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Current Situations of Climate Change in Ca Mau Province, Mekong Delta, Vietnam

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Abstract: The effects of climate change are having a disproportionately harmful effect on Vietnam, among other countries. Climate change is having the greatest impact on Vietnam's coastal zone due to the country's lengthy coastline and its location in Southeast Asia's tropical monsoon belt. Natural disasters such as hurricanes, floods, droughts, and rising sea levels pose a growing threat to the area. The fishing, farming, tourist, and shipping industries are the ones hit the worst. The livelihood vulnerability of households is evaluated in this research using data from a survey of 200 homes in Ca Mau Province. In order to build livelihoods that can last, five types of capital are crucial, according to the research. In coastal areas, climate change has been increasingly detrimental over the last decade, impacting the lives and livelihoods of residential communities. The climate of Ca Mau province is characterized by high tides, droughts, and heat waves. Climate change is causing many types of livelihood losses for coastal populations, according to the report. Ca Mau province's most susceptible assets are its physical and ecological capital. As a result of climate change, people face additional challenges when trying to get the food they need, such as the effects of drought, floods, and severe rains on coastal households.

Keywords: Climate Change; Capital and Livelihood; Mekong Delta; World Suffering; Coastal Areas; Economic and Social Systems; Resilience and Vulnerabilities; GRDP Ranked 38/63.

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1. Introduction

According to the United Nations Framework Convention on Climate Change, adverse effects of climate change are changes in the physical or biological environment that cause significant adverse effects on the composition, resilience, or fertility of natural and managed ecosystems or the functioning of socio-economic systems or human health and well-being. Climate change significantly impacts the socio-economic development of all countries, and all human development efforts are at risk of being destroyed by it. Climate change has potential impacts on different sectors, regions, and communities. Climate change affects the economy, society, and the environment. Vietnam is one of the countries that suffers the most negative impacts from climate change. With a long coastline and located in the tropical monsoon belt of Southeast Asia, everywhere in Vietnam is seriously affected by climate change, especially in 28 coastal provinces/cities. With the advantage of geographical location and biodiversity of marine ecosystems, Vietnam's coastal areas play an essential role in the socio-economic development of many countries worldwide [3]. Coastal ecosystems exist at the interface between land and marine environments, making them Earth's

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most diverse and dynamic ecosystems. Besides, the coastal area plays an essential role in socio-economic development because of its high concentration of population and economic activities [4].

The main effects of climate change on coastal areas include increases in sea levels, changes in sea surface temperatures, increases in the frequency of extreme weather events, and changes in rain and ocean acidification, which pose severe threats to countries with high concentrations of population and economic activity in coastal areas [5]. The most vulnerable coastal areas to the impacts of climate change are low-lying islands and coastal plains in countries exposed to the effects of storms and rising sea levels.

On July 26, 2022, Deputy Prime Minister Le Van Thanh signed Decision No. 896/QD-TTg approving the "National strategy on climate change up to 2050". In particular, the Government's main viewpoint and goal is to adapt to climate change and reduce the level of vulnerability, losses, and risks to the impacts of climate change through improving resilience and adaptive capacity of natural, economic, and social systems, minimizing damage from natural disasters and climate extremes increased by climate change [7]. The most recent and highest-level legal document is the National Plan to Adapt to Climate Change for 2021 - 2030, with a vision to 2050 issued by the Government of Vietnam. Most recently, on December 21, 2021, the Prime Minister of Vietnam signed Decision No. 2157/QD-TTg on establishing the National Steering Committee to implement Vietnam's commitments to the United Nations Framework Convention on Climate Change (COP26) [14]. Thus, it can be said that Vietnam has gradually changed its perspective and action plan on climate change from resilience, prevention, and response to adaptation. To adapt to climate change, we need to assess its vulnerability in people's lives; from there, we must find solutions to climate change [15].

Therefore, building a sustainable livelihood framework for coastal residents to adapt to climate change in coastal areas is an urgent need today. To build a sustainable livelihood framework for coastal residents, research and assessment of the vulnerabilities and ability to adapt to climate change in this community are extremely important. We need research on marine livelihoods to provide policy recommendations and solutions based on scientific evidence to build a sustainable livelihood framework for coastal residents. This article presents climate change situations in Ca Mau province, Mekong Delta, Vietnam. The context of climate change is a valuable lesson for building a sustainable, practical livelihood framework, adapting to climate change, ensuring harmony of people's interests, and implementing the Vietnamese Party's and Government policies.

According to the IPCC, climate change is "a statistically significant change in the mean value or variability of climate characteristics over a long period, often decades or longer [12]. The article uses the General Statistics Office's data set from 2010 onwards and the author's survey data from many years in Ca Mau province. Ca Mau province has a GRDP ranked 38/63 provinces and cities. HDI of Ca Mau province ranks 23/63 provinces and cities. Ca Mau province is one of 13 provinces in the Mekong Delta severely affected by climate change. Ca Mau province has the Ca Mau Cape World Biosphere Reserve. In Ca Mau province, the survey author focused on Dat Mui commune, Ngoc Hien district, Ca Mau province (Figure 1).

Figure 1: Dat Mui commune, Ngoc Hien, Ca Mau [23]

2. Overview Of Research On Climate Change

Madhuri et al. [13] study in Bihar found that education level, livelihood diversity, and household social network expansion are correlated with the ability to cope with the negative impacts of climate change. Panthi et al. [16] in Nepal pointed out that livelihood strategies and access to food are the most important causes of people's vulnerability to the impact of climate change. Stocker et al. [11], in their analysis of climate change vulnerability to agricultural ecosystems in Ethiopia, showed that living standards, technology, and infrastructure are essential factors in adapting to climate change.

In their study in Ghana, Adu et al. [1] also found that social networks and livelihood strategies are essential indicators of households' vulnerability in adapting to extreme weather. Duc [10] shows that social and natural capital factors are two important indicators that affect people's livelihoods in adapting to unfavourable climate phenomena. Pham [9], in assessing the livelihood vulnerability index of Indigenous ethnic households in Himalayan Nepal, found that financial resources, household health, and livelihood strategies affect productivity. Imhen [8], who combined LVI calculation and geographic information system (GIS) to assess livelihood vulnerability, showed that female-headed households lack livelihoods, and families living along rivers are vulnerable to weather changes such as floods.

Patil et al. [6], in their study on Climate Change Perceptions and Drought Adaptation Strategies of Poor Households in Bangladesh, showed that climate change has an impact by increasing up to 5% of households' capital resources by reducing arable land area, reducing forest area, pushing many people out of their homeland to live elsewhere, and reducing income. From there, Alam et al. measured people's climate change awareness and adaptation strategies based on farming time frames, crop changes, and livelihood diversity. In Vietnam, there is much research on climate change. Many reports have pointed out the correlation between climate change and factors of human life.

Imhen [8], in Vietnam's Special Report on Managing Risks of Natural Disasters and Extreme Phenomena to Promote Adaptation to Climate Change, has presented typical negative climate change situations. Climate events such as storms, floods, flash floods, urban flooding, drought, severe cold, saltwater intrusion, to assess the level of exposure, adaptive capacity, and vulnerability have shown changes in climate change. Climate change has a significant impact on the livelihoods of coastal residents. The study also shows that Vietnam needs to have long-term measures and plans to prevent natural disasters and adapt to climate change, demonstrated through the introduction of timely policies from the central to local levels. Increase knowledge about climate change and highlight the role of people's participation in action plans.

Monirul Alam et al. [2] on adaptation to climate change in farming among people in Da Lat City, Lam Dong province, shows that The climate has changed significantly through increased temperature and rainfall, thereby reducing people's crop productivity, increasing crop diseases, and making crops grow slowly. People must invest in machinery, increase knowledge, and change crop varieties and farming techniques to adapt to this situation.

Dieu [19] used DFID's five capital sources analysis framework for rural Phu Yen Province residents. The authors argued that climate change seriously affects residents' capital resources, especially natural capital, human capital, and livelihood activities such as salt making. However, climate change is not necessarily harmful when hot weather conditions increase the quality of fish sauce demand for seafood, stimulate coastal fishing activities, or increase the number of seafood tourists at the beaches, bringing more income to coastal residents. In general, studies on the context of climate change in Vietnam today are conducted with diverse approaches.

3. Current status of climate change in coastal areas of Vietnam

Vietnam is one of the countries strongly affected by climate change. According to the annual assessment of the countries most affected by extreme weather events in 1997-2016, Vietnam ranked 5th in the 2018 Global Climate Risk Index and 8th in the 2018 Global Climate Risk Index for long-term climate risk [17].

Manifestations of climate change in Vietnam include extreme weather events that are increasing in frequency and intensity. New natural disaster records are still being recorded yearly in our country. In the mass media, phrases such as "record heavy rain," "record heat," and "record floods" have appeared increasingly popular. According to statistics, 2017 is considered a record year for natural disasters in Vietnam, with more than 16 historic storms and floods that went against the law [20]. The current average temperature in the North and North Central of Vietnam is 0.5-1.0°C higher than the average temperature of previous years, according to calculations based on updated data of 30 years or more [18].

Sea level rise, saltwater intrusion, lack of fresh water, and loss of water sources. Vietnam has a 3,260 km long coastline, and rising sea levels have been causing severe impacts on Vietnam. According to IPCC recommendations [21], when sea levels rise

by 100 cm, Vietnam's lost land area will reach 40,000 km2, accounting for 12.1% of the total existing land area, leading to a consequence of 17.1 million people will lose their places to live, accounting for 2 3.1% of the population at the time of reporting.

Rising sea levels will also cause complete damage to the Mekong Delta, one of the most enormous rice granaries in the region and the whole country. Climate change threatens food security for Vietnam and the international community because Vietnam is one of the five largest rice-exporting countries in the world. Four climate change scenarios based on the RCP scale of the Ministry of Natural Resources and Environment [20] were given for Vietnam's coastal strips, including: By 2030, the average sea level rise for the entire coastal strip of Vietnam under the scenarios will not differ much. Specifically, according to the RCP2.6 scenario, it is 13 cm; according to RCP4.5, it is 13 cm; according to RCP6.0, it is 13 cm; and according to RCP8.5, it is 13 cm.

However, by the middle of the 21st century, there will begin to be a difference in the rising sea level trend. By 2050, the average sea level rise for the entire coastal strip of Vietnam, according to the RCP2.6 scenario, is 21 cm; according to RCP4.5, it is 22 cm, according to RCP6. 0 is 22 cm, and according to RCP8.5 is 25 cm. By the end of the 21st century, the difference in sea level rise trends according to the scenarios is noticeable. By 2100, the average sea level rise for the entire coastal strip of Vietnam, according to the RCP2.6 scenario, is 44cm; according to RCP4.5, it is 5.3cm; according to RCP6.0, it is 56cm; according to RCP8.5, it is 73cm.

Generally, along the coast of Vietnam, the sea level gradually increases from North to South. According to the Expected Nationally Determined Contribution of Vietnam [21], if sea level rises by 100 cm, over 10% of the area of the Red River Delta and Quang Ninh province, Over 2.5% of the area is in the Central coastal provinces and over 20% of the city area. Ho Chi Minh is at risk of being flooded. About 39% of the area will be flooded in the Mekong Delta region, negatively affecting nearly 35% of the population and the risk of losing 40.5% of the region's total rice output.

The saltwater intrusion phenomenon in Vietnam's coastal areas is most clearly recorded in the Red River Delta and the Mekong Delta. During the dry season, the Mekong Delta is strongly affected by saltwater intrusion, which is a characteristic of the region. The annual level of intrusion has a relatively apparent regularity. However, in recent years, the water source upstream of the Mekong River to the Mekong Delta has changed its natural laws due to the construction and operation of upstream hydroelectric reservoirs, leading to significant changes in saltwater intrusion, causing great difficulties in water supply for agricultural production.

Extreme weather conditions, storms, floods, droughts, heat waves, and forest fires. According to many years of statistical data from the National Center for Hydrometeorological Forecasting, on average, every year, there are about 5-6 storms and 2-3 tropical depressions affecting our country. The storm season starts in June and ends in November and the first half of December. During the year, most storms are concentrated in August, September, and October.

However, in recent years, the frequency of storms and tropical depressions has changed more and more clearly. For example, there are years when up to 18-19 cyclones and tropical depressions occur in the East Sea, but there are also years where only 4-6 cyclones and tropical depressions occur. The number of storms with wind speeds of level 1 2 or higher has increased slightly from 1990 to 2015 [22]. Changes in water resources (rainfall, river water level) in 2018 also increased significantly compared to the average level 2017. In 2018, they also recorded temperature numbers in Hanoi over the past 46 years, with the highest temperature sometimes reaching 42°C. In the past, storms often occurred in the central coastal region, but in recent years, they have tended to move south.

Flood phenomena are common in Dong Thap, An Giang, Long An, Kien Giang provinces, and the Mekong Delta. The most recent major flood in 2011 killed 24 people, including 21 children, and many crop rice dikes were broken. In the last days of October 2018, the Mekong Delta provinces faced the most significant high tide in the past 40 years. The tide rose unusually high in the downstream area and spread back to the upstream area. The level of risk due to storm surges is increasingly widespread. Dozens of dike breaches flooded many production areas and residential areas in Tien Giang, Vinh Long, Can Tho, Hau Giang, and Soc Trang. Floods combined with high tides have caused damage to tens of thousands of people from the region. Dong Thap watershed to downstream provinces such as Bac Lieu, Soc Trang, Hau Giang, Vinh Long, and Can Tho.

In recent years, climate change has led to erratic weather patterns, causing many areas of Vietnam's forests to burn down and seriously threaten forest vegetation. Therefore, forest fires are becoming a severe problem in Vietnam. Forest fires often occur yearly in our country, especially in the dry season, causing severe consequences to the forest area and the creatures' habitat. According to the Forest Protection Department statistics from 2006 to 2009, the average forest area burned annually is 1,400 hectares/year. The forest fire that is considered historic took place for 20 days and nights in U Minh Thuong forest as Kien Giang, on March 24, 2002, burning 3,000 hectares of primary forest.

4. Livelihood characteristics of coastal residents in Ca Mau Province

Ca Mau province is the Southernmost province of Vietnam, in the Mekong Delta region, with an area of 5,294.87 km^2. Of these, the aquaculture land is over 266,735 hectares, rice cultivation land is 129,204 hectares, and forestry land is 103,723 hectares. Ca Mau province has a coastline of over 254km, accounting for 1/3 of the coastline of the Mekong Delta, equal to 7.8% of the coastline of the country, and has many estuaries connecting to the sea, such as Ganh Hao, Bo De, Ong Doc, Ong Trang, Bay Hap, Khanh Hoi. On the sea are the islands of Hon Khoai, Hon Chuoi, Hon Buong, and Hon Da Bac, which are convenient for ships to anchor, shelter from typhoons, and develop the marine economy.

Aquaculture in Ca Mau province is strongly developed, with a total area of over 266,735 hectares. In particular, mainly traditional extensive farming, improved extensive farming, industrial and semi-industrial farming, with specialized models of shrimp, shrimp-forest, and combined shrimp-rice. The total population of Ca Mau province is 1,194,476 people. Of which, the male population is 604,901 people, accounting for 50.64%; The female population is 589,575 people, accounting for 49.36%. At the survey site in Ca Mau province, the study focused on Dat Mui commune, Ngoc Hien district, Ca Mau province.

Dat Mui commune has an area of 93.34 km^2. The commune's population in 2019 was 12,906 people. The commune has the Cape Ca Mau World Biosphere Reserve, recognized by UNESCO on May 26, 2009, with a total area of 371,506 hectares [23]. The livelihood activities of Ca Mau province residents are the forest-shrimp-crab livelihood, which is a prominent feature. Therefore, the awareness of people here to protect the forest is very high. For them, the forest is the source of their family's livelihood.

5. Current Status Of Household Capital Sources In The Context Of Climate Change

5.1. Human Capital

In the survey, only 11% of women are heads of households. The average number of people per household in the study area is 3.9 people/household. The dependency ratio is 70.03%. Thus, one person of working age will support about 0.7 dependents. Household heads are people of working age in the study area. Household heads at the survey sites are also relatively young, all in the working age group (18-60). The health status of household representatives is also quite good, with only 8.7% of household heads reporting that their health is often sick.

Surveying the health status of family members, up to 6.8% of household heads said that in their family, there is a household member with chronic diseases such as arthritis and cardiovascular disease. However, the rate of households without health insurance is high, accounting for 83.60%. The survey shows that many families in the survey site of Ca Mau province are not interested in health benefits and prevention for themselves and their older family members. Research results also showed that up to 14.3% of households had a member who was sick or had to be hospitalized for treatment. Therefore, the research results show that a part of human capital in households has not been well taken care of, and here is the factor of human health.

The survey of the educational level of the household group also shows that 42% of household heads have secondary school education (grades 6-9), followed by 28.17% of household heads with primary school education (grades 1-5), 26.67% of household heads have high school education (grades 10-12).

The survey of main jobs of household heads shows that 30.83% of household heads work related to aquaculture and fishing; 29.66% of household heads believe that they are working for hiring jobs (lam muon) that do not require high expertise and jobs of a freelance nature; 25.83% of household heads are employed in trading; 7% of household heads work in state agencies, and 6% of household heads work in private, manufacturing enterprises.

5.2. Social Capital

Survey results show that households actively participate in organizations that strengthen family relationships. Most households are concentrated around the level where each household participates in less than three different associations and groups. Local official associations have legalized associations implemented through the state, such as farmers' associations, women's associations, youth unions, veterans' associations, and homeland security. Survey results show that 62.2% of households participate in the women's union. 37.5% of households have members participating in youth groups. The proportion of households participating in the farmer's association is 34.2%. The lowest is the homeland secret, with 1.8%.

However, when asked whether households received regular support from associations, mainly loans for family economics, 5.8% of household heads said they did receive support help, and 7.7% of households received help immediately after natural disasters caused by weather. Non-official associations are associations and groups based on customs, practices, regulations,

and operating principles that are pretty loosely determined through interviewing people, such as religious associations and religious associations, compatriots, business associations, and fishing associations.

However, another significant variable is mutual support between family and neighbours. If this relationship is good and harmonious, it will help the family have more jobs, ensure a livelihood, and overcome difficulties after adverse weather events such as storms and floods. In the households surveyed, 44.8% of households often visit their neighbours when they are sick. 33.3% and 30.7% of households often help each other repair houses or help each other with work. Only 6% of households can lend money to neighbours when needed. Survey results on the social capital of households have shown a social network of households in daily life and the ability to cope with negative phenomena and risks of times partly caused by secretion.

5.3. Natural Capital

In this section, the research team presents some of the most essential measurable variables that describe the natural capital conditions for livelihoods for coastal residents in the context of climate change. Accordingly, the proportion of households using tap water in Ca Mau province for drinking is 13%. For natural water sources (well and rainwater) for family activities, this rate is 70%. Research results also show that 17% of households reported that their water source is contaminated with alum and salinity.

Residents also reported some other factors about the natural environment. The situation of coastal waste is the most alarming, with up to 77.3% of households saying that "everywhere you look, you see trash thrown or thrown indiscriminately." The waste in residential areas is less, at 25.7%. Aquaculture has led to other consequences, such as coastal air pollution of rivers, canals, and creeks. These problems more or less affect the ecosystem and natural capital of coastal residents.

Among the natural capital sources for coastal residents, land ownership and cultivated area in crop farming and aquaculture are the most important in livelihood activities. In Dat Mui commune, the average aquaculture household has an area of 54,108.3m^2. The average household area in Ca Mau province is high because it includes the management of forest land area belonging to the National Park.

5.4. Physical Capital

Housing is considered the most essential facility for households and is also a safe shelter when there are negative weather phenomena, such as storms, tornadoes, and heavy rain. Thus, it can be said that to ensure sustainable livelihoods in the context of climate change, households first need to have a solid place to live in coastal areas "to settle down to have a good life.", according to the policy of the Vietnamese Government, localities, and people need to comply with the motto "four on the spot" and "three readies." In particular, solid houses are necessary on-site materials to respond to natural disasters caused by weather.

At the survey site, motorbikes are the most important means of transportation for almost every household, accounting for 87.7%. Although the research sites are all in the coastal area, even in Ca Mau, with a diverse system of rivers, canals, and ditches, the road infrastructure has developed very well over the years, making it difficult for many households to switch to motorbikes to travel easier and faster. Therefore, the percentage of households with boats and motorboats is only 16.8%. Many other essential devices serve the lives of households, such as television (87%) and smartphones (80.2%).

5.5. Financial Capital

The survey results of the project show that the rate of poor households in the study group is 3%. In Ca Mau province, the average income per capita in Group 1 is 1.4 million/person/ month. The average income per capita in Group 5 is 5.1 million/person/ month, 3.64 times higher than Group 1. Research results also show that households in Group 1 in Ca province It is necessary to make great efforts to achieve the criteria of escaping poverty according to national standards. In particular, the income criterion in rural areas is 1,500,000 VND/person/month (about $61 US dollars), and in urban areas is 2,000,000 VND/person/month (about $81 US dollars). Survey results of households' financial capital in research locations show that 23% of households have borrowed money with interest in the past 12 months. 8.5% of households borrowed money from relatives, and only 1.3% borrowed money from neighbours.

The value of assets converted into money in the study sites shows a very high difference between Groups 1 and 5 and between localities. In Ca Mau province, the difference is 1.41 times. Thus, from surveying the financial capital sources of the project at research sites in Ca Mau province, we can see that household income has increased significantly over the past few years. The lives of many coastal residents have also improved very well. The poverty rate has decreased significantly. The changing factors are primarily due to significant economic decisions in coastal areas made by the Party and Government of Vietnam that have helped people have more stable, high-income jobs. Many coastal communities now have many employment options instead of

simply sticking to the sea like before. To say it differently, the coastal community has a diversity of livelihoods, as identified in the previous sections.

6. Vulnerability of coastal residents' livelihoods to the impacts of climate change

Ca Mau province has high temperatures with an average of 27.7 °C. The annual variation of the average temperature reaches its maximum in April (29.2 °C), then gradually decreases and reaches its minimum in January of the following year (26.3 °C), with an amplitude of temperature fluctuation between These two months reaching 2.9 °C. Considering each period, the temperature in the periods 1988-1998, 1998-2008 and 2008-2018 had an average value of 27.0 respectively; 27.7; 28.5 °C with an increasing trend over time.

Amount of rain: Considering each period, the annual rainfall in 1988-1998, 1998-2008, and 2008-2018 has an average value of 2,440.8, 2,542.7, and 2,187.7mm, respectively. The average number of heavy rainy days per year corresponding to these periods is 9.5, 9.7, and 8.3. Thus, it can be seen that the average annual rainfall and the average number of heavy rainy days per year are closely related to an increasing trend.

Storms and tropical depressions: The trend of storms seems to be decreasing. Therefore, storms and tropical depressions tend to have little change compared to the RCP4.5 scenario and are likely to decrease with the RCP8.5 scenario.

Sea level rise: According to monitoring data on average sea level in the North Pacific region from June 1993 to May 2019, sea level changes have an annual cycle with an increasing trend of 2.8 mm each year. On a narrower scale, specifically in the coastal area of Ca Mau province, the sea level rises by an average of 4.0 mm/year.

Salinization: According to monitoring data at Ca Mau station in 1996-2018, the average salinity in the dry season tends to gradually increase with an average increase of 0.47‰ each year. Salinity intrusion in Ca Mau province usually occurs from around December of the previous year to May of the following year, with a peak in late April and early May with high average salinity concentrations reaching 28.4‰ at Ca Mau station.

Especially in the dry season of 2015-2016, saltwater intrusion and drought caused hefty damage to all aspects of Ca Mau province. A prolonged drought with high temperatures, a record in the past 60 years, has occurred across the country and the province, leading to forest fires and saltwater intrusion deep into the mainland, seriously affecting rice production in the 2016 - 2017 season.

According to the report of the Steering Committee for Natural Disaster Prevention, Control, Search and Rescue of Ca Mau province, the drought has damaged nearly 53,000 hectares of rice, 158,000 hectares of aquaculture, 1,500 hectares of fruit trees and other crops; collapsed, subsided, landslides, damaged 112 km of roads, more than 12,000 households lacked running water; estimated damage is 1,412.44 billion VND (about $57 million US dollars).

Tides: High tides occur every year in Ca Mau province, concentrating at the end of months such as October, November, and December. High tides occur throughout the province, concentrating heavily in coastal districts such as Tran Van Thoi, Phu Tan, Nam Can, and Ngoc Hien. Tides are becoming more and more complicated and unpredictable. Each year's trend is higher than last year's.

The Department of Natural Resources and Environment of Ca Mau province argued that in late November and early December 2017, in Ngoc Hien district, some sections of the Ho Chi Minh arterial road to Dat Mui commune were flooded, causing many road surface problems. The destroyed place made it quite difficult for people to move around.

In early December 2018, in Cai Nuoc district, when high tide occurred, the river water rose, causing some low-lying concrete roads to be flooded. Tan Hung Dong commune had seven canals in 6 hamlets that were frequently flooded. Water caused by rising river water affected more than 300 hectares of aquaculture land, and hundreds of meters of concrete roads in rural areas were submerged in water, with some sections flooded up to more than 20cm.

According to the report of the Steering Committee for Natural Disaster Prevention, Control, Search and Rescue of Ca Mau province, in 2018, 9 high tides occurred in the province, flooding 47,515m of roads and embankments, breaking 75m of embankments and causing one damage.

The recent subsidence situation in Ca Mau province has also greatly affected people's lives. Roads managed by the provincial level collapsed at 11 points with a length of 332m. The western sea dyke line, Da Bac - Kenh Moi section, collapsed with a

total length of 240m. For rural transport routes, there are over 1,136 positions subsidence with a total length of over 24.7 km. For irrigation projects, 94 construction lines have landslides and subsidence, totalling over 22,558m.

Data compiled by the research team also shows that in the past ten years, Ca Mau province had 243 people dead, missing, or injured due to natural disasters; 9,827 houses were damaged or collapsed; More than 303,067.86 hectares of cropland and aquaculture area are seriously affected. The number of natural disasters such as storms, floods, high tides, lightning, thunderstorms, tornadoes, and droughts is up to 304 times. The total material damage in monetary terms over the past ten years caused by weather is 1,706.70 billion VND (about $69.2 million US dollars) (Table 1).

Table 1: Damage caused by natural disasters in Ca Mau province [3]

	2010	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**
Human damage	**13**	**10**	**6**	**3**	**9**	**9**	**41**	**77**	**42**	**33**
Number of dead and missing people	11	8	1	2	7	7	31	62	27	29
Number of injured people	2	2	5	1	2	2	10	15	1	4
Housing damage	203	585	365	896	649	623	625	376	1,387	4,118
Many houses collapsed and were swept away	83		83	273	159	175	163	-	310	282
Houses were flooded, eroded, roofed off, and damaged	120	-	282	623	490	448	462	376	1,077	3,836
Damage to agriculture and fisheries (Ha)	15,831.50	19,654	2,833.80	ten	7,098.30	9,884	212,500	14,350	130	20,777
Damaged rice area	-	-	-	-	-	8778	53,000	-	55.40	20,506.56
Damaged crop area	-	-	-	-	-	170	1,500	11,272.80	-	-
Aquaculture	-	-	-	-	-	936	158,000	3,077	75	270.2
The number of natural disasters: storms, floods, high tides, lightning, thunderstorms, tornadoes, droughts.	12	15	12	19	39	8	6	22	15	156
The total value of damage caused by natural disasters (Billion VND)	6.50	38.97	10.40	13	17.8	24,297	1,437.69	44.31	43.43	70.30

7. Conclusion

Climate change has had a significant impact on Vietnam. The population of Vietnam's coastal areas are facing a number of challenges, difficulties, and advantages in their livelihoods as a result of climate change. The Party and Government of Vietnam have made significant changes to their leadership perspectives on livelihoods and climate change since 1996. They have shifted from a focus on reaction, prevention, and resilience to a focus on climate change adaptation, with the commitment to ensure that no one is left behind. For the past ten years, climate change has had a detrimental impact on coastal provinces, hurting the lives and livelihoods of the people who live there. The weather of Ca Mau province is characterized by high temperatures, droughts, and high tides. The results of the study indicate that people who live on the shore experience different types of losses in their livelihoods as a result of climate change. In the province of Ca Mau, the components that are most susceptible are

physical and natural capital. In the context of climate change, it is also rather difficult for the province of Ca Mau to access food. This is a very accurate representation of the lives of people living along the coast who have been affected by a number of progressively severe storms, cyclones, floods, heavy rains, and droughts that have caused significant harm to coastal families.

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