



**Center for Agriculture Forestry
Research & Development**

**IMOLA project
GCP/VIE/029/ITA - LOA/IMOLA/2006/.....**



Final Report

CLIMATE CHANGE EFFECTS IN TAM GIANG - CAU HAI LAGOON

Fund by: Food and Agriculture Organisation of the United Nations

Hue, August 2007

CLIMATE CHANGE EFFECTS IN TAM GIANG AND CAU HAI LAGOON REGION

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1. Introduction

In recent years, many reports on climate and weather showed that, globe climate has been changing from positive to negative site. Temperature regime has become warmer because of many different reasons that led to the change of annual rainfall and caused many serious disasters such as storm, typhoon, land slide and flood.

Our study focus in dynamic of climate in around 10 year from 1997 to 2007 to identify climate change effect to Tam Giang and Cau Hai lagoon region, in order to recommend solution of reducing vulnerability to communes which locate along those lagoons.

This study pays attention to following objectives

- Analysing the changing of climate indices such as temperature, wind direction, annual rain fall in recent 10 years
- Analysing flood level in main river of Thua Thien Hue province, Huong river to recognize the trend of flood level
- Developing vulnerability flood level map of the Tam Giang Cau Hai lagoon

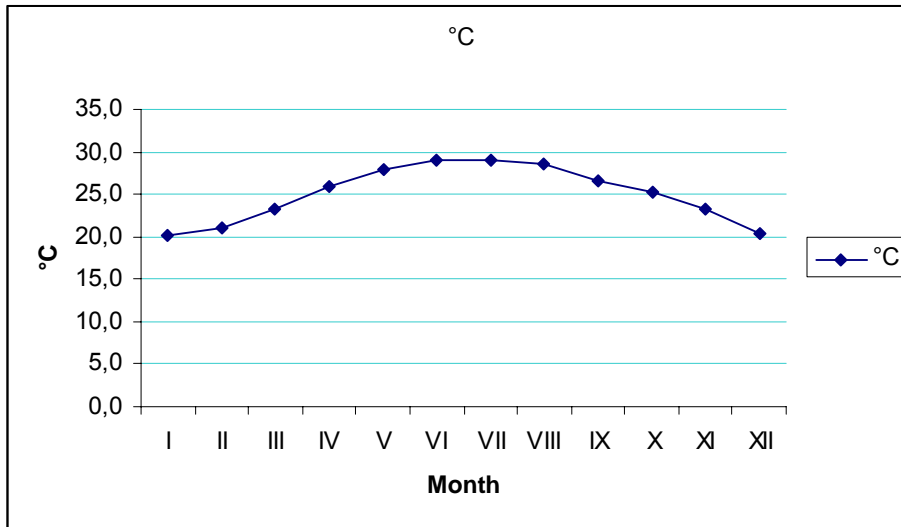
2. Climate change in Tam Giang and Cau Hai lagoon region

2.1. The changing of temperature

According to the monthly records from Thua Thien Hue hydrometeorology department from 1996 to 2007, average monthly temperature in Hue ranges from 20,1°C at January to 29,0°C at June with the average annual temperature around 25°C. It may divide to 2 seasons. High temperature season happens from May to the end of September and lower temperature season runs from October to April of next year (See Figure 1). In general, temperature of Thua Thien Hue has not significantly changed as compare to the temperature of decades before.

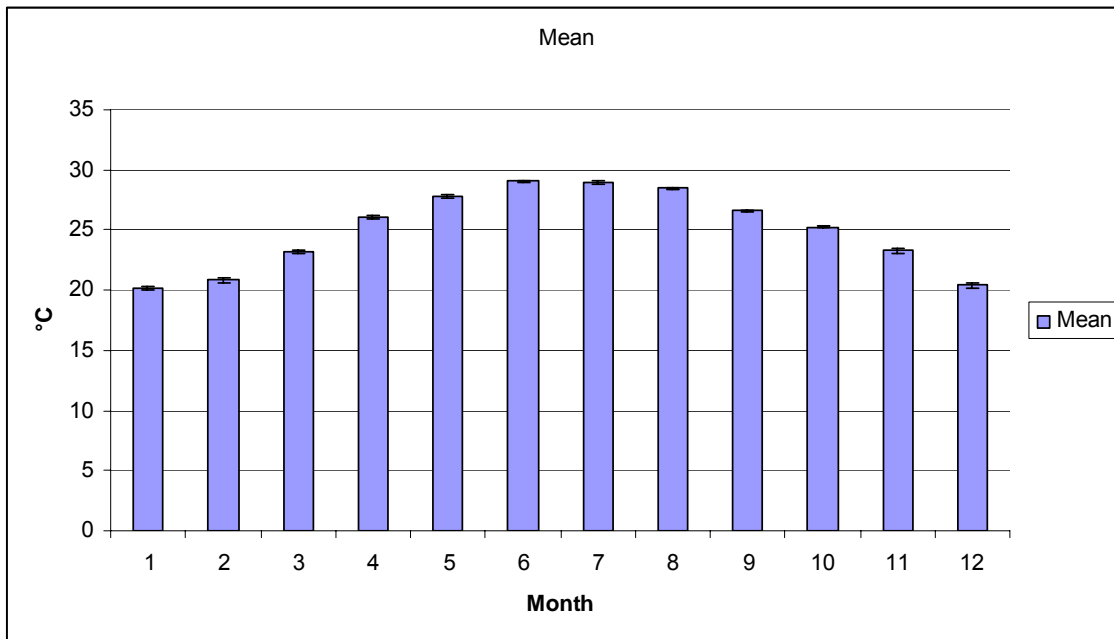
In term of monthly temperature analysis, not significant difference of the temperature in the month were analysed and recorded in Figure 2. In around 10 year, difference of average temperature in each month range from 0.0707 in September to 0.2085 in February. It can be concluded that, no significant climate changing in term of temporary were recorded.

Figure 1: Dynamic of annual temperature in 10 year from 1996 to 2007



Sources: Thua Thien Hue Department for hydrometeorology, 2007

Figure 2: Mean and standard errors of temperature of each month of year from 1996 - 2007



Sources: Thua Thien Hue Department for hydrometeorology, 2007

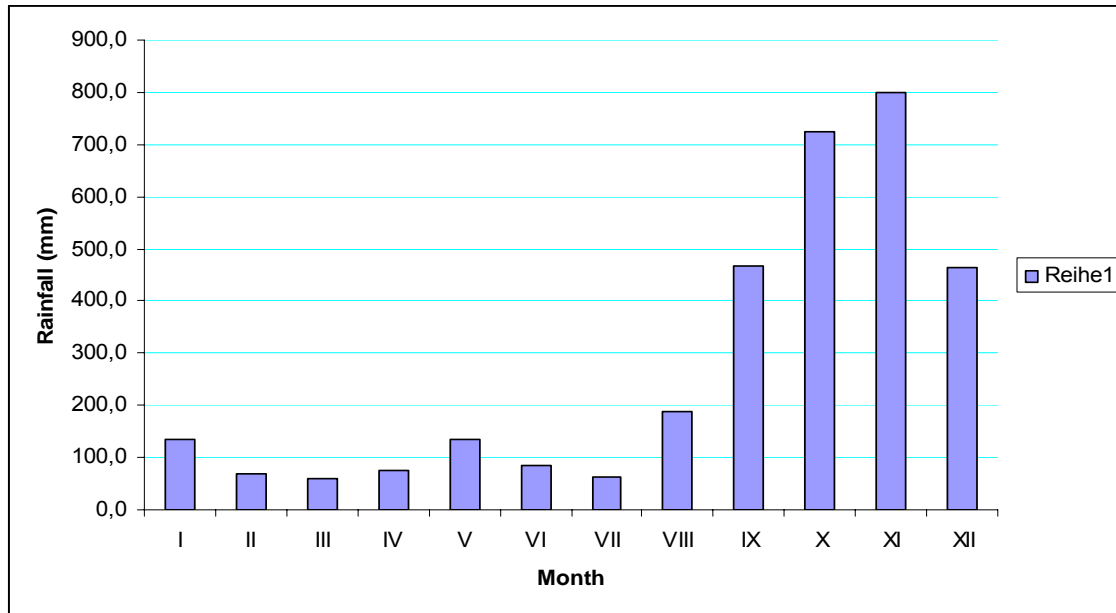
Table 1: Average monthly and annual temperature from 1996 to 2007

| Year | Month | I | II | III | IV | V | VI | VII | VIII | IX | X | XI | XII | NĂM |
|-------|-------|--------|-------|---------|---------|---------|---------|---------|---------|---------|---------|---------|---------|------|
| 1996 | | 20,1 | 18,6 | 23,4 | 23,6 | 27,4 | 28,9 | 29,1 | 28,8 | 26,4 | 25,5 | 23,6 | 19,7 | 24,6 |
| 1997 | | 19,8 | 19,7 | 23,6 | 25,7 | 28,1 | 29,2 | 28,9 | 29,3 | 26,3 | 25,6 | 23,9 | 21,7 | 25,2 |
| 1998 | | 21,7 | 22,3 | 24,5 | 27,1 | 28,6 | 29,8 | 29,4 | 28,9 | 26,3 | 25,1 | 23,5 | 21,2 | 25,7 |
| 1999 | | 19,7 | 21,5 | 24,1 | 25,8 | 26,6 | 28,6 | 29,2 | 28,7 | 27,2 | 25,4 | 23,6 | 17,8 | 24,9 |
| 2000 | | 20,4 | 20 | 22,5 | 26,1 | 27,2 | 28,3 | 28,5 | 28,5 | 26,5 | 25,3 | 22,1 | 21,3 | 24,7 |
| 2001 | | 21,4 | 20,5 | 23,2 | 27,7 | 27,6 | 28,2 | 29,2 | 27,8 | 27 | 25,8 | 21,1 | 20,2 | 25,0 |
| 2002 | | 19,9 | 21 | 23,5 | 26,4 | 27,7 | 28,9 | 29,5 | 27,8 | 26 | 24,9 | 22,7 | 21,6 | 25,0 |
| 2003 | | 19,1 | 22,2 | 23 | 27 | 28,6 | 29,1 | 28,8 | 29 | 27 | 25 | 23,6 | 20,2 | 25,2 |
| 2004 | | 20,3 | 19,8 | 23 | 25,4 | 28,1 | 28,7 | 28 | 28,5 | 26,4 | 23,9 | 22,8 | 20,3 | 24,6 |
| 2005 | | 19,9 | 22,4 | 21,3 | 25,4 | 28,9 | 29,6 | 27,9 | 28,3 | 27,3 | 25,2 | 23,9 | 19,2 | 24,9 |
| 2006 | | 19,9 | 21,6 | 22,7 | 26,4 | 27,3 | 30,1 | 29,8 | 27,8 | 26,5 | 26,1 | 25,1 | 21,6 | 25,4 |
| 2007 | | 19,3 | 22,8 | 24,7 | 25 | | | | | | | | | |
| Delta | | 0,1252 | 0,209 | 0,14147 | 0,18263 | 0,11692 | 0,10062 | 0,10007 | 0,08643 | 0,07074 | 0,09526 | 0,17595 | 0,20266 | |
| Mean | | 20,2 | 20,87 | 23,1636 | 26,0545 | 27,8272 | 29,0363 | 28,9363 | 28,4909 | 26,6272 | 25,2545 | 23,2636 | 20,4364 | |

2.2. The changing of annual rainfall

The annual rainfall of Thua Thien Hue province in 10 year is 3,248 mm. That is large amount as compare to other provinces in Vietnam. As well as temperature, there are 2 main season were recorded in Thua Thien Hue province. Rainy season comes from August and finishes at December. The dry season continues from January to the end of August (See Figure 3).

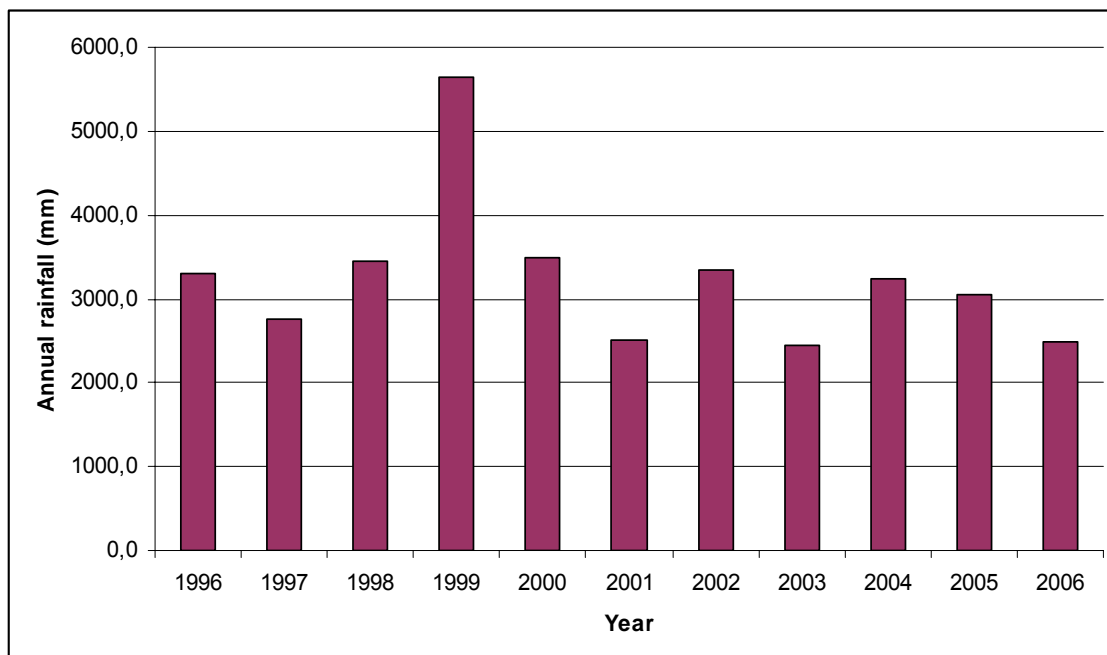
Figure 3: Monthly rainfall in a year round from 1996 - 2007



Sources: Thua Thien Hue Department for hydrometeorology, 2007

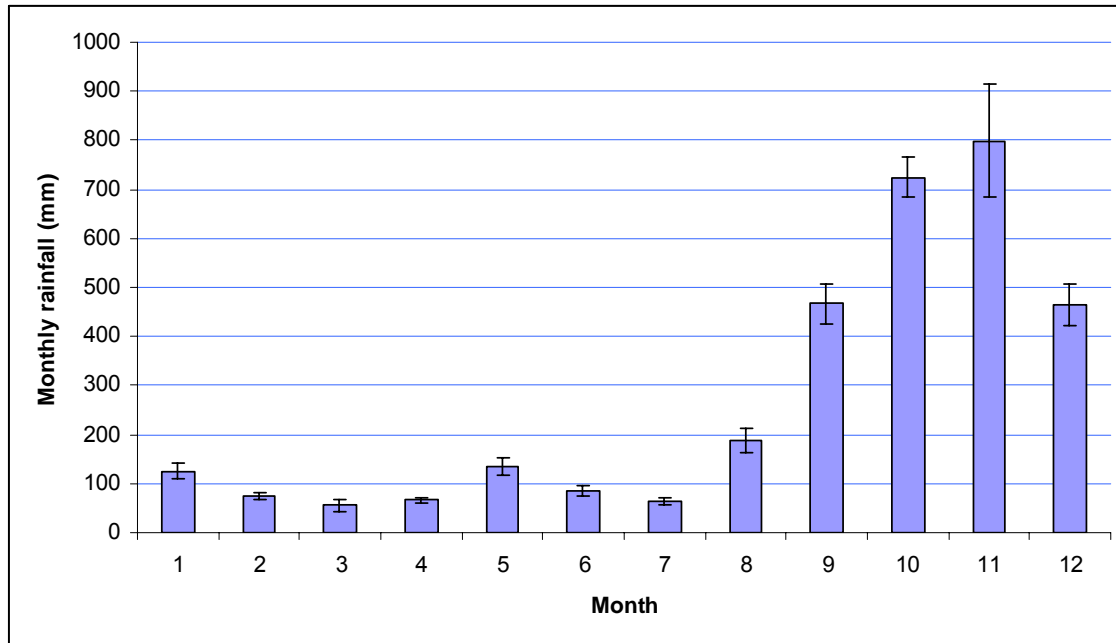
In around 10 years, except for the year 1999, annual rainfall run in the range around 3000mm/year which is presented in Figure 4. The minimum rainfall were recorded in 2001 at 2499 mm.

Figure 4: Total rainfall in 11 year from 1996 to 2006



To clarify the difference of annual rainfall among study year (1996-2006) the error standard of monthly rainfall were analysed. There are not significant difference among monthly rainfall from Januarys to Augusts of the years from 1996 – 2006. The error standards are in the range from 7 to 17 mm per month. However, significant difference occur in the rainy season from Augusts to Decembers (See Figure 5).

Figure 5: Monthly rainfall in 11 year analysis and error standard



Deeply analysing rainfall in a year from August to December in 11 years (1996-2006), except for the year of 1999 with unusual rainfall, there is no significant difference.

Therefore, in series data of rainfall of 11 years from 1996 to 2006, except for 1999, no significant difference of annually rainfall were recorded.

Table 2 presents average annual rainfall of 10 decades from 1911 – 1920.

Table 2: Annual rainfall in decades from 1911 to 2006

| Decade | Annual rainfall (mm) | Max month (mm) | When | Max day (mm) | When |
|-------------|----------------------|----------------|-----------|--------------|------------------------------|
| 1911 - 1920 | 2817 | 1568 | Nov, 1917 | 283 | Oct 13 th , 1916 |
| 1921 - 1930 | 3008 | 1241 | Nov, 1930 | 360 | Nov. 13 th , 1930 |
| 1931 - 1940 | 2631 | 1166 | Oct, 1932 | 433 | Oct. 25 th , 1939 |
| 1941 - 1950 | 3230 | 1547 | Oct, 1949 | 440 | Oct. 23th, 1949 |
| 1951 - 1960 | 2751 | 1078 | Oct, 1960 | 277 | Nov. 11st, 1960 |
| 1961 - 1970 | 2824 | 1792 | Oct, 1969 | 550 | Oct. 5 th , 1969 |
| 1971 - 1980 | 2666 | 1564 | Oct, 1973 | 470 | Oct. 23th, 1973 |
| 1981 - 1990 | 2575 | 1527 | Oct, 1983 | 582 | Oct. 10 th , 1981 |
| 1991 - 2000 | 3093 | 2452 | Nov, 1999 | 978 | Nov. 2 nd , 1999 |
| 2001 - 1006 | 2827 | 1526 | Nov, 2004 | 682 | Nov. 11 th , 2004 |

Table 2 also confirms that, the annual rainfall in around 100 recent years is not too difference. Annual rainfall is always around 3000 mm/year. Big rainfalls come in 2 month October and November with monthly rainfall in the range from 1800 to 2200 mm. The big heavy rains also were recorded in this to rainy months.

2.3. The changing storm and typhoon

Number of storms and typhoons of different years were counted in Table 3. It seems that many year have no storm in Thua Thien Hue province. From 1953 to 1964, there was no storm, that was recorded. Table 3 showed higher frequency of typhoons in recent year in term of year has storm and number of storms in year. About 8 storms were recorded in 1982 and from 5 – 7 storms per year were recorded in years from 1987 to 1997.

With this data, higher frequency of storms in recent year were concluded.

Table 3: Number of storm at Thua Thien Hue province in 40 analysing year

| Year | Number of storm | Year | Number of storm | Year | Number of storm |
|------|-----------------|------|-----------------|------|-----------------|
| 1953 | 1 | 1972 | 1 | 1987 | 5 |
| 1964 | 2 | 1973 | 1 | 1991 | 5 |
| 1965 | 1 | 1975 | 1 | 1992 | 6 |
| 1968 | 1 | 1977 | 4 | 1993 | 7 |
| 1969 | 2 | 1982 | 4 | 1994 | 6 |
| 1970 | 3 | 1983 | 8 | 1997 | 4 |
| 1971 | 3 | 1985 | 2 | 2002 | 1 |

2.4. The changing of flood and flood level in recent year

Main flood season Hue as well as Huong river delta was identified from October to December. In fact, we can classify flood in general at Thua Thien Hue province to following typical floods.

- Early floods: the early floods are small and flood come from May to June because of heavy rain sub season of early summer.
- Late floods: as well as early flood, late floods are also small and short time floods. They come from late December to early January of the next year. Time of late floods are longer than early flood. It take around 7 days.
- Main floods: Main floods are flood season come from October to December at the same time with main rainy season in Thua Thien Hue province. In fact, about 7 – 8 floods a years were recorded. Almost of serious floods come from middle October to middle November. Serious flood comes with heavy rain of storms and continue of two or three floods at the same time. Almost of historical floods happened in this time. Frequency of historical floods in Hue is 1 – 5% with maximum water flow in Huong river was 12,500 m³/s and flood level in Hue at 5.81 m.a.s.l (2 – 2.5 m from ground at Hue city)

Main reasons of floods in Hue are rain, storm, tropical low pressure, Flood come to Hue by heavy rain from the western mountain areas (Huong river and Bo river watersheds) cause strong water low from the upland to lowland. At the same time, monsoon from the sea comes to continental press higher tidal flow. Those two main reasons cause flood to the lowland.

Table 4 present serious floods in Thua Thien Hue province from 1894 to 1999.

Table 4: Historical flood from 1894 to 1999 at Thua Thien Hue province

| Month/year | Damage |
|-------------------|--|
| May, 1894 | Damaged village and kill many people |
| October, 1897 | Flood and tide closed Eo estuary (Hoa Duan) and Sut estuary (Thuan An) |
| September, 1904 | Flood broken 4 spans of Trang Tien brigde and Phuoc Duyen tower at Linh Mu pagoda. Second time closed Eo estuary (Hoa Duan) and Sut estuary (Thuan An) |
| October, 1928 | Broken Thuan An dam |
| September, 1930 | Broken Tu Hien estuary and Thuan An estuary |
| September, 1980 | Killed 173 people |
| July, 1981 | Destroyed 40.000 houses |
| October, 1983 | Killed 252, and hurted 115 people |
| October, 1985 | Killed 604, hurted 234 and losted 98 people |
| October, 1989 | Killed 140 people |
| October, 1989b | Killed 53 and hurted 766 people |
| October, 1992 | Killed 7 people |
| November, 1998 | Killed 31 people |
| November, 1999 | Killed 373 people |

Data set from table 4 explain the higher frequency of flood to Hue thru Huong River in recent year. Except some other reasons of rain and storm as well as the high tidal, natural forest in the upland areas of Thua Thien Hue province play important role in those floods. Forest areas were reduced significantly in around 20 years from 1980 to 2000, that may consider as a main cause of serious floods in last decade.

3. Conclusion

Our main objectives are identification climate change in recent last decade in Thua Thien Hue provinces, which effect directly to Tam Giang and Cau Hai lagoon region. We analysed series data of temperature, annual rainfall in last 10 years and compared with series data from last some decades. Result of the analyse proved that

- No significant on climate changing as base on data of the change of temperature and annual rainfall. Some extreme data of rainfall in 1999 are special data happened in special time.
- Higher frequency of storms, typhoons by year as well as number of storms per years were recorded.
- As well as results from frequency of storms, flood frequency is also higher than some last decade in last ten years. Main reason may come from effects of forest high interfere in the upland areas of Thua Thien Hue province.
- The high flood level at Thua Thien Hue province comes from October to November and at around 5 m. a.s.l.



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Final Report

**STRATEGIES TO REDUCE VULNERABILITY TO
FLOODING OF COMMUNES IN TAM GIANG AND
CAUHAI LAGOON**

Fund by: Food and Agriculture Organisation of the United Nations

Hue, August 2007

The communes of Quang Phuoc of Quang Dien district, Phu An of Phu Vang district, Hai Duong of Huong Tra district and Vinh Hien of Phu Loc district were selected as research sites of this project. These communes are representative for the communes in lagoon of Thua Thien Hue. The results in this study is identified by the community members in facilitating of researchers of CARD of College of Agriculture and Forestry, Hue University.

1. QUANG PHUOC COMMUNE

Quang Phuoc commune is one of 11 communes and town of Quang Dien district. The commune is located in the East of Sia town (Quang Dien district), a lowland area at the end of Bo River. It is often waterlogged in the rainy season and some dykes bordered by Tam Giang lagoon are salty in the sunny season.

The whole commune has 1,733 households with 8,030 people. Of which, 437 households belong to poor households (according to new standard) and 1,991 people, occupying 26.49% in households and 26.47% in people. Number of malnourished children is 145 (accounting for 21.4% of children); number of diarrhoea children is 54 (accounting for 8%). Number of people under labour age is 2,650 (men aged from 18 to 55; and women aged from 18 to 45).

The livelihood of Quang Phuoc commune's people depends mainly on agricultural and aqua production, accounting for 64.4%. The career division in the villages is rather clear. Among 8 villages of the commune, 6 villages participate in the agricultural production (including: Thu Le 2, Thu Le 3, Khuong Pho, Phuoc Lam, and Phuoc Ly) with the participation of 1,424 households, 6,579 people. And 2 remaining villages focus on aqua exploitation (namely Phuoc Lap and Ha Do) with the participation of 193 households. Number of aqua cultivation households is 321.

According to the report of the commune People's Committee, total income of the commune inhabitants in 2005 was 33.977 billion VND. Of which, 25.3% was from cropping; 21.6% was from livestock; 17.5% from aqua cultivation and exploitation; 25.6% from handcraft; and 5% from service. The average income per head is 4,350,000 VND/year. In addition, some households received the source of income from the relatives working in the far places.

Quang Phuoc commune is a commune which has tradition in cultural history. All of 8 villages of the commune achieved the standard in cultural villages and many households were recognized by the authorities as cultural families. With such good and close relation, it facilitated the inhabitants in the commune help each other in misfortune and especially in the natural disasters.

Around 74% of total interviewed households belong to medium and fairly rich according to the national classification standards in 2004. The rate of poor households occupied 1/4.

The reasons cause the poverty for the poor and especially poor households are:

- Losing in the first harvest of shrimp, causing the doubtful debts. And this debt makes the households impossible to borrow more loans for their business.
- Lacking capital for business and investment in the production.
- Shorthanded, old and helpless families.
- Illness, chronic diseases
- The natural disasters destroyed assets and agricultural and aquacultural products.

The survey of actual status and impact of floods on the development process of Quang Phuoc commune showed that, the impacts were different in different times. The inhabitants indicated that from 1953 up to now, the local faced the following history floods:

| Time landmark | Impact |
|----------------------|---|
| Flood in 1952 | Impact of assets, home, aqua equipment, vegetables,... number of dead people was not available. |
| Flood in 1953 | The water went up very highly and prolonged, 40% of houses were destroyed and lost, vegetables, roads and aqua equipment were damaged. Some people were dead, others had to leave for other places (number of dead people is no idea because the flood happened long time ago). |
| In 1973 | Big flood, roads and aqua equipment were destroyed, some dead people. Many people had to leave for other places (could be alive due to the war time) |
| In 1976 | Big flood, water level went up highly and deeply at about 2m. The crops were lost, the inhabitants meet many difficulties. Hence, after the flood, many households moved to the new economic areas (A Luoi, Central Highland,...) |
| Flood in 1983 | The impact level was similar with the flood in 1976. |
| Storm in 1985 | The storm was very big with strong wind at level 12 and gust above level 12. Due to large geography, little firm houses and many households lived on boats (Thuy Dien village), there were 62 dead people, of which 58 people in Phuoc Lap village (living on boats) and 4 people in Ha Do village. More than 50% of houses which were collapsed and whose roofs were blown up, many parts of roads were isolated. in Mai Duong village, serious landslide was caused by waves. |
| Flood in 1999 | This is the biggest flood in the history which the inhabitants have ever met. In this history flood, the water level was more than 3-4 m deep, the time of water logging prolonged near 1 week. In general, compared to previous floods, the flood in 1999 caused the biggest damages for the local inhabitants. |

Following up the impact's frequency and level of floods at local gave us some following comments:

- The occurring frequency of natural disasters increasingly went up.
- The intensity of the natural disasters had the tendency of increasing considerably.
- The damaged level in people and assets in the first stage had the increasing tendency, but in recent time, it is limited thanking to the in time warnings and prevention from the government and from the inhabitants.

Above here are some time landmarks and damages which the local people could remember. And in fact, from 1950 on, according to the document of Do Bang (Do Bang: "Floods in 5 past decades in Thua Thien Hue"), there were many big floods and the affects caused by natural disasters were very severe.

Studying the strengths, weaknesses, opportunities and trends in the flood prevention for the community, we got the results as follows:

| 1- Strengths (S) | 2- Weaknesses (W) |
|--|---|
| <ul style="list-style-type: none"> - The natural disasters often happen every year, so the inhabitants have experience. - The system of warning and forecast for natural calamity is developed (radio, | <ul style="list-style-type: none"> - The technical and material facilities were backward. - Traffic was obstructed - Lacking upland area to move the inhabitants |

| | |
|--|--|
| television, telephone,...) - There were effective support from the authorities at all levels - The boards of Flood Prevention were organized rather closely to assist the inhabitants at necessary | at necessary - Destroying the canals and irrigation works and aquaculture ponds - Cattle and poultry raising met many difficulties, especially in the flooding season - Natural exploitation met many obstacles - Women's daily activities met many difficulties - Commodities were scarce |
| 2- Opportunities (O) | 4- Trends (T) |
| - People's awareness of natural disaster prevention and treatment had positive changes - The supply of information was faster and exacter - The diversification of production activities contributed in limiting the flood's impacts - The floods brought about alluvium, increasing the fertility for the fields | - The change of global climate - A part of local people started to rely on modern equipment, less focused on the traditional experiences - Most of people are poor, so they do not have capability of building houses to prevent from the floods - The environment is polluted, affecting the people's health |

To reduce the impact of natural disaster and increase the inhabitants' capability of coping with different kinds of natural disaster, the local people proposed the following solutions:

- Supporting credit so that the local people can invest in the production
- The authorities should have interference with the banks to increase the borrowing time to suit with the production scope and cultivation circle.
- Investing and enhancing capacity of the information warning systems so that the local people can have a lot of information to be active in the control of natural disaster
- Studying the crops and animal development to be suitable with the climate and weather conditions at local.
- To develop aquaculture sustainably, the breeds must be active and strong
- Establishing the proper purchasing system and price policy
- Carrying out seriously the protection of aqua resources
- Investing and upgrading the inter-village, inter-commune traffic system to be active in the relief when the water goes up high
- Limiting the wastes from agricultural production activities to the lagoon
- Supporting the groups of flood control with the necessary equipment (lifebelts, motor boats,...)
- Supporting the poor households with clean water and building toilet

To limit and minimize the risks in the production and in life, farmers have the following demands:

- Training on the techniques of raising shrimps and knitting nets.
- Technical training on first aid for the people in danger
- Training on management of credit for the local people
- Method of treating drinking water and using water
- Introducing the flood control program in schools.
- Increasing the awareness of community in the management and treatment of wastes to prevent from the environment pollution, especially after the flood.

In the flooding season, the travelling of the commune met many difficulties. The travelling not only from the district, city to the commune, but also the between the villages in the

commune are separated. Therefore, the general policy of the local leaders informed to the households groups, the households in the commune have to apply seriously the 4 on-the-spot methods. It is detailed that: (i) on-the-spot force; (ii) on-the-spot guidance; (iii) on-the-spot logistics; and (iv) on-the-spot means. On the other hands, it must be active in using the from modern to primitive information system at necessary.

To satisfy the above request, the commune People's Committee set up the concrete solutions:

- There are the concrete control plan for every flood when receiving the warning information.
- The commune Flood Control Board has to check directly each resident group to give out the additional methods.
- Checking and upgrading the broadcasting system in the commune.
- Disseminating and encouraging the local people to avoid the subjectivism.
- Preparing the foods (fast noodle) and medicines as requested by the upper levels.
- Clarifying the evacuation ways and sites for each resident area when a big flood happens

2. PHU AN COMMUNE

Phu An commune is far from Hue City 12km in the Northeast, the north borders Phu Tan commune, the East borders Phu Xuan commune (separated by Tam Gang lagoon), the West borders Phu Duong commune and the south borders Phu My commune

According to the figure from People committee of Phu An commune, there are 118 poor households. In Trieu Thuy hamlet, there are 35 households, there are 45 households in An Truyen hamlet, there are 17 households in Truyen Nam hamlet and 21 households in Dinh Cu hamlet. The poor households are distributed "Poor household card", so parent an children will have the benefit from the policy of Government and local about studying, examine...Reason of poverty and hunger

- Lack of experiences in production
- Lack of capital for business and invest for technique
- Too many children in one family (there is one family in Dinh Cu hamlet that has 16 children). This story is known by the Government through newspaper. Or Ms. Huynh This Bong, at the age 31, she has 6 children
- Short of manpower in family, old people have no one to rely on
- Disease in many years
- Disaster damaged the property, agricultural and aquacultural products

Thua Thien Hue province is located in the tropical and monsoon area. The climate here is influenced directly the climate from the North and the South. The main rivers in Thua Thien Hue are Huong river, Bo river, O Lau river, Truoi river. The rainy season is from August to November (Western calendar) with 2500- 2700 mm and often have flood, overflow. The dry season coincides the dry South West wind season, from March to July (Western calendar): drought and salt water influence the rivers.

Phu An commune is up to Phu Vang district, it has some particular characteristics.

- This area have the highest temperature in the province, the average temperature is about 24- 25,2°C
- The total temperature is from 8500- 9000 °C
- The total sunny hours: more than 2000 hours
 - o In the winter, the lowest temperature can reach to less than 10 °C. But in the summer, the temperature is high, sometimes 40°C or even more than that.
- This area have the lowest amount of rain among the province
 - o The amount of rain every years: 2600- 2800mm

- The amount of rain is not distributed regularly each month in a year.
- The total rain amount from January to August is less than 800mm. In June, this area does not have enough water
- This area is influenced seriously from the windstorm, flood and the dry South West wind.

According to the figure of Hydrometeorology Centre in Central Vietnam, the rainy season every year in Thua Thien Hue in general and Phu An commune- Phu Vang district in particular often happen from May, June (Western calendar) and cause the small flood. From September to November (70% amount of rain appear)

From 1978- 2005: there are 98 floods happen in Huong river valley. There are average 3.5 floods above 2nd alert. La Nina happen in some years (1996, 1998, 2000) and in these years, floods happen too many times. The time for each flood last for 3-5 days, or even 6-7 days. The amplitude of flood is from 3-5m.

According to villagers' experiences, the flood often happen in September, October, November- Western calendar (especially in October). Beside flood, storm often occur in September, October, November

(In October or November, flood often occur twice or three times)

Flood and storm often cause damages for property, life, the production and also influence the development of economy and society of the local, and cause serious damages for environment and ecology

Base on the group discussion (FGD), villagers remember clearly some period of time that connected closely with the disaster and the damage of disaster

| Timing | Influence |
|--------------------------|---|
| Flood in 1953 | Damage the life and property |
| Flood in 1975 | Failure 250ha of agricultural productivities |
| Drought in 1977 | Great damage, especially in agriculture. Crop failure, some villagers are hunger. Some have to leave commune to another places for earn living |
| Flood and storm in 1983 | Houses are knocked down, fishing cages are drifted |
| Flood and storm in 1985 | Damage to people and property. There are 40 households in Dinh Cu hamlet that are knocked down. The property damage is about 100 million VND. There are 36 people died in this commune (there are 13 in Dinh Cu hamlet). After the storm and flood, in the year 1985, Dinh Cu hamlet was established. |
| Drought in 1989 | Influence seriously to the productivity and rice. Salty land. |
| Flood and storm in 1998 | Damage to property reaches more than 300million VND. The wind is at level 6, level 7 but some villagers come to the sea and 4 people died |
| Historical flood in 1999 | Damage seriously to property, houses, roads.... and the amount of money is approximately 10.4 billion VND. There are 4 people died |
| Flood in 2004 | Some aqua cultural households are damaged about aqua cultural tools, shrimp, fish.... The damage is about 10 million VND |
| Flood in 2005 | Some aqua cultural households are damaged about aqua cultural tools, shrimp, fish.... The damage is about 20 million VND |

Above are some period of time and some damages that villagers can remember. In fact, from the year 1950, according to PhD Do Bang (Do Bang: "Flood and storm in 5 centuries

in Thus Then Hue province), there are many serious flood and storm and their damages are serious

We can consider that Phu An commune is a place that often influenced by disaster. However, according to each kind of disaster, the influences are different.

Villagers have noticed some changes of climate, scenery, ecology and environment from the sense. These changes are from the change of nature and the impact of people.

According to villagers, in recent years, there are some stable changes about climate

- The flood every year reduces * (*Note: this comment is from villagers and they consider from 2000- 2006)
- It often rains too much in rainy season, in the summer: high temperature and sunny
- The direction of wind changes:

Droughts in recent years damaged the agricultural production and aquaculture. Drought often occurs in May, June, July (Western calendar). Because of the lack of water, the area for Summer- Autumn crop can reach only 60ha. Drought brings the salty, influence the planting productivity and living. With the drought, high temperature in summer increase the salty in lagoon area and fishes, shrimps died. Storm not only damaged the crops, property, life but also the trees.

During and in flood period, the garbage, animal died... polluted the water resource.

The water environment in lagoon is polluted day after day because of the agricultural chemical substance (fertilizer, drugs to protect plants...), garbage of villagers who live along the lagoon area, the usage of chemical substance in aquaculture reduce the fishery productivities, and even the death of fish, shrimps....

Villagers do not know how to apply new techniques in aquaculture, this not only prevent the circulation of water, pollute water but also prevent the move of creature from the sea to lagoon. Before villagers only use tools made from bamboo, net so the influence to water circulation and the creature is just a little. So, the project of net enclosure on lagoon area is really necessary for villagers

Analyze SWOT about the actual state to reduce disaster in this area

| Strong point (S) | Weak point (W) | Occasions /potentials (O) | Challenges/ hazards (T) |
|--|---|--|--|
| <ul style="list-style-type: none"> - From the fact of previous years, villagers had experiences and have high recognition in preventing flood and storm - The Management of preventing flood and storm have some more experiences - The system of preventing flood and storm of hamlets, communes is organized well and | <ul style="list-style-type: none"> - This commune is located in low area (located at the head of salty water resource and end of clean water resource) - When the flood come, it is difficult to use transportation - Many households want to have stable house or high floor house but they do not have money - Lack of means of rescue (the motor | <ul style="list-style-type: none"> - If there is a watering place, this commune will increase the area of Summer- Autumn crop, the economy of villagers will increase, the prevention of flood and storm will get better - Have the consideration of district, province, central about material and spirit - Hope to have the | <ul style="list-style-type: none"> - The polluted water influences the production and life of villagers - Many households catching fish according to exterminate ways - Lack of means for rescue - Disaster does not happen base on the rule |

| | | | |
|--|---|---|--|
| <p>they work enthusiastic</p> <ul style="list-style-type: none"> - There is one place to inform the storm in this commune so villagers can update information - There is an information system in this commune (base on the radio and electric generator) There are 20% of households who have cell phones - There are some means to rescue such as floats... - Many houses are high floor houses. Many households have boats (especially in Dinh Cu hamlet) | <p>boats in this commune are small, can not adapt)</p> <p>Government supplied one speed boat but now it is broken. Many hamlets lack of rescue means.</p> <ul style="list-style-type: none"> - There are many difficulties in polluted environment disposal (polluted water, polluted garbage) | <p>help from some organizations in the country as well as outside about preventing disaster</p> | |
|--|---|---|--|

Prevention

- Preventive is main. Preventive method is implemented with 4 guidelines: (forces, logistics, commander, means at the same places)
- The organizations and implement some activities to prevent flood, storm are important. There is one Management board of preventing flood and storm in the commune, include 22 people (Chairman, Vice chairmen, Head of each department, farmer Union, Women Union, Youth Union, Veteran's Organization, police, leader of each hamlets...Among them , the chairman is also the head of the management board of preventing flood and storm) There are 5- 7 people in Management board of preventing flood and storm in the hamlet (leader of the hamlet, police, medical staff,...) There is one militia board in each hamlet, from 5-7 people
- Before the rainy season, commune also prepares some means, materials to rescue immediately. There is one motor boat in this commune, 100 liters of petrol, 50litres of oil, 20 floats, 50 floats are distributed to each hamlet. In Dinh Cu hamlet, there is one gale warning station, when the flood or storm come, this station will have signal by sirens or lights to call boats come back. This commune has stored 1 ton of rice and 2000 packages of instant noodle

Resist

There are some ways to resist the flood and storm:

- Management board of preventing of flood and storm will be on call 24/24 to direct immediately and solve emergency situations.
- Move villagers to safety places
- Organize activities to rescue when there are some dangerous situations happen
- Distribute food for villagers

- Inform and force some households who still live in the boats or still do aquaculture during the flood and storm period.

Recovery:

Management board of preventing of flood and storm have some ways to recover the flood and storm

- Statistic and inform the damage situation to higher organizations
- Stabilize the production and life of villagers
- Receive and distribute goods to villagers
- Implement to clean environment, prevent diseases
- Propaganda and encourage villagers help and love each other
- Summarize, get experiences, commend and reward some individual, organizations that have contributions in preventing flood, storm

This commune has some policy and strategy to prevent disaster:

- Improve livelihood and increase income, increase the capacity to prevent disaster is the most important strategy of the local
- Abolish the unstable houses, especially give land and support money (commune supports 4 million VND/ household, district support 7 million VND/ household, 4 households/ year) is the 2nd concern of the local
- The third concern is building dam to prevent salty water

The commune also concerns these policies:

- Prepare places to move villagers when there is storm or flood.
- Establish Disaster prevention Committee of the commune, hamlet. With the commune, implement policy 4 in the same places; with the hamlet, implement policy 3 in the same places (commander, means of transportation, force, youth volunteer)
- Prepare some means to rescue (motor boat, float...food, rice, instant noodle, fuel...)
- When there is one person died, Government will support 1million/person

From the fact of life, villagers have some experiences to help them predict some climate change, so that they can reduce damages

Villagers get experiences from observing the change of animal complexion, the change of the moving of some animal or the change in the nature (cloud, wind, star, moon, etc...)

The experience was taken from the previous generations, from the oral, or from folk song...

- *Native knowledge about predicting flood*
 - o When the ant build the nest on high places, there will be big flood that year
 - o Look at the tie on lá cỏ ống to guess how many times of flood and the damages
 - o When the tree named “bông lựu” blossom, there will be flood
 - o Look at the bone at the back of leg of frogs, if we see the black spot at high position, there will be big flood that year
 - o If we look at the Milky Way, we see some faint line, there will be a flood
 - o The gull fly from the sea to the land
 - o Honey build nest on high place: big flood
- *Native knowledge about predicting storm*
 - o Bamboo grow and face into the bush → big storm
 - o Northeast wind appear before 6 hours → big storm
 - o Hornet build nest on the land → big storm
 - o Goby eat grit → big storm

- Stork move from island to land → big storm
- *Native knowledge about predicting drought*
 - “Trăng quàng thì hạn, trăng tán thì mưa”.
 - There are a lot of “day to” in the sky → big drought

Nowadays, with the development of science and technology, villagers base on the modern knowledge such as weather broadcast to prevent. From the survey result, we can consider that there are 56% of villagers often follow the weather broadcast every day, on TV or newspaper. Radio.

However, the villager’s knowledge is precious in some cases. For example, according to villagers, when we see white clouds move from the sea → whirlwind appear later. In this case, meteorological can not inform immediately. The main problem here is analyze the villager’s knowledge and we can base on that to combine the native knowledge with modern knowledge.

To the year 2006, there are 118 poor households in Phu An commune, the rest are average households so it is important to enhance the chance to develop livelihood, reduce damages of flood, storm. Villagers’ requirements focus on these main points:

- ***Training course***
 - job training (garment, electric, etc...) for teenagers so that they can find job in some industrial company or in their commune.
 - Some agricultural households want to join in the training courses about using fertilizer, preventing pesticide, about raising cattle, raising frog, etc...
 - Many households want to join in training course about raising fish such as: cá trê lai, rô phi, chim trắng, etc...
- ***Support technique and infrastructure***
 - Help the local build the water pumping station in Nhu Y river to increase the Summer- Autumn rice crop area.
 - Complete dam to prevent salt water
 - Project and multifield dam to solve the water problem in Summer- Autumn crop

Find out some solutions to solve the pollution problem in Tam Giang lagoon
- ***Support rescue means***
 - Hamlet is the place that participate directly in preventing flood, storm so we need to equip some rescue means such as : motor boat, 50 floats for each hamlet
- ***Credit capital***
 - Lack of capital for developing production is one of the real situations in the local so villagers have high requirements in loan money. The need of each agricultural household is that they can loan at least 5 million VND and 20million VND of each aquacultural households, the time at least 3 years and the maximum interest is < 0.5%

Although Phu An is a place that often damaged by drought, flood, storm, villagers base on the experiences to prevent disaster so in some case, they are embarrassed, especially when the big storm or flood appear. So, the authority and villagers need to be trained some skills:

- The skill of access and solve information when there are the emergency flood, storm
- Some skills to prevent the big flood
- Skills of rescue, first aid
- Skills of environmental disposal after the flood

Above are some basic skills to reduce damages

Tam Giang lagoon is one of the unique scenery not only in Thua Thien Hue province in particular but also in Viet Nam in general. There are a lot of creature resources in lagoon area. In recent 10 years, with the pressure of developing population, the aquaculture is not suitable and with some another reasons, people have negative impact to environment, ecology in this large area

- The long period strategy of Tam Giang, Cau Hai in general and the water area of Phu An commune in particular is the usage natural resources suitable, solve the conflict between developing economy and protecting environment
- The first strategy is project/ rearrange the net enclosure in Tam Giang lagoon and Cau Hai lagoon, make sure that people can exploit natural resources available.

With the strategy, there are some specific solutions:

- Re project the waterway not only for the travelling of boats, for aquaculture but also for safety in recuing in flood, storm season
- Each households should not use net with high density because it is too difficult for water to circulate and the movement of creature from the sea
- Should have a strict rule for those who catch fish with destroyed equipments on the lagoon

The authorities have intended to rearrange the net enclosure on Tam Giang lagoon and Cau Hai lagoon. However, if they want to have effective result, it is necessary to have the contribution and agreement of villagers. And authorities should let villagers know the advantage of these activities.

+ It is important to educate knowledge about environment for villagers those who live in lagoon.

+ Research offices should connect with the local to find the solutions to solve the water pollution in Lagoon area.

+ Have jobs for villagers, create some jobs, services, enhance the life for villagers to reduce the pressure to lagoon → important task

3. VINH HIEN COMMUNE

Vinh Hien is a commune belonging to a coastal plain, being a final commune in the south of the coastal cultivate land of the Tam Giang – Cau Hai lagoon. Vinh Hien commune has the geography lower and lower from West-North to West – South and its 3 directions is bounded by water surfaces, namely East seas, Tu Hien gate and Cau Hai dam connected with Tam Giang lagoon. Its geography is rather diversified, including hills, mountains (available but inconsiderable), sea, dam and lagoon, plain. This is a potential region in developing the tourism, services, aquaculture and exploitation.

The whole commune has 1,898 households, of which 157 households do not have resident land, living floatingly on boats and guardhouse. The households living on boats and guardhouse rely on aquaculture and exploitation over many generations. Therefore, they become the fisherman's associations, career villages specializing in cultivate a fixed kind of product. For that reason, population structure and labour are allocated by villages.

The livelihood of Vinh Hien commune is diversified, including agriculture, aqua exploitation, industry, construction, commerce, transportation and other services. Analyzing the data in table 6.2 showed that the rate of agricultural production households occupied about 10%, no household depends on forestry production, number of aquaculture

and exploitation occupies about 1/3 total number of households of the whole commune. The structure of income resource of the local people can be divided into 4 main groups, including the main income resource from agriculture and aquaculture, the main income resource from industry and construction, the main income resource from services and others, of which the number of households with the income resource from agriculture and aquaculture occupied nearly 50% total number of households. Due to the geographical position, Vinh Hien is one of the tourist sites, and is a place with many aqua and sea foods, so the service and business activity are under good development. The number of households with the income resource from service is rather big, accounting for up to 21.34% total number of households.

In the year of 2005, total number of poor households of the whole commune is 457 households. The poor households belong to the different groups, namely farming group, fishery group, disable and shorthanded group. As reported by communal leaders, up to 2006, 157 households still do not have resident land and have to live on boats or guardhouses and live on aquatic capture. These households live in the commune over many generations. The Resettlement Project for these households has been approved and will be implemented in 2007.

There are many reasons leading to the poverty such as lacking experience in production, lacking capital, a lot of children, lacking man power, elderly, illness, diseases, diseases of aquaculture, aqua equipment was swept away by floods.

To seek for the income resource, the whole communes have more than 800 people working in far places, but their population book remained at local. The people who work in far places could be the secondary schools' pupils. The number of people working in Ho Chi Minh City occupies the highest rate. Most of them go to work all year round and often return home on Tet holiday, however, about 20% of them go to work in far places seasonally. The poor people's wish is to get the technical training, construction of irrigation system, the borrowing program suitable with the poor (the loans of 10 million VND in minimum with the period of 3 years in minimum at the maximum interest of 0.5%/year).

Vinh Hien is the commune in a region affected by the monsoon tropical climate, hot sun, a lot of rains and affected by the sea and continent. The annual average temperature 24oC, the highest temperature is up to 44oC, the lowest temperature is 9oC. The annual average humidity is 83%. The average evaporation is 1,000mm/year. The highest evaporation is often dropped in June and July. The wind directions in summer are mainly South and West-South winds with the speed of 1.3-1.6m/s. In winter, the main wind directions are North and East-North with the speed of 1.6-1.9m/s. The storm wind often happens in September, October and November.

A year is divided into 2 seasons: dry season lasts from March to August with the average rainfall of 47-63mm, the pinnacle is in May, June, July. The rainy season lasts from September to February next year. The biggest rainfall is in October and November, in average, the number of rain days in the pinnacle months is 20-22 days/month, the average rainfall is 680-800mm/month. This is the flooding season in the region.

The strategy of controlling floods and storms is consist of upgrading house, establishing the board and sub-boards of flood control, 4 on-the-spot policy (guidance, facilities, force, logistics). Every village has 1 sub-board of flood control. This sub-board has many members from different sectors including village's head, village's vice-head, youth union, volunteer team of Red Cross branch, Police, Militia, Health,...). Every village has 2 motor boats used in the flooding season at necessary. These boats are used every day by local people to serve production and trade, but as requested, they are mobilized by the commune. The strength, weaknesses, opportunities, trends in reducing the damages caused by natural calamity at Vinh Hien commune are presented in table.

| Strengths (S) | Weaknesses (W) | Opportunities (O) | Trends (T) |
|---|---|---|---|
| <ul style="list-style-type: none"> - There was the support from the provincial, district, communal sectors and boards. - There was guidance of Executive committee and communal government to guide from the commune to the villages and local people. - The local people had experience in forecasting and reducing damages caused by natural calamity - Local people's awareness of controlling natural calamity was raised. - There were the communal and village boards of flood control - There was good communication system (radio, television, telephone). - There was 4 on-the-spot policy (guidance, facilities, force, logistics) - Abundant labour force - The commune has upland area for emigrant at necessary - A part of traffic roads were asphalted | <ul style="list-style-type: none"> - Lacking rescue facilities at village level . - The petrol supply at the flood met difficulty. - The houses were not firm, so easy to be destroyed. - In the riverside and coast, the floods happen regularly every year . - Lacking capital to repair the damage after the floods . - Be isolated at the big floods . - Many fishermen households lack foods (in the months of January, February, September, October) | <ul style="list-style-type: none"> - Vinh Hien will be a place concerned by the central and organizations - There will be Tu Hien bridge to reduce the isolation at the big floods. - Tu Hien fishing port will help the fishery development. - The project helps to design and support the houses. - There is other project to support the damages' minimization. | <ul style="list-style-type: none"> - The floods happen unperiodically, not in the rule. - Sea gate (Tu Hien gate) closes, opens, changes in depth and width unperiodically. - Being eroded by the sea - The local is the place regularly suffering the severe affect of natural calamity. |

Some policies and strategies of natural calamity control of the locality

- Build 01 shrimp breeding station to produce shrimp breeds without disease.
- Improving the ponds with the required depth of 1.2-1.5m.
- Creating the capital resource to overcome the floods' consequence. There are the balanced capital resource, creating conditions for the local people to borrow capital quickly with low interest rate to overcome production after the flood. The local people wish to borrow 5 million VND/household in minimum for the term of 3 years with the maximum interest of 0.5%.
- Improving the irrigation system.

- Supporting rice varieties, water melon varieties.
- Supporting the breeds of pig with meat purpose.
- Supporting the fish source processing factory.
- Providing new rice varieties.
- Supporting the rescuer facilities: equipping with life jackets: 20 jackets/village, hurricane lamps.

Previously, the experience in forecasting the natural calamity plays very important role in reducing the damages. This experience is accumulated through many generations. With the geographical characteristics of the commune, this is a place where often copes with natural calamity. The life of majority of the inhabitants depends mainly on the waterways, so the experience in forecasting the natural calamity becomes more and more important. These are the factors making the local people's experience in forecasting the natural calamity very plentiful.

However, in the past years, due to the development of the forecasting and communication means, these experiences are used less and less. Some native knowledge of forecasting the natural calamity of Vinh Hien commune's people are as follows:

- After the full-moon day of lunar July (15/16/17-21/22/23 of lunar July), it often rains heavily.
- On 29-30 of lunar August –20, 03 of lunar September, it has heavy rains.
- In lunar October, the streets are waterlogged for many days.
- The typhoons often happen in the lunar months of July – August – September.
- If any year when the bamboo shoots spring up closed to the bamboo tree or their direction to the hedges, many big storms will happen.
- Black ants crew to high places, big flood will come. .
- Snails crew to the bamboo stake on the lagoon, there is often big storm.
- On the coast, looking at the clouds and wind direction, when the clouds are orient to the East and connected together, a storm is going to come. There are 4 types of wind, namely the south wind from April to June, the contrary south wind (from Phuoc Tuong pass), the easterly wind from Bach Ma after the storm, the contrary easterly wind from the sea, there will be a storm. If there is contrary easterly wind, the sea water's level will rise highly for some hours.
- Thunderstorm has lightning, but without sound, the rain will be very heavy. If the lightning start from Thuan An to the pass, it is going to rain, but from Thuan An to the sea, it is not going to rain.
- If the bee nests are situated at the high places, there will be big winds, but in the low places, there will be big floods.
- The ant nests are on high places, there will be big flood with light wind.
- Discovering the floods and storms through grass. The number of ties in the middle is equivalent to the number of floods in the year and the clearer the tie is, the bigger the flood is.
- The clouds happen in the East sea, there will be big wind.
- If the wind blows from West-South to East-South, the water will go down.
- In July, looking to the sea' direction, if the clouds are gathered into a mass, there will be big rains. In March, looking to the mountain's direction, if it is much cloudy, there will be strong lightning (looking outside in July, looking inside in March).
- The ants construct their nests at the low places, there will be big storm.
- "It is dry when the halo is near the moon, it is rainy when the halo is far from the moon".

Being a place coping with many floods and storms every year, Vinh Hien commune's people have a lot of experiences to adapt to the natural conditions. This adaptation was expressed through many different aspects such as the activities before the flood, during the

flood and after the flood, the adjustment of livelihood strategies, the bilingual assistance,... The adaptation was also showed in the different levels such as household, village and commune. Some native knowledge about the flood control of Vinh Hien commune's people are as follows:

- Improving the net, upgrading the ponds from August to prevent from the flooding season.
- Buying the dry foods such as noodles, dried shrimp, dried fish, oil, lamp, woods, bags,... before the flooding season or after the weather forecast.
- Excavating the canals.
- Binding and upgrading the house before the floods.
- For the villages, communes: establishing the resident groups, upgrading the dykes, the Board of Flood Control makes the plan in accordance to the "4 on-the-plot" policy, establishing the rescue teams, preparing the rescuer facilities (life jackets, buoys...), preparing medicines.
- Selling animal before the flooding season (solar August).
- Preparing the sites for boat parking.
- Updating the information from radio, newspaper, the communal, village board of flood control.
- When the storm is going to come, arranging rice to high places, moving the domestic facilities to safe places, taking capture facilities on the lagoon to keep at home, harvesting beans and rice.
- The women prepare the dry foods for 3-5 days in minimum. It is important to move people to safe places and prevent facilities to continue the production after the flood.
- Pitching bamboo or putting sand bags in front of house to prevent from strong waves.
- Preventing from traffic landslide in the villages by sand bags.
- When the water rises fast and up to 1-1.5m, moving people and some facilities. The domestic facilities which are too heavy to move are arranged in the high places or bound or tied to be not swept away, moving the children before moving or arranging the facilities.
- Running to other houses or public house (People's Committee) when the water rises fast.
- Mobilizing all of forces to help the heavily affected households, treating and doing hygiene for environment, collecting garbage, treating water according to the health's guidance, upgrading the gardens and fields for next crop. If they do not have condition, they can buy in debt and then pay debt after the harvest.
- Borrowing money to overcome the flood's consequence, to make new corral if it is swept away, ...
- Suggesting to set up more parking places because many boats remained on the lagoon when the big flood came.
- Having good production plan and in time to reduce damages caused by the natural calamity such as using the short-term rice varieties to harvest before the flooding season, raising shrimp and fish in right crop, fish in cages should be harvested early or moved to safe places or surrounded by net if the floods come early.
- Reducing the risk and damages by diversifying the income resource ("there are some careers to change from this to another when risk happened").

Demand in training

- o Technical training on aquaculture (brackish fish raising, freshwater fish raising, ...).
- o Technical training on disease control for shrimp, fish.
- o Technical training on crop (water melon,...)

- Technical training on disease control for crops.
- Technical training on livestock.
- Training of communal extension staff.
- Training on skills of flood control.

Although Vinh Hien is regularly affected by the drought, floods, the prevention from natural disasters depends mainly on the experiences. Therefore, in many cases, they feel confused, especially in the big floods. For that reason, the local people and authorities have the training demand for the following skills:

- Skills of accessing and processing information when there are urgent floods or storms.
- Skills of preventing from the big floods or storms.
- Skills of on-the-spot rescue, first aid.
- Skills of processing environment after the floods.

4. HAI DUONG COMMUNE

Hai Duong commune is isolated with other communes and located inside the Tam Giang-Cau Hai lagoon which belongs to the administrative boundary of Huong Tra district, Thua Thien Hue province.

Hai Duong has special position nearly separated outside the Tam Giang lagoon. The commune is bounded on the east by Indo-Chinese sea, on the west separated with Huong Phong commune by Tam Giang Lagoon, on the north by the Quang Cong commune, on the south separated with Thuan An town by Thuan An beach mouth. One most typical characteristic of Hai Duong commune is that it lasts along a single way from northwest to southeast with inhabitants concentrating along the inter-communal road. Transportation is difficult especially in the flood season.

Total natural land area of the commune is 1.027ha lasting along the inter-communal road, and considered as the inter-village road. The result shows that the agricultural land is about 349,43 ha; non-agricultural land occupies 544,39 ha; un-used land including mobile sandy areas and natural dunes in the east, bordering on the sea is 133,18ha. In the total of land using for production (349,43ha), the rice paddy land occupies around 60 ha; cropping land (chili, beans, sweet potato,...) is about 9 ha; land for aquaculture is 91 ha; land for planting protection forest and sand prevention forest is 189 ha. Thus, actual land using for production is around 40%, this reveals difficulties that the local people have to bear.

The commune has a rather large area of water surface which serves for exploiting natural sources (436 ha), and the un-used land area more than 133 ha is not yet fully invested to develop production.

Whole commune has 1.458 households (HHs) with 8.199 persons (on an average, it is 5,62 persons/household).

- In which:
 - Number of households with living sources mainly depending on agriculture – forestry – aquaculture are 756.
 - Number of households with living sources mainly depending on industry-construction are 164.
 - Number of households with living sources mainly depending on services, trade are 352.
 - Other careers are 218 households

In total of 1.458 households, the number of the poor households (basing on the new criteria of the government) are 210 (occupying nearly 15% of households in whole commune). Average income of the poor households is only around 170.000VND per person per month. In recent time, there are 185 households escaping from the poor, but 103

households are reappear again. The reason of reappear is not mentioned in the commune's report. According to the survey and household interview of the research group, some below reasons can cause the reappear of households:

- Cultivated area is small, poor nutrition and salted,... leading to the low productivity of crop.
- Impacts of natural calamity, flood, drought, land slide,... make production activities and residence of the local people become unstable.
- Households have many children or many people with poor health or illness.
- Impacts of diseases in shrimp and other sea products make many households be indebted in bank and cannot pay.
- They lack capital to invest in production.
- Most poor households have only 2 to 5 different sources of income, but all these sources are dispersed and unstable.
- Major income sources of these households are mainly from agricultural production activities and hired labour. Specific income sources are detailed as following:
 - o Capture fisheries
 - o Agricultural cultivation
 - o Construction activities
 - o Livestock – animal husbandry.

As presented in previous parts, careers and livelihood distribution of the local people depends on the geographic distribution of residential areas. The residential area in the North of Hai Duong commune, where have a lot of agricultural land and favourable water source, the main income is from agricultural production activities such as cultivating wet rice, crop plants and other vegetables. On the contrary, the economy of residents in the south of the commune including villages such as Thai Duong Ha, Thai Duong Thuong, heavily depends on activities related to aquatic products such as catching (on the sea or in the lagoon), aquaculture. The services depending on these carriers are also developed in these residential areas.

The survey result of proportion of income and income sources of the households also reveals that many households have income from the help of relatives (oversea Vietnamese, migrants,...). These sources often play an important role in certain periods, especially in the time of mobilizing capital or at the end of year when households need to spend money for the Tet holidays. However, this income source in general is unstable for the Hai Duong commune.

The climate in Hai Duong commune in particular and in Lagoon area in general is monsoon tropical climate.

Hot season: In the cold season, the average temperature is stable under 20°C, starting from December of previous year to March of next year. In the hot season, the temperature is stable below 25°C, starting from April and finishing at the middle of August. Besides 2 hot and cold seasons, there are transition stage from March to April and from September to November with average temperature around 20°-25°C.

Rain season: The yearly average rainfall is around 2.700-2.800mm. Raining mainly concentrates in September to December. Around May, it often has showery which creates small flood with the rainfall is above 100mm.

Hydrography: Hai Duong commune is directly affected by tide. Although the sea area in Thuan An-Hai Duong has low amplitude of tide (average amplitude is 0,5m), at the rough sea days and flood-tide, the sea water increases highly, sometimes it overflow to the field of the local people. Especially, for aquaculture activities, when the flood-tide occurs, it makes the salinity in the shrimp raising ponds is increased, which affects to the growth of the shrimp, simultaneously, it blows off part of the dyke, and fish and shrimp could escape from the ponds.

Storm and flood:

Every year, Hai Duong in particular and Thua Thien Hue province in general have around 3-4 storms and typhoons. The storm mainly concentrate from August to November. Depending on the specific condition of each year, the force and degree of storms are very different. According to the general evaluation, storm is one natural calamity which damage most production activities and living of the local people.

Floods have greatly affected to production activities of the local people. According to statistic data, it often has two times of flood is time of small flood so called “Lut tieu man” (happening around May); and main season flood (from September to November). The “lut tieu man” is although not big, it hapens in the end of the aquatic products so it creates remarkable damages for farmer.

For the main-season-flood, every year there are around 4 to 7 floods (sometimes only one flood in the year). Exept historical flood (as the 1999 flood), effectiveness of flood to the local people is not high. According to people opinion, the flood can make more clean, open and clear of the environment, the shrimp and fish have few diseases, simultaneously, the flood also brings alluvium to fields and improves the nutrition source for the crop.

The natural calamities in recent year have many changes. Averagely, numbers of floods and storms occur yearly in the local area from 4-7 floods. However, the effective level of storm and flood are different. According to the memory of interviewees, from 1953 up to now, there are big floods and storms as describing below.

| <i>Point of time</i> | <i>Effectiveness</i> |
|---------------------------------------|---|
| The 1953 flood (Flood in Dragon year) | In this flood, the water level increased around 3 mettre. Due to effectiveness of flood, the previous estuary namely Eo beach mouth (belonging to the Hoa Duan village, Thuan An town presently) was filled up and the Thuan An beach mouth was opened replacing the old one and cutting the Huong Hai commune into 2 parts (the Thuan An town and Hai Duong commune as present). The traffic was heavily broken. Many people died (can not remember the number due to the flood went along time). Graves were swept away; soil dyke system preventing the salinity was broken. |
| The 1961 storm | The locality was heavily damaged in crop, rice, property, and cattle. Fortunately, human damage was a few. |
| The 1976 flood | The water level was high and flooded around 1,5mettre. The residential area was isolated into 2 sub-parts. Dyke, crops was heavily damaged. This year the country is just unified, the local people’s living was still unstable which was damaged by the natural calamity, so damaged level was too great. |
| The 1983 flood | The damage level was similar with the flood 1976. After the flood, the salted water overflow to the field which makes the production was interrupted around 1-2 years. |
| The 1985 storm | Big storm with 12 degree of wind level and shocking above 12 degree. In this period, the warning system was not developed; the local people after long time did not meet any big storm so they were subjective and passive. Big wind combined with flood-tide flow the property of the local people to the sea. According to statistic data, nearly 100% of households lost their property, 70% of houses were collapsed or damaged. Houses in the villages Ganh and Cho were leveled ground. In this storm whole province had hundreds died people but Hai Duong commune had no one died. After the storm, 120 households had to move to another area. |
| The 1999 flood | This is the historical flood. Many parts of the commune were |

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| | flowed to the sea, place heavily broken was 200mettre with 15mettre of depth (until April 2002, this estuary just was closed). Two Ganh and don villages were mostly damaged. In this flood, many places were under the water around 3-4 metre depth, the time of flood around one week. Generally, this flood created biggest damages for local people if comparing with previous floods. |
| The 2004 flood | The 2004 flood was also a bid flood for some areas in Thua Thien Hue province. However, the rainfall concentrated mainly in Huong river. In Bo river, the rainfall was a few. The water flowed to low land was not remarkable so it has a few impacts on the production activities of the locality. |

Review the impacts of natural calamity to the local people in Hai Duong commune in particular and in the central Vietnam in general, we have some comments as following:

- The frequency of the natural calamity in recent years were more and more increase
- Intensity and degree of natural calamity were more and more big

For the flood, the water from the upper stream run to the low land is more and more fast. Before, after raining 2-3 days, we just saw mud water, but now only one night we already see the mud water running to the lowland. During the flood, the water speed is too fast.

To evaluate advantages, disadvantages, opportunity and threaten in prevention of natural calamity of Hai Duong commune, we conducted the survey among the leader groups of commune, village, agricultural cultivation group and aquaculture and capture fishery groups. The result is presented in below table.

| No. | Strongness | Weakness | Opportunity | Threaten |
|-----|--|---|---|---|
| 1 | Having sand dune along the coast as a shield to prevent the storm and place for evacuating people when flood coming. | One side is sea and one side is lagoon, so it will create difficulties in urgent case. | The government always pays attention to the storm and flood prevention activities. | Changing in weather in recent years did not obey any rule and unfolded complicated difficult to predict |
| 2 | The field is deposited alluvium so it decreases the expenses for fertilizer. | It is far from the town so the communication during the flood or storm meets many obstacles | There are Committee of Flood and Storm control form provincial to commune and village levels. | Most of local people are poor with temporary house. |
| 3 | The flood water makes the environment in the aquaculture ponds more clean, which decreases disease damage for aquatic products | There is no shelter for the boats so the development of sea exploitation meets many difficulties. | Union spirit, mutual love and affection of the local people are high. | In the rainy and storm season, the electricity often cut –off, so the approach to information is not regular. |

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|---|---|--|--|---|
| 4 | The rainy and storm season occurs with its rule, so the local people can take the initiative of preventing activities | Capital of the local people is limited. | | The indigenous knowledge in predict and prevention of natural calamity is more and more falling into oblivion especially in the young generation. |
| 5 | The local people have high awareness in prevention of natural calamity | The traffic is interrupted so product consumption is unstable. | | Many households still rely on others, and expect the support from government and local authorities |
| 6 | The local people have certain experiences and knowledge in prevention natural calamity. | Dykes are often broken seriously after flood, and the expenditure for repairing and maintaining is high. | | Lacking of life-boat and rescue equipments. |
| 7 | | After flood, garbage from many places running to the lagoon, which leads to impacts on the living environment of the local people. | | |

Before unusual changes of climate condition, with the support of the technical means and the economic development of the local people, the flood and storm prevention activities have considerably changed. Interviewed household groups all agree about the role of the authorities from village level to commune- district-provincial and central levels in storm and flood prevention activities. Every year, before the raining and storm season, the authorities establish the committee of Flood and Storm Control at their organizations. These committees of Flood and Storm Control receive the directions of the higher level and take the initiative of organizing activities in order to minimizing the risks causing by natural calamity.

Policy system of governmental levels in natural calamity prevention

- For the Central Government:
 - o Standing Committee of National Assembly issues supplemented decision on Flood and storm prevention law dated 24/8/2005.
 - o Direction dated 13/3/2006 CT-TTg on Flood and storm prevention and seeking and rescue on the sea
 - o Circular letter between Financial Ministry and Labor-Society- woundish ministry on supporting damages caused by flood and storm.
 - o Appealing of The Central Committee of Father Land Front

- The public telegram and urgent telegram of the Central Committee of Flood and Storm Control.
- Guideline materials for first aid, emergency aid and environmental treatment.
- For the provincial and district levels
 - The decisions of Provincial and district People's Committees at the May, June and July.
 - Plan of Flood and Storm prevention and implementation plan sending to communes.
 - The Telephone book of Provincial and district Committees of Flood and Storm control
 - The public telegram and urgent telegram of the provincial authorities appear in the mass media and official documents
- Commune level
 - From annual June, the commune will establish the Committees of Flood and Storm Control and making plan of flood and storm prevention which has valid until the May of next year.
 - Date 4/8/2006 the Commune Committees of Flood and Storm control has meeting to evaluate the flood and storm prevention in 2005 and discuss the plan for 2006
 - Establishing the sub- Commune Committees of Flood and Storm control of villages
 - Organizing rescue teams
 - Informing implementation plan to sub-committees by documents and informing in mass media.
 - Providing telephone list of members in Commune and village Committees of Flood and Storm control
- Village level:
 - Establishing the sub- Committees of Flood and Storm control at village level, the leaders of the village will take in charge of responsibility. The head of the village will be the permanent vice –chairman of the committee.
 - Organizing rescue teams to cope with urgent cases.

Before, when the weather and flood and storm forecast system was not developed, the economic living of the local people was not high, in order to preventing impact of natural calamity the local people had to base on the experiences or indigenous knowledge to predict the change ability of the weather to prepare for coping. Through collecting information, we found that the local people still maintains experiences related to predict and prevention as follow:

- Before the raining season, observing the location of the bamboo shoot, if the shoot grows inside of the bamboo cluster, that year will has big storm.
- The sea surface is quiet, the wave lights as glow-worm. It means that after 8-10 hours it will appear storm.
- Observing one grass species (co nang). If it has many big culms, that year will has many floods. If that grass species has small and few culms, it means that very few floods occur.
- Disboweling of goby, if in its bowel having many shellfishes, it may has big flood. According to local people's experiences, this fish eats a lot of shellfishes to keep its body heavy, so it can stay at bottom of river to avoid the water flow.
- Normally if "Cang" fishes run to the fish corral, it means that the weather has big changes (heavy raining or storm)
- Shellfishes stick together into big cluster, it means that big flood will appear (the cluster will keep shellfish not follow the water flow)
- When informed the storm coming, the local people cover the roof by straw to avoid the turning up the roof (straw absorbing water will be heavy).

- To avoid diseases after flooding, the fishers often eat garlic or ginger to prevent the cold.

Some support activities in order to increasing opportunity for developing the livelihoods oriented to minimize disaster

Training activities

- Increasing knowledge of aquaculture technique in the pond and cage
- Guiding technique of “Ca Vuot” raising (cá chêm)
- Opening more other career to develop secondary career (construction, machine repair,...)
- Training and guiding pig raising technique.
- Credit training

Investment activities

- Enhancing credit sources for the local people.
- Building integrated model of animal husbandry to help the local people get more income in the raining season.
- Organizing reasonable exploitation the natural benefit (cá dĩa, cá kính, cá hồng, cá mú,...)
- Need regulations to limit the using of exterminated equipments in catching fish

To limit and minimize risks in production and living, the farmer need following demands:

- Training skill in building house which can adapt to environment and avoid the storm and flood
- Enhancing awareness of the community in managing and treating garbage in order to prevent environmental pollution, especially the period after flood.
- Guiding first aid technique for victim.
- Training on credit management for the local people
- Training method of treating drinking water and living water.
- Providing and guiding method of using communication means for distant catching boats.
- Setting up the flood and storm prevention program in curriculum of the school

The strategy for natural calamity prevention of the local authorities

In the raining season, the transportation in the commune will meet many difficulties. Not only the roads from district to commune but also the inter-roads among the villages are also separated. Therefore, the common policy of the local authorities which is grasped thoroughly to groups of household is the 4-on-the spots plan, which in detailed:

- (i) on-spot labor force
- (ii) on-spot leading
- (iii) on-spot logistics; and
- (iv) On-spot means.

Besides, the local authorities have to take initiatives of using communication system from rudimentary to modern means when necessary.

To make sure the requirement as above the commune leaders have built short-term, medium-term and long-term plans. The detailed description as follow:

- For short-term plan:
 - o Having detail plan for flood and storm period when receiving warning information.
 - o The Commune Committee of Flood and Storm Control will directly check each residential cluster to have supplemental plan.
 - o Checking and maintaining the radio system of the commune.
 - o Propagating and mobilizing the local people to avoid the subjective thinking.
 - o Preparing provisions (instant noodle) and medicine as requirement of the superior.

- Pointing out the route and evacuated sites for residential cluster when the big flood and storm appear.
- Medium term and long term
 - Planning for new dyke and dam building and preparing the dyke and dam for production
 - Identify risked or essential areas to have plan for developing safe residential areas
 - Planning areas for boat anchoring,...

The strategy for natural calamity prevention of the local people

Both the local people in the lagoon area in general and the local people of Hai Duong commune in particular understand the impacts and dangerous level of natural calamity towards their livelihood and family. Therefore, when the rainy and storm season is coming, with their best conditions, they have certain preparations. The activities the local people have to do in this time including:

- Before flood and storm season
 - Harvesting and taking all products on the fields, especially aquaculture households, they collect aquatic products before the flood and storm coming.
 - Following up weather information.
 - Repairing boats and preparing fishing equipment and net to catch fish and shrimp in the beginning of flood season.
 - Reserving provisions-food and fuel for human and animal
 - Moving household items to upper places
 - Repairing and reinforcing house
 - Helping households lacking manpower in reinforcing their houses.
- During flood and storm time
 - Managing boats and protecting other exploitation equipments and means
 - Harvesting aquaculture products in the pond and lagoon
 - Reinforcing and protecting house
 - Caring and managing children and elders
 - Selling and consuming harvested products
- After flood and storm time
 - Repairing boats, pond, lagoon and net.
 - Repairing field and reinforcing dyke system to prevent the salinity
 - Repairing house
 - Preparing seedlings for the new production season.
 - Cleaning environment