IMPACTS OF CLIMATE CHANGE AND ADAPTATION STRATEGY SELECTION UNDER CONSTRAINED CONDITIONS IN BEN TRE PROVINCE, VIETNAM

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ABSTRACT

Scientific research has proven that Vietnam's 10 most vulnerable provinces are among the top 25% most susceptible regions in South East Asia, including Ben Tre province. In this study we investigate the impacts of climatic events, specifically salt water intrusion, typhoon and erosion on coastal households. We evaluate their awareness, preparedness and adaptations embraced to mitigate these impacts. Three focus group discussions (FGDs) were conducted to provide an overview of the impacts of climatic events in the province. We also conducted a survey of 300 households to examine the impacts of their climatic risks. Findings showed that salt water intrusion immensely hinders agriculture and aquaculture as well as households' everyday routines. Total loss from the most recent salt water intrusion mounted to USD 77,151. Devastating typhoon Durian resulted in USD 154,155 loss. Compared to these two incidents, erosion appears to be less serious. Total loss from the most recent erosion climbed to USD 28,492. In order to cope with climatic risks, households primarily performed simple actions. An assessment on households' awareness and preparedness of climate change revealed that 98% of respondents have no or little knowledge of climate change; 65% of respondents have not made any preparations for climate change.

Keywords: Ben Tre, climate change, typhoon, salt water intrusion, erosion.

INTRODUCTION

Scientists were long ago aware of the powerful influence of climate on the history of humankind, with respect to biological, cultural and geographical alteration forces. Nonetheless, research in the last few decades uncovered that human actions can generate significant impacts on the climate as well (The New York Times 2012). Climate change is now the single most serious environmental challenge of our time that threatens economic, health, safety, and food security (UNEP– United Nations Environment Programme)[1]

Vietnam is one of the most vulnerable countries to climate change in the world. Impressive achievements in pulling millions of people out of poverty in the past decade are placed in jeopardy due to increasing extreme weather incidents, such as severe rainfall and drought, and climatic changes like sea level rise and warming temperatures (OXFAM 2008). According to the Vietnam Assessment Report on Climate Change (ISPONRE 2009), the country has already experienced changes in fundamental climatic elements as well as extreme weather phenomena such as storms, heavy rains, and droughts. The Report also emphasizes that impacts of climate change are likely to be worst on the agricultural sector and water supplies, and that flooding and drought are likely to be more frequent because of an increase in rainfall intensity and a drop in the number of rainy days. Mekong and Red River deltas, crucial crop production areas, are likely to be rendered barren by salt water intrusion due to rising sea level. Climate change could furthermore engender biodiversity reduction, especially native plant species. Sea level rise could lead to a decline in mangrove forests; adversely impact indigo and forests on the sulfated lands of southern Vietnam; and change the boundary distribution and alignment of primary and secondary forests.

Climate change mapping shows that Vietnam's 10 most susceptible provinces are among the top 25% most vulnerable areas in Southeast Asia, and that Ben Tre (figure 1) is one of these (Yusuf and Francisco 2010). In the arrival of the dry season, Ben Tre often suffers immensely from salt water intrusion that leads to the contamination of fresh water destined for family routine as well as damages to agricultural production. The level of salinity of one percent can be detected throughout the entire province while the salinity threshold for drinking water is less than 0.25 percent. In addition to salt water contamination, unusual typhoons in recent years served as strong evidence that Ben Tre is no longer a typhoon-free area. In 1997, the typhoon called Linda with wind velocity of 120 km per hour accounted for severe damages of USD 14,467,592. Nine years later, the typhoon named Durian with wind velocity of over 133 km per hour had severely devastated the province. Furthermore as segmented by an intricate system of rivers and channels, Ben Tre territory has suffered from erosion which occurs mostly along the riverside. These climatic events are likely to increase in terms of intensity and frequency as climate is changing. Hence, a study which investigates the impacts of climate change on residents, their awareness and preparedness and adaptation strategies as well is opportune.

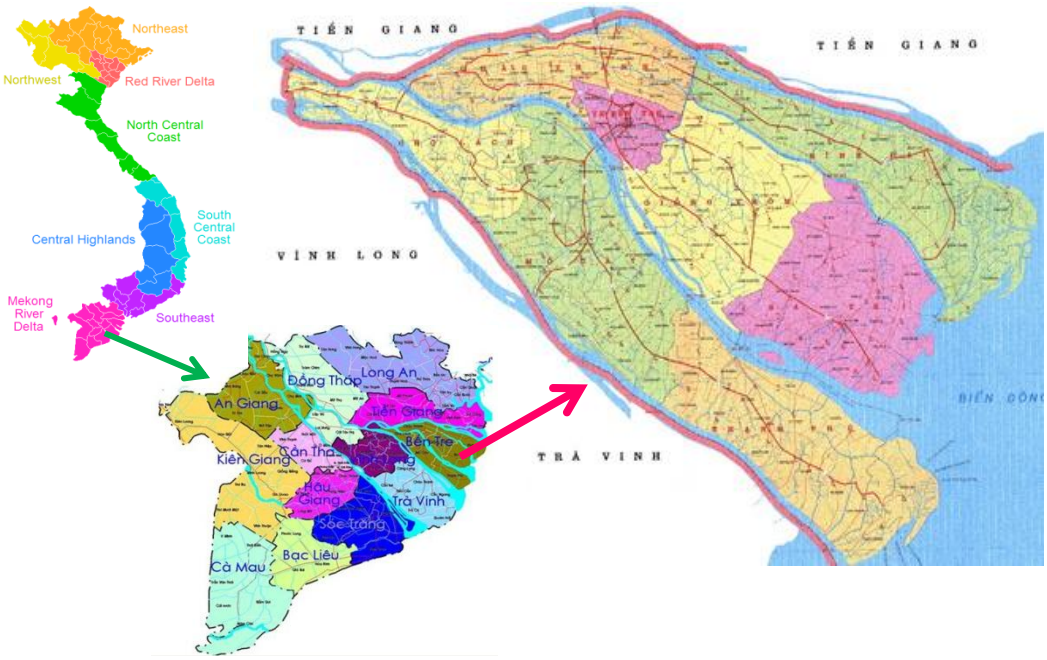

Figure 1. Maps of Vietnam, Mekong Delta and Ben Tre province

OBJECTIVES OF THE STUDY

In general the study hopes to assess the impacts of most recent climatic events including salt water intrusion, erosion, and typhoon on three coastal communes, namely Thua Duc, An Thuy and Giao Thanh, which are chosen as studied sites because they are believed to be most affected in the province. Specifically the study will (1) identify and evaluate the impacts of salt water intrusion, erosion, and typhoon on households along the coasts in the Ben Tre province; (2) assess households' awareness of climate change; and (3) investigate the types and costs of households' autonomous adaptations.

METHODOLOGY

Television shows, radio broadcasts, newspapers and internet, have altogether concluded that Ben Tre is one of the areas in Mekong Delta most affected by climate change. However, there still remains a dearth of specific information to answer the following questions: Which communes have been most affected; how climate change impacts on economic activities and livelihoods; what local residents do to mitigate and adapt to these impacts?. To provide answers to these above inquiries, three tools were employed in focus group discussions (FGD), namely hazard mapping, historical timeline and vulnerability matrix.

In order to enhance further investigation regarding impacts of climate change on coastal residents, their awareness and preparedness, and adaptations as well, a household survey of 300 samples was conducted at three coastal communes. The questionnaire was designed in the light of the results from three focus group discussions. The questionnaire consisted of six parts. The first section provided general information about households. The second section addressed occupations of households. The third section identified types and values of damages resulting from typhoon, saltwater intrusion and erosion. The fourth part assessed awareness and preparedness of households to climate change. The fifth section looked into types and costs of households' autonomous adaptations. Finally, the last section was designed to capture expectations of households toward governments.

Three hundred samples were equally divided among three studied coastal communes of three districts. In each commune, the survey covered all villages with the hope that the samples represented the population. Respondents were chosen based on the economic structure of the commune in order to involve as many occupations as possible, including agriculture, aquaculture and fishing. Respondents were invited with the help of government officials.

FIDINGS

Damages and Values of Damages from Typhoons

Respondents were asked to value the damages caused by the most severe typhoon during the last 10 year which was typhoon Durian in 2006. Among three hundred surveyed households were 205 households affected by Durian with the total loss of USD 154,155 (table I). It took them 40 days on average to recover from the financial impact, 27 days to recover from emotional distress, and 33 days to be back to normal situation. Despite few hours of presence, the incident brought about serious damages. There were one hundred and seventy-two of 205 households reported home damages which summed up to losses of USD 51,114, equivalent to 33.16% of the total loss caused by the typhoon (figure 2). It is calculated that aquaculture incurred the most severe damage (USD 53,004) which accounted for 34.38% of the total loss although there were just 39 farmers impacted. Forty farmers working in agriculture and 20 fishers experienced considerable losses of USD 16,784 (10.89%) and USD 18,789 (12.19%) respectively.

Table I: Damages from typhoon Durian

Types of damages	No of affected households	Value of loss (USD)
Damage to house	172	51,114
Damage to appliance	50	5,619
Damage to livestock	2	149
Damage to assets	15	6,351
Loss in agriculture production	40	16,784
Loss in fishing income	20	18,789
Loss in aquaculture production	39	53,004
Income loss due to work stoppage	6	511
Loss in salt production	3	1,350
Land loss	1	482
Total loss		**154,155**

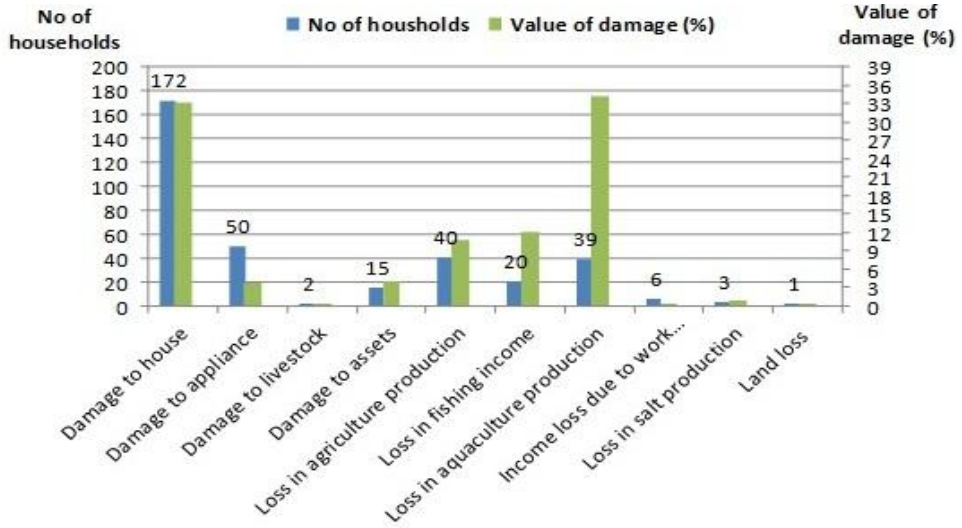

Figure 2. Number of affected households and value of damage (%) caused by Durian

Damages and Values of Damages from Salt Water Intrusion

Respondents were requested to work out values of losses caused by the most recent salt water intrusion. Among three hundred households were 271 households affected by salt water intrusion with the total loss of USD 77,151 (table II). According to them, salt water first intruded inland 9 years ago, and each intrusion lasted 168 days on average. All participants agreed that the level of salinity has increased over years, especially in recent years.

As salt water intruded inland, it brought about serious consequences on agricultural production, freshwater supplies for family routine, aquaculture production, diseases, and on the life years of farm equipment. Specifically, it resulted in a lack of fresh water for 146 households which affected their family routines with the estimated loss of USD 10,385 which accounted for 13.46% of the total loss (figure 3). Aquaculture production of 14 households was also attenuated by salt water which resulted in USD 31,060 loss which was responsible for 40% of the total loss. Salt water intrusion furthermore harmed agriculture, causing 65 farmers to lose their crops with a value amounting to USD 34,279 (44.43%) - the largest loss of all. Diseases and depreciation of farm tools are other impacts of salt water intrusion but the impacts are minor.

Table II: Damages from the most recent salt water intrusion

Types of damages	No of households	Value of loss (USD)
Loss in agricultural production	65	34,279
Lack of freshwater for family routines	146	10,385
Loss in aquaculture production	14	31,060
Diseases	6	1,331
Tools have shorter lifetime	1	96
Total loss		**77,151**

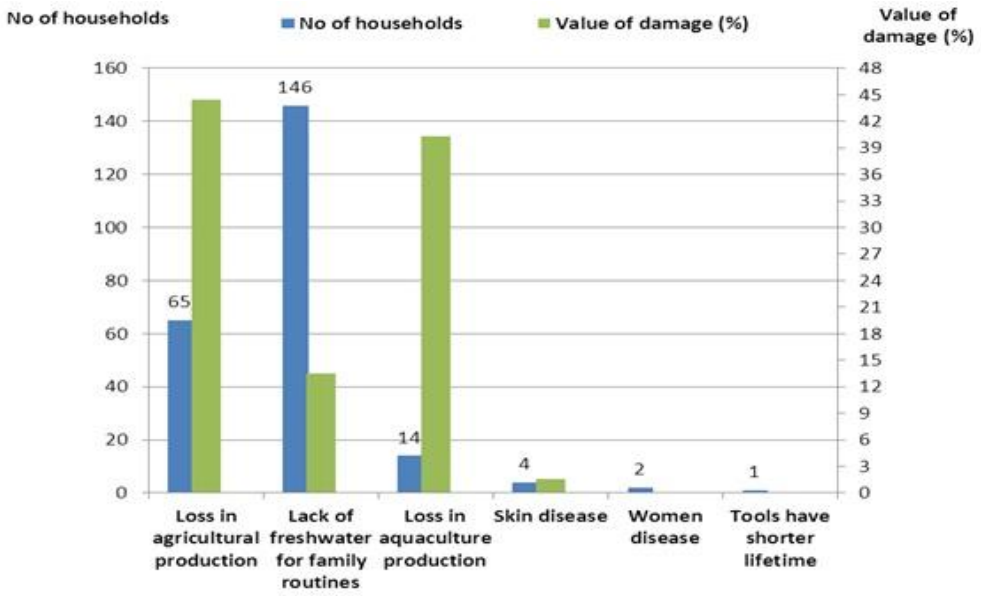

Figure 3. Number of affected households and value of damages (%) caused by salt water

Damages and Values of Damages from Erosion

The number of households (only 36 households) affected by erosion is considerably small in comparison with typhoons and salt water intrusion. Erosion was, however, responsible for a lot of damages to houses, assets, land, aquaculture and agriculture production which resulted in the total losses of USD 28,492 (table III). Ten of 36 households suffered from land loss at a value of USD 13,744 accounting for 48.24% of the total loss (figure 4). Losses in aquaculture and agriculture were substantial: USD 8,970 (31.48%) for aquaculture and USD 3,419 (12%) for agriculture. Damages on assets and houses were USD 5,160 and USD 2,749 respectively.

Table III: Damages from the most recent erosion

Types of damages	No of affected households	Value of loss (USD)
Damage to house	3	2,749
Damage to appliance	0	0
Damage to livestock	0	0
Damage to assets	4	5,160
Loss in Agriculture production	9	3,419
Loss in Fishing income	0	0
Loss in Aquaculture production	12	8,970
Income loss due to work stoppage	0	0
Land loss	10	13,744
Total loss		28,492

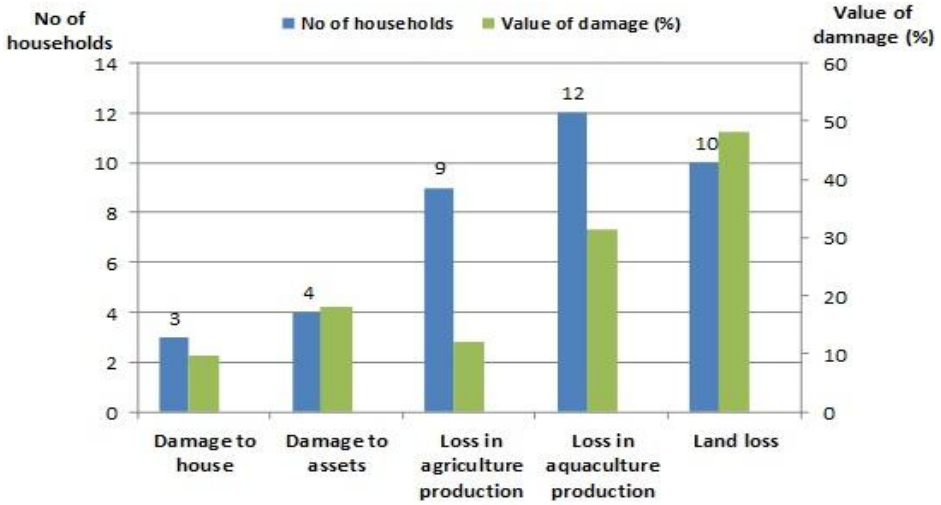

Figure 4. Number of affected households and value of damages (%) caused by erosion

Household's Awareness and Preparedness to Climate Change

As can be shown in figure 5, 38.55% of total surveyed households report that they have no information/knowledge of climate change and 59.67% of households have a little knowledge. The number of households that have adequate knowledge on climate change accounts for only 2% of the total. There are no households which are fully knowledgeable about climate change.

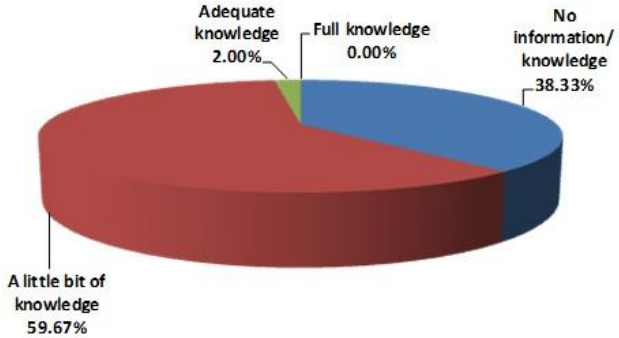

Figure 5. Households' awareness of climate change

What can be seen obviously from the figure 6 is that the majority of households have not made any preparations for climate change accounting for 65% of the total. This can be justified by the large number of households which have no or a little awareness of climate change (98%). There are only 0.67% of the total households that are adequately prepared for climate change although the number of households which have adequate knowledge on climate change is 2%. The rest (34.33% of the total) are somewhat prepared; no households are fully prepared.

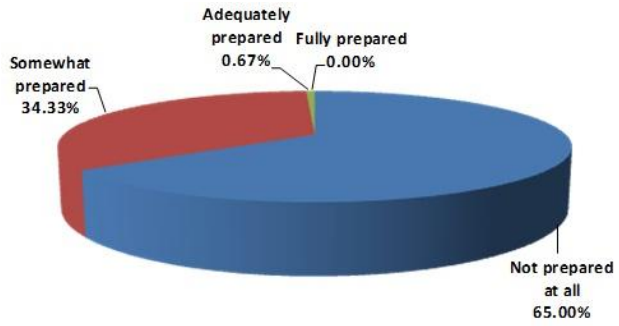

Figure 6. Households' preparedness for climate change

Types and Costs of Household's Autonomous Adaptations to Typhoons

What can be notably seen from the table IV is that only a small number of households undertook actions in order to deal with Durian before its arrival. This is justified by the indifference of the majority of local residents although they did receive early warnings from local authorities. Such indifference originated from the disbelief on the occurrence of the typhoon. House improvement and evacuation were the two most common actions undertaken by households.

Table IV: Actions undertaken by households before Durian hit

Action	No of households
Undertook improvement on houses	38
Evacuated to a safe place	41
Dug canals	0
Planted tree along the perimeter of properties	1
Harvested crops or fish early	1
Reinforced cages/ponds	2
Moved fishing or farming equipment to safe place	7
Joined savings groups/cooperatives	1
Built underground shelter	0
Prepared food	2
Detached properties from the ground	0
Moved properties to safe place	4
Built sand dike to prevent flooding	1

Figure 7 tells us about actions undertaken by households after Durian hit. Given the severe damage to houses, it is not surprising that house improvement was the action performed by most households (172). On average, it costs a household USD 688 to undertake house repairs. Besides repairing houses, replacing fish stock, replanting farm and

reinforcing ponds/cages were also performed. On average, it costs one household USD 90 to replant farms, USD 357 to replace fish stock, and USD 507 to strengthen ponds/cages. Thirty-one households had to borrow money to cope with damages and income losses. The average sum of money borrowed by one household was USD 1,064. Thirty-seven households received financial aid of USD 156 on average from the local government. Seventy-one households decided to save money to deal with future typhoons as well as other incidents, but they refused to reveal their savings.

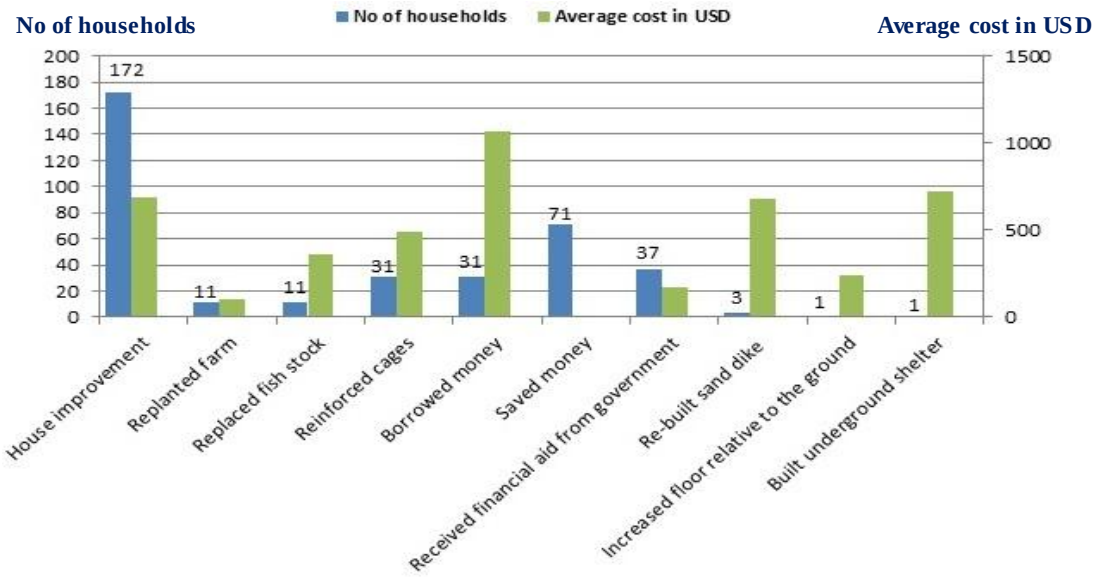

Figure 7. Actions and corresponding costs undertook by households after Durian hit

Types and Costs of Household's Autonomous Adaptations to Salt Water Intrusion

In figure 8 is seen the actions that households carried out to deal with impacts of salt water intrusion. Of 271 households impacted by salt water intrusion, 270 households harvested rain water at the average cost of USD 189.80 per household to build/buy water containers which are often concrete tanks or large baked clay jars. Rain water is used mainly as drinking water. Besides, 143 households bought water from vendors in dry seasons in order make up for the lack of fresh water for daily routines. Purchased fresh water is used mainly for cooking and washing. On average it costs a household USD 71.28 to buy water to meet household water deficit. In aquaculture, 41 farmers built sand dikes around their ponds to mitigate the effect of salt water intrusion. This action costs a household USD 933.71 on average-the largest amount spent on an adaptation. Thirty-two households tapped from a different source, which means that they made new wells with the hope that new wells are unsalted. It took one household USD 83 on average to construct a new well.

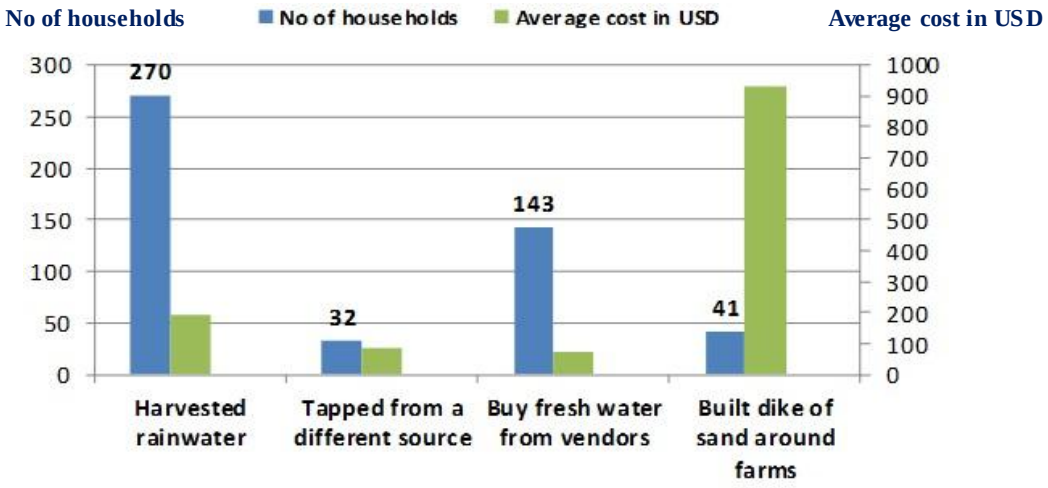

Figure 8. Actions and corresponding costs to deal with salt water intrusion

Types and Costs of Household's Autonomous Adaptations to Erosion

From figure 9, installing temporary protective structures are utilized most by households which cost one household USD 827.15 on average. Compared to other actions which received fewer responses from respondents, this cost is lowest. One household had to relocate permanently at the cost of USD 14,468. Seven respondents reported that they made use of mangroves as an adaptation to erosion. However, since they received plants from the local government, planting mangroves occurred at no costs to them. On average the cost to one household was USD 3,520 to build permanent structures and USD 2,860 to reinforce ponds/cages.

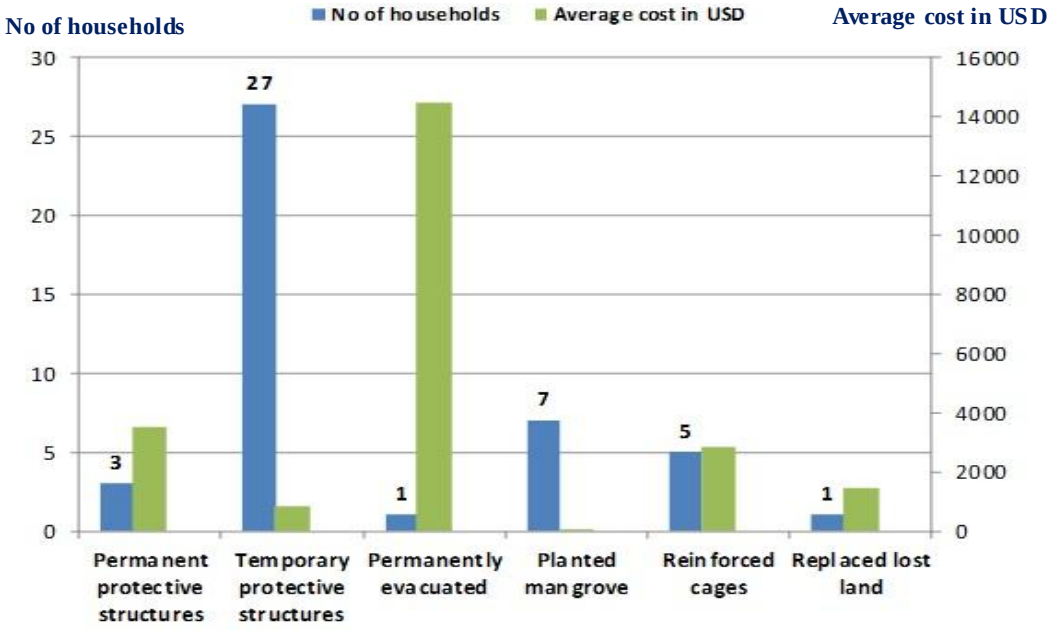

Figure 9. Actions and corresponding costs to deal with erosion

DISCUSSION

Everyone who comes to Ben Tre and listens to the voice of residents should be aware of difficulties brought about by salt water intrusion-the most serious disaster in the province. Two hundred seventy-one respondents of all 300 were impacted by salt water with total losses amounting to USD 77,151. It is important to bear in mind that the figures listed above just reflect the damages from the most recent intrusion of merely 271 households. Salt water intrusion occurs every year throughout the entire province. Without any help from calculations, one can visualize how large the aggregated loss is for the whole province during a particular time horizon.

By referring back to table 2, it can be seen that salt water is more harmful to agriculture than to aquaculture. This is justified by the higher tolerance of aquaculture species to salinity as compared to plants and trees. Nonetheless, in terms of value, aquaculture incurred approximately as much loss as did agriculture (USD 31,060 compared to USD 34,279), which can be explained by higher investment and higher output price of aquaculture products. In addition, salt water intrusion also affected family routines and the supply of freshwater. A few words can express the inconvenience caused by the lack of freshwater. Although households can harvest rainwater or buy freshwater from vendors to use as an alternative source, they have to use it with frugality. The study cannot quantify such an abstract effect of salt water intrusion.

It used to be a belief that was attached firmly in the mind of almost every resident in Ben Tre that the province was free from typhoons. The belief actually held true until 1997 when the first and the worst typhoon named Linda hit the province. Nine year later in 2006, another devastating typhoon called Durian officially removed the belief from all residents' mind.

Durian, which lasted for only a few hours, was responsible for a huge amount of devastation amounting to USD 154,155, and filled inhabitants with alarm for years later. Aquaculture, one of the chief economic activities in the province, suffered the most severe losses in the vicinity of USD 53,004 because of the huge investment covering a vast area of thousands of hectares. There were also losses in fishing income and agriculture amounting to USD 18,789 and USD 16,784, respectively. In addition to impairing economic activities, the incident was also attributed to serious devastation on resident's houses. In Ben Tre, wood, bamboo and nipa palms were main construction materials before the typhoon, making houses prone to damages from strong winds. This explained why a number of houses collapsed, or unroofed as Durian with wind velocity of over 133 km per hour swept the area destroying houses, appliances and other assets.

As mentioned before, erosion is the less serious climatic risk of all in Ben Tre. This is verified by the number of households affected by erosion in the sample: 36 of all 300. In terms of value, total loss caused by erosion (USD 28,492) was even smaller than losses incurred only by aquaculture due to salt water intrusion (USD 31,060), or typhoon (USD 53,004).

By assessing respondents' awareness of climate change, the study revealed that 98% of respondents have no or just a little knowledge of climate change. For those who have a little bit of knowledge, their awareness of climate change is simply associated with changes in wind, rainfall and temperature patterns. Similarly, sea level rise to them is simply the current rising tides which occur with much variation. Since climate change no longer only a discussion

in scientific papers but a real world phenomenon, such of low level awareness of residents could serve as a deterrent to provincial programs efficacy in taking actions to deal with climate change.

As the majority of respondents have very low awareness of climate change, it came as no surprise to see that 65% of surveyed respondents reported that they have not made any preparations for climate change. As we can recall, before typhoon Durian hit, very few residents believed in its occurrence, and therefore, very few preparations were made. This could exemplify the finding.

By examining autonomous adaptations of households in order to mitigate impacts of these climatic risks, one could have the impression that the adaptations are pretty simple. "Simple" here means not requiring much technical knowhow. Regarding typhoon, before its arrival, households made some home improvements as simple as placing sand bags on the roofs, and/or evacuating buildings. After it ended, all they did were mainly: repairing houses, replanting farms, replacing fish stock, and repairing animal cages. Those actions are not only simple but also re-active. This could be explained by households' lack of experience in coping with typhoons. More active actions like raising the house flooring off the ground to prevent flooding during increased water level, saving money for future incidents, or making underground shelters to hide in during typhoon, did extract much response from respondents.

Concerning salt water intrusion, adaptations are somewhat more preventive but remain as simple as possible: harvesting rainwater and/or buying freshwater from vendors. Nonetheless, due to financial as well as technical shortages, that is all they can do. More technique-consuming adaptations like treating water or switching to new species/plants, although listed in the questionnaire, received no mention from respondents.

CONCLUSION

Climate change mapping shows that Vietnam's 10 most endangered provinces are among the top 25% most vulnerable areas in Southeast Asia, and that Ben Tre is among these (Yusuf and Francisco 2010). Particularly at the studied sites, data collected from the household survey indicated that there were serious damages caused by climatic events. Statistics show that typhoon Durian which lasted for a few hours resulted in USD 154,155 loss. Damages from recent salt water intrusion mounted to USD 77,151. As compared to typhoons and salt water intrusion, erosions have affected fewer numbers of households. Estimated losses from most recent erosion damage amounted to USD 28,492. Damages caused by these climatic events actually surpassed those figures listed above because the expense on actions undertaken by households can also be considered as losses. It is important to bear in mind that those figures are calculated based on a sample of merely 300 households. Therefore, the value of damages is definitely much larger for the whole community. In order to cope with climatic risks, households performed mainly simple actions. This reflects financial and technical shortages of households. Assessment on respondents' awareness of climate change revealed that 98% of respondents have no or a little bit knowledge on climate change. With such a low awareness, it is no surprise to see that 65% of respondents reported that they had not made any preparations for climate change.

IMPLICATIONS

A vivid picture of climate change impacts has been delineated through this study with a hope that it could serve as a reminder for the provincial government to incorporate programs/actions mitigating climate change impacts into its socio-economic development plans.

As we know, proper actions originate from proper awareness. Hence, it is crucial that the provincial government should implement more activities to supersede low households' awareness of climate change.

Understandably, coping with climate change requires a firm financial foundation. Hence, the provincial government is expected to be proactive in seeking national as well as foreign investments and/or financial aid to deal with impacts of climate change.

ACKNOWLEDGMENT

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ENDNOTES

1. See at http://www.unep.org/climatechange/Introduction.aspx