STUDY ON IMPACT OF CLIMATE CHANGE ON AGRICULTURE AND FOOD SECURITY

Case studies in Vietnam

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Ha Noi, August 2008

This study is financed by Action Aid

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1. Background

Climate Change (CC) has been emerging as a global issue in recent years, which has received serious attention in series of conferences held across the world. CC has negatively impact to all countries, nevertheless studies suggest that poor country often the hardest-hit ones due to the fact that they are having much more limited resources, compared to developed countries, to cope with the situation. According to finding of a study conducted by the United Nations Development Program (UNDP), Vietnam is the graded fifth in vulnerability under the impacts of CC. As an agriculture-dominant economy, the country's livelihood is being under severe impacts of CC. In a technical seminar held in the early part of this year[1] Minister of Agriculture Mr Cao Duc Phat acknowledged that 73 per cent of the population, especially poor people are suffering from negative impacts of CC and environment degradation.

As the trend and intensity of such disasters is increasing, in 2007 alone, the series of disasters killed 462 people, injured another 856, seriously affected 763,081 households, destroyed 9,908 houses and inundated 173,830ha of crops[2]. While affected communities are constantly searching for solutions, the increasing frequency of disasters is overwhelming the ability of local communities to cope the impact of CC. The findings of UNDP in its poverty study pointed out that "natural disasters constitute a major cause of poverty and vulnerability in Vietnam".

Recently, Vietnamese government begins to pay much attention to CC problems and its effects. Therefore, many national policies and program have been formulated to deal with CC such as program of cohabiting with flood, program of dyke along the sea, etc. In parallel to central and local authorities, many international organizations also participate actively in limiting CC effect on the inhabitants, particularly the poor, for example OXFARM, ACTIONAID, etc. The inhabitants themselves, or together with support from NGOs and local authorities have many solutions or adaptation to deal with natural disaster and CC. In short, Vietnam is not an exception related to CC because it now suffer many negative effects, especially it has great impact on the poor and in provinces of difficulties. Each province has its own solution to deal with this. Therefore, the consolidation of experience solving problems of CC and adaptation of local inhabitants can help much in the formulation of national policies in order to increase the effectiveness of solution for CC.

2. Objectives of the study

This study aims at developing a country specific case study based on the methodology outlined in the TOR for the ActionAid study of the *Impact of CC on Agriculture and Food Security* at international level, with the following objectives:

1. To examine how existing trends in CC on livelihood and food security of local people; to identify existing vulnerability to shocks and stresses and whether this vulnerability is becoming increasingly difficult to cope with
2. To uncover actual adaptation strategies in response to CC, who participates, and how, and what are the limits to existing coping strategies

[1] Seminar on CC organized by Ministry of Agriculture and Rural Development on 16th January 2008 in Hanoi

[2] Source: Report of the Central Flood and Storm Control Committee 2007

3. To analyze if adequate mitigation measures are reflected in the policies and being taken by governments, donors, multilateral adaptation funding mechanisms, and international financial institutions

3. Methodology

The proposed study is an attempt to underline the plight of poor farming community and their increased food insecurity due to the impact of CC. The proposed area for the research is located in Ha Tinh province which is situated the semi-mountainous central coastal region of Vietnam. This area is very much vulnerable to typhoons, flash floods and drought. Thus, the extreme climate conditions have left the people of this province extremely vulnerable to multiple hazards. Two districts of Ha Tinh are chosen to conduct survey: Vu Quang and Loc Ha districts. Vu Quang represents mountainous area whole Loc Ha is a representative of costal or estuary area.

The study will consist of two main components: desk study and primary field research.

- **Desk study** will review agriculture, CC and related policies affecting food security of vulnerable communities.
- **Field research** will collect primary data on CC adaptation and local community and household level coping mechanisms with an explicit focus on the gender dimension. A key concern is uncovering actual adaptation strategies in response to CC, who participates, and how, and how this relates to hunger and food insecurity. Related to this we are interested in uncovering how successful adaptation practiced at household and community levels might be fostered and better supported, and through what kinds of interventions.

The information on the field is collected through the discussions with the local experts, local authorities and the people. In addition, discussions in groups are held and statistic data is collected for reference.

SECTION I: GENERAL OVERVIEW

I.1. Climate change in Vietnam

I.1.1. Current situation of climate change

There is no internationally agreed definition of the term "climate change". Climate change can refer to: (i) long-term changes in average weather conditions (WMO usage); (ii) all changes in the climate system, including the drivers of change, the changes themselves and their effects (usage by Global Climate Observing System); or (iii) only human-induced changes in the climate system (UNFCCC usage). To assess climate change and food security, FAO prefers to use a comprehensive definition of climate change that encompasses changes in long-term averages for all the essential climate variables. The World Meteorological Organization (WMO) requires the calculation of averages for consecutive periods of 30 years. Such a period is long enough to eliminate year-to-year variations[3](see annex 2).

However, in this study, we use the definition of climate change given by Ministry of Natural Resource and Environment[4] as following:

CC is any long-term significant change in the "average weather" that a given region experiences. Average weather may include average temperature, precipitation and wind patterns. It involves changes in the variability or average state of the atmosphere over durations ranging from decades to millions of years. These changes can be caused by dynamic processes on Earth, external forces including variations in sunlight intensity, and more recently by human activities which change component of atmosphere or which result from land exploitation and utilization.

According to observation data, there are some issues related to CC in Vietnam that should be paid attention as follows[5]:

- *Temperature:* In the past 50 years (1951 - 2000), the average temperature in Vietnam had increased 0.7^{o}C. The average temperature of four recent decades (1961 - 2000) was higher than the one of the 3 decades before (1931- 1960). The annual average temperatures during 1991 - 2000 in Hanoi, Da Nang and Ho Chi Minh City were respectively 0.8; 0.4 and 0.6oC higher than in 1931 – 1940. In 2007, the average temperature in all provinces mentioned above were higher than the one in the period of 1931 - 1940 (accordingly 0.8 – 1.3oC) and in the period of 1991 - 2000: 0.4 – 0.5oC. According to Mrs. Nguyen Thi Hien Thuan, Vice Director of the Branch Institute of Economic- Resource and Environment in Ho Chi Minh: *"The climate in Vietnam is 0.1 – 0.2^{o}C in more than 10 previous years. The sea level rises at higher level. Despite of little change in rainfall, the raining time change, the dry season lasts longer, and it is more rain during rainy season which leads to the increase of drought and flood*".[6]

- *Rainfall:* The trend of average annual rainfall in 9 decades (from 1911 to 2000) was not clear in different place: there were periods of increase and decrease. In three months of the end of 2007, the rainfall in the Central region and Northern Tay Nguyen overpasses 100%-150% compared with average rainfall in many years. This led to six continuous floods, which caused serious damages in this region.

[3] FAO, 2008. Climate change and food security: a framework document

[4] Ministry of Natural Resource and Environment, 2008. National target program of coping with climate change and the rise of sea level.

[5] Quote from report of the Ministry of Natural Resource and Environment

[6] Lao Dong newspaper, dated 30/12/2007

➢ *Sea level:* According to observation data, in the pas 50 years in the station of Cua Ong and Hon Dau, the average sea level has increased approximately 20 cm, which coincides with global trend.

➢ *Cold atmosphere:* The number of waves of cold atmosphere affecting weather in Vietnam has decreased considerably in 2 decades recently (end of 20th century and beginning of 21st century). In 1994 and 2007, there were only 15- 16 waves of cold air, which made up 56% of average cold atmosphere. Six seventh of cases in winter (November and December) had a surprisingly little waves (only 1 – 2 waves) and happened in 2 recent decades (March 1990, January 1993, February 1994, December 1994, February 1997, November 1997). An abnormal phenomenon of climate in the context of global climate change is damaging cold that lasted for 38 days in January and February on 2008 and caused great damage for agricultural production.

➢ *Typhoon:* Recently there are more and more intensive typhoon with the orbit moving towards the southern latitude, storming season lasts later and there appears more typhoon with strange orbit.

➢ *Drizzling rain:* The annual number of drizzly in Hanoi had decreased during the decades of 1981- 190 and has reached only 15 days/ year in 10 years recently.

According to the statistic of the Central Flood and Storm Control Committee, flood and storm has happened more frequently, more complicatedly and more seriously at national scale in 3 years recently compared with the other years. Especially a rare phenomenon that has never happened before: floods lasted for long in the centre and there was continuous flood tide in Ho Chi Minh.

The project "Studying the effect of climate change in the Huong river valley and policy for adaptation in Phu Vang district, Hue province" which is implemented by the Institute of Economic Science- Resource and Environment shows that water resource in this area has been changing under the effect of climate change. Accordingly, the temperature tends to increase. The volume of rain clearly increased. In addition, the most of the territory, there is a trend of decrease of rainfall in July and August and increase in September, October and November.

I.1.2. Identification of trends on climate change in Vietnam

According to the report of the Ministry of Resource and Environment, the climate in Vietnam tends to have following changes:

1. The average temperature in Vietnam may increase to 30^{o}C in 2100.
2. The rainfall might be unevenly in different regions and may increase (from 0% to 10%) in rainy season and decrease (from 0% to 5%) in dry season. There may be more fluctuation of rainfall.
3. The average sea level along the coastal range in Vietnam may rise 1 m in 2100.

I.1.3. Impact of climate change

Climate change is now threatening directly Vietnamese people and affecting our safety and the whole economy. According to Ministry of Natural Resource and Environment (2008)[7], Vietnam is one of countries seriously affected by climate change and the increase of sea level. If the sea level raises 1 m, there will be 10% of population directly affected and a loss of 10% of GDP may happen. If there is not any solution, in 2100, Vietnam will loose at lease 12.2% land, which is place for living for 23% of population; many places will be flooded with water for months and economic damage may reach the number of USD17 billion .

[7] National target program of coping with climate change and the rise of sea level

As indicated in the human development report 2007- 2008 of UNDP, if the temperature of the earth increase 2^{o}C, 22 million of people in Vietnam will loose their house and 45% of land for agriculture in the Mekong River Delta, the granary in Vietnam, will sink in sea water.

In the previous years, many natural disasters such as storm, hurricane, flood, etc. happened strangely at large scale and cause difficulties for forecasting, controlling and preventing. Consequently, these disasters created serious damage in terms of people, property and production.

According to the statistic of the Ministry of Agriculture and Rural Development, the storms, landslide, flood and flood tide that continuously happened in 2007 cause damage of more than VND11,600 billion (estimated 1% of GDP). As indicated in the report of the Central Flood and Storm Control Committee, all the storms and flood in 2007 took life of 435 people and injured 850 ones. Natural disaster cause serious damage for people and asset in 50 provinces in Vietnam. Meanwhile flood and flood tide made 113,800 ha of rice inundated in water, destroyed more than 1,300 irrigation infrastructure, took away about 460 km of dyke, 6,900 houses and 921 classrooms. At the same time, 920,900 of houses were overflow of water or lost roofs while many other social economic infrastructures were destroyed. Due to serious impact of natural disaster, the lack of food happens frequently in area suffering from disaster. In 2007, throughout the country, there were 723,900 turns of households with 3,034,500 of turns of inhabitants suffering from the lack of food. This number decreased 6% of turns of households and 11.6% of turns of inhabitants, compared with 2006. The number of people lack of food mainly concentrates on poor area where disasters happen usually like coastal area in the Centre and the Northern Mountain.

I.2. Policy of adaptation and coping with climate change, natural disasters and food security

Recently, there have been many programs and project dealing with climate change and managing the risk of natural disaster, implemented by national and international organizations. The national programs includes: National action program of anti- desertization in the period of 2006- 2010 and orientation for 2020 and Action program to minimize climate change and adaptation to climate change in the sector of agriculture and rural development. Apart from that, there are many other projects dealing with the climate change.

I.2.1. National program

a. National program of anti-desertization in the period of 2006- 2010 and orientation for 2020[8]

The missions of this action program are divided into groups, including:

- Completing legal base to protect land resource, forest resource and water resource in order to prevent and controlling desertization, meeting with new requirements
- Improving knowledge and training human resource and improving infrastructure for technique, and research, serving activities of controlling and preventing desertization
- Conducting survey and evaluating situation of desertization as well as research identifying main cause of desertization and making proposition to cope with this in Vietnam
- Organizing economic activities and transferring technology, managig and developing land, forest and water resources to make contribution to socio- economical development, poverty and hunger alleviation in the area related to desertization

[8] Decision 204/2006-QĐ-TTg issued on 02/9/2006

- International cooperation to implement international convention on desertization

Many projects are established for implementation, coinciding with each of the above missions.

b. Action program to minimize climate change and adaptation to climate change in the sector of agriculture and rural development

The followings are main content, and mission of the program:

- Establishing information system and website on climate change
- Organizing conferences and workshops as well as training course to collect and process information
- Building center of data on CC, implementing research program on the effect of CC and proposing solutions for CC
- Applying modern technology in using, protecting and developing such resource as forest, soil and water
- Seeking for references and checking all the document related to legal regulation and policy of the sector
- Renewing procedure and regulation for sector management such as standard, technical criteria in planning, designing and building system of infrastructure for agriculture and rural development
- Making a cooperation mechanism among ministries, sectors, central and local levels, as well as mechanism to control program and project
- Checking the planning of infrastructure for agriculture and rural development, cultivation system for agriculture, fishery, forestry as well as system of anti- disaster, etc
- Holding economic activities and technological transfer to protect, manage, develop and using such natural resources as soil, water and forest
- International cooperation in reducing the effect of CC and adapting to it

At the second conference on" Making plan to prevent, and control CC, reduce its effects and recover after CC" held on 30th August in Vinh Phuc, experts provided concrete solution to cope with effect of CC in Vietnam. They include: (i) improving dyke system with the additional height of 50 cm in 2020, especially the one from Quang Ngai to Kien Giang; (ii) planting 300,000- 350,000 has of mangrove forest and anti-mobilized sand forest inshore; (iii) distributing and using reasonably fresh water. The scientists also proposed to provide water and conduct environment sanitation activities for areas infected by salt, island, drought and flooding a suggested to change plants and varieties for the region affected by CC, for example studying to produce new varieties of drought and waterlogged resist.

c. National Strategy for natural disaster prevention, response and mitigation to 2020

General goal of Strategy[9] is to mobilize all resources to effectively implement disaster prevention, response and mitigation from now up to 2020 in order to minimize the losses of human life and properties, the damage of natural resources and cultural heritages, and the degradation of environment, contributing significantly to ensure the country sustainable development, national defense and security.

Accordingly, the activities of disaster prevention and control are implemented under the principal of cooperation between the State and the people in order to maximize the State

[9] Decision No172/2007/QĐ-TTg, dated *16 November 2007*

resource and mobilize all resource of the community, organization, and individuals inside and outside the country.

This strategy aims at enhancing capacity of forecast related to storm, drought, salt invasion, earthquake, tsunami and other dangerous phenomena. The main task is to increase the period of forecasting for storm and tropical low pressure, ensure forecasting these phenomena before 72 hours.

In order to achieve the objective, the strategy defines nine groups of missions and general solutions as listing below:

1. Consolidating the system of laws, policies and mechanisms
2. Consolidating organizational structure
3. Human resources development and social mobilization
4. Financial resources
5. Community awareness raising
6. Developing science and technologies related to natural disaster prevention, response and mitigation.
7. Ensuring safety for dyke, reservoir and dam systems
8. Enhancing the search and rescue capacities
9. Promoting international cooperation and integration

Apart from that, the strategy also identifies groups of missions and taks to control and prevent natural disaster in five regions, including the Red River Delta and the North Central, the Central Coast, the Eastern South and Islands, the Mekong River Delta, mountainous areas and Central Highlands and Sea areas.

d. National target program of coping with climate change and the rise of sea level

To deal with effect and risk of CC efficiently, the Ministry of Natural Resource and Environment has made up a national target program to deal with this. The purpose of this program is to *evaluating the level of CC effects in different aspects, and localities in different periods as well as making feasible action plan to cope with CC in the short and long runs* in order to ensure sustainable development of the country and take advantage of opportunities for development as well as cooperate with global community to minimize CC and protect air system for the earth.

This program has set its main tasks as follows:

1. Making assessment of level and impact of CC in Vietnam
2. Proposing solution to deal with CC
3. Developing scientific and technological program on CC
4. Enhancing capacity of organization, institutions and policy on CC
5. Raising the awareness of CC and the resource development
6. Strengthening international cooperation

e. National strategy on food safety to 2020 and vision for 2030

The Ministry of Agriculture and Rural Development is developing a national strategy on food safety to 2020 and vision for 2030, which originate from the fact that the world has to cope with food crisis under the risk of increase in natural disaster, and disease because of CC. Vietnam is now facing with many difficulties and challenges of increased population. As a result, its demand for food also augments. Meanwhile the productivity tends to decrease,

the prices of input material do not cease to rise, and the pestilent grows very fast because of intensive cultivation and multicropping.

The objective of this program is to maintain rice area of 4 million of ha in 2010, 3.6 million of ha in 2020 and stabilize rice area of 3.5 has from 2020 to 2050. The rice yield is supposed to reach 36.5 million of ton in 2010, 39.8 million of ton in 2020 and 40.5 million of ton in 2030.

According to scientist, the following solutions for food safety should be applied:

1. Making general plan of rice production at national and provincial scales
2. Investing in infrastructure, science and technology
3. Controlling the increase of population
4. Protecting and managing land for rice cultivation
5. Supporting food producers and for area planned for rice cultivation
6. Making forecast of food demand

1.2.2. Project

In addition to national project, there are also some projects associated with CC that have been implemented in Vietnam. Some of them are[10]:

1. Project on poverty and environment with climate change
2. Project on enhancing capacity to control flood for poor households in the Mekong river delta, Vietnam[11]
3. Project on capacity building for community to prevent and cope with natural disaster in Vietnam, especially flash flood in the high region [12]
4. Project on preventing disaster related to CC[13]
5. Program of adaptation to CC in coastal and mountainous regions

In conclusion, in terms of the aims of the policies, all the issued policies can be divided into 2 main groups which aim at both preventing and adapting to climate changes, through community awareness raising; investing to infrastructure, science and technology, and strengthening the institutional capacity such as making a cooperation mechanism among ministries, sectors, both at the central and local levels to cope with the CC.

In terms of the targeted beneficiaries, some policies are in favor of the rice growers (aiming at protecting and managing rice land cultivation and ensuring food security), but there are not has drafting policies for protecting fish men.

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[10] Please see annex for detail

[11] http://www.undp.org.vn/undpLive/System/What-We-Do/FoCus-Areas/Disaster-Risk-Management/Project-Details?contentId=2509&languageId=4&categoryName=Disaster-Risk-Management&CategoryConditionUse=/Subject-Areas/Disaster-Risk-Management&

[12] http://www.undp.org.vn/undpLive/System/What-We-Do/FoCus-Areas/Disaster-Risk-Management/Project-Details?contentId=2508&languageId=4&categoryName=Disaster-Risk-Management&CategoryConditionUse=/Subject-Areas/Disaster-Risk-Management&

[13] http://www.redcross.org.vn/projectDetails.aspx?id=17

In terms of regions, the issued policies are rather concentrated on the coastal regions (the Central Coast) and Mekong River Delta than other regions like mountainous areas (West Northern provinces which are coping with high risks from CC and natural disasters).

Most of the issued policies covered only in the medium-term period, which have been taking into effects from now till 2030. Vietnam has not yet prepare the policies coping with the CC in the further long-term period, to 2050 for example.

SECTION II: FIELD RESEARCH

II.1. Climate change and mechanism for adaptation, controlling and prevention in Ha Tinh province

II.1.1. General overview of social economic in Ha Tinh province

Ha Tinh is the littoral provinces in the Northern Centre, which is located at the East of Truong Son mountain range. It is narrow and slide terrain (leaning from West to East). The total area of natural land is 6026 km2[14], placing in 3 groups of main terrain: mountain and hill, valley and delta along the coast. The mountainous area makes of 80% of the total area while the delta is very small and separated by mountain and river.

The land for agriculture in this province is 460182 ha (76% of the total area), while the area for forest is about 77346 ha (13% of the total area). The rest of more than 65 thousand of ha is land that is not being in use (11%), but 70% of this land is rocky mountain.

Ha Tinh is situated in the area of monsoon climate and its climate is divided into two season: hot and cold seasons. Hot season lasts from April to September, with the average temperature of about 21-29^{o}C. During the period of May- August, there are hot waves that make the temperature reach the highest level of 38-39^{o}C. The number of sunny day in a year is approximately 100-120 days. Normally it is sunny in 10- 15 days, and then comes hard rain. During sunny days, the moisture in the air is usually very low. In Winter, from November to January, the temperature fluctuate from 20.8^{0}C (in November) to 17.5^{0}C (in January). The cold waves often last for 10-15 days with very low temperature; sometimes it is about 10^{o}C.

Ha Tinh is the province that has the highest rainfall in the North of Vietnam with the average annual rainfall of over 2000 mm, particularly over 3000 mm in some place. Although there are many rivers, the rivers in the Centre in general and in Ha Tinh in particular are very short, with high slope. Therefore, whenever there is hard rain, the flash flood will come at the upper stream and flood at large scale in narrow delta long the coast. However, when the rain goes, the river flows weaken. Some rivers even become dry unless there is rain in 15 days. Ngan Sau river is a particular example, its length is 131km, but only 37km locates in Ha Tinh. and the shortest river is Cay river: 9km. Ha Tinh has 137 km of costal range.

Regarding agricultural production, the area for cultivation is about 172 thousand has, in which food plant makes up 64% (110 thousand of ha). Rice is the main crop with the percentage of 92% of food plant area. The annual rice yield is 476 thousand ton with the average productivity of 4.5 ton/ ha. However, this yield depends much on weather condition in different years. Rice is cultivated in all 3 crops (spring, autumn and winter) but the highest area and productivity can be found in spring crop and the lowest is in winter crop.

With the population of 1288 thousand people, the province has average food per capita of 230 kg/person/year (1.1. Table 1). Nevertheless, the average food per capita in different districts differs from each other. In Western mountainous area as Vu Quang district, this number reach only 145kg/person/year while in Can Loc, it is 333 kg/person/year[15].

In the frame of this research, we conducted rapid survey in 2 districts, representing two main kinds of terrain in Ha Tinh province, that is mountainous district of Vu Quang and littoral district of Loc Ha.

Vu Quang district was founded in 2000, 70km from Ha Tinh city to the west and has 42 km of border with Lao. Its area is 62.284 ha and its population is 35.877. The territory of this district is rather complicated with slopes, rivers- at high slope. It contains of two main

[14] The information referenced in this section come from Ha Tinh statistical book and the website of Ha Tinh province (http://www.hatinh.gov.vn)

[15] Ha Tinh statistical book, 2006

terrains: mountainous area and the low area along Ngan Sau River. Agriculture and forestry is two main types of production activities in this district.

On the contrary, Loc Ha district stretches along a cost of 12km length. It is 13 communes, 87,000 people, and covers 11,830 ha. Its terrain is divided into two main areas: (i) riverside of low lying area, including such communes as Ho Do, Mai Phu, Thach Chau, Thach Kim, Thach Dang and Thach My where develops the production of salt, farm produce and aquatic products with better economic condition compared with other communes in the district; (ii) high-lying area, including the rest of communes (this area contain both delta and mountain, its inhabitants live mainly on agriculture (rice, farm produce) and a part of fishermen catch seafood). The growth speed of average annual income in recent years have reach the number of 10%/ year. In 2006, its GDP is 4.93 million VND/capita.

II.1.2. Situation of climate and weather changes in Ha Tinh province

In the previous years, especially from 2002 up to now, there have been much changes in the weather in Ha Tinh province towards irregular and complicated development. It does not obey the normal rule, this make forecasting activity more difficult. The following are those associating with changes in temperature, sea level and flood.

- Changes in temperature

During hot season, the temperature is higher now, indicated experts and inhabitants. In addition, the hot lasts longer. Take the date of 22/4/2008 in Huong Khe as an example, the temperature reached 42^{o}C, that means 2^{o}C higher than the highest temperature over years now (in the past, only about 40^{o}C).

In cold season, after very cold waves, there have been recently sun waves. It should be noted that in the winter of 2007/2008, Ha Tinh and Northern provinces had a record of cold wave that lasted continuously 38 days. At that time, in Ha Tinh, the lowest temperature was 7^{o}C (measured in Loc Ha district) and 8.1^{o}C (measured in Huong Son district)

- Storm

Normally the rainy and flood season in Ha Tinh is from September to November. Main storms comes to Ha Tinh are storms number 7, 8 and 9. But recently this has changed, Specifically, the period of storms has enlarged from August to December. In 2007, the storm number 2 appear on 5/8/2007in Ha Tinh caused heavy rain, in some area, the rainfall reached 1000 mm, which led to serious flood with intensive volume and fast speed.

- Rise in sea level

Both experts of the Department of Agriculture and Rural Development in Ha Tinh and inhabitants along the sea of Loc Ha district confirmed the rise of sea level. According to observation, the tidal flow is 10- 12 cm higher than 10 years ago. In fact, only the storms of level 7 and 8 can rise the sea level at the level of storm leveled 10 as in the past (compared with the year of 1999). Consequently, 100% of the well, which have just digged since two years in Ho Do commune, Loc Ha district become useless because of salt invasion. This makes inhabitants along the coast meet so many difficulties.

As judged by experts of the Department of Agriculture and Rural Development in Ha Tinh province at this moment, the seawater invades in the river 10km more, compared with previous years. Besides, another reason why this situation happens is the construction of dam to keep water at upstream. In addition, this make the river flow to the sea become weaker.

- Flood

Flood is the annual phenomenon in Ha Tinh province. However, recently it happened intensively. The crest of a flood is higher, its flows is stronger. The number of flood/ month is bigger. The speed of flood is faster. In the past, the flood used to happen only after 2 days 2 nights of hard rain. But now it can appear only after 1 day 1 night of big rain.

The time of flood appearance also changes. Before, the flood used to happen in September and October, however, it can occur from April to December now. For instance, in 2003, great flood came to Ha Tinh in April and caused much damage. On 5/8/2007, together

with hard rain of over 1000ml, the flood appeared and destroyed totally 5000 ha of rice, 4000 ha of other plants such as peanut, green bean. At that time, Vu Quang district much suffered from the flood.

- Drought

Although much rain, Ha Tinh has to face with great drought because the rain often concentrates on August- October and due to slope terrain. Apart from that, the hot and high temperature make drought more serious. Many people indicated that the irregular situation in hot season recently made a phenomenon "drought even when there was not sun", then the drought became more serious, the field could keep less water and paddy could not adapt to new situation even when it had been irrigated.

- Flash flood

Flash flood often happens in mountainous district of Ha Tinh province. It occurred in Huong Son, and Vu Quang in 2002. This kind of disaster causes much damage in terms of people, house and agricultural production.

II.1.3. Damage from climate change and natural disaster

- Damage cold and hoarfrost

- Killing plants: including 5 ha of forest for wave barrier: in Ho Do, 100 has of rice and 50 has of farm produce in Thinh Loc commune and seedling of winter- spring in 2007

- For those producing salt, the situation of so much hoarfrost and hoarfrost lasts for long increase moisture in the air, which leads to the unreadiness of sand for salt production as well as reduce nutrition of sand. Then more labors are needed and more sand must be brought to augment the nutrition for sand. Consequently, the labor productivity is much affected.

-100 % of households catching seafood are affected because the time for going out the sea includes only 2-3h/ day, instead of 5- 6 h/ day under the situation of normal weather. As a result, their production reduces about 40% and they become lack of food.

- Reducing food productivity: (rice yield of Thinh Loc commune reduces 40%) because some of rice area is not cultivated in time. For poor households and those close to the poor, rice yield reduces 50% because of the cold. With the average scale of production of 1 sao/ household, the damage of the cold is rather big. Take the family of Mr. Nguyen Dinh Tien- a household close to the poor in the 1st region- as an example, his rice yield is only 7 quintal, instead of 1.5 ton/ year/ 6 sao. That means only 45% as normal. In addition, his summer- autumn crop is 1 month late because of the cold. As usual, he can sell from 5 to 6 quintal of rice to have enough food for the family. In addition, for poor household like Mrs. Nguyen Khac Phong's, his family can harvest only about 45% of rice yield as usual, he lost 2 sao of farm products which is equal to 2 million VND. This made his family malnourished for 2 months (His family is often undernourished in 20 days). Meanwhile, Mr. Nguyen Quoc Bao 'household- a close to the poor in 2nd region- has 5 members and 2 sao of rice field. His productivity of rice is only 2 quintal, instead of 3 quintal/ 2 sao of rice/ year. Then his family has been starveling in 5 months.

- The inhabitants have to fire light.

- Drought

- The inhabitants cannot plant vegetable in summer- autumn crop, which brings them high economic efficiency. That is why their income becomes lower. The poor households are those much suffer from this.

- Reducing plant productivity: According to Vu Quang inhabitant, unless drought happens, the productivity of green bean in summer- autumn crop can increase 20%. Thinh Loc also suffers from low rice productivity (50%) in summer- autumn crop because of drought.

- Increasing production cost: According to assessment of farm households in Vu Quang district, the cost for irrigation in rice summer- autumn crop (for varieties that have growth period of 100 days) is equal to rice winter- spring crop (for varieties of 160- 170 days growth)

- The inhabitants do not have fresh water: 100% of them do not have fresh water, some have to buy it at the price of 30,000 VND/m^3. Those who have relatives in the city must transport water for eating and drinking over 3 km of road while they themselves have to go to the city for washing and taking bath. Under such circumstance, their income much decreases, the number of food consumed also decreases from 50 to 70% compared with normal. At that time, all the income serves the purpose of food. If there is not drought, they can use rainwater in 3 months.

- Lack of fresh water in production and daily life: In Ho Do commune, the biggest damage can be found in the area of off- season vegetable, which brings rather high income for the inhabitants. Mrs. Pham Thi Can' family- an average household- must get rid of planting off-season vegetable because of draught and changed to plant peanut and sesame. For livestock activities, the draught make the animal, poultry and water- bird lack of water and feed. Livestock households had to spend from 10-20 million VND more for the feed (For flock of about 2,000 animal and poultry). Mr. Nguyen Quoc Khanh, the owner of breeding farm (producing 2,000 poultry/ farrow) said that normally he invested 30 million VND/farrow (which lasted for 2 months). However, now, because of drought he must invest 30% more (equal to 40 million VND) because each farrow now last for 3 month. This means that he get lower profit.

- For aquaculture in fresh water, although the areas of pond in every household both serve aquaculture activities and fresh water, they now become dry and cannot be taken in use. Mr. Le Doan Huong, who lives in Thinh Loc commune, said that he had to fill up his pond for cultivation because of the lack of water despite that he used to breed chicken and other poultry.

The income of household is therefore affected. All the households showed that their food security is not ensured because they cannot produce farm products. The quantity of farm products that they consumed reduced from 50 to 70% and their most of their income must serve the demand of food.

- Irregular climate change

- In 2007, because of less sun, much rain, and short period of sun (there used to have small of rain in 5- 10 minutes every 5- 7 days), the moisture was very high. This made salt dry slowly, and decrease 30% of salt yield. For Mrs. Truong Thi Dinh, a poor household, but has 1000m^2 of salt production, in 2007, due to ineffectiveness of salt production, cheap price and abnormal weather, the productivity of salt production was so low that all the labors in her family decided to work for others in the cities. She said that she could get only 8- 10 thousand dong for a working day in salt production, but to be in others' service in the city, she could earn 30 -50 thousand dong/ day. In addition, take Mr. Le Mien as another example of salt production in Ho Do commune, his annual salt yield reaches the number of about 3 ton and each crop of salt, he can earn from 4,800,000-5,000,000 VND. However, in 2007, due to short period of sunny day and wet sand because of rain, it took him 2-3 days to make a haul of salt after the sun came. Accordingly, his productivity is only over 2 ton of salt in 2007. However, with the price of only 1,800-2,100 VND/kg like today, he can get only about 4,000,000 million VND/ crop but spends more time to make salt.

- For catching seafood, the irregular fluctuation of the sea causes considerable obstacle for those living on this activity. Whenever they have to come back from the sea because of heavy sea, it costs them 100 thousand VND for petrol, excluding other cost. Mr. Ha Minh Tan- Vice Head of Agriculture Office in Loc Ha district- who is responsible for aquaculture showed that the abnormal weather (sunny in a wide range of days then comes the rains or storms, water is separated into layers) would make aquatic products die because of oxygen shock. Mr. Tan also said that for 3 years now, those working in aquaculture activities in Ho Do had lost a lot. Many families had lost totally their shrimps. Sharing the

same opinion, Mr. Nguyen Van Dau, who invests much in aquaculture in Ho Do commune with annual income of about 100 million VND said that in 2007, because of abnormal weather, a part of his shrimps died, which had caused him a damage of about 30 million VND. However, thanks to other activities, his family was not very much affected, especially concerning food problem. Nevertheless, it is quite a big damage for other households who do not have any more capital to recover their production.

- The rise of sea level

- At Ho Do commune, before they could use water from the well for daily activity. However, now, 100% of these wells become salty and cannot be used anymore. The situation of lack of fresh water becomes more and more serious. For those producing salt, the drainage of salt field do not work well but they still have to use it to make salt although knowing that it now become polluted.

- At this moment, there are 45 households in Thinh Loc commune living near the shore. These persons need to be moved to other place in case of storm. The inhabitants here said that if they had to move only when there had been storm of 10^{th} level before, now they have to move whenever the storms come. Otherwise, their place will be flooded with seawater.

- Sea water encroaches to river and makes it salty. As result, this water cannot be use for agricultural production. Therefore, it needs to be measure the level of salt to decide whether it is applicable for agricultural activities or not.

- Storm and flood

- Dead: in 2007 there were 31 person killed by storm, flood and whirlwind.

- The infrastructure is destroyed: In 2007, there were 408 solid and semi-solid houses being taken away be storm and flood; 53 thousand of houses being taken the roof and 29 thousand of houses were seriously destroyed in water.

- The agricultural production is much affected: In 2007, 8148 ha of rice during summer- autumn crop and winter crops did not make a rice and 11331 ha of farm produce were damaged or have poor crop. At Vu Quang district, the winter crop of maize lost totally, the summer- autumn crop of green bean can be harvested only on the first time and lost 50% of its productivity. To make matter worse, disease of cattle and poultry broke out after the flood.

- Many areas for rice summer- autumn crop deem to be more efficient but the inhabitants dare not to cultivate because they are afraid of flood.

- Transportation, irrigation and dyke system are seriously damaged.

- The living environment becomes polluted, and it takes the inhabitants much time to clean.

- The students have to stay at home because of flood.

- For those producing salt, the flood and rain destroy dyke around salt field, destroy soil to make salt. The water sweeps away sand and reduces nutrition in sand. The rain make salt stock wet and melt. This means the salt stock disappear nearly completely.

According to statistic, the flood caused a demand of 1135 billion VND in 2007, which makes up 15% of the provincial GDP.

The flood effect on households is very clear:

- For those producing salt, the rain and storm cause flood and take away the dyke around salt fields as well as break down soil to make salt. The water also takes away the sand and erodes nutrition in the sand. Meanwhile, the rain makes salt stock become wet or make the salt melt totally. More specifically, for Ms. Truong Thi Nga family, the storm blows the roof of her salt stock and takes away 2 ton of salt in the stock. To make the matter worse, it break down completely the dyke system around salt field and reduce the nutrition in the sand. At the same time, dirty water flows into the dikes that keep water to make salt.

Therefore, she has to buy again the sand to make 5 sao of salt, which costs her 500,000 VND/sao. In addition, she must spend more than 2,000,000 VND to make salt compartments and another 1,100,000 VND for dredging the dikes. That means the total fee for investment after flood increase from 20-30% than normal. Another example is Mrs. Pham Thi Can who lost totally, when the 5th storm blow away the roof of her house and destroy her salt stock and farm products.

- In terms of Thinh Loc commune, the 5th storm blow up the roofs of 125 houses and destroy 45 ha of crop and other public infrastructure with the total damage of 1.16 billion dong. For instance, 2 sao of rice field of Mr. Nguyen Quoc Bao's family is flooded, his house loses the roof. The total damage for his family is about 5 million dong. However, the most important thing is that he lost livelihood. To make the matter worse, with the long- lasting cold and drought, his family is estimated to have been malnourished for 5 months in this year.

II.1.4. Climate change, natural disaster and food safety

There are four main types of food cultivated in Ha Tinh provinces, namely rice, maize, sweet potato and cassava. The area for rice account for most of cultivation area, then the area for maize follows. Rice is cultivated in three crops (spring, autumn and winter), but most of rice is planted in spring. The rice area in winter- spring is the highest and it also brings the biggest productivity. Meanwhile the winter crop only produces a small amount of rice. It is mainly in costal delta and tends to decrease. We do not find tenth-month rice in mountainous area because it is in raining and flood season.

The average food productivity per capita in the province is rather high, but it is quite different among places.

At Vu Quang district, the rice in Winter- Spring crop only makes up 81% of the yield while the Summer- Autumn crop occupies for 19% of the total yield. The winter crop is not found here. For years, it can be seen that the area for summer- autumn crop is on the decrease because of rain and flood. That is why the inhabitants decide to plant other kinds of plan. Only at the low-lying field, the rice remains to be cultivated because this area is not suitable to change to other plants. For example, in Duc Huong commune, in 250 has of summer- autumn crop, the rice makes up only 10 has. Another example is An Phu commune, since 2007, rice is not cultivated in summer- autumn crop.

In such good crop in 2006, the average annual number of food (concerting to rice) per capita at Vu Quang district is only 145 kg while rice makes up 117 kg. With the demand of rice per capital of about 15 kg/ month, rice production here only serve 65% of this demand. More specifically, the winter crop provides rice for 65% of this demand while the summer-autumn only meets with 12% of the demand. Then the inhabitants here have to buy rice at the market thanks to their income from other sources. Moreover, maize, potato and cassava are used as supplemented food and serve the purpose of breeding activities. In addition, the other sources of income come from planting peanuts, green bean; raising cow, pig and poultry; as well as from other non-agricultural activities.

There is less risk for winter- spring crop, compared with summer- autumn crop. For winter- spring crop, there following criteria may affect rice yield: very cold weather and pestilent insect. However, for summer- autumn crop, the farm households have to face with the lost of the crop (including rice and other kinds of plants). At Vu Quang, averagely rice of summer- autumn crop contributes to satisfy 12% of rice demand of the inhabitants. Then if they lost the crop, the income during this time also disappears.

Flood not only makes the inhabitant lost their crop but also affect other activities. During the flood, breeding activities get stuck. Therefore, the inhabitants often sell their buffalos, cows, and calves. They only keep cow or buffalo breeding, or calves when they are so small. Pig and chicken are also sold out. Only the piglet is so small that they cannot sell, they keep it at home. Nevertheless, the number of such breeding household is very small. This means that during the period of September and December, breeding activities is not great at all. This also means that they lost one source to get income. In addition, during the

flood, they cannot participate in other economic activities. The field is unused because it takes them much time to deal with the flood. Then after the flood, they have to clean their house, arrange their furniture and bring their cattle home. As a result, there is not any non-agricultural activity. To sum up, the flood takes their food, decrease their production, reduce their income and hinder their food access.

At Duc Huong commune, Vu Quang district, only 70% of households in commune produce enough food for the whole year, in which in some communes, there are only 5-7% of farm households satisfy their annual food demand while the rest is underfed from 8 months. Poor households often lack of food for 8 months but average households have to face with this problem in 4 months. For many poor households in Duc Huong commune, even during rice production period, they only consume 10 kg of rice/ month, and use maize, and sweet potato to fill the lack of food. During months that they do not have any food they produce themselves, they only consume about 30 kg of rice/ month for 5 persons and compensate their demand of rice by maize and sweet potato. However, to make the mater worse, the quantity of maize and sweet potato cannot satisfy completely their demand. That is why some poor households answer us that at that time they have to suffer from hungry because they cannot afford to buy rice.

Production system at Duc Huong, and An Phu communes, where we conduct a survey can be briefed as the follows:

Winter- Spring crop: rice, peanut, maize

Summer- Autumn crop: green bean, maize inserting to green bean

Winter crop: maize

Among the three above crop, the summer- autumn and winter- spring crops face with the risk of flood. In 2007, these two communes lost totally these two crops. According to our survey, an average household showed that in 2008 they can get 2.5 million VND from green bean during these two crops, but they lost totally in 2007, excluding investment in seedling and manure. Similarly, they lost completely two sao[16] of maize during winter crop. This household was lack of food only for 1 month, but thanks to food support from international organization, they do not have to suffer from starvation.

On the contrary, poor households only produced 600 kg of paddy (equivalent to 360 kg of rice) in 2007, while their demand if 840 kg. This mean they are lack of 55% of the total amount of rice. Although supported by the government and international organizations, they expressed that this support meet their demand for only 1 month, then they have to buy themselves rice for 6 month. In the mean time, the other income from agricultural production is not enough and due to flood, their breeding activity cannot develop, they have to work for others and do not eat enough.

In general, only a small number of households in Vu Quang district can produce enough food for a year. Meanwhile, breeding activities is less developed. In many villages in Duc Huong commune, 90% of households do not raise pig and nearly 100% of poor households do not participate in this activity. For those breeding pig, their knowledge is very limited. Most of them obey traditional technique to raise pig, use redundant products of agriculture for breeding that means breeding depends on the production of maize and sweet potato. Thus, the productivity is so low, and economical efficiency is the same. To make the matter worse, some even lost. Therefore, they do not want to raise pig. This also means that most of their income comes from cultivation and that if they lost crop, they have to face with much of difficulties.

Apart from flood, drought is also a cause of decrease in income. Because of drought, the yield of summer- spring crop is very low. All of farmers agree that is there is enough water to irrigate, the productivity of green bean will be much higher (at this moment, it is 1.4 ton/ ha).

[16] 1 sao= 360 m^2

At Loc Ha district, for those who do not have agricultural activities, they live on making salt and catching seafood and climate change has indirect effect on their food safety. Because of flood and rain, dyke system is destroyed, which affects their salt field and leads to sand erosion. This also increases their cost for production and at the same time reduce the productivity. The households estimated that their salt productivity in 2007 decreased 30%. This means their income also on the downward. For those catching seafood, the cold lessen the time for going out to sea. In addition, it costs them much when putting out to sea but have to come back because of flood and storm. As a result, their income decreases considerably. In terms of those taking part in agricultural activities in Thinh Loc commune, in normal condition, the households produce enough food for their demand, the average households even have food redundant to sell. Nevertheless, in 2007, due to the cold during winter- spring crop, these households had to harvest 1 month later, which made them suffer from the lack of food for 1 month.

II.1.5. Natural disaster, food safety and women

The women plays an important role in agricultural production, Due to small area for agriculture, and low yield, in many households, they have to work far from home during the time that is not any crop, or even for a year. Then all house work and field work are put on women' shoulders. At Vu Quang district, some of men often work outsider after the Winter-Spring crop, then the women must be responsible for Summer- Autumn crop and cope with flood. From the opinion of inhabitants there, it is not difficult for women to control flood because they get acquaintance of flood since they were small. Moreover, there is emergency team for community in case needed.

At Loc Ha district, where the men often work far from home, the role of women become more important. They are not only the breadwinner but also participate in all kinds of activities, such as anti-disaster. This is a difficulty of the locality in controlling disaster. For poor household, most of the men work far away, then the women must ensure food security in their house and they are the breadwinners.

- At Ho Do commune, Loc Ha district, 90% of the labors find their work at cities or industrial zone. Then, the women become main labor in their family. Even in those households whose men do not get out of their province, the women still play the main role in generate family income (with aquaculture activities). The women is responsible for many important works, for instance:

+ For those whose husbands work outside the province: the women take care of the children, their family, and production at locality (making salt and producing farm product). In addition, they take part in social activities as well. Even when the family is lack of food during flood and between crop periods, they have to manage it.

+ For other family, the women are only in charge of housework, nad take part in production activities with their husbands.

+ During the storm and flood, the women is the main local force dealing with this. That is why this is one of the local difficulties in anti- disaster activities

- In Thinh Loc commune, due to the fact that agriculture is main activity, the number of men migrate to other province is not great. There is only 50% of the families that have men working outside their commune, in which 20% go for work all the year round and the rest only get out of their village when there is not crop. That means:

+ For those whose husbands do not work outside, the women do not play the main role in livelihood because the husbands are in charge of production activities.

+ For those whose husbands go out to work through out the year, the women is responsible for taking care of the children, and family activities. When there is a lack of food, they must manage themselves without support from their husbands.

Then, it can be seen that the women ensure food security in poor households and they are the breadwinner. However, for other kinds of households, they are only responsible for taking care of their children, family activities and on site production.

II.1.6. Support to coping with natural disaster

To help farm households coping with natural disaster, the local authorities at all levels always ensure to provide information related to weather and disasters that may happen as well as support them to move their assets and property and to make schedule for cultivation that prevent flood and reduce damage.

Those non-governmental organizations as ActionAid, Oxfarm Hong Kong, etc provides much support for communes, village and inhabitants with solution to control, and prevent disaster as well as aids in case needed. At the same time, they help them to organize team of relief at communal level.

During the flood, there are usually teams providing aids for inhabitants. And after the flood and disaster, there are many other supports for farm households, such as:

- Food, products for domestic use
- Money
- Seed, breeding, manure, agricultural material

These supports are very important, especially for poor households whose productions only satisfy 50% of their demand. That is why many households are provided with food for 3-4 months.

Apart from aids after the flood, non-governmental organizations also support farm households to make model of production with an aim of diversify their activities as well as increase their income. For example, ActionAid help farm households in Vu Quang district to create a model of rabbit, chicken and pig breeding.

II.2. Strategy to adapt and controlling climate change in Ha Tinh

Based on climate change and disasters in the recent years and historical experience, the provincial strategy and measurements to cope with climate change and disasters are developed and applied from local government to households. Ha Tinh is very vulnerable to extreme climate conditions like floods and droughts. Warming of the surrounding seas will have considerable impacts on the coastal resources. Most of our settlements are along the coasts and riverines, and rising sea level could have a devastating impact on them. Despite all the adaptive and mitigation measures the local citizens're undertaking, it is still not possible to prevent CC impacts even in the next year.

The local authority and citizens identified the deforestation situation as a major contributor of CC impact, which leads to more severe natural disasters in the recent years. In order to cope with that, water-management and forest management as well as conservation program have been chosen as tools to react to the impacts of climate change.

II.2.1. Concentration of the provincial authority

Now the provincial authority focuses much on

- Construction of riverhead irrigation works to restore water and regulate flood; for example, Ngan Truoi dam. When this construction finished, it helps reduce flood level (height of flood crest, rising rate of flood) for lower districts (Vu Quang, Duc Tho); The construction of dam is not only helpful in keeping water but also reduce the water flow to flooding region in rainy and floody season in order to decrease the intensive of the flow as well as flood level.

- Development of sea dyke system to prevent seawater invasion to fields. The sea dyke system can withstand tropical storms at level 10 combined with rising tide.

- Riverhead afforestation program to cut down floods and flash floods. The forest is planted at the riverhead to keep water in the soil, reduce the water to lower land as well as limited flash flood, etc. This program has been implemented in the riverhead forest of Vu Quang and Huong Son districts.

- Propaganda program to provide knowledge on flood and disasters prevention to people. Provincial plan is to make television program on solution to deal with and adapt to disaster and successful example at localities.

- Adjustment and transformation for proper crops structure, harvesting agricultural products before floods arrive. Thanks to annual weather forecast, the province make plan for crop and recommend their inhabitants with suitable plants

- Build annual disaster prevention plan. Annually, before the flood and rainy season, the province has plan to deal with disaster and avoid its damage. Based on this plan, local organizations and agencies follow with action plan in detail, dealing with each disaster case.

II.2.2. At district level

At district level, there has not yet strategy to adapt to and deal with CC, but only strategy to prevent flood and natural disaster. Annually, the district develops flood and disasters prevention plan, which specifies what need to be done before and after flood, details as follows:

- All districts have to make flood and disaster prevention plan;
- Assignation of district staff who is in charge of operating flood and disaster prevention at locality
- Provision of weather and climate information to localities in order to remind people of prevention
- Development of crop plan for agricultural production and follow up this plan in accordance with weather forecast. Based on weather forecast, and concrete situation, the district People Committee makes a plan of crop for communes. Then the leaders of these communes are responsible to implement the plan for the farmers to follow by announcement, propaganda and making an agenda of water supply, etc.

II.2.3. At communal level

According to the our survey, the communes develop their own plan for flood and disasters prevention and having a flood prevention committee. This committee regroups representatives of the Communal People Committee, and social and political organizations such as youth, veteran, and women unions. All the members of this committee is assigned to supervise and speed up the prevention before and during the flood.

Each village has a relief team, including the young and members of civil organizations like women union and farmer association. Before flood season, the relief team comes to each household to identify whether they need support or not. The relief team helps those who require moving their furniture and food to higher places before the flood comes.

II.2.4. At household level in mountainous district (Vu Quang district)

Having tradition of annual flood, the households have rich experience in flood prevention, details as follows:

a) Production preservation:

- Adjustment of crops system: In summer-autumn crop, people used to grow rice, but in the last 7 - 8 years, rice area has been reduced and replaced by green beans. Though the beans still suffer risk of flood, it can be harvested after one-month growth, so that it has higher harvest opportunity than rice. The beans are completely harvested by the end of August. This changes This change is made thanks to the experiment of planting green bean, which has short time of growth but high productivity, conducted by the agriculture extension service of the district. The farmers find that this brings them higher profit and less risk compared with rice. Then gradually they change from planting rice in summer- autumn crop to green bean.
- Adjustment of crops and using short-day varieties (to ensure harvest time before flood season from August to October). People grow late spring rice with short-day varieties which have high productivity to cut down the risk of severe coldness. For example, in 2008, severe coldness lasted until February but the productivity remained high thanks to short-day varieties. Summer – autumn rice and winter maize are also short-day varieties with high productivity. The application of new varieties in production is conducted thanks to agriculture extension service and NGOs.
- Application of technology to reduce crops growing time, for example growing winter maize in ..., plastic coverage for rice seedling when it is cold...
- Arranging livestock breeding in order to harvest before flood season. When there is flood, it is difficult to find a place to live and food to eat. Then it become harder to continue breeding activities, especially when the number of animal is so big. By experience, the farmers decide to raise animal so that they can sell them before the flood comes. Only when the animal is not big enough to sell, can they keep it during flood. The breeding households have many ways to raise pigs and poultry during the flood, for example raising poultry and pigs on banana raft and high shelf when flood arrives. For buffalos or cows, they often move them to higher place. These are experiences in livestock activities of the households here.
- In flood season: People move to live on high shelf of their houses while the poor who do not have high shelf move to relatives and neighbor's house or to public school.

b) Life and property preservation:

- Building high shelf inside the house as storage place of goods and foods for man, feed for livestock and residential place for people in flood season
- Each household has one boat for transportation in flood season
- Moving women, children and elderly to stay in tents in high land (for several days in flood season)

c) Health preservation:

- Buying cans and tanks for hygienic water storage in flood season
- Covering wells to protect safe water sources for after-flood usage

II.2.5. At household level in costal district (Loc Ha district)

➢ Salt production households

- Heightening the garden ground up to 1 meter to build warehouse for salt storage and preservation

- Making full use of sunny day and start working at 7 instead of 8 as usual

➢ Aquaculture households

- Using air plough and coconut branches to prevent air shock for aquatic livestock when weather change

- Instead of taking input water at beginning tide, people use input water at the end of tide for hygienic water from the sea

- Fishing households

- Using different fishing methods (crabs, herrings, silver fish) to increase the productivity

- Observing weather forecast and weather condition to avoid rough sea

- After storms and severe coldness, fishing productivity reduces, so that they cut down the number of fishing days and increase the fishing hours per day to compensate the productivity

- Farm households

- For people growing rice in low land: they increase fertilizer amount to speed up the growth of summer-autumn rice for early harvesting

- For those growing rice in higher land: due to lack of water in drought season, people grow rice in winter season (small area and low productivity) to keep the land

- Using substitute crops: growing peanut, sesame instead of vegetable in drought season; using underground water for drought area

- Using short-day rice varieties in substitution for those which affected by severe coldness

- For farm households in Ho Do, because they can not grow off-season vegetables, many poor households catch oyster in wave barrier forest to earn their living or migrate to cities as hired labour. In the last drought, number of participants in this activity increased by 200 people.

Moreover, well-off people can buy water from the city or build tanks for rainwater storage. For the poor households in Thinh Loc, they have to collect firewood or cut down casuarina plants, which they grow to sell for food or work as hired labour. Many households have to borrow money to buy food. For poor households in Ho Do, people use different materials to shield their house in cold season and heater to cope with the coldness if there are elderly. People also search for temporal sources of livelihood like fishing near the wave barrier forest, working as hired labor in the locality.

In brief, the strategy to cope with and adapt to CC has recently mentioned at provincial level after the Government defined some program and strategy to deal with CC. This strategy focuses on the reduction of natural disaster by building lake and dam to keep riverhead water, and sea dyke to prevent waves, as well as planting watershed, and at the same time informing the local inhabitants with information on flood and natural disaster. The adaptation to CC in agricultural production mainly refers to the crop planning and variety to avoid flood. This activities is effective in the sense of changing time of crop in Vu Quang district when the farmers here decide not to plant summer- autumn rice, instead, they plant green bean. For the farmers, because living in flood region, they have much experience to cohabit with the flood.

II.3. Demand on policy and support of community and farm households

The gap of adapting and preventing CC mentioned above show the requirement of preparing policies which concentrated more in the mountainous areas (West Northern provinces which are coping with high risks from CC and natural disasters for example managing sloping land, develop forests, upgrade irrigation systems, protect water sources and aiming to reduce poverty in the desertification-affected areas, or floods-affected areas.

Fish men and fishery sectors in the high risk areas needs to be benefits of policies or program for helps them to adapt with the CC, due to the fact that even they have been

severely affected by the CC and natural disaster in the lasting years. The people and community living in the high risks zones of CC extremely needs external supports to raise their community awareness, with science and technology knowledge to promote crops transition to improve their livelihood, through organizing the extension models, training, communication campaigns...

Interviewing the local citizens in the 2 districts of Ha Tinh province: one in the mountainous area, and one in the sea area about their needs to supports to cope with the CC, the answers as follows:

II.3.1. Demand on supports for Vu Quang district

- Require Provincial and District authority to approve for the plan of building irrigation system:

People Committee and farm households in Duc Huong commune demand to build a pump station and canal for watering 150 ha area of cultivation in four villages. With this system, about 60 ha area for peanut and maize will be transferred to rice production for higher economic benefit. Besides, this irrigation system also helps increasing the productivity of winter-spring rice, peanut and summer green beans.

- Require District authority to support further on R&D activities for agricultural and rural development to poverty reduction

Farmers in Vu Quang demand support on agriculture extension training, particularly husbandry to improve the breeding effect and increase their income

- Needs to receive supports and aids for purchasing tools to preventing loss in natural disasters:

+ People Committee of commune in flood area of Vu Quang desires a solid boat (aluminum or iron) to serve the relief work in flood season

+ Communes in flood area also require electric generators for information work. Currently, lack of electricity when flood arrives make communication system stop working, even the mobile phone

+ Building safe water tanks for people in flood season

+ Establishing solid areas for people to avoid flood. Currently, people moving to higher land often live in temporary tents which are easy to break down and harmful

+ Farm households desire support in terms of food, varieties, livestock and fertilizer to over come the flood consequences

II.3.2. Demand on supports for Loc Ha district

- Require Provincial and District authority to approve for the plan of building irrigation system:

+ Building a canal from Ba La Do Diem dam to citizen zones to solve the living water issue for people

+ Installing water pipe from company producing to households in order that the citizens can assess clean water more easily

+ Upgrading current dyke system to a solid one to reduce the threat of sea water invasion and minimize the risk of leaking

- Needs to receive supports and aids for purchasing tools to preventing loss in natural disasters

+ Continue to be supported with the construction of water containers and rain containers, especially for poor households and those in difficulty

+ Establishing a resettlement zone for 45 households living by the sea who often have to move when storm comes

+ Support a loudspeaker system and electric generator for the district to maintain information provision to people when storm arrives

SECTION III: PROPOSITION AND CONCLUSION

III.1. Proposal to control and reduce effect of natural disasters

In fact, the local demand on this matter is rather big. However, in this section, we only indicate activities that the local authority and inhabitants would like to take part in and that we find them essential to help them deal with the problem of CC.

III.1.1. At provincial level

Recently Ha Tinh province has made a communication campaign on the risk of natural disasters, catastrophe, mechanism of changes and adaptation as well as good models of adaptation on television for its inhabitants. With precious experience in CC, ActionAid should engage in this activity to help local inhabitants reduce natural disaster damage and impact. The cost for this activity is estimated about 150 million VND/year.

III.1.2. At district level

a. Crop structure transformation
   - Off-season bean variety
   - Reducing winter rice area, increasing summer-autumn rice area: demand for short-day varieties

b. Demand for science and technological advance application to improve the productivity:
   - High productivity hybrid rice varieties
   - Hybrid peanut varieties

c. Application of new crop varieties to improve the income: local tea, grapefruit, orange

d. Direct support for poor household suffered by disasters: seeds, livestock, fertilizer, consume goods

III.1.3. At communal and village levels

a. Tools for disaster relief and alleviation:
   - 1 Motor boat 1.5 ton load, lifebuoy, life-jacket for the households (children and elderly)
   - Boats for difficult households, particularly poor households with woman leader
   - 1 electric operator for the commune

b. Strengthening the infrastructure for disaster prevention and alleviation of the commune:
   - Building embankments in flood season
   - Settlement houses for people living in higher land in flood season: 1 house with 5 rooms for 200-300 people/1 commune
   - Building water tanks in higher land for migrated people in flood season

c. Support varieties, livestock for household suffered from flood season,

III.1.4. At household level

a. Households in Loc Ha (coastal area)

Those are demand for support to adapt in production and livelihood of the household:

- For salt producers in by-river low land in Ho Do: :
  - Improve, transform and clean the canal No. 1 and No. 2 which are polluted in order to enhance the salt quality, reduce the time to collect trash and seaweed which follows daily tide to salt fields
- For rice grower in higher land without irrigation system of Thinh Loc commune:
  - Speed up the project of construction of irrigation system for more than 100 ha area; this project was built by the People Committee of the district
  - Survey to identify the proper fertilizer to improve land quality of this 100 ha area
  - Using different crop varieties with high outputs and productivity instead of current rice and crops area (peanut and sesame in difficult weather condition). For instance, using crop varieties like gourd and melon (water melon, cucumber...), increasing crop area; using proper varieties will provide 2 -3 times higher profit than current profit from rice cultivation in this area.
  - Develop the plan and map out the area to use the underground water source properly when it is drought; however, it is necessary to combine with using different varieties which require less water.
- For breeding and rice growing households in low land of Thinh Loc
  - Improve and strengthen current irrigation system, construct new canals for effective watering rice and providing water for fresh water fish raising
- For crop and vegetable producers in Ho Do:
  - Building 1 km canal system from Ba La Do Diem dam to improve current 70 ha of crop and vegetable area, promoting the development and effectiveness of off-season vegetable production as a local advantage
  - Using varieties that better adapt to dry and sunny condition like melon, gourd...

b. Proposal of household supporting policy in Vu Quang (mountainous area)

For An Phu and Duc Huong commune – representatives for Vu Quang district, the current crops system is quite proper. Growing green beans instead of summer-autumn rice is a wise choice thanks to short growing period and ability to be harvested partly after 30 - 40 days. Therefore, this crop can avoid flood even early ones. Current issue is training and applying high productivity varieties to fieldwork as well as increasing investment to gain higher productivity.

Some poor households use much less fertilizer amount than average ones, so that they just receive low productivity (about one third of productivity of average household). These poor households have no capital and economic potential, so they can not invest much.

We recognized that husbandry in Vu Quang mostly follows traditional ways of making full use of agricultural products which leads to quite low productivity. Number of pig breeding households is small because of no capital and low efficiency. Therefore, it is necessary to establish industrial breeding models to improve household income. Industrial breeding can provide product after 2 -3 months. Currently, some households are testing this new breeding technique and prove its high economic effect. Together with investment on pilot model, technical training for local people is also required.

Cows and buffalos breeding is popular in the households but it is difficult to increase the number due to lack of food and shelter in flood season. Hence, husbandry development should focus on other livestock like pigs, chicken... to diversify the household income.

Some communes leave post-harvested winter-spring areas fallow while these can be watered. These areas can be used for re-born rice cultivation. Some localities in the north (Ninh Binh) has successfully used this model and received about 1 ton of paddy/ha in 1 – 1.5 month after the winter – autumn crop. Pilot model of should be established in small area prior scaling up.

It is necessary to establish small credit model for local people to facilitate their access and effective use of the capital.

III.2. Conclusion

Climate change is no longer a new issue in Vietnam since climate change phenomena like higher temperature in summer, lower temperature in winter... were acknowledged. Long lasting heat with higher max temperature is increasing while longer coldness with lower temperature also occurs in winter. Total rainfall does not change much but rain allocation varies greatly with higher rainfall in rainy season and lower rainfall in dry season. Number of tropical storms making landfall in Vietnam is increasing with changes in its law: more and more storms coming to the south and sea level is about 10 cm higher than before.

Above mentioned climate change phenomena create many different natural disasters for Vietnam like flash flood, flood, rising tide... These disasters not only damage transportation and irrigation infrastructure, people's property and create crop failure but also cost many lives. In 2007, disasters caused loss of 1% of Vietnamese GDP.

Although Vietnamese government has just approved the national strategy for adaptation and coping with climate change, series of programs and projects has been implemented to adapt and cope with this issue. These programs also have support of international organizations.

Vietnamese government at different levels annual develops disasters and floods prevention plan. Many measurements were implemented by the government to alleviate the disasters and climate change damages as follows:

- Develop and strengthen the irrigation system, lakes, dams and sea dykes to prevent flood
- Riverhead afforestation
- Propagandize and educate people on disasters and flood prevention
- Developing early warning system for local people
- Establishing plan and support people when disasters strike
- Arranging crops and support local people to transform production system and apply technical advance
- Local inhabitants also have many different methods to adapt and cope with changes and disasters. For example, people in mountainous areas have following methods:
    - Adjustment of crops system and cultivation schedule to ensure harvesting before flood season
    - Application of technologies to reduce growing period on field like winter maize cultivation in soil ball, plastic coverage to protect rice seedling when it is cold, short-day varieties…
    - Shelter for livestock in flood season: making rafts, shelves, moving to higher land…
    - Construction of high shelf as storage place for food and goods as well as living place in flood season
    - One boat per household for transportation in flood season

- Migration of women, children, elderly to higher land and temporary living there (for some days in flood season)
- Buying cans and tanks for hygienic water storage in flood season
- Covering wells to keep hygienic water for after-flood usage

For coastal households, depending on household's production system, people have different methods as follows:

- Heightening the ground for salt storage
- Using high productivity and short-day varieties
- Crops changes
- Improving non-agricultural activities

In general, people in Ha Tinh province remain poor, so that they have limited ability to adapt and cope with disasters and climate change. Hence, it is necessary to have policies and supports for their adaptation. These supports aim at not only solving short-term damages but also taking long-term livelihood of local inhabitants into account.

ANNEX 1

1. Tables

1.1. Table 1: Average annual food production

	Unit	Ha Tinh province	Vu Quang district	Loc Ha district
Population	person	1288513	32851	87610
Cereal production	Ton	494937	7965	17688
Paddy production	Ton	475938	6411	17577
Cereal production per person (equivalent rice)	kg/person/year	230	145	121.1
Rice production per person	kg/person/year	222	117	120
Maize production per person	kg/person/year	14.7	47.3	1.3
Cassava production/person	kg/person/year	30.2	23.0	-

Note: Ha Tinh and Vu Quang in 2006, Loc Ha in 2007

1.2. Table 2: Summary of emergency aids of the institutions for inhabitants in Loc Ha district

No.	Supporting institutions	Support objectives	Support contents
1	Farmer Association of Ha Tinh province	Recovery the consequences of Tropical storm No. 2 and No. 5 in 2007	500.000 VND/1 household to buy sand for salt production recovery in Ho Do commune
2	People Committee of Thinh Long commune	Recovery of Tropical storm No. 2 and No. 5 in 2007	7000 kg rice, goods and 15 million VND
3	Ha Tinh Centre for Community Development (HCCD)	Recovery of storms, floods and hunger alleviation in between-crop-period in 2007-2008	12.347 kg rice for 400 households in Ho Do commune
4	People Committee of Loc Ha district and other institutions (annex)	Recovery of storms, floods and hunger alleviation in between-crop-period in 2007-2008	34.347 kg rice for Ho Do commune

Source: People Committee of Loc Ha district, Ho Do commune and Thinh Loc

1.3. Table 2*: Summary of program and project supporting locality in enhancing capacity for adaptation and livelihood of households towards natural disaster*

No.	Program/ Project	Objective	Schedule of implementation and situation
I	**Loc Ha district**		
1	Project on construction of dam of Ba La Di Diem, invested by the Ministry of Agriculture and Rural Development	Forbidding salt invasion in the area of Hong Loc and Ich Hau communes to bring fresh water to all the areas lack of fresh water in the district	Ongoing project, from 2002 - 2009
2	Project on construction of fishing port and place to avoid storms, directed by te Ministry of Agriculture and Rural Development	Developing aquatic product catching, reducing damage for fishermen when there are storms	Ongoing project, 2006 – now Total budget of 27 billion
3	Projects estimated to be approved		
3.1	*Project on fresh water, designed by the Institute of Irrigation Planning/ Ministry of Agriculture and Rural Development, and invested by the People Committee of the province*	*Bringing fresh water from the river to communes cultivating rice, farm produce and working in aquaculture*	*2009-2011*
3.2	*Project on construction of dyke along the sea and rivers*	*Preventing the salt and improving the lack of fresh water for the local people*	*Waiting for approval*
II	**Ho Do commune**		
1	Project supporting the plantation and maintenance of plants to prevent wave (10,000 m2)	Preventing storms and sea water invasion, limiting sand flow	Planted in1994 1994-now: continue to maintain and take care the area of plant
2	Community Development Center- ActionAid project	Supporting local people with 85 of fresh water container	Ongoing project Beginning of 2008- now
III	**Thinh Loc commune**		
1	IFAD project	Supporting the construction of transportation roads along the sea and the irrigation system	Implemented in 2002
2	ECHO project (ActionAid)	Supporting local people to improve their livelihood	Giving poor households 22 buffalos and cows

			2008
3	Wincom project	Supporting local people to improve their livelihood	Supporting the poor and policy family having accidents in the storm and flood with 39 buffalos and cow 2008
4	Program 106, for poor communes along the sea	Supporting the construction of irrigation system, transportation system and school	Waiting for approval of detailed project, not be implemented

Source: People Committee of Loc Ha district, Ho Do commune and Thinh Loc

2. Some projects related to climate change

2.1. Project of anti-flood capacity building for poor household in the Mekong delta, Vietnam [17]

Location: An Giang

Project duration: 13 months**, Starting at:** February 2007

Budget: US$182.250 from USAID and UNDP

Managing agency: People Committee of An Giang

Operation agency: Agriculture and Rural Development Department of An Giang

Objectives:

Alleviation of vulnerability of poor households living by-river and by-sea in An Giang province due to negative impacts of annual floods via piloting anti-flood housing technology.

Main outputs:

- Developing and strengthening the anti-flood ability of house foundation, which is consolidated with low-cost but high quality synthetic soil material, for coastal and in-land poor communes of two districts of An Giang;

- Providing training program on how to build and maintain the house foundation as well as how to reduce the risk of disasters for the communities, particularly isolated households which remain outside residential zones

2.2. Project on capacity building for the communities to prevent and cope with common disasters in Vietnam, particularly flash flood in mountainous areas [18]

Location: Lao Cai and Kon Tum province

Project duration: 15 months, **Starting at:** February 2007

Budget: US$ 550,589 in which US$ 26,897 from UNDP and US$ 523,692 from EC/ECHO

Managing agency: People Committee of Lao Cai province

Operation agency: Canadian Centre for International Cooperation and Studies (CECI) and People Committee of Kon Tum province

Objectives:

Alleviation of vulnerability of people in 06 mountainous communes via significant improvement of capacity and institution of main partners at different levels: centre, province, district and community; in which referring to flash floods, land slides and other risks in mountainous areas of Vietnam

Main outputs:

- Improvement of provincial/ district/ commune trainers' capacity as well as tools and methods to assess the risk, to make risk reduction plan and integrated propagandize with community participated risk management

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[17] http://www.undp.org.vn/undpLive/System/What-We-Do/Focus-Areas/Disaster-Risk-Management/Project-Details?contentId=2509&languageId=4&categoryName=Disaster-Risk-Management&CategoryConditionUse=/Subject-Areas/Disaster-Risk-Management&

[18] http://www.undp.org.vn/undpLive/System/What-We-Do/Focus-Areas/Disaster-Risk-Management/Project-Details?contentId=2508&languageId=4&categoryName=Disaster-Risk-Management&CategoryConditionUse=/Subject-Areas/Disaster-Risk-Management&

- Enhancing awareness, capability and practical application in alleviating vulnerability to flash floods, land slides and other disasters in six selected communes and significantly improving the vulnerable reduction capability in all mountainous communities.

- Strengthening institutional capability for CBDRM integration and planning for disaster risk alleviation in annual strategy, plan and budget for socio-economic development at central, provincial and district level; particularly reducing vulnerability to flash floods, land slides and in cooperation with other partners.

2.3. Project on Prevention to disasters related to climate change[19]

- Budget: 315,000 EURO

- Duration: 2003-2005

- Short-term objectives: Capacity building for Vietnamese organizations, agencies and people on adaptation, prevention and coping with disasters related to climate change.

- Long-term objectives: Reduction of damages for vulnerable people in Vietnam due to disasters related to climate change.

- Implementation scale and location: Nghe An, Ha Tinh, Quang Binh, Ninh Thuan, Binh Thuan.

- Beneficiaries: Vulnerable people in selected communes and districts under the project

2.4. Program on Adaptation to climate change in coastal and mountainous areas

Strategic framework 2007-2010 of International Union for Conservation of Nature (IUCN) in Vietnam

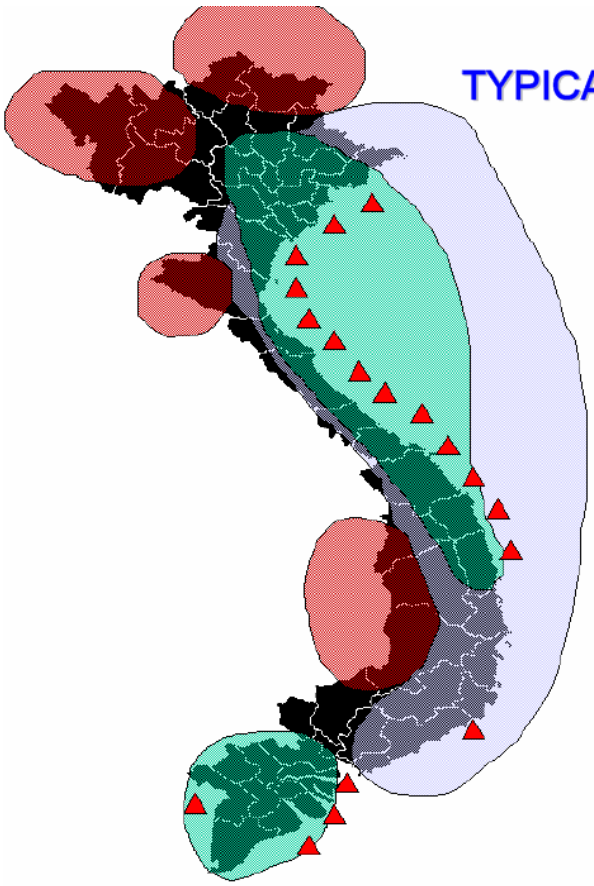
Activities:

Focus on adaptation strategies to cope with potential impacts of climate change in coastal and mountainous areas together with rural communities, particularly the minorities;

Setting standards for special ecological systems as foundation to define climate change; integrating climate change issues to current tools and programming mechanism;

Providing information and knowledge of potential impacts of climate change to the community; IUCN had developed the strategic framework for period 2007-2010 in Vietnam with four objectives as follows: state governance, environmental programming, environmental services and climate change.

[19] http://www.redcross.org.vn/projectDetails.aspx?id=17



TYPICAL DISASTERS IN VIET NAM

Flood

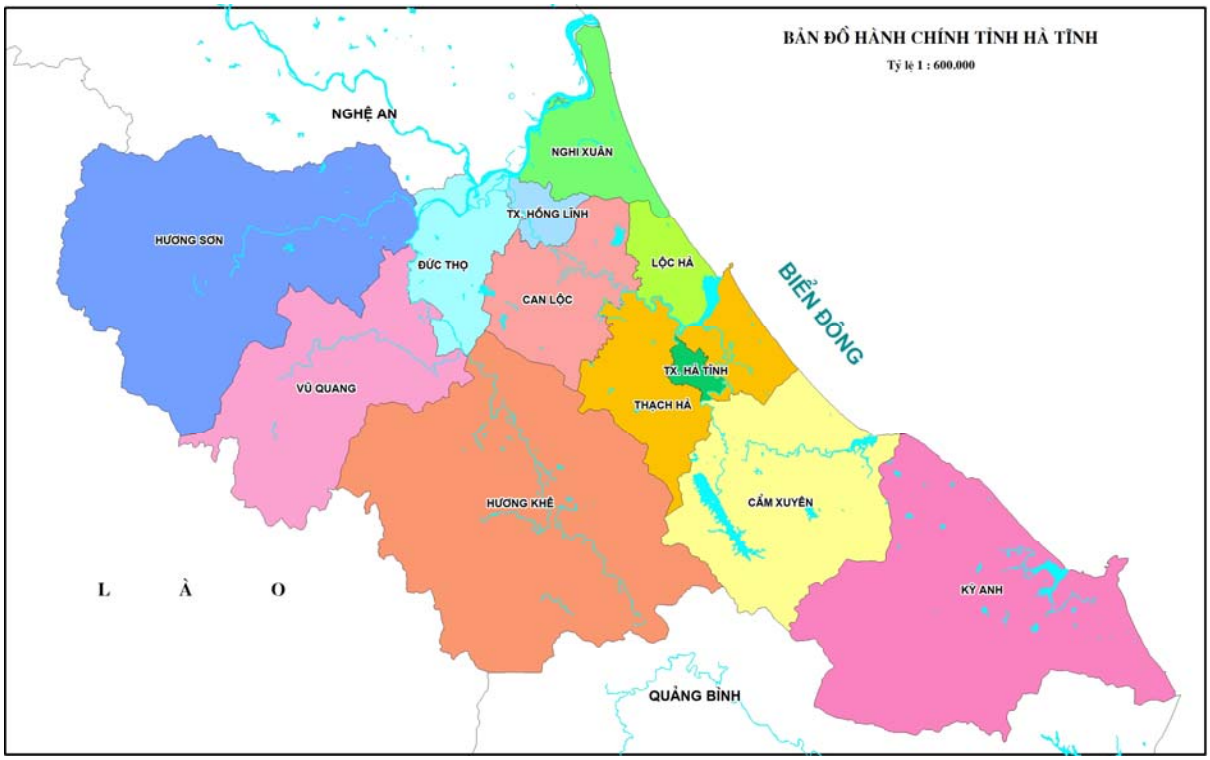
Flash flood

Storm and typhoon

Storm surges

Not on map:

- Drought
- Salt invasion
- Forest fire
- River bank and shoreline erosion



ANNEX 2

Different definition of climate change:

World Meteorological Organization

Climate change (WMO usage): (1) In the most general sense, this term encompasses all forms of climatic inconstancy (i.e., any differences from long-term statistics of the meteorological elements calculated for different periods but relating to the same area), regardless of their statistical nature or physical causes. Climate changes may result from such factors as changes in solar emission, long-term changes in the earth's orbital elements (eccentricity, obliquity of the ecliptic, precession of the equinoxes), natural internal processes of the climate system, or anthropogenic forcing (e.g., increasing atmospheric concentrations of CO2 and other greenhouse gases).

(2) The term is often used in a more restricted sense to denote a significant change (i.e., a change with important economic, environmental and social effects) in the mean values of a meteorological element (particularly temperature or amount of precipitation) in the course of a certain period, where the eans are taken over periods of a decade or longer (WMO, 1992[20], updated on 10 June 2005).

United Nations Framework Convention on Climate Change (UNFCCC):

A change of climate that is attributed, directly or indirectly, to human activity, alters the composition of the global atmosphere and is in addition to the natural climate variability observed over comparable periods (IPCC, 1995[21]).

Intergovernmental Panel on Climate Change:

Climate change (IPCC usage): Climate change as referred to in the observational record of climate occurs because of internal changes within the climate system or in the interaction among its components, or because of changes in external forcing, either for natural reasons or because of human activities. It is generally not possible to make clear attributions between these causes. Projections of future climate change reported by IPCC generally consider the influence on climate of only anthropogenic increases in greenhouse gases and other humanrelated factors (IPCC, 1995).

[20] **WMO.** 1992. *International meteorological vocabulary, 2nd edition*. Publication No. 182. Available at: http://meteoterm.wmo.int/meteoterm/ns?a=T_P1.start&u=&direct=yes&relog=yes#expanded

[21] **IPCC.** 1995. *Climate change: a glossary by the Intergovernmental Panel on Climate Change.* Available at: www.ipcc.ch/pdf/glossary/ipcc-glossary.pdf.