

# Awareness and Preparedness of Coastal disasters among a Fast-growing Coastal Community in Central Vietnam

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## **Abstract:**

Climate change is a matter of global concern as it is the cause of many natural disasters. With about 3,260 kilometers of coastline, Vietnam is considered one of the most vulnerable countries against coastal disasters such as typhoons, storm surges, and even tsunamis. However, some coastal areas of Vietnam have rarely encountered extremely large disasters for at least several decades. Therefore, the vast majority of the local inhabitants may not realize the extent of the danger to their neighboring coastal communities due to coastal disasters. This paper presents some survey results to find out the perception of people in Phan Thiet City, a fast-growing coastal city in Central Vietnam, about coastal disasters as well as their response to natural disasters.

A number of field surveys and interviews were conducted to local inhabitants in coastal communities covering various ages and occupations. The results show that most people in these areas have not experienced devastating coastal disasters such as tsunamis or storm surge. Therefore, it is not surprising that the results of the analysis indicate that most people in these areas are not significantly aware of the

vulnerability of coastal disasters. Despite the low frequency of coastal hazards in the area, the consequences of any significant event would be disastrous to the community. The analysis results also indicate the urgent need of early warning systems for natural disasters and the improvement of awareness against coastal disaster of local inhabitants as well as evacuation plan during coastal disasters.

**Keywords:** Coastal disaster, storm surge, typhoon, Phan Thiet City, Vietnam

## 1. Introduction

Vietnam is one of the most vulnerable countries against coastal disasters, such as typhoon, storm surges, coastal floods and tsunami (Thao et al., 2014). A storm surge is a rising of the sea water levels as a result of high winds pushing on the ocean's surface, combined with the effect of low pressure at the centre of the typhoon while tsunami is caused by the displacement of a large volume of body of water. Earthquake, volcanic eruption and landslides underwater were considered the main causes that generate tsunami. The destruction of tsunami is inconceivability. The waves generated by tsunami can devastate nearby or even distant shorelines. But only after the Indian Ocean Tsunami had recorded, the worldwide awareness about tsunami in particular and coastal hazards (including storm surge and tropical cyclones) in general has been increasing (Shibayama et al., 2013).

Vietnam, with a long stretch of coastline of more than 3260 km, is one of the most vulnerable countries to coastal disasters, especially storm surges caused by tropical cyclones. More than 70% of all natural disasters in the country are due to typhoons, and the frequency and damage totals appear to have been increasing in recent times (Takagi et al., 2015). Despite a number of prominent events in the past decade, few people inside or outside of Vietnam realize the true vulnerability of the country against natural hazards, be it due to typhoons or the possibility of a distant source tsunami reaching the country (Thao et al., 2015).

The impact of the coastal disasters on people and property is enormous, especially in coastal areas, such as Phan Thiet City. Coastal disasters are inevitable, therefore, it is necessary to provide appropriate solutions to minimize loss of human and property damage caused by coastal disasters. There are many mitigation countermeasures, both "hard" solutions (such as sea dykes, breakwaters, early warning systems, etc.), and "soft" solutions (such as awareness and preparedness of people on issues).

However, it appears that the vast majority of Vietnamese people may not be aware of the perils facing their coastal communities, which are suffering from frequent coastal floods (Esteban et al., 2014). It is similar to the inhabitant communities in Phan Thiet City. There are multiple reasons behind this lack of awareness to coastal hazards in Vietnam. In fact, extremely large disasters have not taken place in Vietnam for at least several decades, whereas other neighboring disaster-prone countries have experienced several large disasters exceeding 5,000 casualties in this period (e.g. Japan: Typhoon Vera (known in Japan as Isewan Typhoon) in 1959), Great Hanshin Earthquake in 1995, Great East Japan Earthquake in 2013, Philippines: Moro Gulf Earthquake in 1976, Typhoon Thelma (Uring) in 1991, Typhoon Haiyan (Yolanda) in 2013, Indonesia and Thailand: Indian Ocean Tsunami in 2004, (Esteban et al., 2015).

In this paper, the authors attempted to make a

general assessment of the state of the awareness against storm surge and tsunami by the Vietnamese inhabitants in Phan Thiet City which is located in the Central of Vietnam. The existence or not of coastal disaster awareness and preparedness can be reflected by a number of factors, such as the degree of risk knowledge, the willingness to take measures for the reduction of risk, the willingness to evacuate, the willingness to support authorities' efforts to reduce disaster risk, or taking protection measures individually, etc. (Thao et al., 2014). From the point of view of the authorities in the country, it would be their ability to control the risky situation in order to reduce the damage while at the citizen level, awareness can be manifested by individual protection such as evacuate.

The present paper will focus on results that have been collected through field trips carried out in Phan Thiet City and analysis that will indicate the urgent need of early warning systems for natural disasters and the improvement of awareness against coastal disaster of local inhabitants as well as evacuation plan during coastal disasters.

## 2. Coastal Disaster in Vietnam

Vietnam's long 3,260-kilometers coastline is battered every year by up to 10 storms, killing hundreds, even thousands of people (Takagi et al., 2015). The Gulf of Tonkin is a body of water between Vietnam, the Chinese Island of Hainan, and Mainland China, provides one of the most frequently used paths for Pacific typhoons originating near the Philippines to strike the Asian mainland. Seven to eight tropical storms hit the central of Vietnam each year and usually trigger coastal floods and other disasters. It is predicted that global warming will bring to the region more rain, stronger typhoons and higher sea levels and make the flooding problem

worse.

Some of extremely powerful typhoons that struck Vietnam can be listed as follow:

- In November 1997, Typhoon Linda raked across Vietnam's southern tip, killing 3,111 people and destroying crops. It was the worst storm since 1904. Many of the dead were fisherman who were out at sea when the storm hit. According to a report from the UN Department of Humanitarian Affairs: During the night of 2 November 1997, Typhoon Linda hit South Vietnam affecting all the Southwestern provinces where, for two days, there were strong rains, in places as much as 100 -150 mm of rainfall. The typhoon was the strongest recorded in the area for the last 100 years and caused unexpectedly huge losses (UNDP, 2003; Takagi et al., 2015).
- In 2006, typhoons Chanchu, Durian and Xangsane left hundreds dead and caused millions of dollars' worth of damage. Durian killed at least 75 people in Vietnam in December. In May more than 240 fishermen and scores of boats were lost to Typhoon Chanchu. In October Typhoon Xangsane killed at least 70 people and brought widespread flooding and destruction (Natural Disasters in Vietnam, 2017).
- Typhoon Haiyan, in November 2013, could be considered another event that has greatly increased awareness about storm surges not only in the Philippines but also within the wider world (Takagi et al., 2014). With the maximum sustained wind speeds were around 160 knots, typhoon Haiyan was considered the largest record history of Western North Pacific. As the result of a large storm surge that generated by the typhoon, Tacloban city was seriously destroyed and suffered terrible

damage. Follow the number of death toll that the National Disaster Risk Reduction Management Council (NDRRMC) declared on 29 January 2014, 6,201 individuals reported dead, 28,626 injured and 1,785 still missing (Takagi et al., 2015).

Typhoons are normally accompanied by storm surges. During the past 30 years, half the typhoons have caused a storm surge of over 1m, 30 percent of typhoons over 1.5m, and 11 percent of typhoons over 2.5m. These typhoons and storm surges have often overtopped - and frequently destroyed - sea dykes, flooding lowland coastal areas. In Viet Nam, the losses caused by floods and typhoons seem to be increasing over time, as in the rest of the world. For example, about 540 people were killed by floods and typhoons annually in the period 1985 to 1989, whereas in the years 1976 to 1979 (Natural Disasters in Vietnam, 2017).

While typhoon is considered the main source of coastal disasters, the possibility that a tsunami could potentially affect the Vietnamese coast is not high (Ca and Xuyen, 2008; Thao, 2015) analysed 25 scenarios for tsunami generation prepared by Ministry of Natural Resources and Environment, and then the five most dangerous scenarios were selected to simulate the tsunami propagation in the East Sea of Vietnam. The results show that after an earthquake takes place in the western coast of Luzon Island (in the Philippines), a tsunami would reach the middle part of the Vietnamese coast approximately 90 minutes later and would gradually propagate to the northern and southern coasts of the country. The tsunami height would reach a maximum height of between 1 m and 5 m, especially for the potentially most hazardous earthquake scenario at the Manila Trench. Work by other researchers arrive at similar conclusions (Ca, 2014,

Okal et al., 2011).

Phan Thiet City is located in the South of Central Vietnam, which is to be affected by coastal disasters (see Figure 1). However, according to statistics database of national, in the past few decades, only more than 10 typhoons and tropical depressions hit the area, with the average wind speed of 39-49 km/h. During this period, there were only a few storms such as Typhoon TESS in 1988 (103 - 117 km/h), Typhoon LINDA in 1997 (62 - 74 km/h), Typhoon DURIAN in 2006 (> 133 km/h) landed in the area (Natural Disasters in Vietnam, 2017)



Figure 1. Location of Phan Thiet City in Vietnam

The hazards of coastal disasters are enormous, especially the impact on people. However, with the less frequency, the awareness of people on this issue is not high. Thus, when a disaster occurs, the impact on their lives could be enormous, especially with a fast-growing area as Phan Thiet.

### 3. Field Surveys

#### 3.1 Methodology

Field surveys was conducted in two times

(January 2016 and February 2017) at four coastal communities in Phan Thiet (Duc Long Ward, Phu Trinh Ward, Ham Tien Ward and Mui Ne Ward) (see Figure 2).

The surveyed locations that were selected based on:

- The areas affected by coastal disasters such as typhoons and storm surges.
- The areas may be affected by the coastal disasters.
- The areas of fishermen, such as fishing village, fishing port, ...
- The areas are concentrated in different occupations, such as People's Committee office, tourist area, ...

The authors went to the selected areas, meet with each person to issue the survey form and collect it immediately afterwards. The sites surveyed during the first time were marked with no duplication during the second one.



Figure 2. Locations of field survey

The assessment about the awareness and preparedness against storm surge and tsunami was made based on the data from the questionnaires. The questionnaire was drafted simply and aimed at all type of people (from the inhabitants of coastal communities to local officials), and at all adult ages (from 18 to over 80 years old).

The questionnaires were collected and the results

were analyzed and evaluated.

### 3.2 Results

As a result, a total of 123 valid respondents (n=123) were collected, 47 in the first time, and 76 in the second (see Table 1.)

Table 1. The valid responses by surveyed areas

Areas	Coordinates	First Time	Second Time
Duc Long Ward	E 108°04'59" N 10°54'37"	05	-
	E 108°04'45" N 10°54'32"	-	09
Phu Trinh Ward	E 108°05'49" N 10°55'47"	30	-
	E 108°05'48" N 10°55'49"	-	12
People's Committee of Phu Trinh Ward	E 108°05'49" N 10°56'06"	-	27
Agriculture and Rural Development Department of Binh Thuan Province	E 108°06'08" N 10°55'52"	-	07
Ham Tien Area	E 108°14'33" N 10°57'12"	08	-
	E 108°13'53" N 10°57'19"	02	-
	E 108°10'07" N 10°56'05"	02	-
Mui Ne	E 108°18'00" N 10°56'24"	-	08
Phan Thiet Fishing Port	E 108°06'11" N 10°55'13"	-	13
<b>Total</b>		<b>47</b>	<b>76</b>

From the 123 valid responses collected, there are 68 respondents (55.3%) within areas affected by natural disasters (such as Duc Long, Phu Trinh, Ham Tien), the remains for the others. And among valid responses, there are 81 respondents (65.9%) that are directly affected by their lives, assets and income in case of natural disasters occur (including Duc Long, Phu Trinh, Ham Tien and Phan Thiet Fishery Port), and 42 ones (34.1%) of the public areas (such as the People's Committee, the resorts and the Agriculture and Rural Development Department).

Figure 3 shows how respondents were predominantly young, with 66% being under the age of 40, which could be considered typical in a country with a young population such as the Vietnam (Esteban et al., 2014). Most people aged 50 and over, who have experienced some storms, and the damage caused by natural disasters. However, people under the age of 30, who are not experienced, can understand the impact of the disaster due to school.

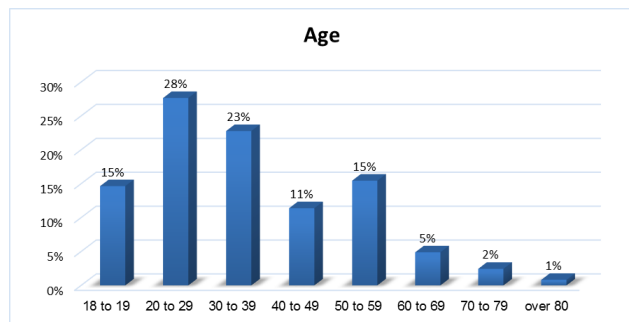


Figure 3. Age distribution of respondents (n=123)

Due to the opportunistic nature of questionnaires only a moderate amount of effort was made to preserve a male/female balance, which resulted in 52% of the respondents being male, and 48% of females.

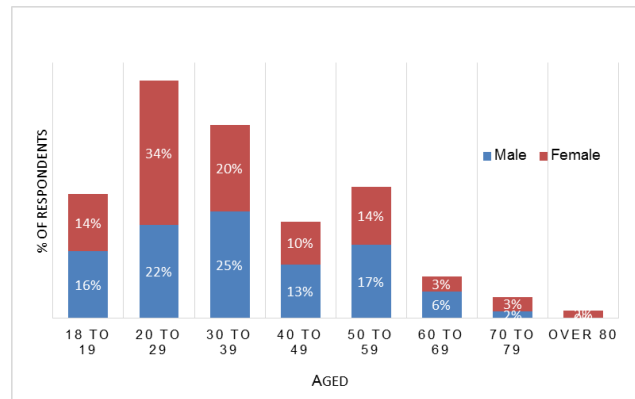


Figure 4. Age distribution of respondents by sex (n=123)

The surveyed location affected the occupation of respondents. Up to 25% are fishermen, 17% are office workers, and 12% are labours. Most of the women surveyed were housewives, accounting for 15% of the respondents. Only 6% were students in both surveys, indicating that very few people left school after finishing high school. According to survey results, the employment rate is quite high, accounting for 71% (see Figure 5.).

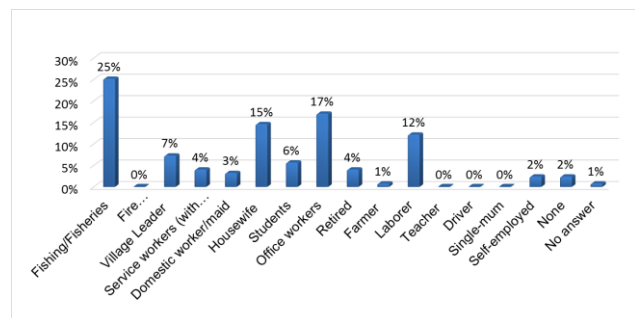


Figure 5. Occupation of respondents (n=123)

## 4. People's Awareness

### 4.1 Flooding

In Duc Long area (see Figure 6.), which has been affected by typhoons and storm surges, 100% of people said “Yes” for the question “*Is your place in danger of flooding from the sea or rivers?*”. Of which, 15% of the population thought that it is very strong danger as shown in Figure 7.



Figure 6. Duc Long Area <sup>1</sup>

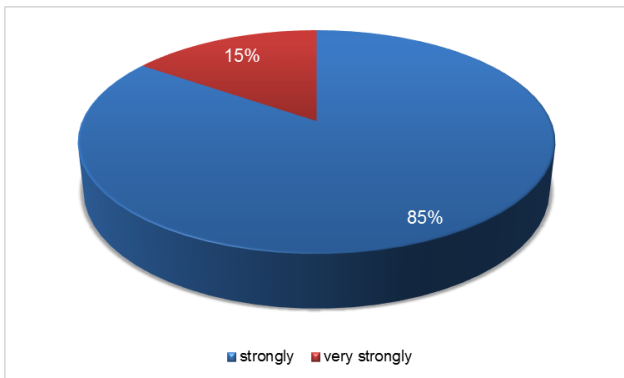


Figure 7. Distribution of the opinion of respondents regarding whether they thought their house is at danger of flooding from the sea or rivers at Duc Long Area (n = 14)

The small fishing community of Phu Trinh, which sits on the margins of the Ca Ty River in the city of Phan Thiet, was selected to survey (see Figure 8.). It

is one of the lowest points in the town, only situated around 49 cm above Mean Sea Level according to the authors’ surveys. So it is sometimes inundated during the rainy season. However, the survey results show that 33% of the respondents were completely unaffected, 32% were slightly affected, 19% were moderate and 16% were severely affected, as shown in Figure 9. According to the observation of the authors, all of houses are built on columns (timber or concrete), with floors higher than 1.0 meters above ground. Water from the Ca Ty River also drops rapidly. This may be some of main reasons to reduce danger caused by flooding.



Figure 8. The small fishing community of Phu Trinh<sup>2</sup>

<sup>1</sup> Pictures were taken in 2017

<sup>2</sup> Pictures were taken in 2016

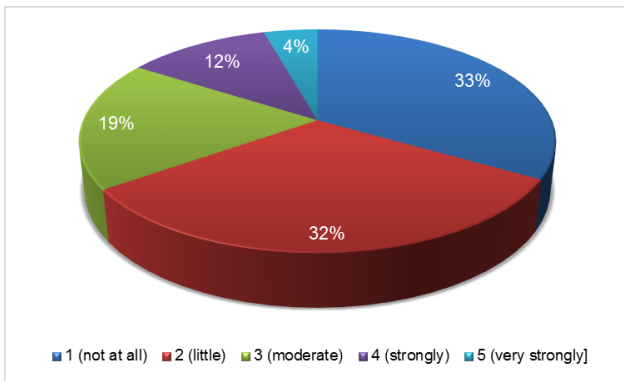


Figure 9. Distribution of the opinion of respondents regarding whether they thought their house is at danger of flooding from the sea or rivers at Phu Trinh Ward (n = 69)

With the same question, at Ham Tien and Mui Ne area (see Figure 10.), up to 40% respondents felt that their place is not in danger of flooding from the sea, 28% were little, and only 5% worried in danger of flooding, as Figure 11. Although located on the coast, Ham Tien and Mui Ne are less affected by flooding due to high terrain.

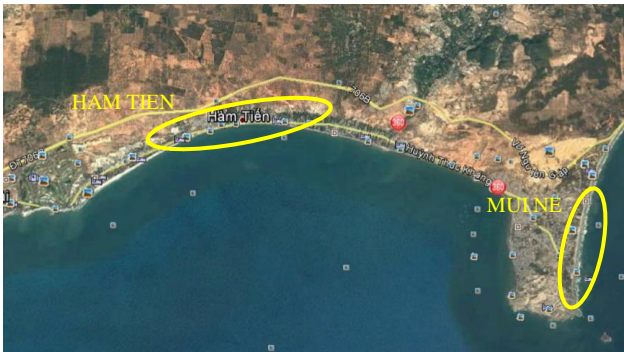


Figure 10. Ham Tien and Mui Ne area

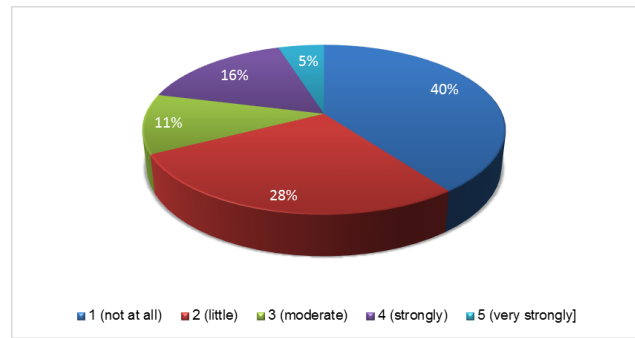
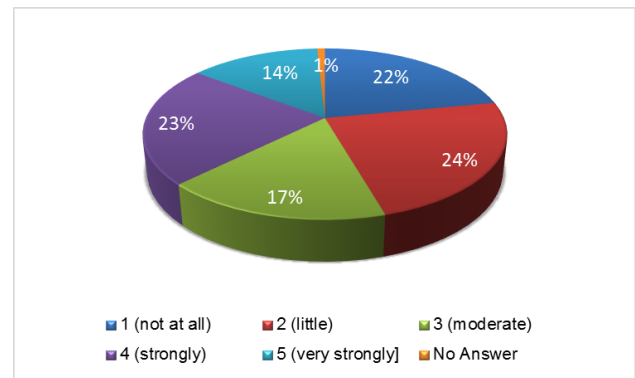


Figure 11. Distribution of the opinion of respondents regarding whether they thought their house is at danger of flooding from the sea or rivers at Ham Tien and Mui Ne (n = 20)



#### 4.2 Typhoon and storm surge

In terms of awareness, 58% of respondents indicated that they knew what a storm surge was, though only 37% thought that these posed a high or very high danger to them, see Figure 12. In line with this answer, their interest in evacuation was not that high, though 47% of respondents indicated that they knew how to evacuate in the event of a storm surge.

Figure 12. Distribution of respondents who think that a storm surge constitutes a real danger for them (n= 123)

#### 4.3 Tsunami



Regarding tsunamis, the number of respondents who were aware about the nature of these phenomena was higher (up to 67% of respondents knew), and 74.8% thought that it could represent a high or very high danger to them (which jumped to 86.2% of respondents if the “moderate” danger is included, see Figure 13).

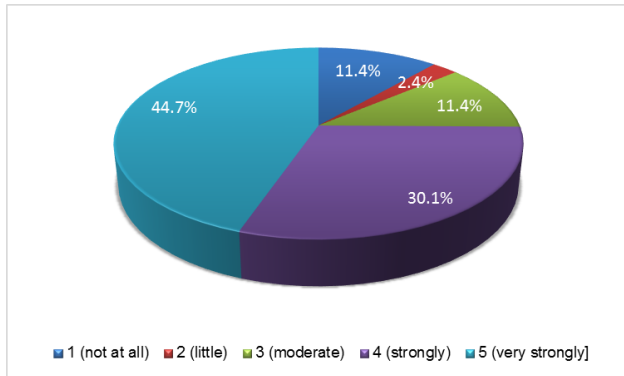


Figure 13. Distribution of respondents who think that a tsunami constitutes a real danger for them (n= 123)

However, only 27% indicated that they knew how to evacuate in such an event. Nevertheless, the fact that any awareness exists is rather remarkable, considering how there has been no tsunami in recent times in Vietnam (Thao, 2015, Esteban et al., 2014). This awareness is arguably the result of recent events in other countries, such as Japan and Indonesia (Esteban et al., 2013).

### 5. People’s Preparedness

Regarding people’s preparedness, as above mentioned, the percentage of respondents who know how to take in evacuation was very low, only 47% in the event of a storm surge and 27% of tsunami.

And until now, up to 54% respondents did not know if children learn about storm surge/tsunami disasters in school, and how to evacuate or not, 26% said no, and only 20% said yes, see Figure 14. This

suggests that the most of local people were not or less interested in preparedness to respond to coastal disasters.

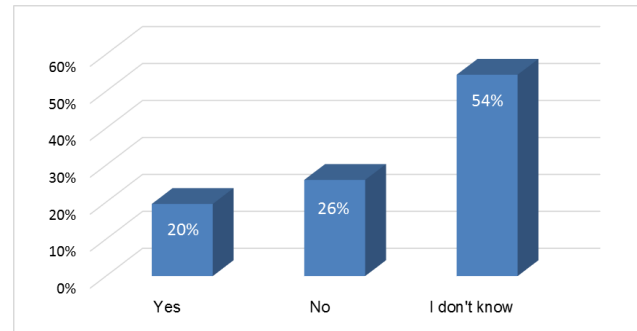


Figure 14. Distribution of respondents who know children learn about storm surge/tsunami disasters in school, and how to evacuate (n= 123)

According to interviews, the people in Phan Thiet were suffered from DURIAN Typhoon in 2006, more than 10 years ago. The authors think that this is one of reasons to affect their preparedness of coastal disasters. Thus, among of 123 respondents, only 38% were affected by coastal disasters. Of these, 11% were totally destroyed, 32% were major damaged and 57% were minor, see Figure 15.

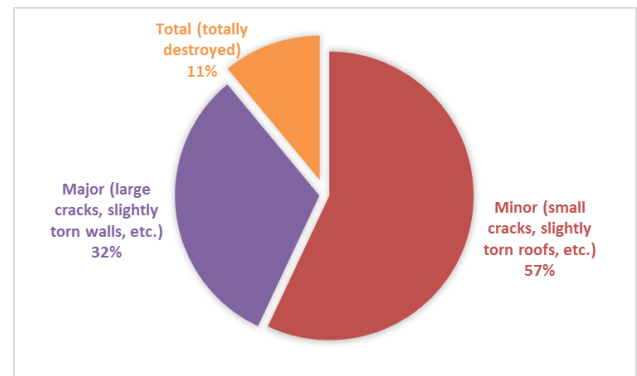


Figure 15. Distribution of respondents who were affected by storm surge/tsunami disasters (n = 47)

Moreover, methods to announce people about disaster information are also considered by the authors. Survey results show that more than 60% of respondents get information on the storm surge and typhoon via television, radio or public address systems, see Figure 16. Thus, in case of not a natural

disaster warning system, these methods can help the people to evacuate in time.

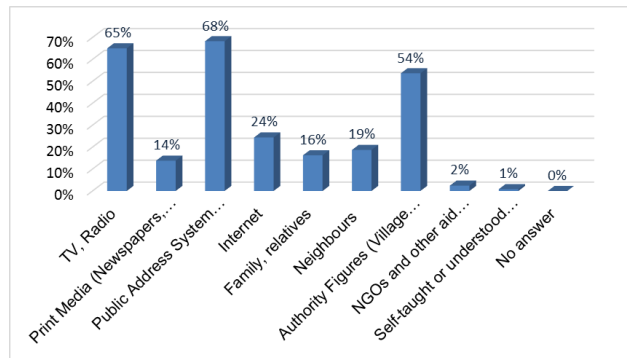


Figure 16. Distribution of how respondents get information on the storm surge and the typhoon (n=123)

## 6. Discussion

The awareness of local residents about natural hazards depends on a number of factors such as culture, education, the policies of local and national governments, and experiences in past.

According to statistics database of national, in the past few decades, only more than 10 typhoons and tropical depressions hit Phan Thiet City, with the average wind speed of 39-49 km/h. During this period, there were only a few storms such as Typhoon TESS in 1988 (103 - 117 km/h), Typhoon LINDA in 1997 (62 - 74 km/h), Typhoon DURIAN in 2006 (> 133 km/h) landed in the area (Natural Disasters in Vietnam, 2017). With such low frequency, and not strong magnitude of the storms, their devastation to the human and property of the Phan Thiet community is not great. Therefore, people have little experience in awareness and preparedness to coastal disasters.

In terms of culture, there has been little natural disasters so far, so people do not have the habit of learning about it. Some older residents also claim

that their families may be living with disasters. In their experience, in the event of a loss, they will rebuild, and after a few years their lives will be overcome.

Up to now, although Vietnam has not suffered from many natural disasters, pupils' programs also take into account natural disasters and their impacts. However, the content is only at the introductory level, not to mention disaster details. Moreover, the area of Phan Thiet City is almost severely affected by natural disasters, so people are not much interested in enhancing this content in the curriculum.

Therefore, the awareness of people about the disaster of Phan Thiet City is quite low. And consequently as a result, the level of preparedness for natural disasters is low comparing with other coastal areas in the north part of Central Vietnam (Thao and Anh, 2015).

The level of awareness and preparedness can be reflected by a variety of factors, depending on the protection measures implemented, willingness to evacuate, and the various measures taken by authorities or individuals. To increase awareness and preparedness of people about coastal disasters, sometimes the local authorities hold the training on coastal disaster response to vulnerable area. After each training, the awareness of the people increased slightly, they know how to protect themselves and to evacuate in case of disasters.

Besides, follow the recent surveys and interviews, a Natural Disaster Warning System has not yet established in Phan Thiet City. However, some traditional methods (such as Public Address System, or announcements from neighbors), and more modern means (such as television and the internet) can also help people to evacuate in time in case of

disasters.

The survey results show that even in coastal areas, people's awareness and preparedness for natural disasters are still poorer than those of neighboring countries such as the Philippines, Indonesia, etc. Therefore, if natural disasters occur, the damage would be huge in terms of people and property, and it indirectly affects the development of the economy within areas. This has been seen through the statistics of damage from the typhoon and storm surge that have occurred in the past.

## 7. Conclusion

Nowadays, the extreme weather phenomenon (tsunami, storm surge, and cyclone) is not a problem for any particular country but a global problem, even rich countries such as United States and Japan can also be affected by these events. Vietnam, with 3,260 km of coastline, is likely to have increased coastal disasters. And their impacts will not small to the coastal communities.

Building a work such as sea dyke just can protect area from natural disasters to a certain level. For instance, with a very strong typhoon this work also can be destroyed and area was threatened. So in this case safety measures in the protection against natural disasters are evacuation systems. Although most of people just considered evacuation is a providing plan against disasters but actually, this is the most important measure that directly save people's life. For a successful evacuation against coastal disasters it is not only necessary to have a warning system, but for the local population to be aware of the dangers posed by a tsunami (Esteban et al. 2013) or storm surge, and know what to do in such an event.

In addition to improve people's awareness and preparedness of coastal disasters, the disaster

warning systems needs to be developed in sensitive areas. However, while waiting for the construction of the warning system, some simple methods can also be applied effectively, see Figure 16.

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