Journal of Nature Studies 13 (1): 1-8
ISSN: 1655-3179

CLIMATE CHANGE ADAPTATION OF COASTAL COMMUNITIES IN THE RED RIVER DELTA BIOLOGICAL RESERVE, VIETNAM

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ABSTRACT – Because information is vital in planning with regard to climate change adaptation, this case study assessed the vulnerabilities of coastal communities in Giao Thien and Giao Xuan in Giao Thuy District, Vietnam to climate change. Methods used include survey, key informant interview, and review of documents of which 194 households served as the sample size. A pre-tested interview schedule was used to gather data. Descriptive statistics such as frequency distribution, percentages, and means were used to describe the data. Findings revealed that the climate change adaptation of the coastal communities include plan to build infrastructures and/or facilities and renovation of houses. Prior to the occurrence of the typhoon, the communities prepared food, water, batteries, kerosene, candle, and materials to shield their houses, and evacuate when needed. The preparation activities are concentrated on human needs and safety and securing the shelter. The preventive measures of the coastal communities as a climate change adaptation strategies entail large-scale investment that are beyond their control thus cannot be considered as their own adaptation strategies but rather on the part of the government. However, they were able to identify that infrastructures is a good adaptation strategy. For this study, the climate change adaptation only focuses on the occurrence of strong typhoon and flooding. Other threats from climate change specifically on their livelihood does not form part of the climate change adaptation of the communities thus, considered insufficient..

Keywords: climate change, climate change adaptation, coastal communities, Red River Delta Biological Reserve.

INTRODUCTION

The long coastline of Vietnam has 28 provinces bordering the sea with numerous small fishing communities (Han, 2007). These areas depend on the country's aquatic resources for food, livelihood, and employment (GSO, 2006 as cited by Pomeroy, Nguyen, & Thong, 2008). However, recent research reveals that by 2050 sea level will rise 33 centimeters more in the area and by 2100, it will rise up to one meter (Dasgupta et al., 2007). This implies that these communities will be vulnerable to typhoons, tornados, and flooding. Thus, the livelihood of the coastal communities will be highly affected by climate change. Hence, it is imperative to determine now the climate change adaptation along coastal communities.

Climate change adaptation refers to the ability of ecological, social or economic systems to adjust to climate change including climate variability and extremes. It also pertains on how to moderate or offset the potential damages of climate change and to take advantage of associated opportunities with changes in climate or to cope with the consequences thereof (Easterling et al., 2007).

In planning for adaptation to climate change, information is crucial (Lagos & Wirth, 2009). According to the Organization for Economic Cooperation and Development (OECD, 2010), there is a need to identify how coastal communities adapt to climate change in order to determine the productivity and sustainability of the systems and for framework

To cite this paper: Ha, O.D. and Pintor, L.L. 2014. Climate Change Adaptation of Coastal Communities in the Red River Delta Biological Reserve, Vietnam. *Journal of Nature Studies.* 13 (1): 1-8

purposes. According to Lagos and Wirth (2009), many Least Developed Countries (LDCs) and small islands have a limited capacity to respond to the challenge of adaptation on climate change. In this regard, it is timely and very important to document the climate change adaptation strategies of the coastal communities to serve as models for countries that have limited capacity to adapt to climate change.

One of the adaptation strategies to climate change is the strengthening of community capacity. In the context of climate change, community capacity is the ability of the communities to adapt to real and potential impacts. The common goal is to reduce the vulnerability of the community. Vulnerability is the susceptibility of a community to the results of climate change. Due to climate change, the communities need to prepare in a locally meaningful and policy-relevant way (Sharmalene et al., 2003).

In view of the foregoing, it is worth knowing to study coastal communities as cases in climate change adaptation considering that baseline information is vital for planning purposes specifically in terms of policy formulation and implementation of community development programs.

In Vietnam, one of the most important reserved areas is the biological reserve of Red River Delta certified by UNESCO. The UNESCO officially assigned an international biological reserve certificate for its biological reserve in Xuan Thuy National Park, Giao Thuy District, Nam Dinh province because of the rich resources found in the area. This indicates that the vicinity is conducive as a study site due to its environmental, economic, and social importance and most importantly to the people in the area. Thus, this study sought to determine the climate change adaptation of the coastal communities inhabiting the locale by specifically identifying their preparation activities and preventive measures.

Methodology

The study utilized a case study approach using different methods such as survey among households in coastal communities and review of documents. The study was conducted in the biological reserve of Red River Delta, particularly in the core area which is the Giao Thuy District under Nam Dinh province. Giao Thuy District is located in the easternmost province of Nam Dinh adjacent to South and East China Sea. The headquarters of the national park is in Giao Thuy District.

The two communes namely Giao Thien and Giao Xuan in Giao Thuy District were chosen as study sites because both are the most adjacent to the sea and bear all the direct effects of climate change. Their source of income is agriculture and fishing. It can be implied that these communities are the ones who will be highly affected by climate change.

Slovin's formula was used to determine the sample population at 10% margin of error. Out of the 5,721 households in the two communes, 194 households served as the sample size. Simple random sampling was used in selecting household heads that would serve as respondents of the study. A pre-tested interview schedule was used to ensure validity and reliability of the research instrument. Involved in the pre-testing activity were households in other communes in the biological reserve. The survey was conducted from September to October 2012. Enumerators were hired to fast track the primary data gathering of which orientation and leveling off were done to ensure the correctness of data. The categories of information gathered include the preparation activities and preventive measures on climate change adaptation. Descriptive statistics such as frequency distribution, percentages, means, and standard deviations were done to describe the data.

Results and Discussion

The respondents had individual plans on adapting to climate change due to their awareness on climate change. Most (20.2%) of them planned to prepare equipment for mobilization and build solid and firm infrastructures and/or facilities (Table 1). Relevant to this is the study on vulnerability of households by Shen et al., (2011) which revealed that it is necessary to build houses that are strong enough to withstand typhoons. Meanwhile, 14.7% of the respondents answered

that they prepared food, renovated their houses, and shielded their house first and move to a safe place (14.1%).

Table 1. Respondents' preparation plans for the occurrence of climate change.

PARTICULARS	GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
	F.	%	F.	%	F	%
Preparation Activities	(n=81)		(n=82)		(n=163)	
a. Prepare equipment for mobilization. Build solid and firm infrastructure and/or facilities.	21	25.9	12	14.6	33	20.2
b. Prepare raw materials (bamboo, sandbags, net) to shield the house when the storm comes	12	14.8	16	19.5	28	17.2
c. Prepare food, renovate houses, and prepare sandbags to prevent floodwaters.	8	9.9	16	19.5	24	14.7
d. Shield the house and move to a safer place.	12	14.8	11	13.4	23	14.1
e. Monitor information on television, radio, and newspapers regularly, and solidify house.	12	14.8	9	11.0	21	12.9
f. Restructure crops (drought-resistant and pest-resistant crops).	2	2.5	6	7.3	8	4.9
g. Clear bushes, plant trees and mangroves.	1	1.2	6	7.3	7	4.3
h. Permanent housing capacity and environmental protection.	5	6.2	2	2.4	7	4.3
i. Shield the aquaculture area, and move to the evacuation area.	4	4.9	2	2.4	6	3.7
k. Environmental protection campaign against indiscriminate exploitation of natural resources, preparation of facilities.	2	2.5	2	2.4	4	2.5
l. Prepare pumps and drainage in agricultural lands	2	2.5	0	0.0	2	1.2
Total	81	100.0	82	100.0	163	100.0

For the infrastructure plans in preparation to climate change, most of the respondents intended to renovate their houses (22.2%) and affirm the needs to improve sea dike, upgrade water supply and sewerage system (21.6%). On the other hand, other respondents planned to repair sea embankments to prevent sea water intrusion (16.5%), and to build public facilities (8.2%). The infrastructures identified by the respondents was highly imperative in avoiding the impact of climate change in coastal communities.

The most cited adaptation strategies based on the study of Predo (2010) that was implemented by most households include the temporarily transferring to evacuation area, restructuring of housing unit, and moving to a safe place permanently. This was being practiced by communities to ensure the safety of the members of their households.

Table 2. Infrastructure plans intended for implementation in preparation to climate change.

PLANS	GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
	F.	%	F.	%	F.	%
a. Renovation of house	26	26.8	17	17.5	43	22.2
b. Improve sea dike, water supply, and sewerage	18	18.6	24	24.7	42	21.6
c. Repair sea embankments to avoid salt water intrusion	9	9.3	23	23.7	32	16.5
d. Build public facilities	8	8.2	8	8.2	16	8.2
e. Build infrastructure to avoid typhoon	0	0.0	6	6.2	6	3.1
f. Building of fresh water tank	2	2.1	2	2.1	4	2.1
g. No answer	34	35.1	17	17.5	51	26.3
Total	97	100.0	97	100.0	194	100.0

Table 3 shows the plans of the respondents on how to improve their houses. Most of them will use steel to reinforce their houses (42.3%), plan to solidify and repair their respective houses (27.8%), and build two-storey houses so that they will not be reached by flood (10.3%). Results showed that these were the communities' perceived keys to avoid damage

in the property during strong typhoon and flooding.

In Sta. Cruz, Bato, Camarines Sur, Philippines because the communities have no money to build concrete houses they resorted to movable houses made of light materials to move their houses whenever there is a need to evacuate due to flooding (Bondad, 2008). Bowron and Garry (2011) stressed that adaptation planning involves responding to the impacts of climate change, both proactively and reactively. It includes preventive measures and mitigation measures to reduce its effects.

Table 3. House improvement plans intended for implementation in preparation to climate change.

	PLANS	GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
		F.	%	F.	%	F.	%
a.	Use steel to reinforce the house	41	42.3	41	42.3	82	42.3
b.	Solidification and repair the house	20	20.6	34	35.1	54	27.8
c.	Build two-storey houses to avoid floods	13	13.4	7	7.2	20	10.3
d.	Building of houses in regional clusters	2	2.1	4	4.1	6	3.1
e.	Ensure the quality of the house to adapt to climate change	0	0.0	2	2.1	2	1.0
f.	No information (no answer)	21	21.6	9	9.3	30	15.5
	Total	97	100.0	97	100.0	194	100.0

The respondents had already experienced typhoons for several times. The activity of the majority (62.4%) prior to the occurrence of typhoon included preparing materials such as bamboo, wooden pillars, and sandbags that can be used to shield their houses. Others shielded their houses from strong winds by closing their windows (16.5%) while the rest intend to build concrete houses (12.4%). In a study conducted by Shen et al. (2011), households ensure the safety of their properties before the occurrence of strong typhoon. This implies that the communities find this as an effective strategy to adapt to climate change.

Table 4. Respondents' preparation activities to secure their houses.

	ACTIVITIES	GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
		F.	%	F.	%	F.	%
a.	Preparation of materials (bamboo, wooden pillars, sandbags) to shield the house, clear the bushes and trees around house	59	60.8	62	63.9	121	62.4
b.	Shield the house by closing the windows due to strong winds	9	9.3	23	23.7	32	16.5
c.	Solidification/ concrete houses	20	20.6	4	4.1	24	12.4
d.	No information (no answer)	9	9.3	8	8.2	17	8.8
	Total	97	100.0	97	100.0	194	100.0

The answers of the respondents were based on their experiences when a typhoon is coming. Majority (75.7%) of the respondents cited that they prepared food particularly rice, dried fish, noodles and water. The data obtained only show that the priority of the respondents is food to eat since they are not aware of how long will the flood subside. By reserving food at home, they were assured that they will not get hungry even if they cannot go out of their respective houses to purchase food. On the other hand, others (11.9%) cited that they stored water in containers and place it in a high area in the house.

Table 5. Preparatory activities of the respondents during typhoon.

	PREPARATIONS	GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
		F.	%	F.	%	F.	%
a.	Reserve food (noodles, rice, dried fish) and water	70	72.2	77	79.4	147	75.7
b.	Reserve water in closed containers and transfer to the high area	9	9.3	14	14.4	23	11.9

c.	Prepare rice, things that float such as plastic containers and car tires	6	6.2	0	0.0	6	3.1
e.	No information (no answer)	12	12.4	6	6.2	18	9.3
	Total	97	100.0	97	100.0	194	100.0

Table 6 presents the preparation being done by the respondents in terms of fuel and light. Data showed that most (19.6%) of the respondents prepared batteries, kerosene, and candle whenever they learn that a typhoon is coming. Thirty seven respondents (19.1%) prepared batteries for lighting and for listening to their radio for news. Others used fuel like gas for cooking and to load accumulator. Based on the most common answer of the respondents, majority of the respondents used batteries for lighting and listening to the news during typhoon.

In a study conducted by Penalba et al. (2008), households generally prepare alternative lighting materials and cooking fuel at the onset of the rainy season because lost of power is common during that time. The common adaptation strategies of the households included preparing candles, lamps with rechargeable batteries, and kerosene lamps as well as charcoal-fuelled stove.

Bowron and Davidson (2011) indicated that preparation is one of the climate change adaptation planning among Canadian communities at the municipal level. This shows that preparation is essential and considered as a good adaptive mechanism.

Table 6. Uses of fuel and light during typhoon.

USES OF FUEL AND LIGHT		GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
		F.	%	F.	%	F.	%
a.	For batteries, kerosene, and candle	14	14.4	24	24.7	38	19.6
b.	For cooking, for lighting, and accumulator	24	14.8	13	13.4	37	19.1
c.	For lighting and radio to track the news	19	19.6	18	18.6	37	19.1
d.	For lighting and gas for cooking	7	7.2	24	24.7	31	16.0
e.	For lighters, kerosene, and accumulator fully loaded	7	7.2	4	4.1	11	5.7
f.	For firewood/husk for cooking, oil lamps, and batteries for lighting	4	4.1	4	4.1	8	4.2
g.	To reserve batteries for lighting and kerosene	2	2.1	4	4.1	6	3.1
h.	No answer	20	20.6	6	6.2	26	13.4
	Total	97	100.0	97	100.0	194	100.0

Table 7 presents the plans of the respondents as preventive measures in response to climate change. Results showed that all respondents (100%) plan to build dikes. On the other hand, majority planned to enlarge the reservoir (68.6%) and upgrade the drainage system (58.8%). These measures will prevent the household-respondents from experiencing flooding. Thus, may defer their need to evacuate their houses whenever there is a strong typhoon. In a research study conducted by Macapawa (2011) in Catablingan, General Nakar, Philippines the community together with the Local Government Units reinforced the Catablingan Creek with sand bags to avoid flooding. On the other hand, the Buenos Aires program emphasized the need for preventive measures and planning related to climate change, as well as for contingency planning, particularly for droughts and floods (UNFCCC, 2006).

Table 7. Planned preventive measures for climate change.

PARTICULARS	GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
	F.	%	F.	%.	F.	%
Technical Flood Protections *						
Raise dikes	97	100.0	97	100.0	194	100.0
Enlarge reservoirs	63	64.9	70	72.2	133	68.6
Upgrade drainage systems	69	71.1	45	46.4	114	58.8
Natural Retention of Flood Water *						

Floodplain restoration	81	83.5	72	74.2	153	78.9
Change of water use	75	77.3	82	84.5	157	80.9
Maintain Mangrove Conservation						
Yes	95	97.9	87	89.7	182	93.8
No	2	2.1	10	10.3	12	6.2
Total	97	100.0	97	100.0	194	100.0
Improve Forecasting and Dissemination Information						
Yes	80	82.5	81	83.5	161	83.0
No	17	17.5	16	16.5	33	17.0
Total	97	100.0	97	100.0	194	100.0
Adaptation of Insurance Schemes Against Flood Damage						
Yes	65	67.0	59	60.8	124	63.9
No	32	33.0	38	39.2	70	36.1
Total	97	100.0	97	100.0	194	100.0

* - multiple response

Majority (78.9%) of the respondents had plans to restore flood plain, conserve mangrove forest (93.8%), and improve forecasting and information (83%) (Table 7). In the case of Labo, Camarines Norte in the Philippines, their strategy of improving information on climate change adaptation was by airing a daily program through the DWLB-FM radio station to educate the community. The Local Government Units likewise provided each village with a battery-operated transistor radio to have access to information. Communities in the mountains were advised when there is a need to evacuate due to intermittent but long rains that can trigger landslides (Galvez, 2008).

Table 8 presents the necessary preventive assessment in response to climate change. Results showed that all the respondents (99%) cited the need to raise the dikes. On the other hand, majority affirmed the need to enlarge the reservoir (79.4%); upgrade the drainage system (68.8%); and restore flood plain (79.9%). Similarly, majority (79.9%) affirmed the need to change the use of water and conserve mangrove forest (94.8%). It only shows that the communities are aware of the important role of mangrove forest in climate change adaptation.

Table 8. Needed preventive measures for climate change according to the respondents.

PARTICULARS	GIAO XUAN (n=97)		GIAO THIEN (n=97)		TOTAL (n=194)	
	F.	%	F.	%	F.	%
Technical Flood Protections*						
Raise dikes	97	100.0	95	97.9	192	99.0
Enlarge reservoirs	71	73.2	83	85.6	154	79.4
Upgrade drainage systems	70	72.2	63	64.9	133	68.6
Natural Retention of Flood Water*						
Floodplain restoration	81	83.5	74	76.3	155	79.9
Change in water use	81	83.5	74	76.3	155	79.9
Maintain Mangrove Conservation						
Yes	95	97.9	89	91.8	184	94.8
No	2	2.1	8	8.2	10	5.2
Total	97	100.0	97	100.0	194	100.0
Improve Forecasting and Dissemination Information						
Yes	97	100.0	95	97.9	192	99.0
No	0	0	2	2.1	2	1.0
Total	97	100.0	97	100.0	194	100.0
Adaptation of Insurance Schemes Against Flood Damage						
Yes	81	83.5	63	64.9	144	74.2
No	16	16.5	34	35.1	50	25.8
Total	97	100.0	97	100.0	194	100.0

* - multiple response

The United Nations Environment Program (UNEP, 2006) indicated that the wave energy can be reduced by 75% from a wave's passage from a 200 meters mangrove forest.

Conclusions and Recommendations

The focal point in the preparation activities of the coastal communities in relation to climate change lies on human needs and safety and securing the shelter. For human needs and safety, it focuses on survival as part of human instinct whereas securing their shelter before evacuating and planning to build concrete/two-storey house was seen as a

household investment that needs to be protected.

The preventive measures of the coastal communities as a climate change adaptation strategies entail large-scale investment that are beyond their control and cannot be considered as their own adaptation strategies but rather on the part of the government. However, this implies that they were able to identify that infrastructures is a good adaptation strategy that can be of help so as not to experience the adverse effects of climate change in their community.

The climate change adaptation of the coastal communities only focus on the occurrence of strong typhoon and flooding. Other threats from climate change specifically on their livelihood such as fishing, aquaculture, and agriculture does not form part of the climate change adaptation of the communities thus, considered insufficient.

The coastal communities should coordinate with the government with regard to the importance of infrastructures and public facilities in preparation for climate change. Knowing alternative sustainable livelihood should be part of the communities' climate change adaptation for economic reasons. Hence, the government should provide assistance to the community. Moreover, the community should continuously conserve the mangrove forest resources considering that this natural resource has the capability to combat climate change, avoid saltwater intrusion, and limit the damage caused by natural disasters.

ACKNOWLEDGMENT

The conduct of the study would not have been possible without the funds granted by Southeast Asian Regional Center for Graduate Study and Research in Agriculture (SEARCA). Thus, deepest appreciation is given to SEARCA for the financial support that provided an avenue to contribute to the body of knowledge.

STATEMENT OF AUTHORSHIP

The first author conducted the literature search, prepared the conceptual framework, identified thematic points, formulated recommendations, and initiated the writing of the manuscript. The second author initiated the concept, identified some issues, formulated recommendations, and reviewed the paper.

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JOURNAL OF NATURE STUDIES
(formerly Nature's Bulletin)
ISSN: 1655-3179