

NATURAL DISASTERS AND THEIR EFFECTS ON LIVELIHOODS OF THE PEOPLE IN VINH LONG PROVINCE

CÁC THẢM HỌA TỰ NHIÊN VÀ ẢNH HƯỞNG CỦA CHÚNG ĐẾN SINH KẾ CỦA NGƯỜI DÂN Ở TỈNH VĨNH LONG

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ABSTRACT

Vinh Long is one of the provinces in the Mekong Delta affected by natural disasters. Some of them (salinity intrusion, droughts, floods and landslides) have greatly affected the livelihoods of the people in the province. Field survey, data collection and analysis of official statistics showed that in 2017 flooding and tidal inundation affected 27.03% (24,497.27 ha) of agricultural land. Droughts also affected about 30% of the rice land area (equivalent to 17,600 ha). Drought together with salinity intrusion from the east entering inland caused salinity up to 5.5‰. Cyclones also occurred with low frequency, affected about 102 hectares of crops. River bank landslide and erosion of four major river mouths and several small branches in the province were also revealed. Many sections of the rivers experienced landslides of more than 2.7km in length and erosion up to 32m.

KEYWORDS: *Natural disaster, livelihood, Vinh Long province*

TÓM TẮT

Tỉnh Vĩnh Long là một trong số những tỉnh ở Đồng Bằng Sông Cửu Long bị ảnh hưởng bởi các thiên tai. Trong số chúng (xâm nhập mặn, hạn hán, lũ lụt và sạt lở) đã ảnh hưởng rất nhiều đến sinh kế của người dân trong tỉnh. Bằng phương pháp thu thập khảo sát thực địa, thu thập dữ liệu và phân tích thống kê cho thấy trong năm 2017 lũ lụt và triều cường đã ảnh hưởng đến 27.03% (24.497,27 ha) diện tích đất nông nghiệp. Hạn hán cũng đã ảnh hưởng khoảng 30% diện tích đất trồng lúa (tương đương 17,600ha). Hạn hán cùng với sự xâm nhập mặn từ hướng biển đông xâm nhập vào đất liền làm cho độ mặn tăng lên đến 5.5‰. Lốc xoáy cũng có xảy ra nhưng với tần suất thấp, ảnh hưởng khoảng 102 ha hoa màu. Sạt lở bờ sông và xói mòn của 4 con sông chính và một vài nhánh sông nhỏ đã được đánh giá. Có nhiều đoạn sông chiều dài sạt lở bờ đến hơn 2.7km, xâm thực vào đất liền có đoạn đến 32m.

TỪ KHÓA: *Thảm họa tự nhiên, Sinh kế, Tỉnh Vĩnh Long*

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1. Introduction

The Mekong Delta, one of the largest agricultural centers in the south of Vietnam (Le Van Khoa, 2003),

consists of 13 provinces. In recent years, natural disasters such as floods, droughts, saline intrusion, landslides, storms, etc. have occurred in a dense frequency which severely affects the environment, people and development in the Mekong Delta (Mekong Delta). This is the land of the lower Mekong, characterized by low land, soft and quite flat with a system of dense rivers. Therefore, the Mekong Delta is vulnerable to natural disasters.

Vinh Long is located in the Mekong Delta. It has a total natural area of 47.82 km² (149,680.74 ha) and is divided into 08 administrative areas (01 city, 01 town and 06 districts) (Figure 1). Flat terrain with a slope of less than 20% is lowered from north to south, along with four major rivers (Hau River, Tien River, Co Chien River and Mang Thit River) which supply water for people's economic and social activities in the area. Annual average temperature is from 27-28°C, lowest temperature is 16.7°C and highest is 38.3°C. The rainy season usually lasts for 7 months, from May to the end of November. Annual average rainfall is from 1,300 to 1,600 mm. Hydrology is affected by the rainfall so the flow rates of the rivers are often changing and complex.

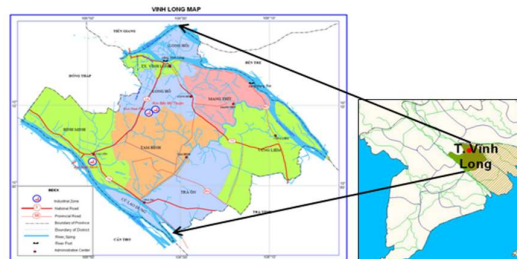


Figure 1: Vinh Long Province in the Mekong Delta

Due to the meteorological, geographical and ecological changes, natural disasters have caused great losses to the natural environment and livelihoods of the people in the province. However, over the past time, the province has no statistics on natural disasters and impact on people's livelihoods in the province. The study "Natural disasters and their effects on livelihoods of the people in Vinh Long province" was conducted to: (i) survey on natural disasters that occurred Vinh Long province and (ii) to assess effects of natural disasters on people's livelihood.

2. Research methodology

Data and information about natural conditions, geographic location, hydrological regime and natural disasters were collected from the Department Resources and Environment of Vinh Long Province. Data on land use, agricultural production, crop calendar and natural disasters and damages caused by natural disasters were collected from the Department of

Agriculture and Rural Development, Steering Committee for Natural Disaster Prevention and Search and Rescue in Vinh Long Province.

Field survey was conducted in areas affected by natural disasters to collect data related to socio-economic damage. Local government officials and people affected by natural disasters were also interviewed to assess the impact of natural disasters. Salinity, and submerged depth during inundation were also measured.

The MIKE-GIS model was carried out and a spatial map that shows the locations and extent of saltwater intrusion of areas submerged was formed. Data collected was aggregated, coded and analyzed using the Microsoft Excel and presented through tables and charts.

3. Results and discussion

3.1. Natural disaster statistics and frequency of occurrence

From the reports in the last 10 years showed that natural disasters occurred in Vinh Long Province included inundation, drought, saline intrusion, river bank erosion, thunderstorms and cyclones. Among them, drought and flooding occurred annually with 1 - 2 times per year and the time lasting several months. Riverbank erosion, thunderstorms, storms and cyclone were determined as unexpected and the occurred frequency listed in Table 1.

Table 1: Statistical frequency of natural disasters caused by riverbank erosion, thunderstorms and tornadoes

Years	The occurred frequency of disaster natural (counts)	
	Riverbank erosion	Thunderstorms, storms and cyclone
2007	5	7
2008	4	10
2009	-	4
2010	3	6
2011	4	10
2012	9	10
2013	10	15
2014	6	5
2015	39	5
2016	110	10
2017	125	16
Total	315	98

(Source: Department of Agriculture and Rural Development of Vinh Long province, 2007 – 2017)

Note: "-"Data not yet available

Table 1 showed that the riverbank erosion disaster increased every year and occurred with more than 300 times in the past 10 years. Besides that, the total length of riverbank erosion measured more than 31.396m, in which the largest length was up to 2.700m. The largest width of erosion into the mainland was 32m and the largest depth up to 12m. Thunderstorms, storms and cyclone were occurred at least 4 times per year (2009), at most 16 times per year (2017); and the total number in the past 10 years was 98 times.

3.2. Impact assessment by natural disaster

3.2.1. Riverbank erosion

River erosion caused damage to property (such as loss of residential land, ruining houses, crops, and the damaged riverine routes caused to disrupting travel and freight) and risk to harm to human's life. The statistical results from 2007 to 2017 showed that there were 1094 houses affected by riverbank erosion, in which there were more than 59 houses where residents were forced to move to another place; the total damage was estimated over 31.5 billion Vietnam Dong (VND) (Table 2). The cause was mainly determined by the effect of flow, the natural vortex, the topography of the meandering river, and human impact (such as river sand mining, riverbed dredging, and dam construction...).

Table 2: The statistics on damage caused by riverbank erosion during 2007 - 2017

Years	The damage caused by riverbank erosion		
	The number of the affected houses and facilities	The number of the displaced houses	Estimated damage amount (million VND)
2007	11	2	1.000,00
2008	11	3	475,00
2009	20	10	15,00
2010	8	-	-
2011	1	-	-
2012	26	7	12,00
2013	7	3	56,00
2014	24	-	-
2015	22	-	-
2016	105	-	12.347,91
2017	859	34	17.665,54
Total	1.094	59	31.571,45

(Source: Department of Agriculture and Rural Development of Vinh Long province, 2007 – 2017)

3.2.2. Thunderstorms, storms and cyclone

Vinh Long province was less directly affected by storms, but was often affected by the fringe storm and tropical depressions, thunderstorms and cyclone. The statistical results by Flood Prevention Board in Vinh Long province showed that thunderstorms, storms and cyclone caused damage to houses, facilities and the life of the people. From 2007 to 2017 years, there were more than 3.000 houses collapsed, lost roofs and fire; killed 11 people and injured 14 people; the total damage was estimated at over 31 billion VND (Table 3).

Table 3: The statistics on damage caused by thunderstorms, storms and cyclone

Years	Damage by tropical depressions, thunderstorms, storms and cyclone			
	The number of houses collapsed, lost roofs and fire	The number of dead	The number of injured	Estimate d damage amount (million VND)
2007	363	2	-	1.335,00
2008	80	1	4	1.081,00
2009	113	4	1	1.569,00
2010	80	2	-	1.301,00
2011	345	1	2	2.664,00
2012	835	1	6	9.698,00
2013	210	-	-	3.147,50
2014	185	-	-	1.946,00
2015	140	-	-	1.488,35
2016	297	-	-	3.086,80
2017	363	-	1	3.969,80
Total	3.011	11	14	31.286,45

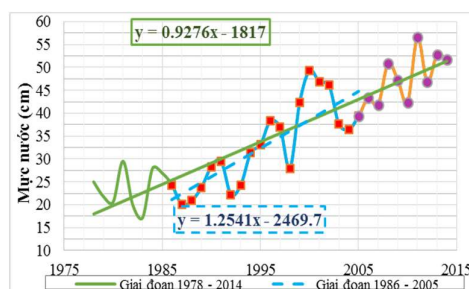
3.2.3. Floods

Vinh Long province was located in the area that affected by floods and tides of the Mekong River. Floods began to appear when water from rivers raised and affected the area of Vinh Long province. Flood comes from the upstream water of the Mekong Delta river systems that flow down through the Tien and Hau rivers and the northern part of the Vinh Long province area. Annual, flooding was usually occurred in mid-August, culminating in late September and mid-October.

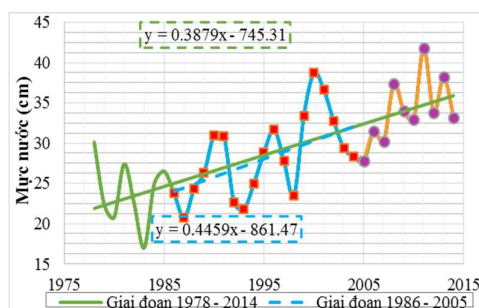
Inundation often occurs when floods combine with high tides that have affected some land areas of Vinh Long province. This is due to the flat topography and low-lying areas, multiple and complex from the flow systems, some poor drainage areas. Inundation was assessed through the annual water level

measurements on large rivers and the inundated locations that were shown on the map from survey data.

The annual water level measurements were done at two stations (Cho Lach and Can Tho) on two large rivers of Mekong river that flowing through Vinh Long province. The results showed that the average water level at stations increased to 0.93 cm per year (Figure 2). In 2017, the measured water level was higher than the average for many years 0.20 - 0.40 m. Results proved that the water level in the rivers has been increasingly rising in the stage of 1978 to 2017. The results were similar to previous research by the Irrigation Science Institute of Vietnam, besides that, the cause is determined by climate change and causing the water level rise (Pham Thi Huyen Trang, 2016).



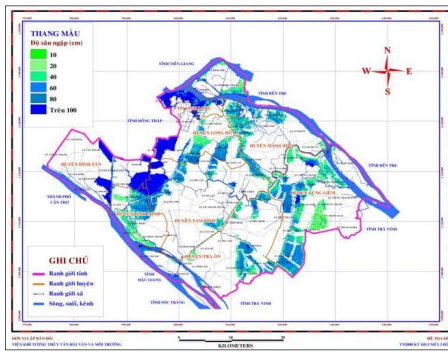
(a)



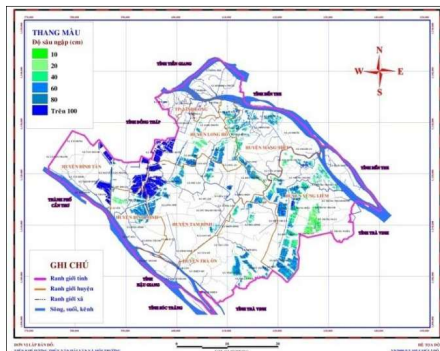
(b)

Figure 2: Water level trends at the monitoring stations (a) Can Tho station, (b) Cho Lach station

Through MIKE 11 - GIS calculation model, the results were described the inundated areas map in Vinh Long province (Figure 3). It was showed that the inundated areas mainly occurred in Vinh Long city, Binh Tan and Binh Minh districts with the inundated areas up over 1m, the remaining districts inundated with average 0.1 - 1m.



(a)



(b)

Figure 3: Maps of the inundated depth calculation in 2016 (a) When the highest tide and (b) inundated rice paddy land

In the recent years, many roads, houses, buildings and farmland have been inundated by flood and tides which affected to the livelihood of people in Vinh Long province. The inundated depth was determined to be about 15 – 50 cm (Department of Natural Resources and Environment of Vinh Long province, 2015).

In the inundated depth maps (Figure 3) showed that many areas were inundated. Specially, the Vinh Long city area most cared because this is an urban area with the densely populated place. The remaining inundated areas were located near canals and rural areas. The statistical results indicated that the agricultural land group was most affected with inundated land area accounting about 27.03 % (the inundated area about 24.497,27 ha); the estimated damage about 1 – 5 billion VND/ha; The area of industrial land, house and office building were inundated about 24.76% (about 8.769,29 ha). Specific data on the inundation land area of each district in Vinh Long province was presented in the Table 4.

3.2.4. Drought

Annual, droughts occurred at Vinh Long province during the low tide period from January to April every year. The drought has affected people living in high terrain areas, areas without water. In the past, natural disasters due to the occurred drought have not been

Table 4: The inundation land area of each district in Vinh Long

adequately considered. In the past, natural disasters due to the occurred drought were less considered, therefore, the statistical data related to the impact level of the livelihood was little unrecorded. The affected areas by droughts were often agricultural land areas. The statistical results in the recent years were done on the damaged rice area which was shown in Figure 4.

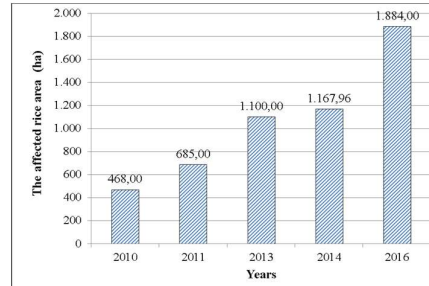


Figure 4: The affected rice area by drought

Figure 4 showed that the affected rice area by drought was increased from 2010 to 2016. However, due to a severe drought occurred in 2016 the affected rice area was increased. In 2016, there were 1,884 hectares of plants died due to lack of water, the estimated damage nearly 300 billion VND; In which, three districts were most damaged as Vung Liem, Mang Thit, and Tra On. The occurred drought in 2016 with two causes were identified as (1) The impact of the El Nino phenomenon causes severe sunshine, the lowly rainfall and the rainy season ended sooner than every year; and (2) The amount of water from upstream of the Mekong River flowing through the rivers of Vinh Long was sharply reduced. This is due to the hydropower dam systems that built on the mainstream of Mekong River. In addition, the upstream countries of the Mekong River have increased using water due to forming new agricultural lands, establishing industrial clusters along the Mekong River.

3.2.5. Salinization

Salinization occurred during the period of the appeared drought in combination with the low tide, the saltwater intrusion deep into the mainland. The salinity on Co Chien river was monitored at Vung Liem station, the results showed many fluctuations and increased over 10 years observation with the measured salinity from 1.6‰ up to 5.5‰ (Figure 5).

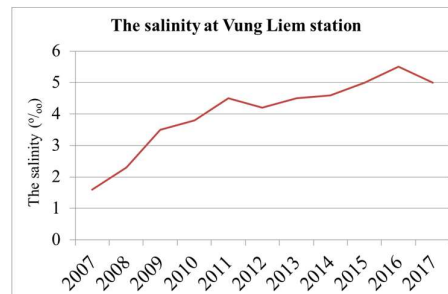


Figure 5: The salinity at Vung Liem station

	Binh Minh	Binh Tan	Long Ho	Mang Thit	Tam Binh	Vinh Long city	Tra On	Vung Liem	Total
The total area of the agriculture land (ha)	5.528,22	10.631,30	10.345,09	8.999,07	18.902,81	1.700,10	16.524,84	17.991,59	90.623,04
The inundated agriculture land area (ha)	2.345,22	2.165,89	3.866,65	2.117,27	3.174,92	685,29	2.815,55	7.326,50	24.497,27
The inundated ratio (%)	42,42	20,37	37,38	23,53	16,80	40,31	17,04	40,72	27,03
The total area of industrial land, house and office building (ha)	2093,86	2.394,20	5.458,56	3.578,4	6.692,32	1.777,39	6.273,85	7.149,96	35.418,54
The inundated area of industrial land, house and office building (ha)	908,39	437,55	1829,79	807,18	1151,63	986,51	954,23	1694,01	8.769,29
The inundated ratio (%)	43,38	18,28	33,52	22,56	17,21	55,50	15,21	23,69	24,76

The salinity distribution maps of Vinh Long province were constructed by using the GIS tool in combination with the MIKE 11 model from the highest salinity data of 2007, 2010, 2013 and 2016 years (Figure 6). As the results indicated that the salinity has changed in overtime and invaded deep into the mainland in Vinh Long province. The highest salinity in Vinh Long up to 8‰ in 2016 on Co Chien river. The trend of salinity in Tien River was higher than Hau River. The salinity 1‰ covered almost all of Vung Liem district and a small part of Mang Thit district. The boundary salty 0.5‰ on Co Chien on Song Hau rivers measured at the boundary of My Phuoc commune, Mang Thit district and Vinh Long - Tra Vinh boundary, respectively.

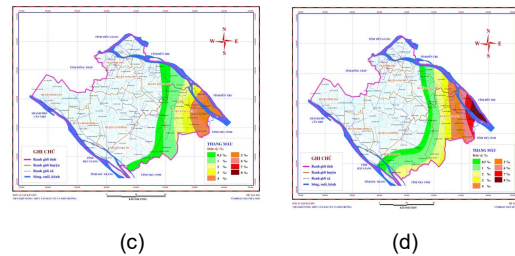
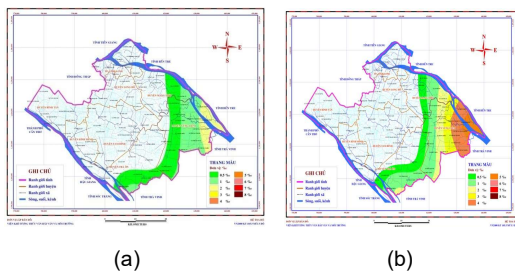


Figure 6: Highest salinity in years at main river branches in Vinh Long Province (a) 2007, (b) 2010, (c) 2013 and (d) 2016



Increased salinity affected the local people's water supply and agricultural production. Salty water intruding into the agricultural areas caused the flowering of crops failed and death of the young plants. As a consequence, the acreage of the arable land was reduced and the yield of the crop was decreased. According to the survey results and statistics showed that in 2016 there were 23,179.63 hectares of rice land affected by saline intrusion, estimated losses of more than 250 billion VND. The results of the interviews showed that the rice crop was mainly damaged in the period of waiting for harvest. In addition, prolonged salinity intrusion also affected the crop calendar of the next crop due to not enough fresh water source to irrigate crop. Causes were determined by the salty water coming soon, the decreased fresh water from the upstream, prolonged hot weather.

4. Conclusions

Main natural disasters in Vinh Long province were floods, droughts, storms, saline intrusion, and river bank erosion. The results showed that over the past 10 years, there were more than 300 cases of river bank erosion (in which the most in 2017 up to 125 cases). Some areas landslide occurred more than 2.7km, erosion into the inland more than 32m in length and up to 12m in depth. There were 98 cyclones and storms occurring at least 4 times a year. Floods occurred during the three months of the year (August - October each year), with the highest flooding level over 1m. Droughts also occurred from January to April every year, resulting in the salinity intrusion entering inland with the highest salinity determined to be over 5.5‰. Statistics showed that the natural disasters caused a great damage, affecting people's livelihood, health, farming land and property.

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