2011). Living in hazardous waterscapes: Gendered vulnerabilities and experiences of floods and disasters. *Environmental Hazards, 9*(1), 43-53.

Retrieved from http://www.tandfonline.com.elibrary.jcu.edu.au/doi/abs/10.3763/ehaz.2010.SI02

Suwa, S. (2005). *Activities to create the new trend of the disaster mitigation education by the students of the environment and disaster mitigation course of Maiko High School.* Paper presented at the World conference. Retrieved May 5, 2015, from http://unesdoc.unesco.org/images/0015/001590/159067eo.pdf

Tabara, J, Dai, X, Jia, G, McEvoy, D, Neufeldt, H, Serra, A, Werners, S & West, J. (2010). The climate learning ladder. A pragmatic procedure to support climate adaptation. *Environmental Policy and Governance, 20*(1), 1-11. doi: 10.1002/eet.530

Tadege, A. (2008). Climate Change and adaptation measures in Ethiopia. Economic focus: *Bulletin of the Ethiopia Economics Association, 11*(1), 15-24.

Tashakkori, A. & Teddlie, C. (2003). Handbook of Mixed Methods in Social & Behavioral Research. Thousand Oaks: Sage.

Tam, V. T., Batelaan, O., & Beyen, I. (2016). Impact assessment of climate change on a coastal groundwater system, central Vietnam. *Environmental Earth Sciences, 75*(10), 1-15. doi:10.1007/s12665-016-5718-y

Terry, G. (2009). No climate justice without gender justice: an overview of the issues. *Gender & Development, 17*(1), 5-18. doi:10.1080/13552070802696839

Teerawichitchainan, B., Knodel, J., Loi, V. M., Huy, V. T. (2010). The gender division of household labour in Vietnam: Cohort trends and regional variations. *Journal of Comparative Family Studies, 41*(1), 57-85

TLCGR. (2014). Thinh Loc community economy, population and Environment.

Thu, T. N., Loan Bui Thi Phuong, Van, T. M., & Hong, S. N. (2016). Effect of water regimes and organic matter strategies on mitigating greenhouse gas emission from rice cultivation and co-benefits in agriculture in Vietnam. *International Journal of Environmental Science and Development, 7*(2), 85. doi:10.7763/IJESD.2016.V7.746

Toan, D. T. T., Kien, V. D., Bao Giang, K., Van Minh, H., & Wright, P. (2014). Perceptions of climate change and its impact on human health: An integrated quantitative and qualitative approach. *Global Health Action, 7*(1), 23025-8. doi:10.3402/gha.v7.23025

Tong, T. M. T., Shaw, R., & Takeuchi, Y. (2012). Climate disaster resilience of the education sector in Thua Thien Hue province, central Vietnam. *Natural Hazards, 63*(2), 685-709. doi:10.1007/s11069-012-0178-5

Tran, D. T., Saito, Y., Dinh, V. H., Nguyen, V. L., Ta, T. K. O., & Tateshi, M. (2003). Regimes of human and climate change impacts on coastal changes in Vietnam. *Journal of Regional Environmental Change, 4*(1), 49-62. doi: 10.1007/s10113-003-0062-7

Tran, T. A. (2015). Post-disaster housing reconstruction as a significant opportunity to building disaster resilience: A case in Vietnam. *Natural Hazards, 79*(1), 61. doi:10.1007/s11069-015-1826-3

Tran, T. A., Tran, V. P, Nguyen, K. H., & Dinh, Q. Q. (2016). *Gender analysis in building climate resilience in Da Nang Challenges and solutions*. Retrieved from http://pubs.iied.org/pdfs/10784IIED.pdf

Trinh, L. T., Vu, G. N. H., Van Der Steen, P., & Lens, P. N. L. (2013). Climate change adaptation indicators to assess wastewater management and reuse options in the Mekong delta, Vietnam. *Water Resources Management, 27*(5), 1175-1191. doi:10.1007/s11269-012-0227-6

Trinh, T. D. (2005). *History of Thinh Loc community*. Ha Tinh.

Trung, P. T. (2013). Climate change and its gendered impacts on agriculture in Vietnam. *International Journal of Development and Sustainability, 2*(1), 52-62. Tyndall Centre for Climate Research, University of East Anglia.

Truong, M. T. (2010). *Building Resilience: Adaptation strategies for coastal livelihoods most at risks climate change impacts in central Vietnam*. Retrieved from http://www.unpei.org/sites/default/files/PDF/vietnam-PolicyBrief-coastal-livelihoods.pdf

Tuyet-Hanh, T. T., Lee, J., Oh, J., Van Minh, H., Ou Lee, C., Hoan, L. T. . . . Long, T. K. (2016). Household trends in access to improved water sources and sanitation facilities in Vietnam and associated factors: Findings from the multiple indicator cluster surveys, 2000-2011. *Global Health Action, 9*(1), 29434-8. doi:10.3402/gha.v9.29434

Ty, T. V., Sunada, K., Ichikawa, Y., & Oishi, S. (2012). Scenario-based impact assessment of land Use/Cover and climate changes on water resources and demand: A case study in the Srepok river basin, Vietnam—Cambodia. *Water Resources Management, 26*(5), 1387-1407. doi:10.1007/s11269-011-9964-1

UN Vietnam [United Nations Vietnam]. (2009). *Gender and Climate Change in Viet Nam: A Desk Review*. Retrieved from http://portal.unesco.org/en/files/44957/12385110459Climate_change_and_Gender.pdf/Climate%2Bchange%2Band%2BGender.pdf

UNESCO [United Nations Educational, Scientific and Cultural Organization]. (2015). *Not just a hot air: Putting Climate Change Education into Practice*. Retrieved from http://unesdoc.unesco.org/images/0023/002330/233083e.pdf

UNESCO. (2012). *Education Sector responses to Climate Change*. Retrieved from http://unesdoc.unesco.org/images/0021/002153/215305e.pdf.

UNESCO. (2013). *Climate change in the classroom*. Retrieved from http://www.unesco.org/new/en/brasilia/about-this-office/single-view/news/climate_change_in_the_classroom/

UNFCCC [United Nations Framework Convention Climate Change]. (1992). Article 6: Education, training, and public awareness, p.16. Retrieved from http://unfccc.int/cooperation_support/education_outreach/overview/items/8946

UNFCCC. (1998). Article 10e, p.10. Retrieved from http://unfccc.int/cooperation_support/education_outreach/overview/items/8946

UNFCCC. (2007). *Climate change: Impacts, Vulnerabilities, and adaptation in developing countries*. Retrieved from https://unfccc.int/resource/docs/publications/impacts.pdf

UNFCCC. (2008). Challenges and opportunities for mitigation in the agricultural sector. Technical paper (FCCC/TP/2008/8). United Nations Framework Convention on Climate Change, New York. Retrieved from https://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/1_unfccc.pdf

UNFCCC. (2012). Climate change education as an integral part of the United Nations Framework convention on climate change. *Journal of Education for sustainable Development, 6*(2), 237-239. doi:10.1177/0973408212475203

UNFCCC. (2017). *Education, Training and Public Awareness under Article 6 of the Convention*. Retrieved from http://unfccc.int/cooperation_support/education_outreach/overview/items/8946.php

UNFCCC. (2017). *Intended Nationally Determined Contribution of Viet Nam*. Retrieved from http://unfccc.int/home/items/6078.php?q=INDC+vietnam&cx=009772925632828311246%3Agjvsnghto1u&ie=UTF-8&sa=

Ung, M., Luginaah, I., Chuenpagdee, R., & Campbell, G. (2015, 2016). Perceived self-efficacy and adaptation to climate change in coastal Cambodia. *Climate, 4(1)*, 1. doi:10.3390/cli4010001

UNICEF [United Nations Children's Fund]. (2012). *Climate Change Adaptation and Disaster Risk Reduction in the Education Sector*. Retrieved from https://www.unicef.org/cfs/files/UNICEF-ClimateChange-ResourceManual-lores-c.pdf

USAID. (2011). *Climate Change in Vietnam: Assessment of issues and options for usaid funding*. Retrieved from https://www.usaid.gov/sites/default/files/documents/1861/vietnam_climate_change_final2011.pdf

USAID. (2015). *Infographic: Raising Climate Change Awareness of Communities in the Lower Mekong Basin*. Retrieved from http://mekongarcc.net/resource/infographic-raising-climate-change-awareness-communities-lower-mekong-basin

USAID. (2017). *Climate Change Risk Profile: Vietnam*. Retrieved from https://www.climatelinks.org/sites/default/files/asset/document/2017_USAID_Vietnam%20climate%20risk%20profile.pdf

Vaughan, C., Gack, J., Solorazano, H., & Ray, R. (2003). The effect of environmental education on schoolchildren, their parents, and community members: A study of intergenerational and intercommunity learning. *The Journal of Environmental Education, 34(3)*, 12-21. doi: 10.1080/00958960309603489

Vize, S. (2012). Using education to bring climate change adaptation to Pacific communities. *Journal of Education for Sustainable Development, 6*(2), 219-235. doi: 10.1177/0973408212475202.

Vo, V. M., Nguyen, M. V., & Chau, P. (2013). *Survey results and suggestion of Climate change education model for Students in Urban areas of Da Nang*. Retrieved from http://i-s-e-t.org/resources/case-studies/survey-results-suggestion-education-model-da-nang.html

Vo, V. V. (2011). Rural People's Livelihoods-A Case Study in a Commune at Mekong Delta, Vietnam. *Society of Environmental and Rural Development, 2*(1), 65-69. Retrieved from http://www.iserd.net/?page_id=86

Wals, A. E. (2012). *Shaping the education of tomorrow: 2012 full-length report on the UN decade of education for sustainable development. Unesco*. Retrieved from http://unesdoc.unesco.org/images/0021/002164/216472e.pdf

Wang, J., Huang, J., & Yang, J. (2014). Overview of impacts of climate change and adaptation in china's agriculture. *Journal of Integrative Agriculture, 13*(1), 1-17. doi:10.1016/S2095-3119(13)60588-2

Warner, K., Hamza, M., Smith, O. A., Renaud, F., & Julca, A. (2010). Climate change, environmental degradation and migration. *Natural Hazards, 55* (3), 689-715. doi: 10.1007/s11069-009-9419-7

Webber, R.P. (1985). *Content Analysis*. Sage, Newbury Park, CA: Sage

WHO [World Health Organization]. (2016). *Drinking-water*. Retrieved from http://www.who.int/mediacentre/factsheets/fs391/en/

Wheeldon, J. (2010). Mapping mixed methods research: Methods, measures and meaning. *Journal of Mixed Methods Research, 4*, 87-1-2.

Wibeck, V. (2014). Enhancing learning, communication and public engagement about climate change – some lessons from recent literature. *Environmental Education Research, 20*(3), 387-411. doi:10.1080/13504622.2013.812720

Williamson, T., Hesseln, H., & Johnston, M. (2012). Adaptive capacity deficits and adaptive capacity of economic systems in climate change vulnerability assessment. *Forest Policy and Economics, 15*, 160-166. doi:10.1016/j.forpol.2010.04.003

WNET Education. (2016). *What is the history of constructivism, and how has it changed over time?* Retrieved November 7, 2015, from http://www.thirteen.org/edonline/concept2class/constructivism/index_sub4.html

World Bank, UNDP, AUSAID, FAO, SDC … CARE. (2011). *Vietnam Development Report 2011: Natural Resources Management*. Retrieved from http://siteresources.worldbank.org/INTVIETNAM/Resources/VDR2011EnglishSmall.pdf

World Bank. (2017). *Vietnam – Overview.* Retrieved from http://www.worldbank.org/en/country/vietnam/overview.

World Bank. (2000). *Vietnam development report 2000: attacking poverty*. Retrieved from http://www.worldcat.org/title/vietnam-development-report-2000-attacking-poverty/oclc/46863296

World Bank. (2010). *Economics of adaptation to climate change: Vietnam*. Retrieved from https://openknowledge.worldbank.org/bitstream/handle/10986/12747/702720ESW0P1080UBLIC000EACC0Vietnam.pdf?sequence=1&isAllowed=y

World Bank. (2010). *Potential climate change mitigation opportunities in the agriculture and forestry sector in Vietnam: background paper*. Washington, DC: World Bank. Retrieved from http://documents.worldbank.org/curated/en/174131468320698514/Potential-

climate-change-mitigation-opportunities-in-the-agriculture-and-forestry-sector-in-Vietnam-background-pape

World Bank. (2011). *Climate-Resilient Development in Vietnam: Strategic Directions for the World Bank*. Retrieved from http://siteresources.worldbank.org/INTVIETNAM/Resources/CCStrategyVNFinal-Eng.pdf

World Bank. (2011). *Gender and climate change: 3 things you should know*. Retrieved from http://siteresources.worldbank.org/EXTSOCIALDEVELOPMENT/Resources/244362-1232059926563/5747581-1239131985528/5999762-1321989469080/Gender-Climate-Change.pdf

World Bank. (2013). *Vietnam: Achieving Success as a Middle-income Country*. Retrieved from www.worldbank.org/en/results/2013/04/12/vietnam-achieving-success-as-a-middle-income-country

World Bank. (2015). *Vietnam - Rural population*. Retrieved from http://www.tradingeconomics.com/vietnam/rural-population-wb-data.html

Yaro, I., Lamai, S. L., & Oladimeji, A. A. (2005). The effect of different fertilizer treatments on water quality parameters in rice-cum-fish culture systems. *Journal of Applied Ichthyology*, 21(5), 399-405. doi:10.1111/j.1439-0426.2005.00654.

Yu, B., Zhu, T., Breisinger, C., & Nguyen, M. H. (2010). *Impacts of Climate Change on Agriculture and Policy Options for Adaptation The Case of Vietnam*. IFPRI Discussion Paper 01015August 2010. Retrieved from http://reliefweb.int/sites/reliefweb.int/files/resources/A06030A0F205087E4925777C001E6988-Full_Report.pdf.

Zhai, F & Zhuang, J. (2012). Agricultural Impact of Climate Change: A General Equilibrium Analysis with Special Reference to Southeast Asia. In Anbumozhi, V., Breiling, M., Pathmarajah, S., & Reddy, R. V. (Eds), *Climate change in Asia and the Pacific: How can countries Adapt?* (pp.17- 45). India, the USA, the UK: Sage.

APPENDICES

Appendix A: Baseline questionnaire

A. DEMOGRAPHIC INFORMATION

1. How old are you?

11-14 ☐
15-20 ☐
21-30 ☐
31-40 ☐
41-50 ☐
51-60 ☐
Over 60 ☐

2. **Gender:**

Male ☐ Female ☐

3. What is your completed highest education level?

No formal education ☐
Primary school ☐
Secondary school ☐
High school ☐
College/University ☐

4. What is your main job?

Farmer ☐
Teacher ☐
Student ☐
Local government staff ☐

5. How many years have you live in Thinh Loc?

Less than 1 year ☐
2-5 years ☐
6-10 years ☐
11-20 years ☐
21-30 years ☐
Over 30 years ☐

B. CLIMATE CHANGE KNOWLEDGE

6. How are you familiar with the following concept or terms?

Familiarity	Extremely	Very	Somewhat	Not too much	Not at all
Climate change					
Global warming					
Greenhouse gases					
Greenhouse effect					
Carbon dioxide					

7. Do you think that climate change is happening?

Yes ☐
No ☐
Not sure ☐

8. In your opinion, what are the causes of climate change?

Mainly caused by natural processes ☐
Mainly caused by human activity ☐
Partly caused by natural processes and partly caused by human activity ☐
Don't know ☐
Not sure ☐

9. In terms of human activity, what do you think are the causes of climate change (tick as many as you think are important)

Burning fossil fuels such as coal oil, gas, petrol ☐
Deforestation such as cutting down forest and burning forest ☐
Utilise harmful chemicals in agriculture ☐
Industries using fossil fuels for manufactories ☐
Not sure ☐
Don't know ☐
Others (Please specific) ……

10. If nothing is done to reduce climate change in the future, how serious a problem do you think it will be for the world, Vietnam, and your community?

How serious	The world	Vietnam	Your community
Very serious			
Somewhat serious			
Not so serious			
Not serious at all			

11. When, if at all, do you think your community will begin to feel negative effects from climate change?

- Right now ☐
- In the next 5 years ☐
- In the next 10 years ☐
- In the next 30 years ☐
- In the next 50 years ☐
- In the next 100 years ☐
- Beyond the next 100 years ☐
- Never ☐
- Don't know ☐

12. How much do you think climate change will harm you and your family; your community members; as well as your community's future generations?

	A great deal	A moderate amount	Only a little	Not at all
You and your family				
Your community members				
Future generations				

13. If nothing is done to address climate change, what do you think will be observed in the next 20 years in your community?

Phenomena	Very likely	Some what	Not very likely	Not at all
More droughts and water shortages				
More severe floods				
Higher fluency of strong storms				
More saltwater intrusion				
Higher sea level rises				
Disappearance of many species of fish				
Disappearance of many species of plants				
Crop productivity is reduced				
Famines and food shortages				
Loss of livelihood				

14. Do you know any current policy proposals to address climate change?

- A lot ☐
- Quite a few ☐
- Some ☐
- Not very many ☐
- None ☐

C. CLIMATE CHANGE ADTITUDES

15. How concerned are you about climate change?

- Very concerned ☐
- Fairly concerned ☐
- Not very concerned ☐
- Not at all concerned ☐
- No opinion ☐

16. How important is the issue of climate change to you personally?

- Extremely important ☐
- Very important ☐
- Somewhat important ☐
- Not important ☐

D. ACTIVITIES RELATED TO CLIMATE CHANGE

17. How often do you implement the following activities?

Activities	**Very often**	**Often**	**Sometimes**	**Never**
Cut down trees to build houses, sell, or cook				
Cut down mangroves				
Litter on the coastal zone				
Burn straws after finishing crop				
Burn domestic garbage				
Remove sand from the sand dyke				
Burn forest				
Let waste water comes out on to public roads				
Remove rock from mountain to build house or for business goals				

18. What have you done to address climate change? (Tick as many as you done)?

- Stopped cutting mangroves ☐
- Planted more mangroves ☐
- Planted trees and bushes ☐
- Look after trees and bushes ☐
- Built sea walls (cement/ sand bags/rocks…) ☐
- Installed rain water tank ☐

Nothing ☐
Others (please specific)…….....

19. Which of the following would best help reduce climate change? (Tick as many as you think they are important)

Central Government Initiatives ☐
Local government Initiatives ☐
Community action ☐
Individual and family action ☐
Voluntary action ☐
Environmental groups ☐
Industry/Companies Initiatives ☐
International community Initiatives ☐
Don't know ☐
No action needed ☐
Other (Please specific) ……

E. SOURCE OF CLIMATE CHANGE INFORMATION

20. Where do you get information about climate change? (Tick as many as applied)

Television ☐
Radio ☐
Newspapers ☐
Books ☐
Internet ☐
Local government staff ☐
Neighbours ☐
Relatives ☐
Friends ☐
Teachers ☐
Family's members ☐
Community education programs ☐
Others (Please indicate) ……

21. Do you think that a future climate change education program should be conducted in your community?

Yes ☐
No ☐
Don't know ☐

If a climate change education program is conducted in your community, will you attend?

Yes ☐
No ☐
Not sure ☐

Appendix B: Evaluation questionnaire

Demographic information

Gender: Male ☐ Female ☐

Age: ……

Occupation:

- Secondary school student ☐
- School teacher ☐
- Farmer ☐
- Local government staff
- Primary school student ☐

Climate change knowledge

1. How are you familiar with the following concept or terms?

Familiarity	Extremely	Very	Somewhat	Not too much	Not at all
Climate change					
Global warming					
Greenhouse gases					
Greenhouse effect					
Carbon dioxide					

2. What are clues of climate change? ……

3. What are the main sources of greenhouse gases? ……

4. Think about climate change causes. Show how strongly you agree or disagree with each the following statements?

Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Burning fossil fuel contributes to enhancing climate change					
Using fertilizers for crops contributes to enhancing climate change					

Using pesticides for crops contributes to enhancing climate change					
Land use changes contributes to enhancing climate change					
Respiration of animals contributes to enhancing climate change					
Cutting trees contributes to enhancing climate change					
Deforestation contributes to enhancing climate change					
Using vehicles contributes to enhancing climate change					
Landfill contributes to enhancing climate change					
Waste and wastewater contributes to enhancing climate change					
Industrial activities contributes to enhancing climate change					
Producing and using plastic bags contributes to enhancing climate change					
Producing and using plastic bottles contributes to enhancing climate change					
Producing and using electricity contributes to enhancing climate change					
Growing and cultivating rice					

5. Think about climate change impacts in your community. Show how strongly you agree or disagree with each the following statements?

Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
Climate change suffers many types of ocean creatures					
Forests are more prone to deadly infestations due to climate change					
Our Arctic creatures need ice, but it is vanishing due to global warming					
Climate change affects human health					
Climate change affects animal health					
Climate change exacerbates the poverty situation					
Climate change contributes to enhancing the unemployment rate					
Climate change causes unexpected migration					
Climate change enhances environmental pollution issues					
Climate change causes loss of education					

Climate change attitudes

6. Think about each of the following statements. Does it sound like the kind of thing that you would think? Tick (*v*) the box matching the most correct answer?

Statements	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
I feel more worried after listening and watching about climate					

change warns in the intervention program					
I am scared that my community would be disappeared due to sea level rise					
I regret that I cut trees and do not take care of trees					
I regret that I drop litter					
I regret that I do not pay more attention on the climate change issue					
I feel sorry that I use fertilizers and pesticides for crops					
I regret that I use nylon bags for shopping instead of baskets					
I regret that I do not turn off electricity equipment after leaving school, workplace, and home.					
I feel sorry that I use traditional cookers					
I feel sorry that I use motorbikes/cars for my travelling instead of walking or riding bicycles					
I feel sorry that I do not manage my breading facilities well					
I regret that I do not participate in the environmental campaigns in community and schools					
I regret that I burn straw after crops					
I regret that I burn garbage					
I regret that I do not conduct the waste classification					

I regret I dig sand from the coastline and sand dyke					
I regret that I do not save water daily					

Climate change mitigation

7. The kind of cookers used in your household (Tick (v) if YES)

Cookers	Last year	This year
Gas cooker		
Electricity cooker		
Biomass cooker		
Other (specify please)		

8. Have you participated to plant and protect trees within the last 6 months?

Place	Plant trees	Protect trees (water, caring of trees, not cutting trees)
At home		
At school		
At hamlet/community		
At forest		

9. Your modes of transportation used when you travelled to the following places?

	Car	Motorbike	Bicycle	Walking
Workplace				
Last year				
Present				
Market				
Last year				
Present				
Farm				
Last year				
Present				
School				
Last year				
Present				

Other hamlets				
Last year				
Present				

10. Shopping bags used?

	Nylon bag	Reused plastic basket	Wooden basket	Paper bag
Last year				
Present				

11. Have you ever reused nylon bags and plastic bottles?

	Last year	Present
Nylon bags		
Plastic bottles		

12. Have you turned off electricity equipment before leaving the following places?

Place	Last year	Present
Workplace		
Classroom		
Home		

13. Have you conducted recycle behaviour?

	Last year	Present
Family		
School		
Workplace		

14. Have you changed the proportion of meat in your meals in the last 6 months?

Increase ☐

Maintain ☐

Reduce ☐

15. What have you or your family members fed your cattle in the last 6 months?

	Grass	Processed food	Crop straw
Increase			
Maintain			
Decrease			

16. What have you or your family members done with crop straw in the last 6 months?

Burning in the field ☐
Producing mushrooms ☐
Producing organic composting ☐
Making animal food ☐
Other (specific) ☐

17. What have you or your family members done in using fertilizers within the last 6 months?

	Chemical fertilizers	Organic fertilizers
Reduce		
Maintain		
Increase		

18. How often have you or your family members cleaned cattle facilities within the last 6 months?

Daily ☐
Weekly ☐
Monthly ☐
None at all ☐

19. How often have you or your family members participated to clean public canals within the last 6 months?

One per week ☐
One per month ☐
One per couple of months ☐
None at all ☐

Climate change adaptation

20. How often have you conducted the following activities in the coastline within the last 6 months?

	Collect garbage	Plant trees	Protect sea-wall
Daily			
Weekly			
Monthly			
None at all			

21. What have you or your family members done to cope with water shortages or droughts in the last 6 months? (tick as many as are true)

    Saving water daily ☐
    Building more tanks or water jars ☐
    Digging irrigation canals/wells ☐
    Planning to apply short day crops ☐
    Planning to apply polyculture ☐
    None at all ☐

22. What do you or your family members, school, community, and workplace plan for the next flood/storm season? ……

23. Have your school/workplace/ community organised competition/workshop/training about climate change within the last 6 months?

    Yes ☐ No ☐

Appendix C: Climate change education program (Handout for students)

SECTION 1: CLIMATE CHANGE OVERVIEW

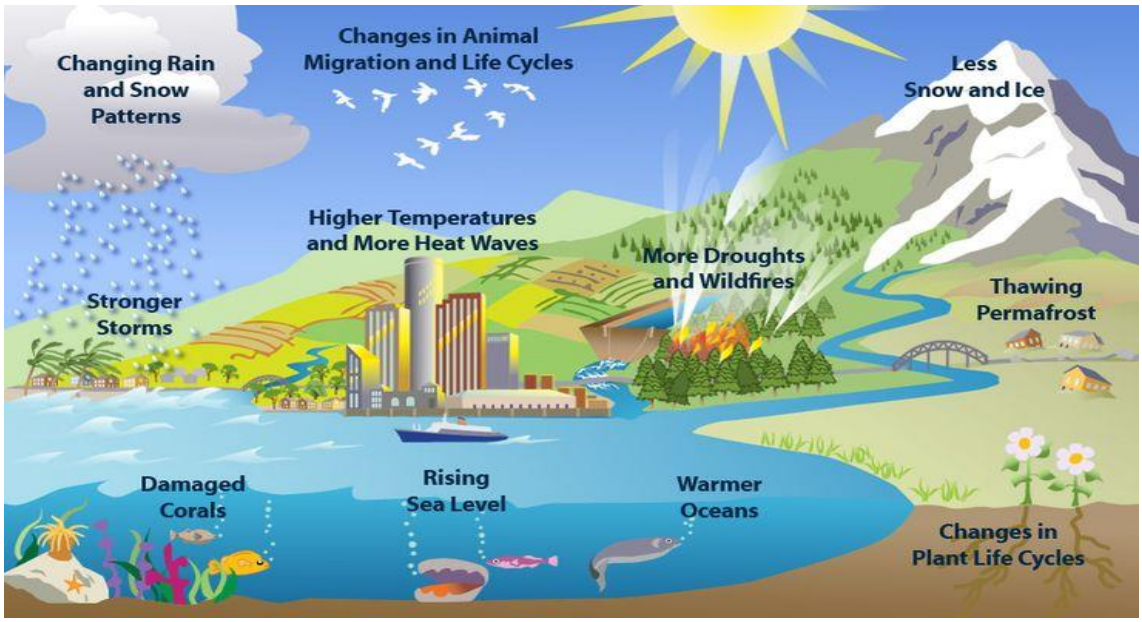
Handout 1: Climate change trends in Vietnam and worldwide

1. What is climate change?

Our planet is changing

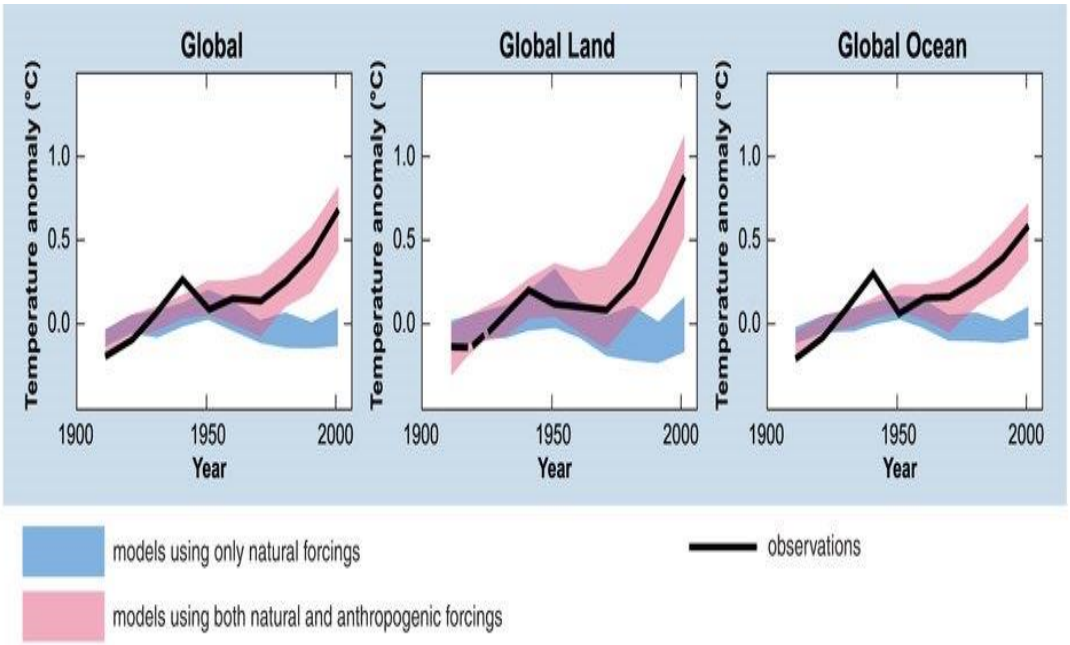
2. Evidence of global climate change and Vietnamese climate change

Clues of climate change



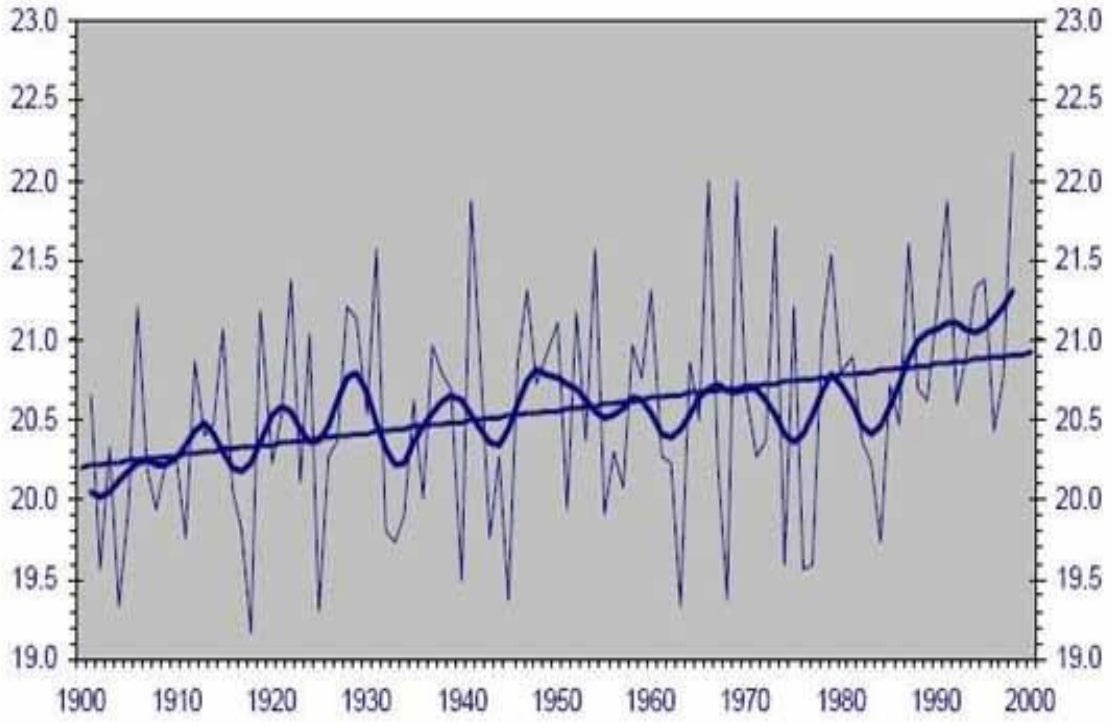
a. Temperature rise

Global temperature rise



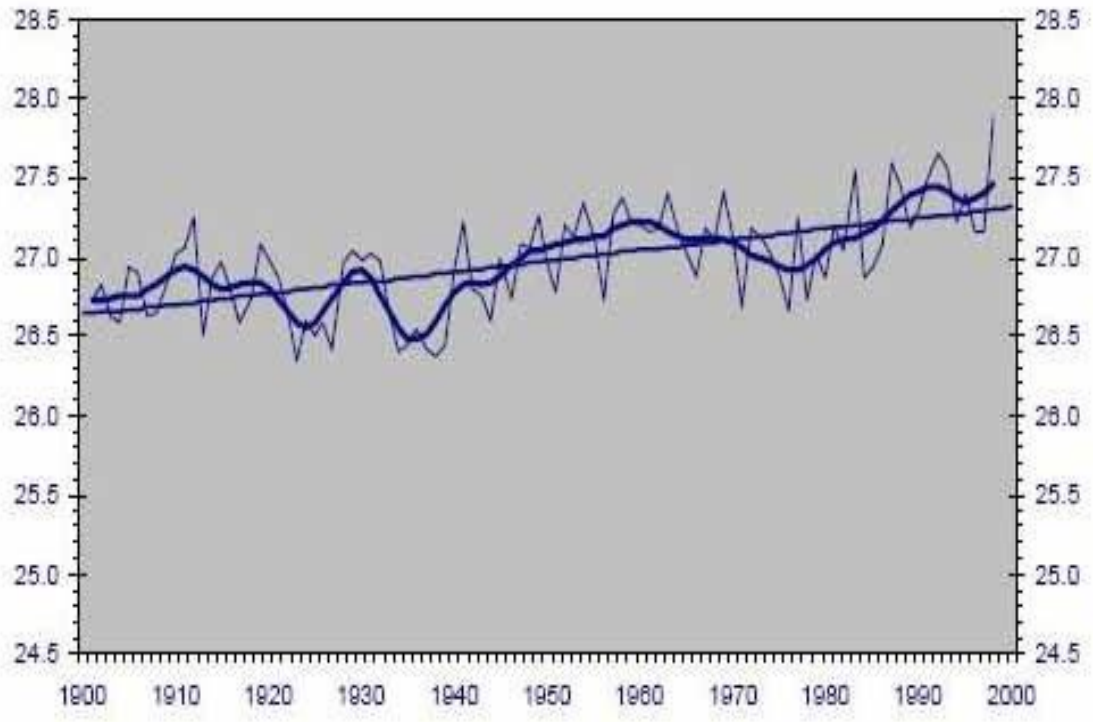
Source: IPCC (2007)

Analysis of climate change in Vietnam- Winter temperature, 1901- 1998



Source: Schaefer, Dirk. 2003. German Vietnam Seminar. Hanoi, October 27-30, 2003

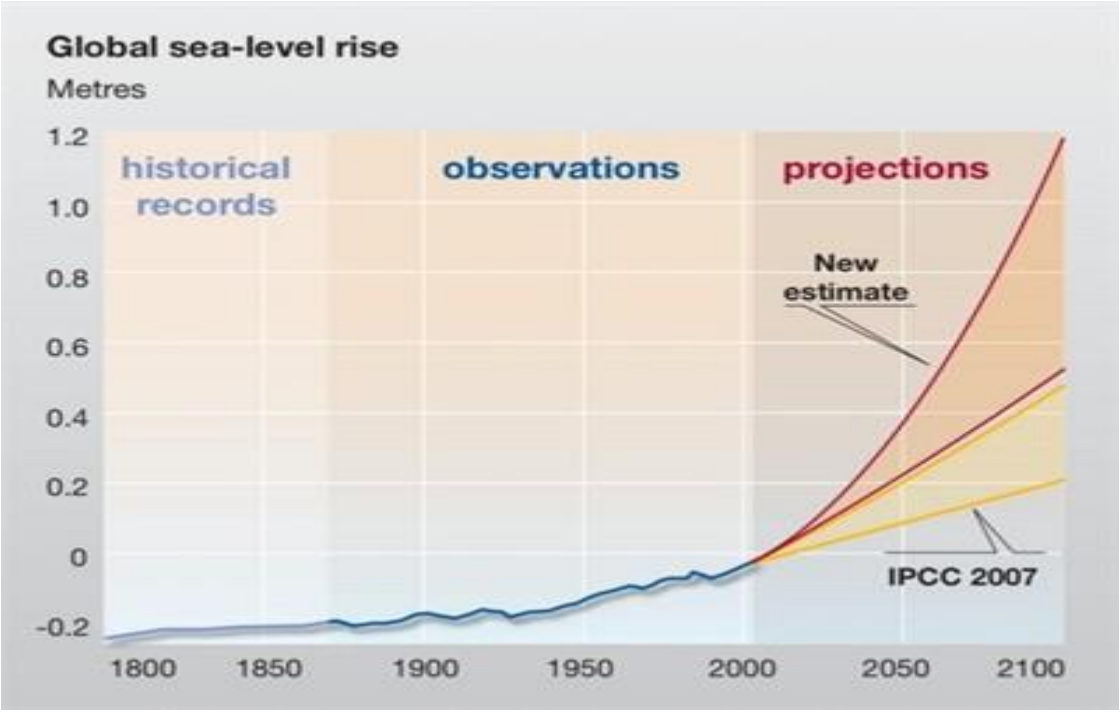
Analysis of climate change in Vietnam- Summer temperature, 1901-1998



Source: Schaefer, Dirk. 2003. German Vietnam Seminar. Hanoi, October 27-30, 2003.

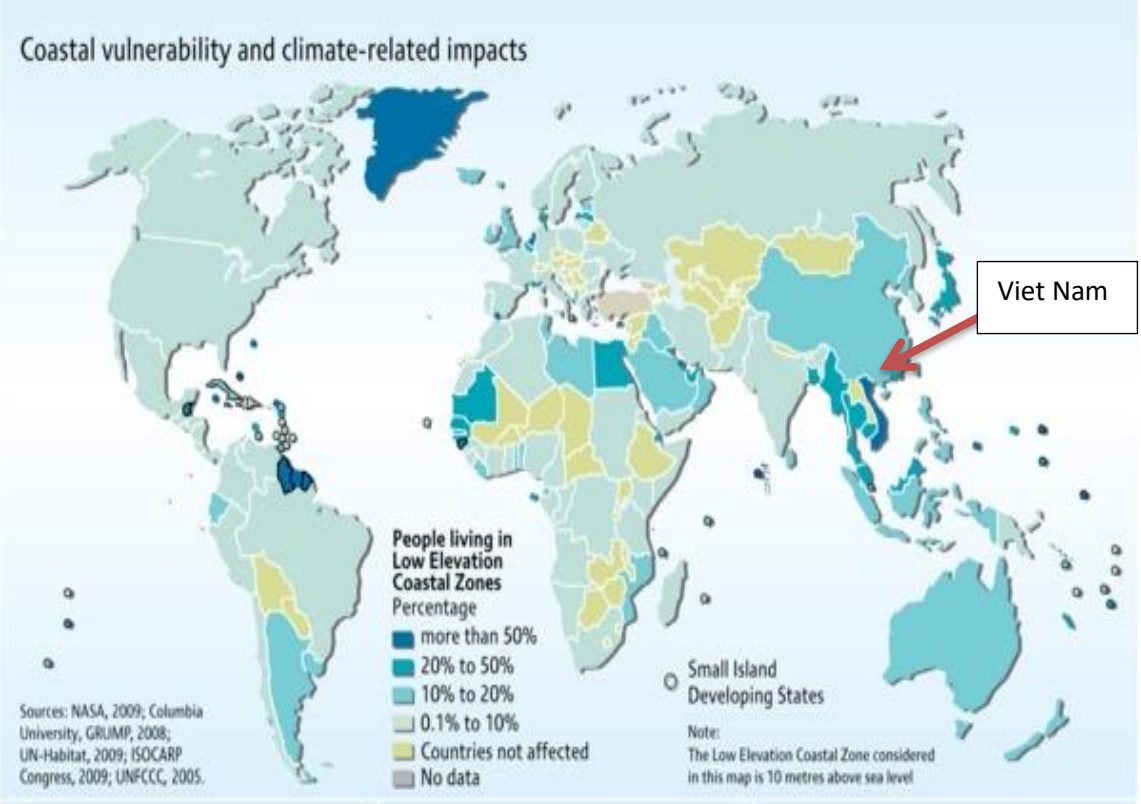
b. Sea level rise

Global mean sea level



Source: Riccardo Pravettoni & UNEP/GRID-Arendal (2009)

Coastal vulnerability and climate change – related impacts: Over 50% of Vietnamese living in low elevation coastal



Source: Pravettoni & UNEP/GRID-Arendal (2009)

Sea level rise in Vietnam with a low greenhouse gas emission senior (B1)

Khu vực	Các mốc thời gian của thế kỷ 21								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Móng Cái-Hòn Dáu	7-8	10-12	14-17	19-22	23-29	28-36	33-43	38-50	42-57
Hòn Dáu-Đèo Ngang	8-9	11-13	15-17	19-23	24-30	29-37	34-44	38-51	42-58
Đèo Ngang-Đèo Hải Vân	7-8	11-12	16-18	22-24	28-31	34-39	41-47	46-55	52-63
Đèo Hải Vân-Mũi Đại Lãnh	7-8	12-13	17-18	22-25	29-33	35-41	41-49	47-57	52-65
Mũi Đại Lãnh-Mũi Kê Gà	7-8	11-13	16-19	22-26	29-34	35-42	42-51	47-59	53-68
Mũi Kê Gà-Mũi Cà Mau	8-9	11-13	17-19	22-26	28-34	34-42	40-50	46-59	51-66
Mũi Cà Mau-Kiên Giang	9-10	13-15	18-21	24-28	30-37	36-45	43-54	48-63	54-72

Source: Ministry of Natural Resource and Environment, Vietnam (2011)

Sea level rise in Vietnam with a medium greenhouse gas emission senior (B2)

Khu vực	Các mốc thời gian của thế kỷ 21								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Móng Cái-Hòn Dáu	7-8	11-12	15-17	20-24	25-31	31-38	36-47	42-55	49-64
Hòn Dáu-Đèo Ngang	7-8	11-13	15-18	20-24	25-32	31-39	37-48	43-56	49-65
Đèo Ngang-Đèo Hải Vân	8-9	12-13	17-19	23-25	30-33	37-42	45-51	52-61	60-71
Đèo Hải Vân-Mũi Đại Lãnh	8-9	12-13	18-19	24-26	31-35	38-44	45-53	53-63	61-74
Mũi Đại Lãnh-Mũi Kê Gà	8-9	12-13	17-20	24-27	31-36	38-45	46-55	54-66	62-77
Mũi Kê Gà-Mũi Cà Mau	8-9	12-14	17-20	23-27	30-35	37-44	44-54	51-64	59-75
Mũi Cà Mau-Kiên Giang	9-10	13-15	19-22	25-30	32-39	39-49	47-59	55-70	62-82

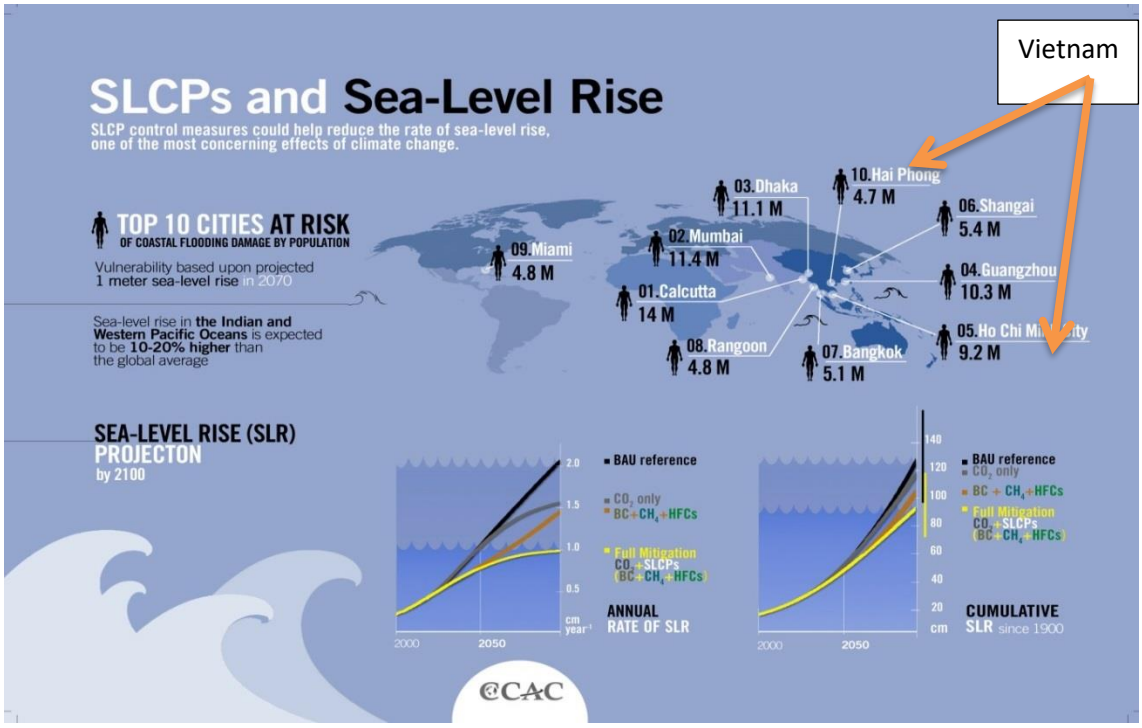
Source: Ministry of Natural Resource and Environment, Vietnam (2011)

Sea level rise in Vietnam with a high greenhouse gas emission senior (A1F1)

Khu vực	Các mốc thời gian của thế kỷ 21								
	2020	2030	2040	2050	2060	2070	2080	2090	2100
Móng Cái-Hòn Dáu	7-8	11-13	16-18	22-26	29-35	38-46	47-58	56-71	66-85
Hòn Dáu-Đèo Ngang	8-9	12-14	16-19	22-27	30-36	38-47	47-59	56-72	66-86
Đèo Ngang-Đèo Hải Vân	8-9	13-14	19-20	26-28	36-39	46-51	58-64	70-79	82-94
Đèo Hải Vân-Mũi Đại Lãnh	8-9	13-14	19-21	27-29	36-40	47-53	58-67	70-82	83-97
Mũi Đại Lãnh-Mũi Kê Gà	8-9	13-14	19-21	27-30	37-42	48-55	59-70	72-85	84-102
Mũi Kê Gà-Mũi Cà Mau	8-9	13-14	19-21	26-30	35-41	45-53	56-68	68-83	79-99
Mũi Cà Mau-Kiên Giang	9-10	14-15	20-23	28-32	38-44	48-57	60-72	72-88	85-105

Source: Ministry of Natural Resource and Environment, Vietnam (2011

Top 10 cities at risk of coastal flooding damage by population



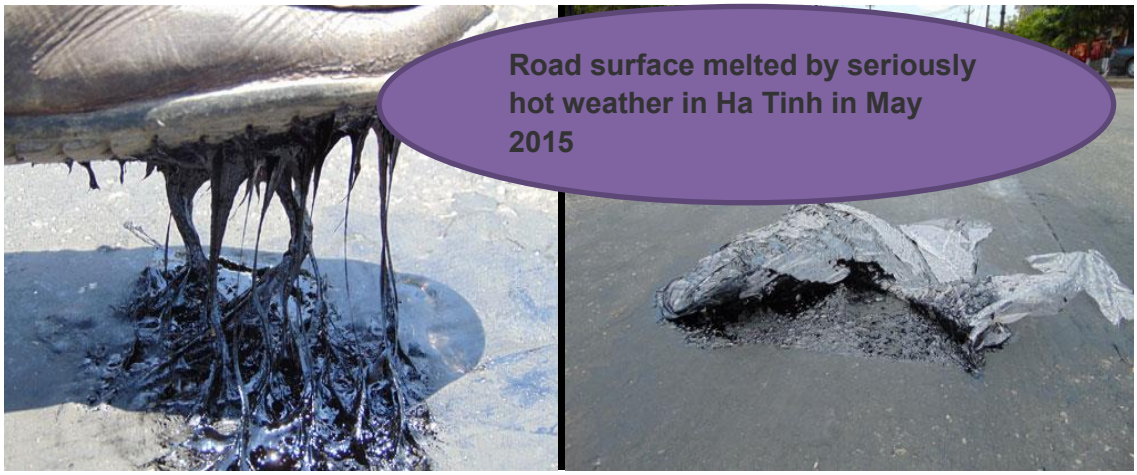
Source: GRID-Arendal (2014)

c. More intensity and frequency of floods and storms

d. More intensity and frequency of droughts

e. More intensity and frequency of bushfires

f. Hotter in summer and colder in winter



g. More intensity and frequency of natural disasters:

The simplest way to understand “natural disasters” is that natural disasters can come about because of climatic or geological events. Droughts, floods, storms, cyclones, and bushfires are common disasters from climatic events, while earthquakes, tsunamis, volcanoes are mostly caused by geological events (NSW Education and Communities, 2010).

Disasters in Japan (2011), Haiti (2010), and Nepal (2015)

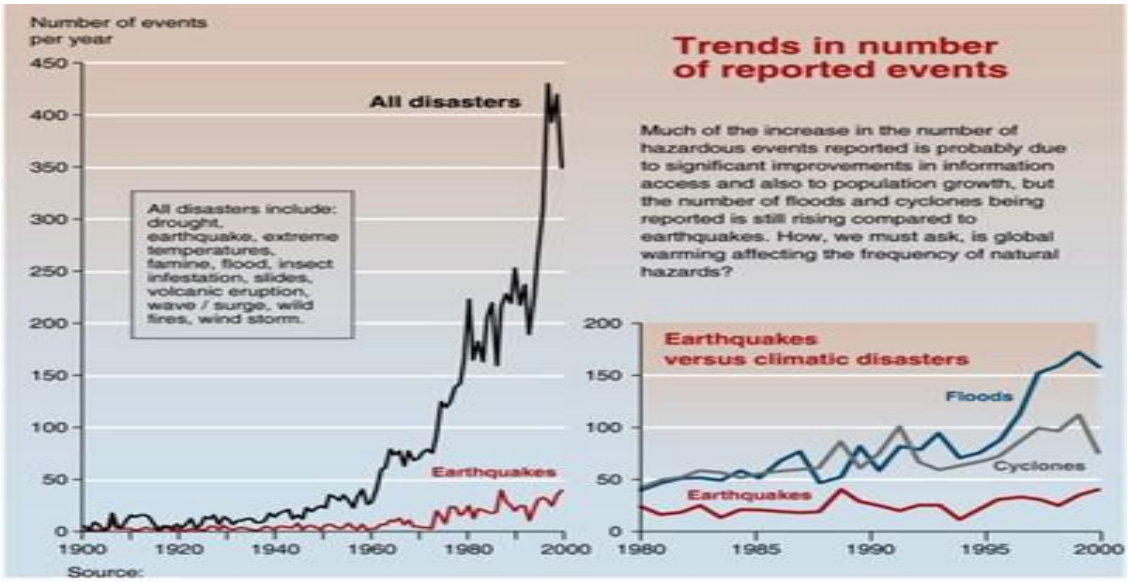
Haiti Earthquake (2010): On 12 January 2010, Haiti’s Earthquake was the country’s most powerful in more than 200 years causing more than 200,000 people killed, and 1.5 million left homeless. Moreover, thousands of homes, schools and hospitals were

destroyed. Five years after the Earthquake, approximately 80,000 people are still living in tents and makeshift shelters in Haiti (The Thompson Reuters Foundation, 2015).

Japan tsunami (2011): On 11 March 2011, a tsunami was trigger by a 9.0 magnitude earthquake causing the deaths of more than 16,000 people and property damaging severely (The World Vision Australia, 2011).

Nepal Earthquake 2015: The Earthquake hit Nepal on 25 April 2015, causing approximately 7,600 deaths and over 16,390 injuries. Over 255,900 houses were destroyed, while a further 234,000 were damaged, as well as 1,383 schools were estimated to be damaged by the earthquake in 26 districts (The Baptist World Aid Australia, 2015)

Trend of natural disasters



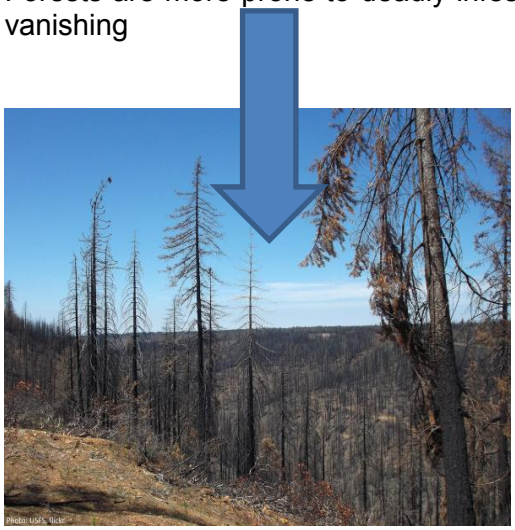
Source: Emmanuelle Bournay, UNEP/GRID-Arendal

Handout 2: What are the main impacts of climate change?

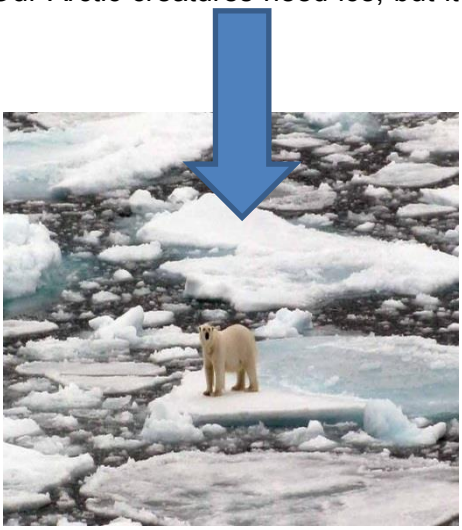
Examples of impacts of climate change

Coral and shellfish are suffering

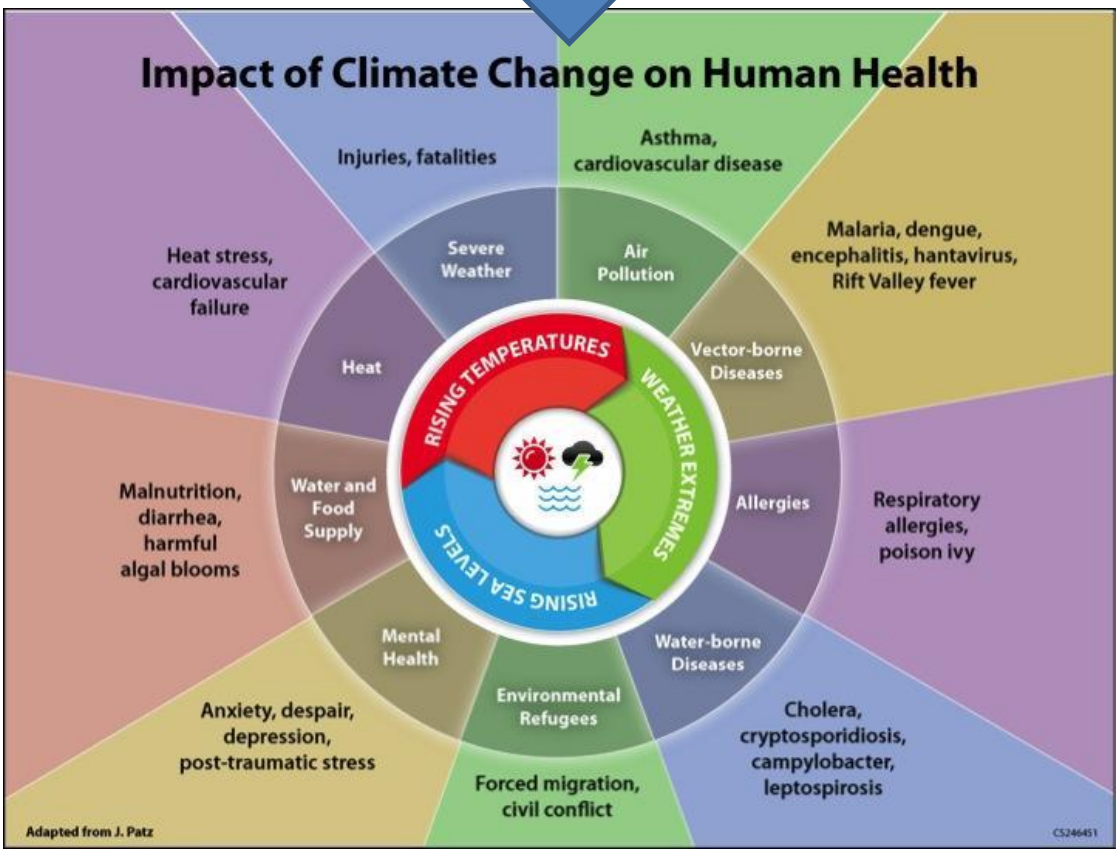
Forests are more prone to deadly infestations



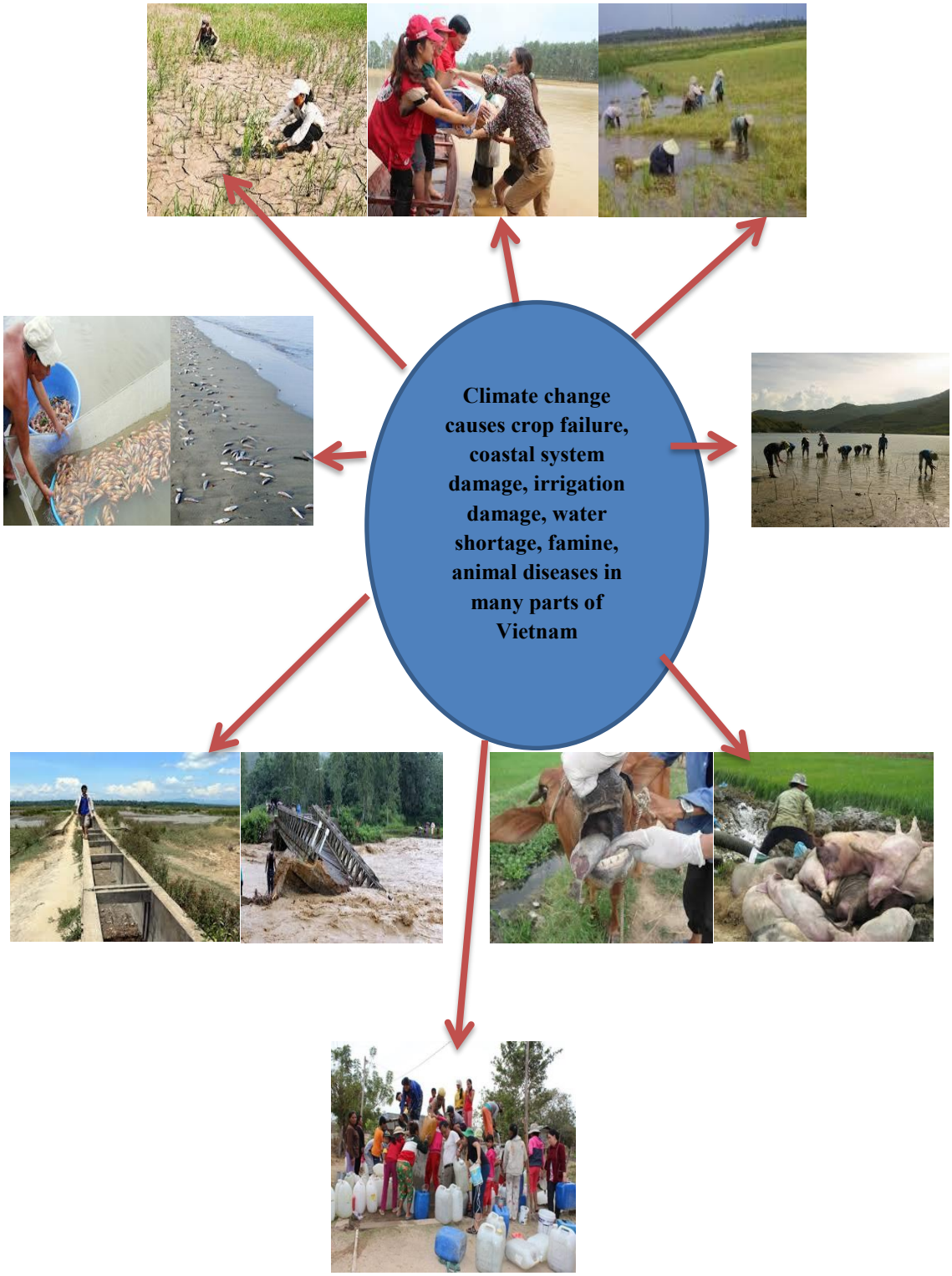
Our Arctic creatures need ice, but it is vanishing



Climate change cause human health problem



Source: U.S Climate Change Resilience (2015)


Climate change causes crop failure, coastal system damage, irrigation damage, water shortage, famine, animal diseases in many parts of Vietnam

Increase unemployment and unexpected migration because of droughts, foods, and soil salinity caused by sea level rise

Climate change destroys houses, sea-walls, roads, and other important infrastructure in Vietnam

Environmental pollution caused by death fish and floods.

Loss of education and ineffective study caused by floods and severe heat.

SECTION 2: CLIMATE CHANGE CAUSE

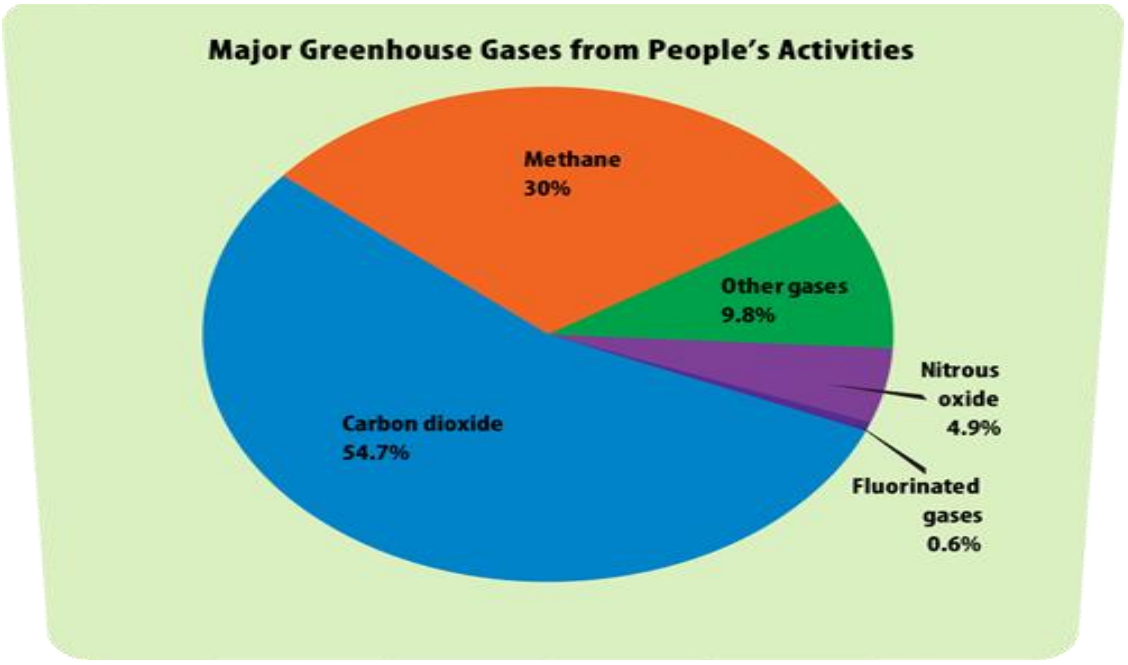
Handout 3: Greenhouse gases

Climate change is the result of changes in our weather patterns because of an increase in the Earth's temperature. This is caused by increases greenhouse gases in the atmosphere.

1. *What is greenhouse gas?*

Greenhouse gases have always been a natural part of the atmosphere. They absorb and re-radiate the sun's warmth and maintain the Earth's temperature at a level necessary to support life (Healey, 2000). Because these gases absorb the heat, they keep the average surface temperature on Earth around 14°C. Without the natural greenhouse effect, the Earth's average surface temperature would be around -19°C.

Major greenhouse gases from human' activities

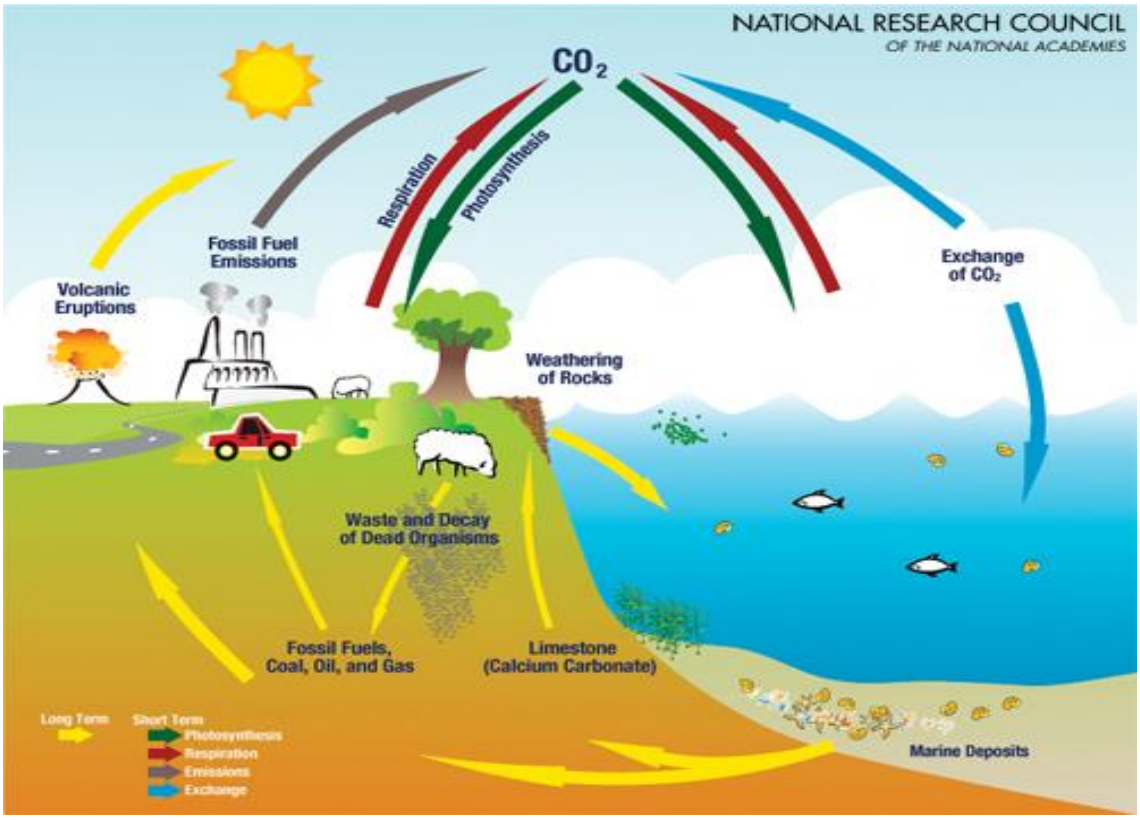


Source: IPCC (2007)

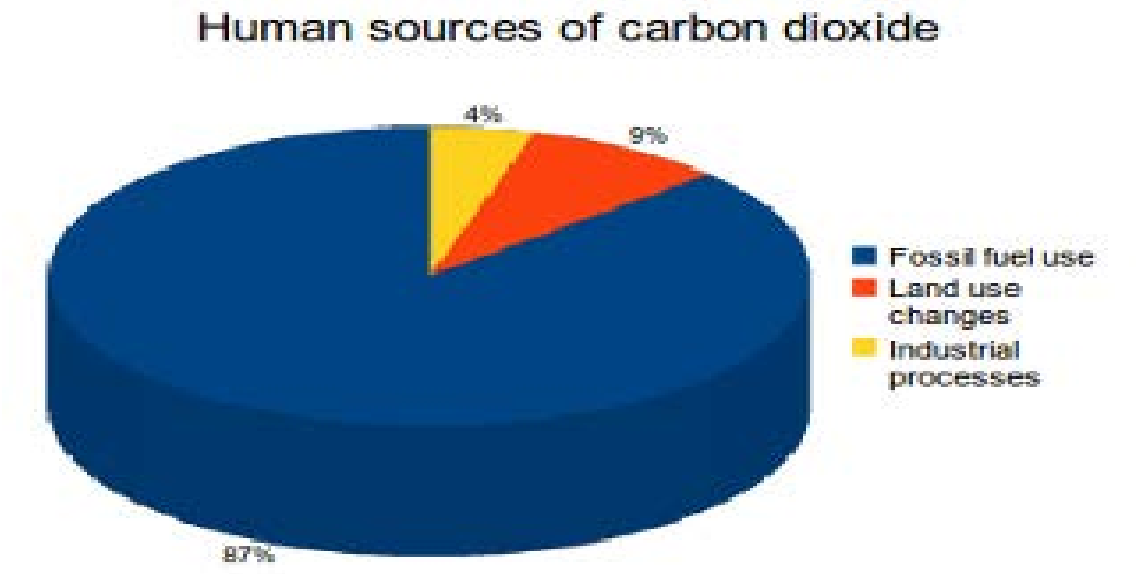
2. *Main elements of greenhouse gases*

Carbon dioxide (CO2): CO2 actually only a small part of the atmosphere, but one of the most important GHGs. CO2 is released naturally into the atmosphere through volcanic eruptions and animal respiration but it is also released through human activities such as deforestation and the burning of fossil fuels for energy. CO2 also spends a long time in the atmosphere, increasing its impact. Since the industrial revolution, humans have increased atmospheric CO2 concentration by 30 %).

Carbon dioxide cycle



Source: The National Centre for atmosphere research (2015)

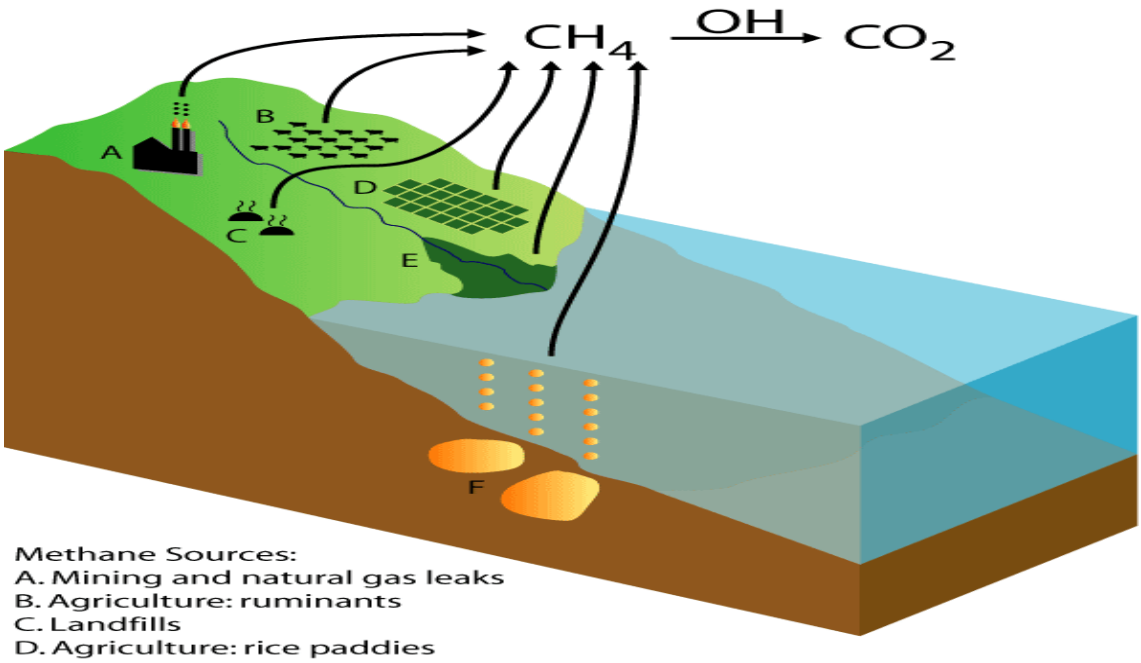


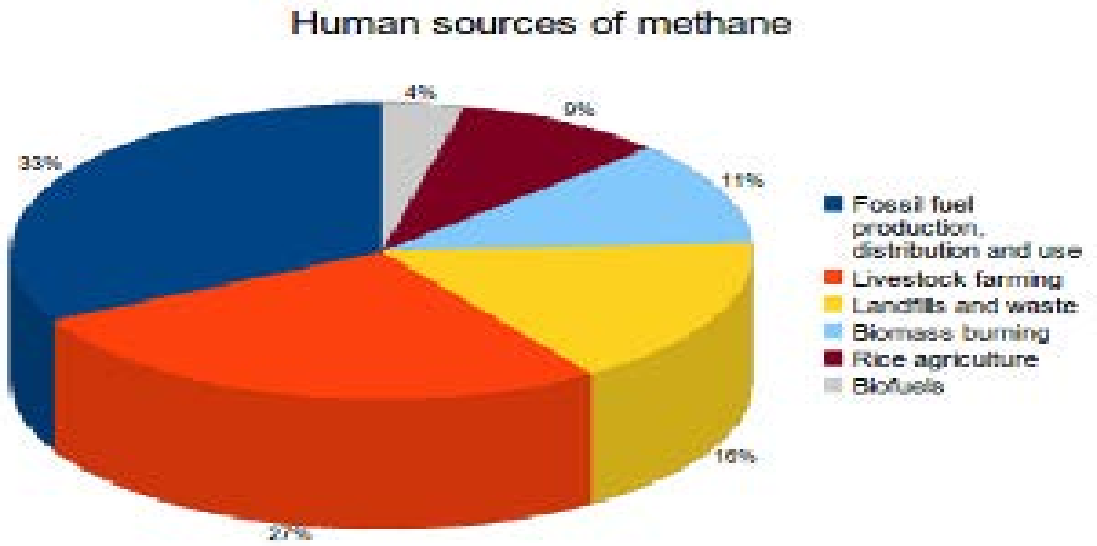
Source: Le Quéré, C. et al. (2013)

Methane (CH_4): The second most important GHGs, is produced both naturally and through human activities. The most significant sources of CH_4 come from the

decomposition of organic matter e.g. in landfills and in agriculture. Another large source is from the digestion of ruminants (cows, goats etc.). CH_4 is a stronger GHG than CO_2 because it can absorb more heat; however, it is much less abundant in the atmosphere.

Methane source

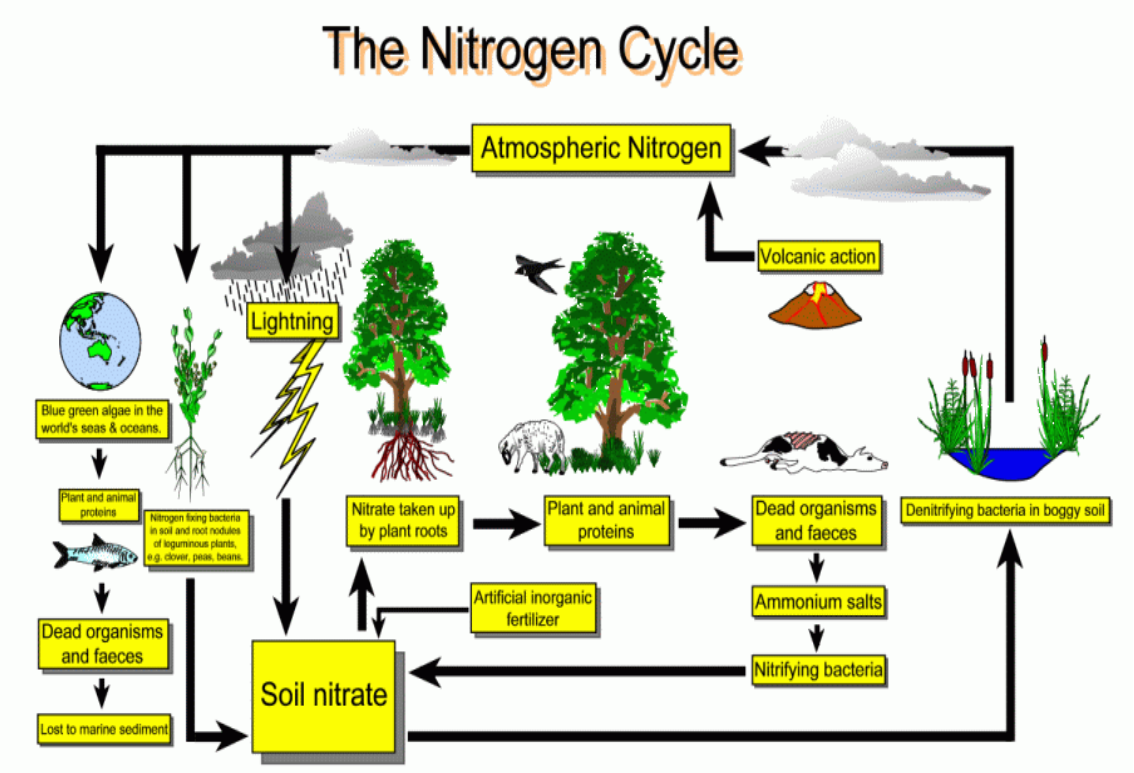


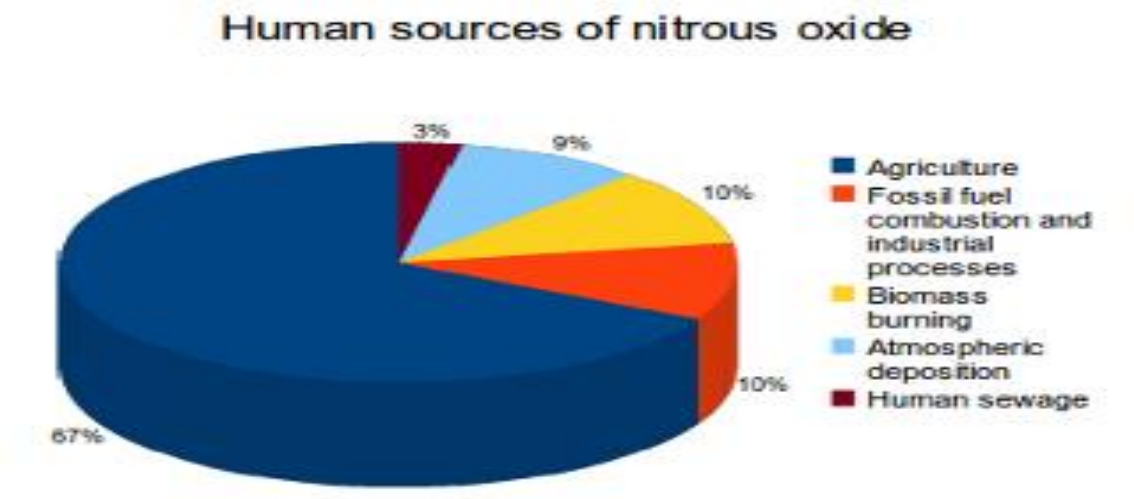


Source: Bousquet, P. et al. (2006).

Nitrous oxide occurs naturally in the atmosphere as one of the many forms nitrogen can take. However, large amounts of released nitrous oxide contribute significantly to global warming. The main source is the use of synthetic fertilizer in agricultural activities.

Nitrous oxide is also released from during the manufacturing of synthetic fertilizers. Motor vehicles release nitrous oxide when operating with fossil fuels like gasoline or diesel.



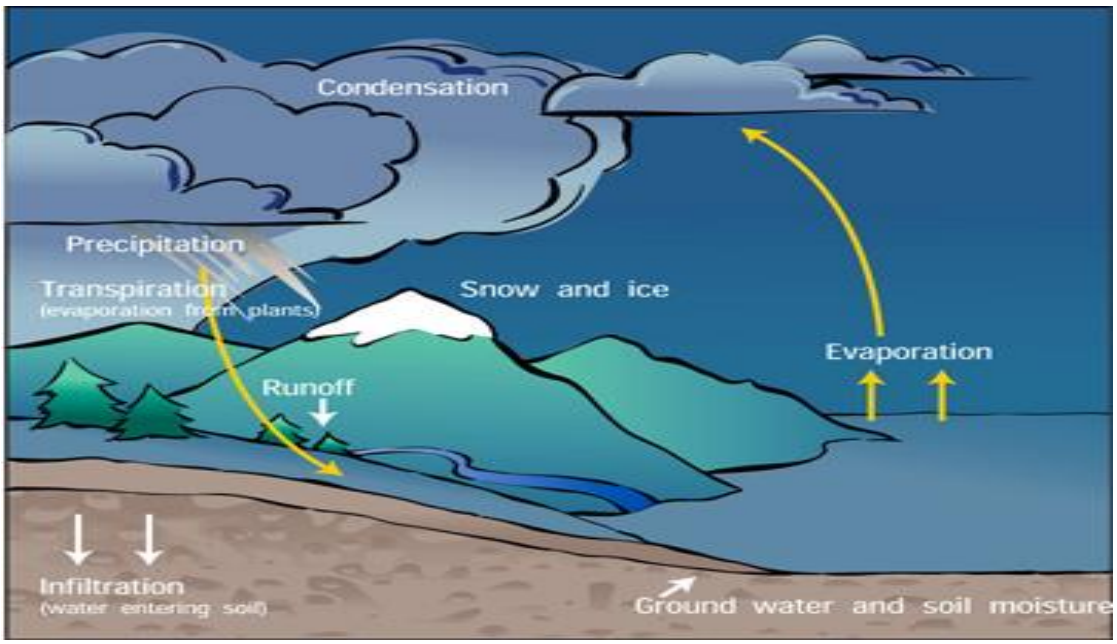


Source: IPCC Fourth Assessment Report: Climate Change (2007)

Chlorofluorocarbons (CFCs): CFCs are produced for industrial use, mainly in refrigerants and air conditioners. CFCs affect adversely on the Ozone Layer.

Water vapour (H_20): Water vapour is the most abundant greenhouse gas (GHGs); however because it spends just a short time in the atmosphere, and humans have a very large impact on the amount of water in the atmosphere, it is not considered the most important GHGs.

The water cycle



Source: The National Centre for atmosphere research (2015)

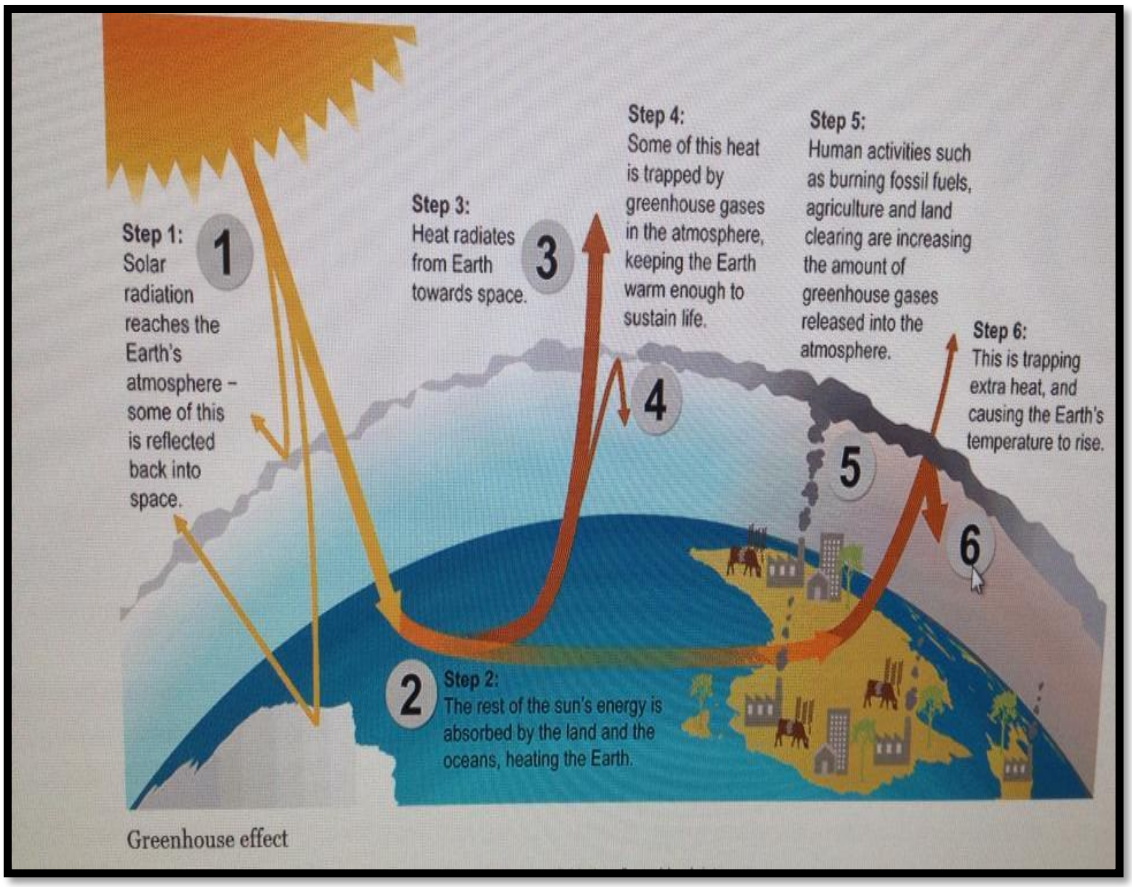
Handout 4: Global warming and greenhouse effect

What is global warming? Global warming refers to the recent and ongoing rise in global average temperature near Earth's surface. It is caused mostly by increasing concentrations of greenhouse gases in the atmosphere. Global warming is causing climate patterns to change. However, global warming itself represents only one aspect of climate change (US EPA, 2015)

What is greenhouse effect?

The greenhouse effect is a natural process that warms the Earth's surface. When the Sun's energy reaches the Earth's atmosphere, some of it is reflected back to space and the rest is absorbed and re-radiated by greenhouse gases.

Greenhouse effect



Step 1: Solar radiation reaches the Earth's atmosphere - some of this is reflected back into space.

Step 2: The rest of the sun's energy is absorbed by the land and the oceans, heating the Earth.

Step 3: Heat radiates from Earth towards space.

Step 4: Some of this heat is trapped by greenhouse gases in the atmosphere, keeping the Earth warm enough to sustain life.

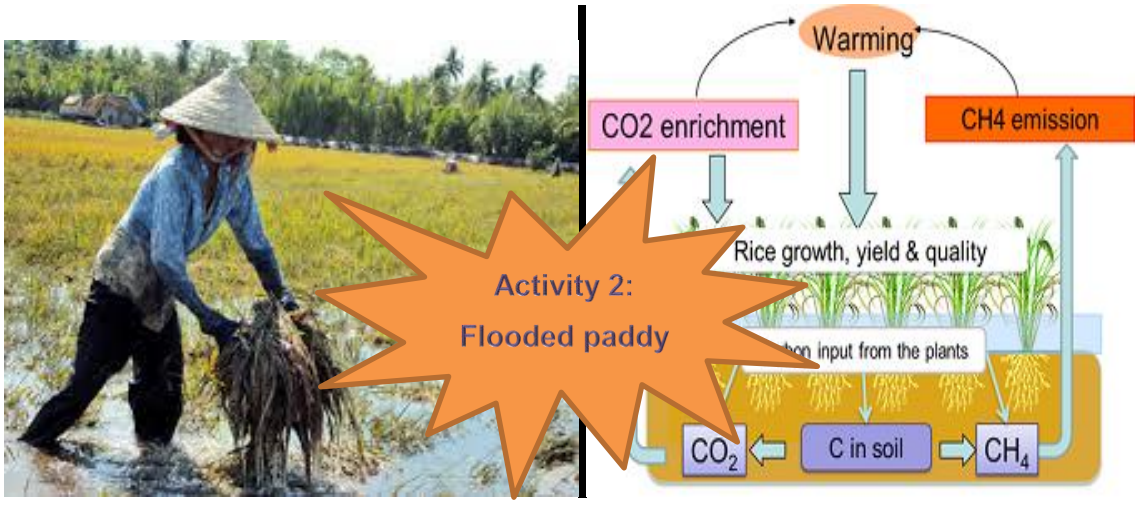
Step 5: Human activities such as burning fossil fuels, agriculture and land clearing are increasing the amount of greenhouse gases released into the atmosphere.

Step 6: This is trapping extra heat, and causing the Earth's temperature to rise.

The problem we now face is that human activities – particularly burning fossil fuels (coal, oil and natural gas), agriculture and land clearing – are increasing the concentrations of greenhouse gases. This is the enhanced greenhouse effect, which is contributing to warming of the Earth.

Handout 5: What have you done to exacerbate climate change?

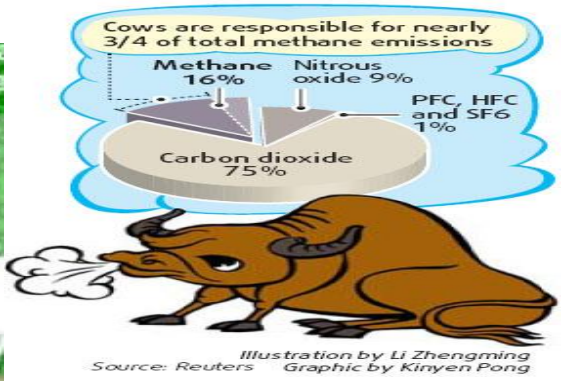
Note: There are nearly three billion people around the world burn coal or solid biomass (including wood, charcoal, agricultural waste, and animal dung) in open fires or inefficient stoves for daily cooking and heating. In addition to the health burden from smoke inhalation, burning solid fuels releases emissions of some of the most important contributors to global climate change: carbon dioxide, methane and other ozone producing gases (Global Alliance for clean cook stoves, 2015).

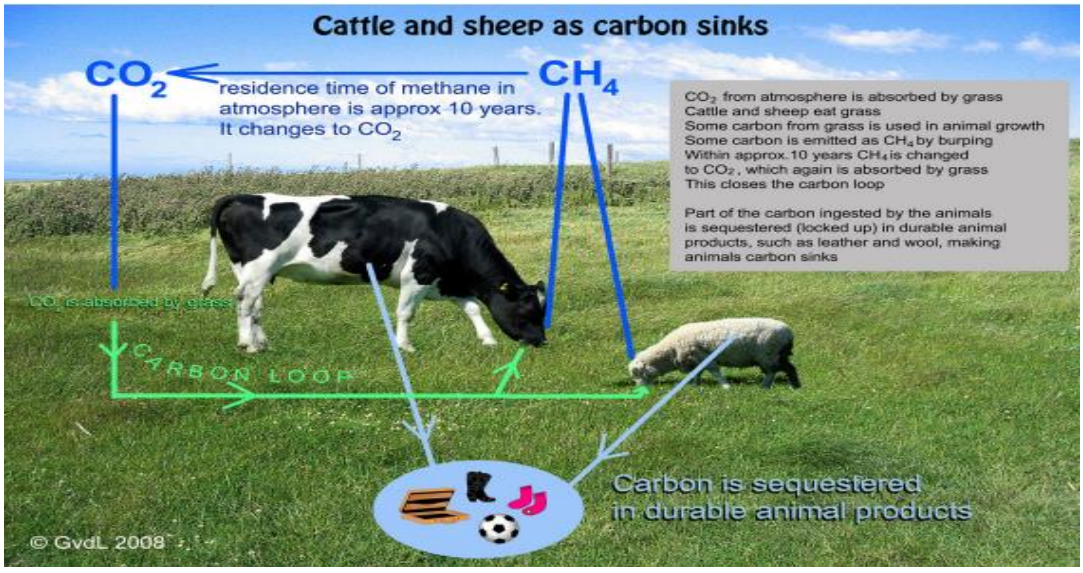


Activity 3: Using fertilizers and pesticides for crops

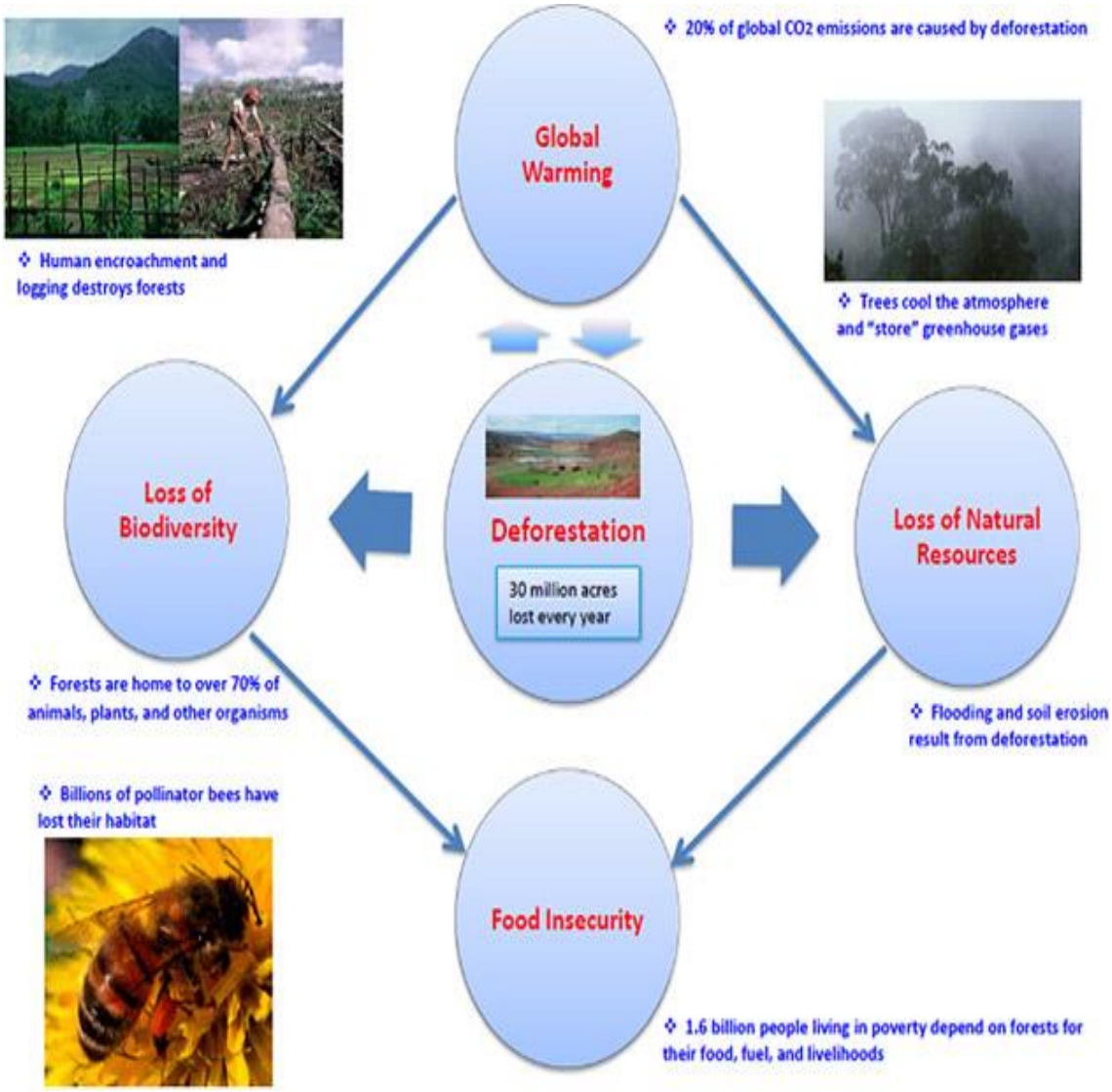
Activity 4: Land clearing and land use

Activity 5: Ruminants





Deforestation and climate change

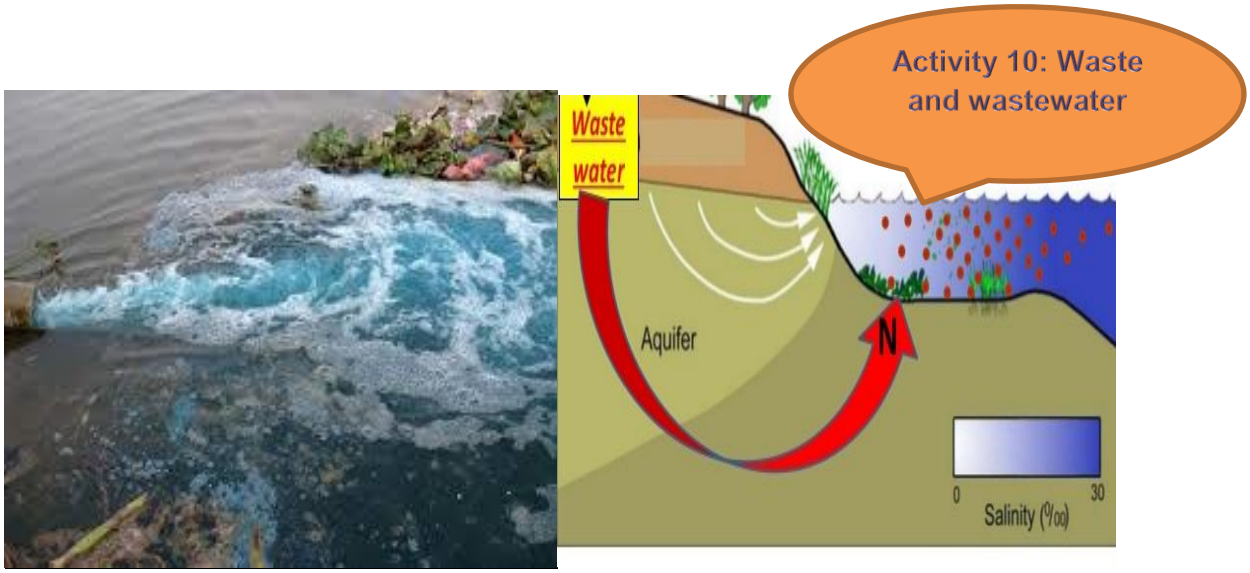


Source: The Alabama Cooperative Extension System (2015).

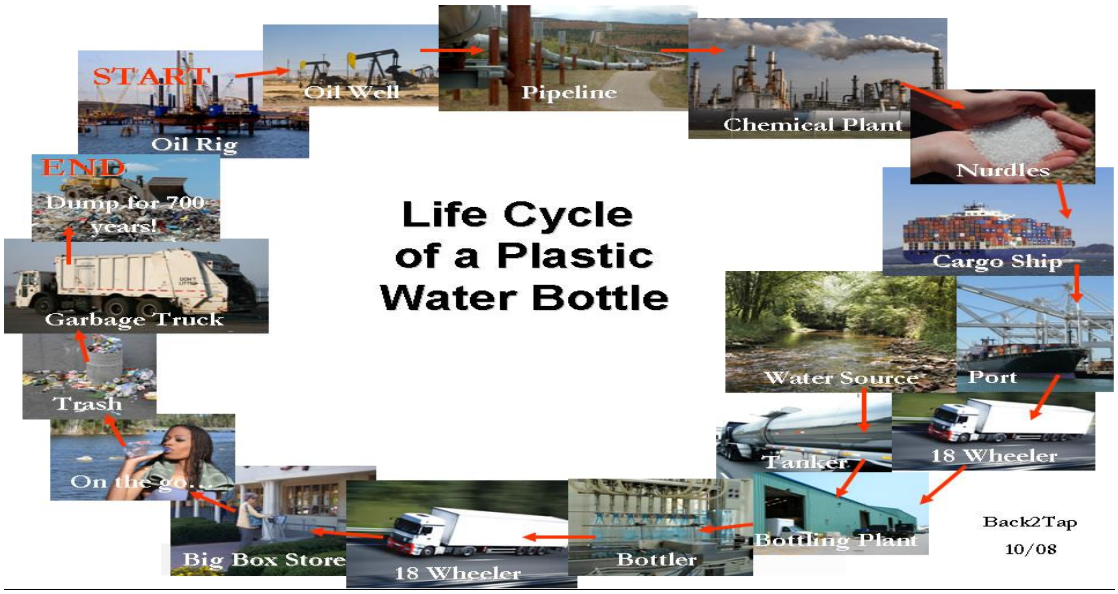
Activity 7: Using transportation and Agricultural machinery


Activity 8: Industry
CO_2


Activity 9:
Landfill
Landfill
Leachate


Activity 10: Waste and wastewater
Waste water
Aquifer
N
0
30
Salinity (‰)

Activity 11: Plastic bags and bottles

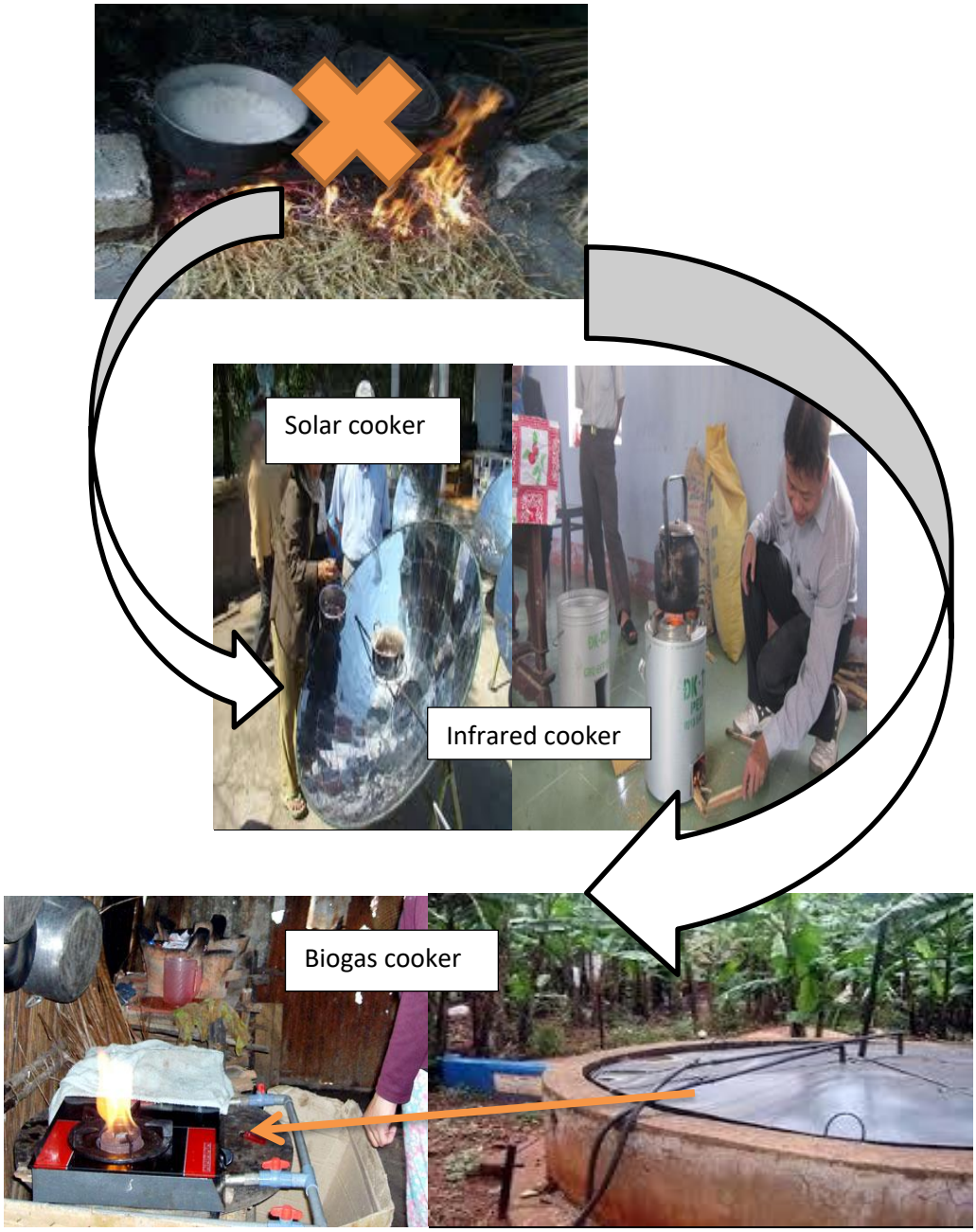


Activity 12: Electricity use and production

SECTION 3: CLIMATE CHANGE MITIGATION AND ADAPATION

Handout 6: Strategies to help mitigate greenhouse gas emissions

Action 1: Using effective cookers



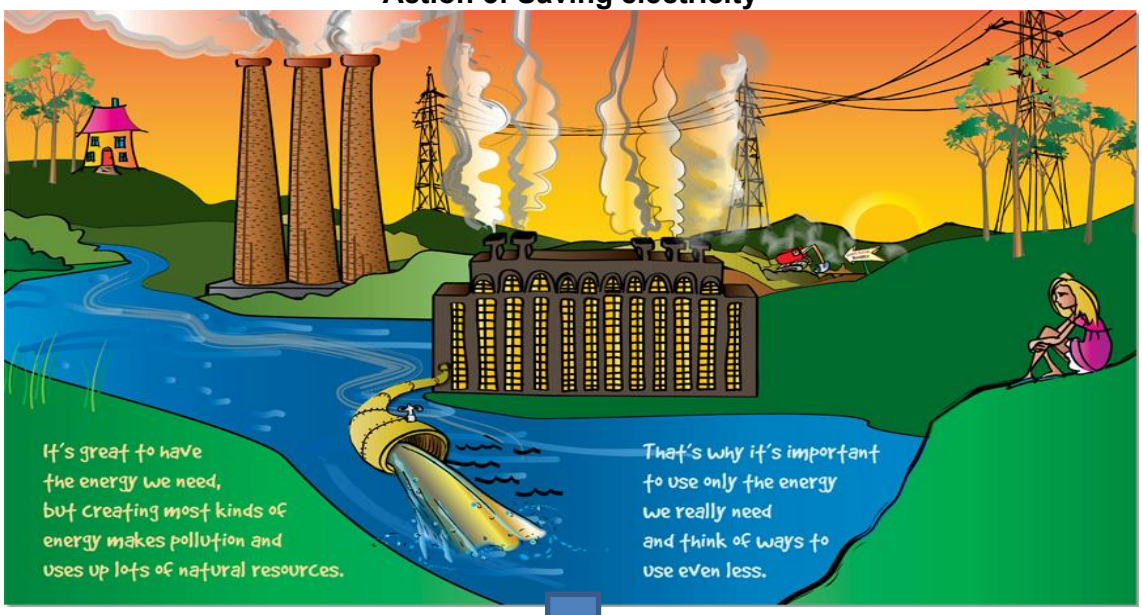
Action 2: Planting trees

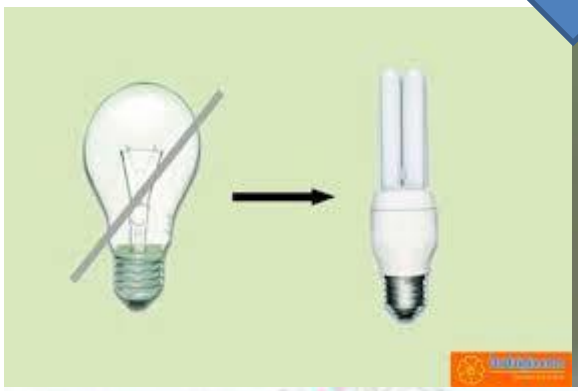
Action 3: Minimizing carbon footprint of transportation

Action 4: Using effective shoping bag

Because: The production of 1 kg of polyethylene, which used to produce plastic bags, requires the equivalent of 2 kg of oil for energy and raw material. Burning 1 kg of oil creates about 3 kg of carbon dioxide. In other words: if we produce one kg of plastic, about 6 kg carbon dioxide is created during production and incineration.

Action 5: Saving electricity



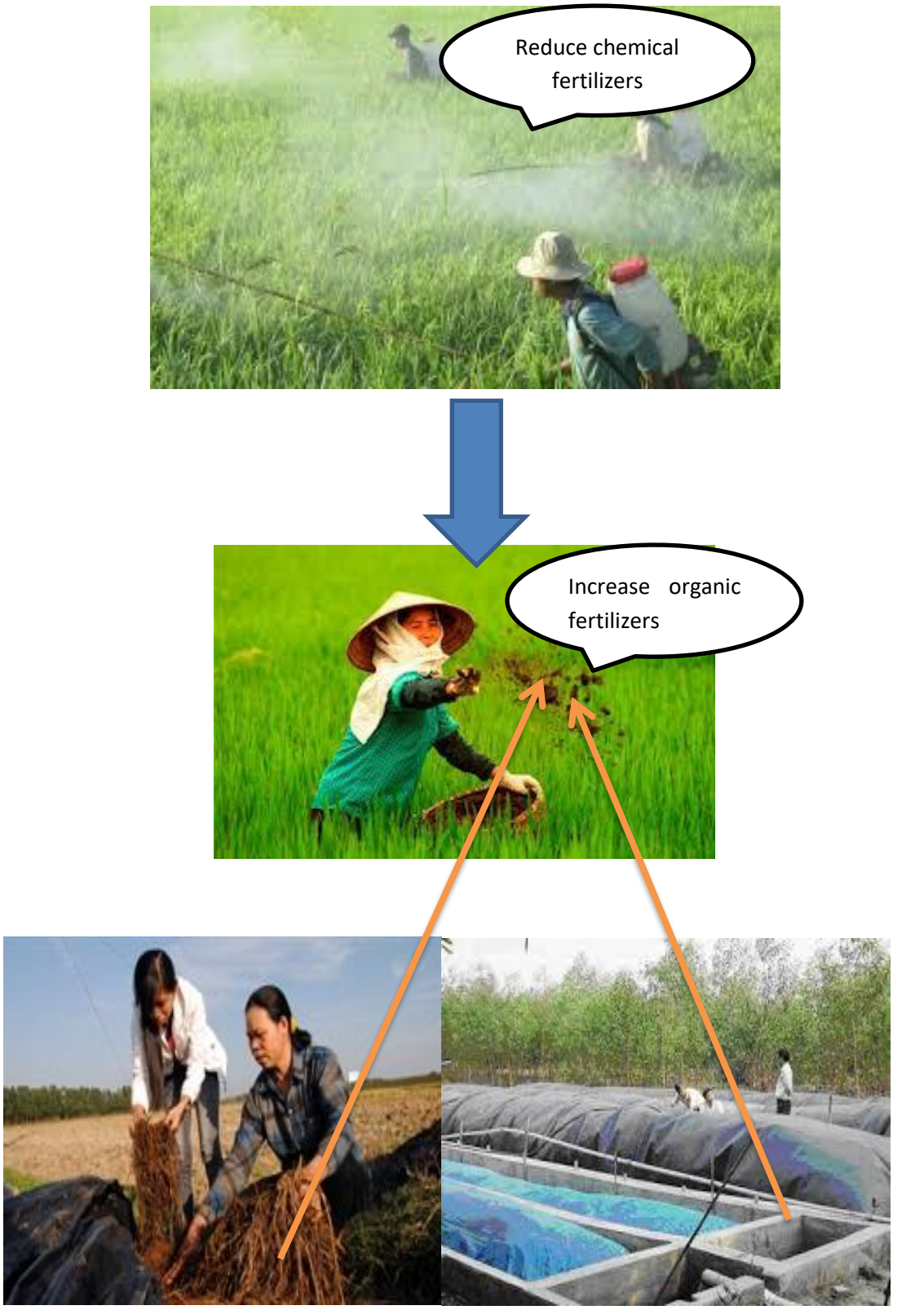


Action 6: Recycling

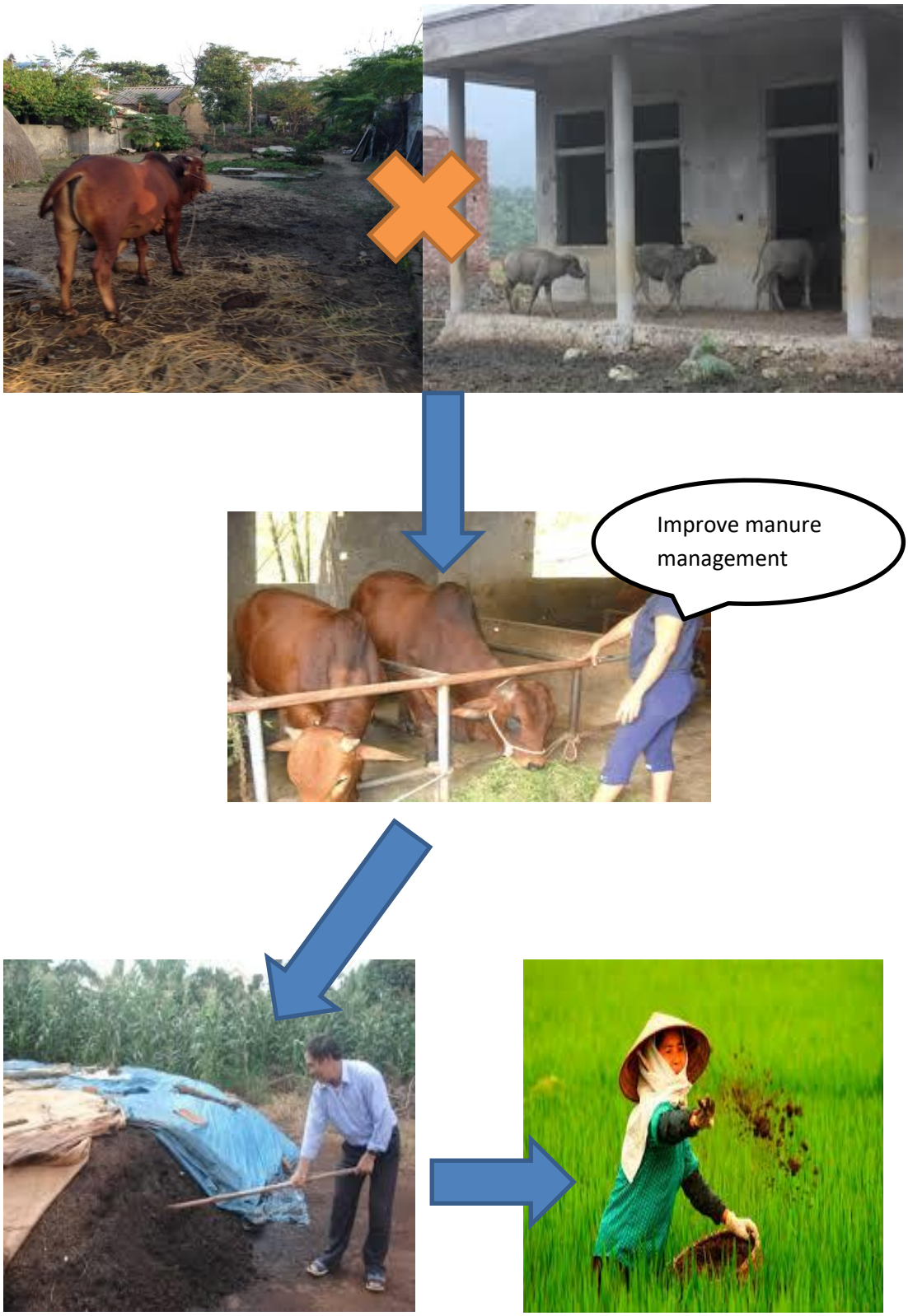
Action 7: Reducing meat consumption

Action 8: Using straw for effective ways

Action 9: Using organic fertilizers



Action 10: Improvement animal manure management



Action 11: Clean village cannals

Important strategy: Spread out and education to help mitigate and adapt to climate change

Handout 7: Strategies to adapt to climate change in coast communities

1. Key strategies to adapt with sea level rise

2. Key strategies to adapt to floods and storms

Step 1: Before flood and storms, you need:

Strengthen houses and

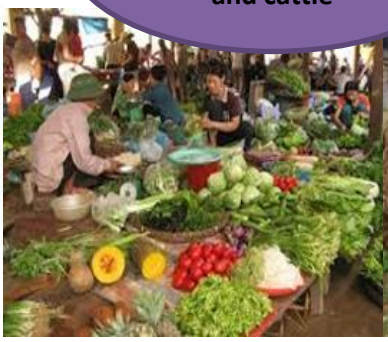




Strengthe n dykes

Trim branches of big trees

Store food and medicine for people and cattle


Step 2: During floods and storms

Follow and update weather forecasts from



Migration plan


Emergency preparation and actions



Step 3: After floods and storms

Aid activities from local governments and organizations

Community Hygiene activities

Recovery activities

3. Key strategies to adapt to drought and water shortage

Appendix D: Teacher's fact sheet

Fact sheet 1: Weather, climate, and climate change

Weather	*Climate*	*Climate change*
Weather is the meteorological state of the atmosphere at a specific place and time, possibly for an hour, a day or several weeks. **For example, it was raining today at school. Yesterday it was sunny at home.**	The climate is the common, average weather conditions at a particular place over a long period (for example, more than 30 years). For example, Vietnam has a tropical monsoonal climate	*Climate change* refers to any significant change in the measures of climate lasting for an extended period. In other words, climate change includes major changes in temperature, precipitation or wind patterns, among other effects, that occur over several decades or longer

Fact sheet 2: Evidence of climate change in worldwide and Vietnam

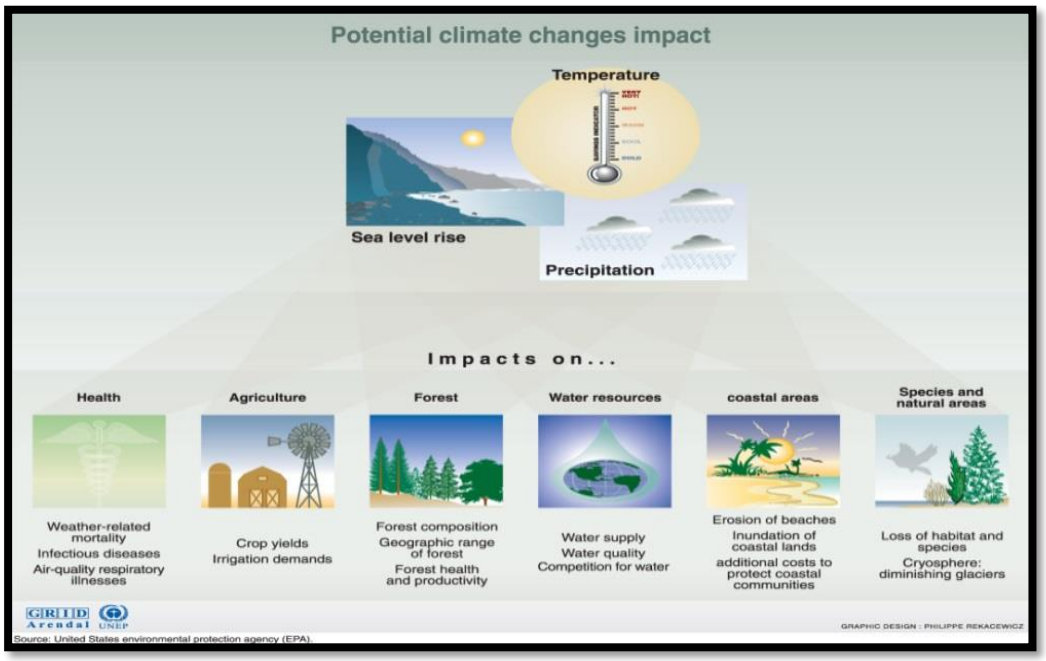
	The world	Vietnam (MONRE, 2010)
Temperature rise	According to IPCC (2007), in the 20th century, the average temperature of all continents and oceans significantly increased. The global surface temperature reconstruction show that Earth has warmed since 1880. Most of the warming occurred in the past 35 years, with 15 of the 16 warmest years on record occurring since 2001. The year 2015 was the first time the global average temperatures were 1 degree Celsius or more above the 1880-1899 average. Even though the 2000s witnessed a solar output decline resulting in an unusual deep solar minimum in 2007-2009, surface temperatures continue to increase.	During the last 50 years (1958 – 2017), the temperature in Vietnam increased by about 0.5 – 0.7 ^{0}C. MORNE predicted that by the end of 21st century, the temperature in Vietnam would have increased by 1.6 – 3.6^{0}C in the North and in the South relative to baseline period 1980-1999.
Sea level rise	Global sea levels have risen at an average rate of 1.8 millimetres per year over 1961 to 2003. This rate rose to around 3.2 millimetres per year from 1993 to 2012. However, rates of sea level rise are not uniform around the globe and vary from year to year (Healey, 2014).	During the period of 1993-2008, sea level rise rate was 3mm/year. By mid-21st century, sea level rise is projected to have risen by 28-33cm, and by the end of 21st century, by about 65-100cm, relative to the baseline period of 1980-1999.
Extreme weather events	- Extreme weather events include heatwaves, bushfires, tropical	- Typhoon: • More typhoons of higher intensity

	cyclones, cold snaps, extreme rainfall and droughts. - Evidence shows that the frequency and intensity of many extreme weather events are changing. For example, the number of extreme hot days and warm nights has been increasing, while the frequency of cool days and cool nights has been decreasing in many areas of the world (Healey, 2009). - Rainfall patterns are changing around the world. Research shows the global water cycle is intensifying with a warming climate, which means wet areas are likely to become wetted and dry regions are likely to be drier in response to climate change (Healey, 2009).	• Last longer • Tending to move southwards - Cold fronts: • The overall number of cold fronts has increased significantly • Taking more frequently - Rainfall: • The average annual rainfall has decreased over Northern climate zones but increased over Southern zones. • The overall number of heavy rainfall events has increased across the country

Fact sheet 3: Climate change impacts

Climate change causes temperature rise, sea level rise and precipitation; therefore, leading to huge impacts on several aspects of human existence such as health, agriculture, forest, and water management, as well as coastal and natural management.

Some key potential climate changes impacts



Source: The United States Environmental Protection Agency (2015).

Fact sheet 4: How do human activities contribute to enhancing climate change?

- **Energy Supply:** The burning of coal, natural gas, and oil for electricity and heat is the largest single source of global GHGs.
- **Industry:** GHGs from industry primarily involve fossil fuels burned on-site at facilities for energy. This sector also includes emissions from chemical, metallurgical, and mineral transformation processes not associated with energy consumption.
- **Land use and forestry**: GHGs in this sector primarily include CO_2 emissions from deforestation, land clearing for agriculture, and fires or decay of peat soils.
- **Agriculture:** GHGs from agriculture mostly come from the management of agricultural soils, livestock, rice production, and biomass burning.
- **Transportation:** GHGs from this sector primarily involve fossil fuels burned for road, rail, air, and marine transportation. Almost all (95%) of the world's transportation energy comes from petroleum-based fuels, largely gasoline and diesel.
- **Commercial and residential building:** GHGs from this sector arise from on-site energy generation and burning fuels for heat in buildings or cooking in homes.
- **Waste and Wastewater:** The largest source of GHGs in this sector is landfill methane (CH_4), followed by wastewater methane (CH_4) and nitrous oxide (N_2O). Incineration of some waste products such as plastics and synthetic textiles, also results in minor emissions of CO_2.

Fact sheet 5: Climate change mitigation

Definition: Climate Change mitigation refers to efforts to reduce or prevent emission of greenhouse gases (US.EPA, 2015).

Mitigation strategies to help reduce GHG emissions

1. Using improved cook stoves in Vietnam (energy saving cook stoves)

Replace traditional stoves with improved cook stoves and gas cookers to reduce both black carbon and $C0_2$ emissions. Nearly three billion people use biomass fuel such as wood, dung, leaves, or agricultural remnants for heating and cooking in South Asia. Using biomass fuel for heating and cooking in South Asia is responsible for 26% of black carbon emissions globally and 2.7% of the global disease burden (United Stated Environmental Protection Agency, 2015). Improved stoves use multiple types of fuel and support large-scale adoption of clean and safe household cooking solutions as a way to save lives, protect health, and reduce climate change emissions. Furthermore, an improved stove is a simple and cheap initiative to replace traditional cooking which cause greenhouse gas emission, human disease, and waste fuel.

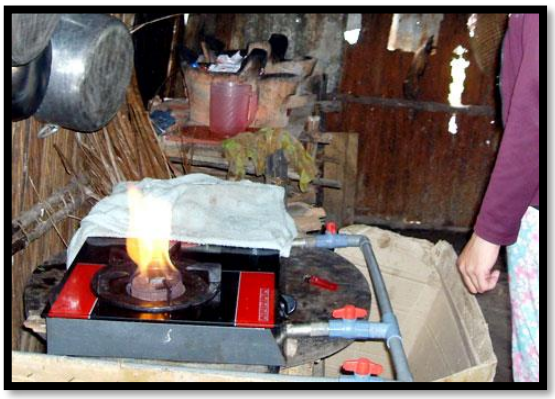
Three types of improved stoves should be useful in Vietnamese rural areas, including:

Type 1 is parabola cooker and solar cooker, which uses solar energy to enhance temperature that is suitable with the Vietnamese climatic condition.

Parabola cookers and solar cookers

Type 2 is stove-using biogas.

Biogas is produced from animal manure and fermented organic pollutants without air. Biogas tunnels double benefits for households raising livestock, including environmental protection and saving energy by using biogas for cooking, heating, and lighting.



Type 3 is an infrared cooker. This cooker uses agricultural byproducts such as crop straw, corncob, sawdust, and rise husk, which cause air pollutants and land pollutants in many Vietnamese rural areas. The infrared cooker saves fuel, gives high temperatures, and is safe for users. In addition, scraps after cooking are mixed with animal manure to become a useful organic fertilizer for crop and improve land yield.

2. *Activities to help mitigate GHG emissions in agriculture*

- Stop burning straw after harvesting and domestic use to reduce CH4, black carbon.
- Save irrigation and adjust irrigation
- Use crop's straw for animals' food.
- Use more organic fertilizers and less chemical fertilizers and pesticides in yield crops. It was found that in many Vietnamese rural areas, farmers only use 0.5 – 1-ton organic fertilizer per hectare while it is recommended that farmers should use 8-10 tons of organic fertilizers per hectare ("Using excessive allowed of fertilizers," 2011).

3. Activities to help mitigate GHG emissions by planting trees and forest

Trees and forests help to slow climate change because they absorb carbon dioxide during photosynthesis. Trees also absorb noise; provide shade, which helps keep streets and houses cooler in the summertime. One tree can absorb 1 million tons of $C0_2$ during its life, therefore:

- Stop cutting trees and forest for cooking and selling.
- Plant more trees at schools, gardens, and villages
- Plant and protect forests
- Prevent potential bushfires

4. Activities to help mitigate GHG emissions in husbandry

The most useful and popular ways to reduce GHGs in terms of husbandry are:

- Reduce feeding grass to cattle
- Increase feeding of processed food for cattle and other animal
- Clean animal's facilities
- Improve animal's manure use: convert to fuel and crop's manure

5. Activities to help mitigate GHG emissions in transportation

- Buy fuel efficient vehicles
- Use bicycles or walk if you do not travel too far. It can help save 0.3kg $C0_2$ per km without driving.
- Keep vehicle's tires inflated to help saving fuel and therefore mitigate $C0_2$.

6. Changing living habit and saving energy

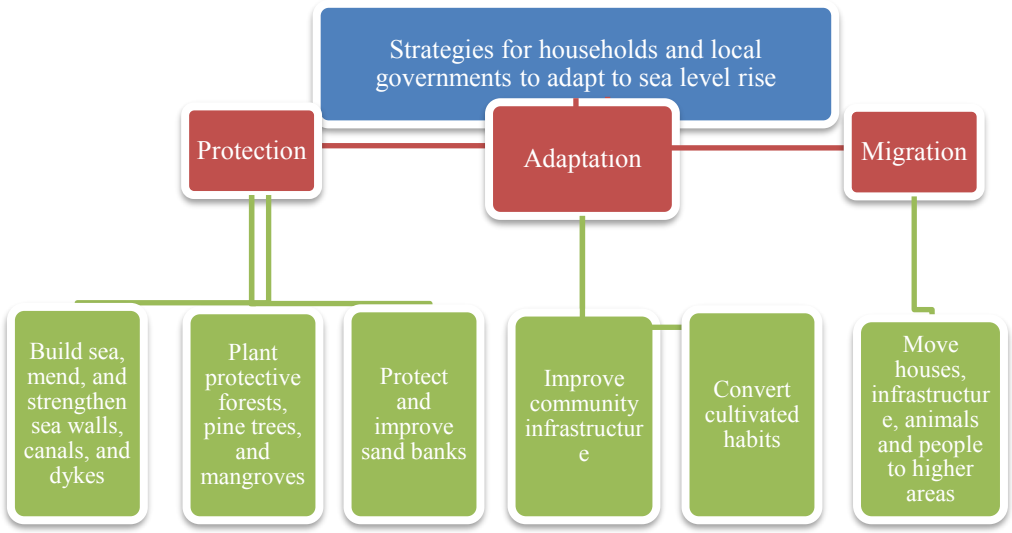
- Reduce eating meat.
- Eat alternative foods such as soybean, organic food, and vegetarian.
- Use hand- baskets to shop to avoid plastic bags.
- Print and write on double - sided papers
- Recycle plastic bags, papers, plastic bottle
- Turn off electricity equipment when not in use. This can help to reduce GHGs by several hundred kgs $C0_2$/year.
- Use compact 11W lights and other energy saving equipment.
- Consider buying locally grown food and local products: The further your food and products travel, the more greenhouse gas emissions are produced in transporting the food from the farm to your plate.
- Reduce hot water use because boiling water needs a lot of energy.

Factsheet 6: Climate change adaptation in the coastal areas

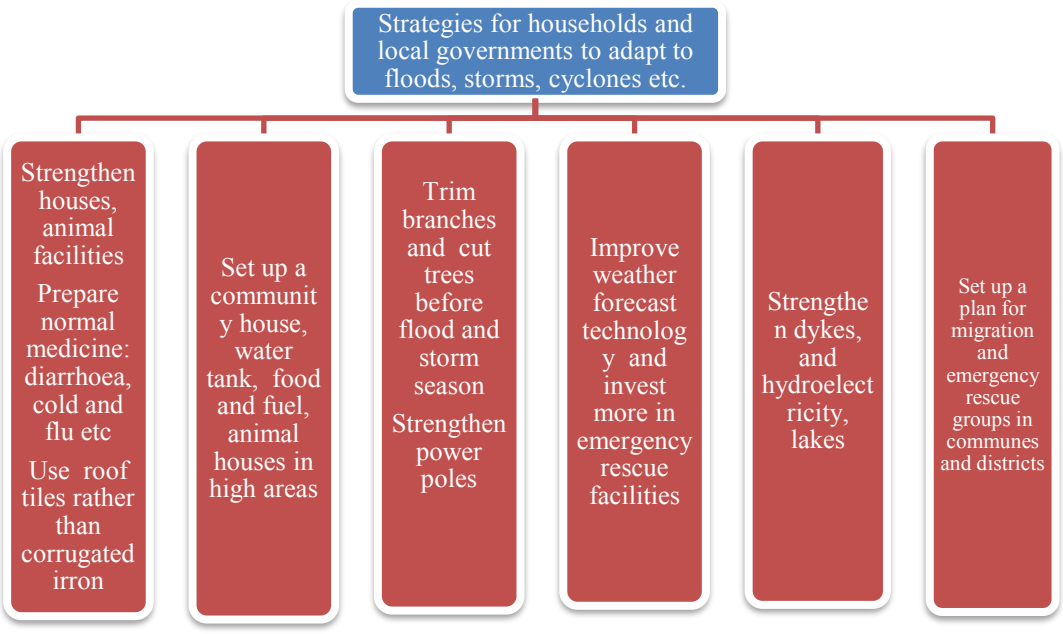
Definition: refers to any adjustments to human activities that make us less vulnerable to actual or expected climate change and associated climate variability, or actions that take advantage of opportunities presented by climate change.

Adaption strategies in coastal Vietnamese communities

1. Adapt with sea level rise



2. Adapt to floods and storms



3. Adaptive strategies with drought and water shortage