SUSTAINABLE LIVELIHOODS’ ADAPTATION AGAINST
CLIMATE CHANGE FOR POOR HOUSEHOLDS IN CA MAU,
VIETNAM

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Abstract
The study was conducted to assess livelihood vulnerability and propose sustainable livelihood strategies for poor rural households in Ca Mau due to the impacts of climate change. 150 poor households in Ca Mau were randomly selected to collect data with regard to health, food, knowledge and skills, land, properties, and financial condition etc. All of these components are analyzed through five resources identified in the sustainable livelihoods framework. The level of exposure, sensitivity and adaptability of the indicators of livelihood vulnerability to climate change is calculated on the basis of five resources (human, nature, society, finance and physical capital). The results of the study measured the livelihood vulnerability index in Ca Mau at 0.3528. Accordingly, the study proposes livelihood strategies for poor rural households such as diversifying capital mobilization; strengthening linkages between scientists, farmers and policy makers; enhancing coastal ecosystem management and developing community livelihood.

Key words: household vulnerability, climate change, sustainable livelihood strategies

1. INTRODUCTION

Climate change is affecting the Mekong Delta in far-reaching ways. Impacts related to climate change are noticeable across the region and in many fields such as agriculture, infrastructure and ecosystem and others. In particular, climate change affects Ca Mau province, through more extreme weather events and natural disasters such as storms, cyclones, landslides, flooding, drought, and saline intrusion. Ca Mau is the only province affected by both the tidal regime of the East Sea and the West Sea. Sea level rise is increasing the area of inundated soils, which in turn will increase the area of salt-contaminated soil. Saline intrusion diminishes the province's freshwater agricultural ecology. In addition, extreme heat, sea level rise, and heavy rainstorms are affecting infrastructure like roads, residential areas, urban areas, and industrial zones. For the coastal areas, the landslide along the river can be caused by sea level rise.

On the other hand, climate change is thought to affect the poor and poor families. Many nearly-poor households have been reduced to poverty due to the climate change effects. First of all, the main livelihoods of poor people (farming, aquaculture and fishing) are often linked to natural resources that are vulnerable to climate change. For this reason, the poor farmers will be first affected when these resources are damaged in the context of climate change. Secondly, the abilities of poor households to recover and adapt to
climate change impacts are very low. Because rural communities are highly dependent upon natural resources for their livelihoods and social structures and also have a monotonous livelihood activity, their livelihood diversification is often difficult. In particular, they often have limited resources, including financial resources and the quality of human resources.

By the end of 2016, Ca Mau province has 23,646 poor households, accounting for 7.96% of the total number of households in the province; and 11,388 nearly poor households, accounting for 3.83%. The regions in which the highest percentage of poor households exists are U Minh district with 16.78%; followed by Dam Doi district (12.8%), Tran Van Thoi district (10.03%), and Ngoc Hien district (9.35%) (Ca Mau Department of Labor - Invalids and Social Affairs, 2017).

In recent years, in the context of climate change, there have been a number of studies in Vietnam analyzing vulnerability in the Mekong River Delta, as highlighted by the WWF study - Vietnam (2012); Care (2009); and Oxfam (2008). As for Ca Mau, there was also a study on vulnerability assessment in the context of climate change under the GIZ project in 2014 and assessing the vulnerability of climate change to the livelihoods of the coastal communities by Nguyen Quoc Nghi (2016). However, up to now, no specific study has assessed livelihood vulnerability and propose a sustainable livelihood strategy to adapt and reduce vulnerability to poor households in Ca Mau in the context of climate change. Therefore, this study was done.

2. BACKGROUND AND RESEARCH METHODS

2.1. Background

Vulnerability is becoming increasingly comprehensive, and many studies have combined environmental and risk-based changes with socio-economic dimensions to determine vulnerability and the ability of community, environment and ecosystem in development. Vulnerability is not a static concept; it changes with time and space. Vulnerability to climate change depends on variation of climates and the extent to which a system is exposed, sensitive, and adaptable (IPCC, 2007). The vulnerability is "the degree to which a system is susceptible to, or cannot cope with, the adverse effects of climate change, including extremes of climate change and behavior." Vulnerability is closely related to the nature, extent and rate of climate change that a system
experiences, along with the sensitivity and response capacity of that system (IPCC, 2007). The study mainly focuses on the assessment of vulnerability caused by climate change and the impacts on household economy by means of index method. Statistics are used in economics to standardize numbers and can be easily compared to different sample sizes as well as comparable to a particular standard. The vulnerability index identifies the causes of vulnerability to the system, thereby identifying a causal link between causes and outcomes, ranking and comparing lesions across regions (Fussel, 2009). An index vulnerability assessment approach aims at regulating indicators into a common indicator to compare and explain vulnerability. From the concept of the IPCC (2007), the index method is based on indicators from three components of the vulnerability: exposure levels\(^1\) - an indication of the biophysical effect, sensitivity\(^2\) and adaptive capacity\(^3\) (sensitivity and adaptation capacity) - socioeconomic characteristics.

A system with high exposure levels and sensitivity is not necessarily called a vulnerability because both of these factors are not paying enough attention to the ability of the system to respond to climate change. In most studies on vulnerability to climate change on the household, the vulnerability index was defined as a function of exposure, sensitivity, and adaptability, with the relationship as follows: \(V = f (E, S, AC)\).

Establishing vulnerability can be done in the following steps: Identifying the factors that make up the vulnerability, then identifying specific indicators. These indicators are selected based on the ability to collect data, personal findings or previous studies. Indicators are calculated so that the higher the value of the indicator is, the higher the level of vulnerability is.

Furthermore, the study uses a sustainable livelihoods framework developed by the Department for International Development – the United Kingdom (DFID) in 1999 to

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\(^1\) Is climate change characterized by its characteristics, magnitudes, and proportions. For example, changes in temperature, heavy rain, and droughts (GIZ) could have a negative impact on people, livelihoods, infrastructure, economy, society, and property (IPCC, 2012).

\(^2\) Is the response of systems or consequences to climate change (Thomas Fellmann). According to the IPCC (2007), the extent to which a system is affected may be good or bad due to climate change. It can be directly (change in yield due to temperature change) or indirect (damage caused by coastal floods due to sea level rise).

\(^3\) The ability to adjust / change the rules, processes or structures of the system in response to climate change (Watson et al., 1996). The IPCC (2007) defines adaptive capacity as “the ability of a system to successfully adjust to climate change to reduce future losses, to take advantage of opportunities and (or) solving problems”.

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assess livelihood vulnerability in the context of climate change in Ca Mau, by analyzing the status of five resources of "livelihood": Finance, people, society, material and nature, in a vulnerable context (trends, seasons, climate change ...). A livelihood is considered sustainability when it promotes human potentials as well as the ability to overcome pressures or unexpected changes. There is a strong link between livelihood and vulnerability. Accordingly, vulnerability to livelihoods is characterized by a "no guarantee" for household living in the face of the changing external environment. Livelihoods of rural people depend on their livelihood assets, which are factors that reduce poverty through a social and institutional policies. As such, this approach is very close to the concept of multi-dimensional poverty under Decision 59/2015 / QD-TTg on multidimensional approach poverty for the period 2016-2020 in Vietnam to reflect accessibility to basic living facilities that a household needs to survive.

Based on the concept of vulnerability of IPCC (2007) and the theory of sustainable livelihoods of DFID (1999), the author develops a system of indicators assessing livelihoods caused by climate change in Ca Mau including indicators of human capital; natural capital; social capital; financial capital and property funds. Details of vulnerability indicators developed by the authors are concretized when calculating indicators for poor households in Ca Mau.

To calculate the indicator of livelihood vulnerability, the study simulates the research carried by Hahn et al. 2009; there are also changes in the major factors and sub-factors of LVI to match the condition, object and objectives of the study. The formulas are as follows:

Since the indicators are expressed in different units, the indicators will be normalized according to the following formula:

\[
\text{Index}_{sw} = \frac{x_{sw} - x_{\text{min}}}{x_{\text{max}} - x_{\text{min}}}
\]

Where:

- \( x_{sw} \): The root index represents the province \( w \)
- \( x_{\text{min}} \) and \( x_{\text{max}} \): respectively the minimum and maximum values for sub-components / metrics
After standardization, each sub-component / metric is calculated as the mean value for each of the main components as follows:

\[ H_w = \frac{\sum_{i=1}^{n} index_{swi}}{n} \]

Where:

- \( H_w \): is one of the main components of the province
- \( index_{swi} \): represents the subcomponent
- \( n \): total number of sub-components in a main component

After calculating the major components, the next step is a weighted average of the factors (human capital, natural capital, financial capital ...). The number of dependent components has been taken as the weights to calculate the indices for the main components. The formula is as follows:

\[ VI (H) = \frac{w_1H_1 + w_2H_2 + \ldots + w_nH_n}{w_1 + w_2 + \ldots + w_n} \]

Where:

- \( VI (H) \): A weighted average of human capital
- \( w_i; \ w_{ni}; \ w_n \): number of dependent components of each major component

When the values of each major component (human capital, natural capital, social capital, financial capital, and asset capital) are calculated, it will be weighted averages Funds to obtain household livelihood damage index (LVI), according to the formula:

\[ LVI = \frac{w_1V_L + w_2V_N + w_3V_S + w_4V_F + w_5V_P}{w_1 + w_2 + w_3 + w_4 + w_5} \]

\( w_1, w_2, w_3, w_4, w_5 \) are the number of components of human, natural, social, financial and property funds (H, N, S, F, P).

Livelihoods index (LVI) ranged from 0 to 0.6, with the least vulnerable to the most.

2.2. Models and Research Methodology

Therefore, the DFID analysis framework is consistent with the objective of the study on sustainable livelihood approach for the poor in Ca Mau in the context of climate change. The proposed analysis framework is as follows:
The research applies both qualitative and quantitative methods including observation, group discussions, policy interviews and interviews with poor households. Two districts, Dam Doi and Ngoc Hien, were selected for the survey. Each sample was selected based on the following two criteria: (i) households living in the most vulnerable areas due to climate change; and (ii) the poorest households. In these two districts, households, especially coastal households, are inundated and eroded by waves and high tide, while the livelihoods of the poor households are small fishing and hired labor. In particular, Ngoc Hien district is separated as an island since it is bordered by the sea in the East, West, and South directions, while the North one is adjacent to Cua Lon and Bo De rivers. As a result, the district is affected by floods, saline intrusion and typhoons which make the district a vulnerable area. In Dam Doi district, there are many sources of income, but with large population, the land fund for production is reduced; thus, the vulnerability of the district is greatly increasing.

3. RESULTS
3.1. The results of assessing livelihood vulnerability index of poor households in Ca Mau

The indicators system provided in the section 2.1 that are applied in this research to the poor household survey in Doi Ngoc and Ngoc Hien districts are to assess the livelihood vulnerability of poor households due to climate change. The detailed descriptions of the evaluation results are presented in the following table:

<table>
<thead>
<tr>
<th>Capitals</th>
<th>Main</th>
<th>Sub-components</th>
<th>Unit</th>
<th>Observation</th>
<th>Max</th>
<th>Min</th>
<th>Vulnerab</th>
</tr>
</thead>
</table>

Figure 1: The author’s proposed framework based on DFID (1998)
<table>
<thead>
<tr>
<th>components</th>
<th>value</th>
<th>vulnerability index</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Households characteristics</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dependents</td>
<td>53.2</td>
<td>0.5320</td>
</tr>
<tr>
<td>Female head of the households</td>
<td>13.4</td>
<td>0.1340</td>
</tr>
<tr>
<td>Vulnerability index on households’ characteristics</td>
<td>0.3330</td>
<td></td>
</tr>
<tr>
<td>Health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Family members with chronic diseases</td>
<td>2.13</td>
<td>0.0213</td>
</tr>
<tr>
<td>Households in need of healthcare/ medical support</td>
<td>1.58</td>
<td>0.0158</td>
</tr>
<tr>
<td>Days in hospitals for treatment</td>
<td>Days/ Years 4.0 360</td>
<td>0.0110</td>
</tr>
<tr>
<td>Health vulnerability index</td>
<td>0.0160</td>
<td></td>
</tr>
<tr>
<td>Food</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Food shortage</td>
<td>8.0</td>
<td>0.08</td>
</tr>
<tr>
<td>Households without crop diversification</td>
<td>34.3</td>
<td>0.343</td>
</tr>
<tr>
<td>Food vulnerability index</td>
<td>0.2115</td>
<td></td>
</tr>
<tr>
<td>Vulnerable livelihoods’ strategies</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Households without livelihood diversifications</td>
<td>45.8</td>
<td>0.458</td>
</tr>
<tr>
<td>Households earning a living out of farming</td>
<td>67.2</td>
<td>0.672</td>
</tr>
<tr>
<td>Households with stable incomes</td>
<td>73.4</td>
<td>0.734</td>
</tr>
<tr>
<td>Households with members working in non-agricultural sections</td>
<td>32.8</td>
<td>0.328</td>
</tr>
<tr>
<td>Unemployment months</td>
<td>Month s 3 12</td>
<td>0.250</td>
</tr>
<tr>
<td>Vulnerable livelihoods’ strategy index</td>
<td>0.4884</td>
<td></td>
</tr>
<tr>
<td>Knowledge and skills</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heads of households with primary education</td>
<td>58.6</td>
<td>0.586</td>
</tr>
<tr>
<td>Households not participating workshops on adaptation to climate change</td>
<td>87.2</td>
<td>0.872</td>
</tr>
<tr>
<td>Households with all members participating in the training workshops</td>
<td>92.1</td>
<td>0.921</td>
</tr>
<tr>
<td>Vulnerability index on knowledge and skills</td>
<td>0.793</td>
<td></td>
</tr>
<tr>
<td>Weighted average of human capital (H): Vulnerability about H</td>
<td>0.3972</td>
<td></td>
</tr>
<tr>
<td>Natural Land</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Households without agricultural land</td>
<td>24.2</td>
<td>0.342</td>
</tr>
<tr>
<td>Households with a piece of agricultural land</td>
<td>25.1</td>
<td>0.251</td>
</tr>
<tr>
<td>Households with uncultivated land due to climate change</td>
<td>38.2</td>
<td>0.382</td>
</tr>
<tr>
<td>Households losing land due to climate change</td>
<td>4.12</td>
<td>0.0412</td>
</tr>
<tr>
<td>Vulnerability index on land</td>
<td>0.254</td>
<td></td>
</tr>
</tbody>
</table>
Households in shortage of clean water | % | 62.1 | 100 | 0 | 0.621  
Households with a lack of fresh water | % | 9.12 | 100 | 0 | 0.0912  
Vulnerability index on water sources | 0.356  
Forests and other natural resources  
Households dependent on forest resources | % | 25.2 | 100 | 0 | 0.252  
Households assuming forest resources are becoming scarce. | % | 87.6 | 100 | 0 | 0.876  
Households assuming other natural resources are becoming drained. | % | 78.3 | 100 | 0 | 0.783  
Vulnerability index on forest resources | 0.637  
Climate change  
Average times of flooding in the past 5 years | Quantities | 04 | 10 | 0 | 0.400  
Households with soil erosion | % | 14.2 | 100 | 0 | 0.142  
Households assuming changes of annual rainfall and saltwater intrusion are affecting their lives. | % | 58.3 | 100 | 0 | 0.583  
Households not being notified of impacts of climate change to their livelihoods. | % | 41.6 | 100 | 0 | 0.416  
Vulnerability index on climate change | 0.385  
Vulnerability index on natural capital (N): Vulnerability on N | 0.398  
Social  
Social networks  
Households not being supported | % | 17.4 | 100 | 0 | 0.174  
Households with members having no social interactions | % | 6.73 | 100 | 0 | 0.0673  
Households not coming to the local government for any assistance in a year | % | 7.17 | 100 | 0 | 0.0717  
Vulnerability index on social capital (S): Vulnerability on S | 0.104  
Financial  
Income and finance  
Households with credit loans | % | 59.9 | 100 | 0 | 0.599  
Households subsidized with finance | % | 17.3 | 100 | 0 | 0.173  
Households not being able to access to financial services | % | 38.1 | 100 | 0 | 0.381  
Households with no income generated from agricultural, fishery and forestry activities due to climate change | % | 7.12 | 100 | 0 | 0.0712  
Vulnerability index on financial capital (F): Vulnerability on F | 0.304  
Properties  
Production facilities  
Households with temporary housing | % | 23.1 | 100 | 0 | 0.231  
Households with housing | % | 13.2 | 100 | 0 | 0.132
The results of the study show that the livelihood vulnerability index of poor households in Ca Mau is 0.3528, which indicates the average vulnerability of livelihoods. The value of the main components ranges from 0.1 to 0.4. In particular, natural capital and human capital are the most vulnerable.

Major components of human capital such as knowledge, skills and livelihood strategies have the highest vulnerability index, 0.793 and 0.488, respectively. This is because the majority of poor households are dependent on risky resources, so they do not have a fixed source of income. In addition, the percentage of households with a low level of education is very high, with a very high proportion of poor households not participating in training workshops for adapting to climate change.

Major components of natural capital have very high vulnerability indexes such as forests and other resources (0.637) and climate change (0.385). Land and forest resources are important natural resources for smallholder farmers. However, for poor households, the land for agricultural productions is very small. Many households do not have land for their livelihood, while forest resources are increasingly scarce. Many poor households in Dat Mui commune, Ngoc Hien district have no access to forest resources, leading to reduced incomes and increasing vulnerabilities. Moreover, in recent years, sea level rise has caused difficulties in catching aquatic products, damage to property and livestock. In some coastal areas, because of the risk of being exposed to flooding, salinity intrusion, the impact of storms, large-scale rain, erosion, and tornadoes, the level of vulnerability will be greater in the future.

Financial capital is also worth considering with a 0.304 vulnerability index, especially in the context of the current economy. Because of their inability to accumulate, and with limited access to credit capitals, poor households often lack the funds to secure the livelihood strategies they pursue. Moreover, the rate of poor households prioritizing the use of loans to solve immediate difficulties as well as for the minimum needs is very
high; therefore, there will definitely be little to no investment spent on production, which leads to the lower production efficiency.

In addition to the above-mentioned funds, the results of the livelihood vulnerability assessment in Table 1 also show that social capital and property capital have lower vulnerability indexes. This may be due to the fact that households have more connections with the community to gain access to care, sharing and learning experiences. A large number of poor households have participated in local associations such as the Farmers' Association and the Women's Union, accounting for 45.3% of the surveyed households. At the same time, local authorities have also paid attention to the living conditions of poor households. The electricity, water supply and transport systems have made significant positive changes in livelihood improvement and sustainable poverty reduction.

3.2. Recommendations for sustainable livelihoods solutions to adapt and mitigate the impacts of climate change on poor households in Ca Mau

For Human capital

Among the sub-components of the Human capitals, the index on knowledge and skills have made an integral contribution toward the more increasing vulnerability for the poor. In fact, although there have been hundreds of workshops about adaptation to climate change organized for years by the cooperation among scientists and government, still great number of households have refused to get the benefit (up to 87.2%) because of two main reasons. The first is the effects of climate change have gradually come with little physical evidence year by year so farmers thought that their attendance would be a waste of time. The second is the farmers’ presence in those workshops were not compulsory for all of them. As a result, with lack of the perception of fact and the suitable resilience method against the negative changes in climate, they keep destroying mangrove forest which is also the protection from sea intrusion for farming purposes. Therefore awareness, education and propagandas on climate change should be broadened in more effective ways such that those who do attend the workshop will be given the most priority from bank’s loan and other governmental financial supports. Aside from inactively being trained in workshop, farmers’ mindset about climate change must be refreshed through local radio publicizing climate change issues.
Improving the quality of human capital through promoting vocational training for the poor in the dynamic direction. Successful stories right in their own area are to be shared to attract other farmers’ attention as output is increased with less effort than the old means when following the new technique. In order to the training more advantageous and interesting to farmers. Besides the temporary solutions, there must be long-lasting plans for educating the local people. They are integrating climate change into school as an official course even in kindergarten and primary school\(^4\), also educational practices should be combined in study programs and syllabus; encouraging the development of networks and cooperation on climate change education. Investment in education is the most central issue that the province must focus on. As a matter of fact, a large number of people in Cau Mau are living with stable income (73.4\%) but they still fall into vulnerability of livelihoods’ zone. This fact proves that stable income dose not make much sense because of their inherent habits of living of not taking care the sustainable future. Gradually changing their attitudes must be done from now on through education at the young ages.

*For Financial capital*

Establishing a diversified fund managed by a board of delegates from local government and farmers’ Union. The fund must be mobilized from various capital sources, including state budget funds, capitals from organizations and individuals for investment purposes on farmers. The operating mechanism of the fund has their own mission, plans for short-term climate change’s resilience, and strategies for long-term climate change’s adaptation. Farmers who seriously take part in climate change programs will be assessed as high commitment to be received favorable endowments from the fund. Credit loans provided by the fund should be operated in a flexible way with regard to loan amounts, formalities, procedures and duration. Besides, there must be periodic supervisions to ensure whether the money is effectively used in the right way in order for the decision of keeping granting them. Specifically, part of the fund will definitely be invested in the purchases of needed production materials\(^5\) during the program while the the rest is used only to support the farming such as fertilizers, seedlings and other related expenses rather than to the daily living activities. What is more, there should be

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\(^4\) Up to 58.6\% of households surveyed did get primary education as their highest achievements

\(^5\) Amount to 52.7\% of households having no production facilities
included specific instructions for effective planting stages, this is a kind of business plan instead of giving away the money and leaving the farmers with no where to go with a lump sum endowment. It is essential to create favorable conditions for poor households to access other preferential credit programs such as pupils and students, housing for poor households and clean water in order to create conditions for poor households to settle difficulties in the lack of education, clean water, and environmental sanitation.

For Physical capital

Poor households with less farming land, equipment and tools need to be consulted and supported to apply land saving models, progress efficiency of using land by producing modern production methods. It is also important for the poor to produce more products and improve production value to increase income and have a chance to escape poverty sustainably. For those poor households without farming land, it is recommended to get employment counseling and change to appropriate occupations to generate income. For poor coastal households specializing in small, near-shore fishing, and the province should provide support to these households for loans to invest in buying fishing gear to improve fishing efficiency. Additionally, the province needs to build the necessary infrastructure to facilitate travel for people in the area, including poor people, which will contribute to the development of local economy.

The issue of mitigation of climate change is not really received much attention from various stakeholders due to the financial constraints (investment cost for technology and related risks). The new market of green technology and the lack of infrastructure have not met the requirements, and accordingly, local people have difficulties in accessing clean energy sources. Information system about the potential mitigation is not complete and accurate; therefore, the province needs to increase investment in infrastructure as well as green technology.

For Natural capital

Reinforcing the management of community-based mangrove forest resource: The mangrove forest ecosystem is a very important resource and a source of benefits for the poor whose livelihoods are dependent on nature. The planting and protection of mangroves in Ca Mau Province needs special attention. Mangrove management requires active involvement of local communities through the efficient operation of farmers and
Mangroves Management Board elected by local people. Land use planning activities also require active involvement of the community in all areas, together with local authorities and stakeholders. Spreading the model of shrimp farming under the mangrove to as many farmers as possible. Farmers who do not own cultivated land and production facilities assessed to be highly vulnerable. Consequently, in order to ensure the demand for living, farmers have no way to destroy mangrove forest ecology by fishing near the shore. The problem can be solved by a program designed for the transition to other livelihoods that no longer heavily depend on natural capital. The program can be effectively carried out in the connection with government poverty reduction programs.

For Social capital

Building and developing models of economics adapting to climate change such as:

Marine ecosystem co-management model: Creating mechanisms and methods to promote people, authorities and stakeholders to exploit and benefit from the marine ecosystems, as well as to protect and develop those sources of great benefits in a sustainable way.

Sustainable community-based fishing and aquaculture model: Supporting fishermen to exploit or cultivate aquatic products in an eco-friendly manner with the ability to adapt to climate change and with planning that do no harm to sea ecology and marine resources.

Coastal ecotourism is a way to diversify livelihoods, to increase incomes for coastal people and reduce the pressure on direct exploitation of marine ecological resources through ecotourism development at the local areas, in which the local people provide and manage the services.

Establishing the connections between the state government, enterprises and poor farmers: The province and districts should build appropriate infrastructure to create favorable conditions for farmers to produce commodities with comparative advantages; The State and enterprises should not only determine the market for each key product of the local but also build a "High-tech Agricultural Production Complex" that is capable of creating branded products; Agricultural insurance is a very meaningful program for
poor farmers in agriculture and is of great significance in adaptation to climate change in Ca Mau; for the poor households, it is necessary to strengthen the environmental protection, and at the same time, there should be forms of support and incentive forms of agricultural insurance in the context of climate change so that poor households are assured of producing and developing their livelihoods.

Integrate disaster risk reduction and climate change adaptation into the socio-economic development plan of the district and province through: Situation analysis, finding solutions and identifying priorities related to climate change and adapting to climate change for socio-economic development; and consulting and getting feedbacks from the people, which ensures the broad participation, contribution and support of the people and relevant departments.

4. **CONCLUSION**

Climate change has been affecting almost all areas, constraining local, regional or national socio-economic development as well as hindering human development. Vulnerability assessments of different regions or sectors for the impacts of climate change are the basis for policy makers to have appropriate adaptation measures in each of these areas as well as for the community to have adaptive measures for themselves.

Vulnerability assessment by means of index is an effective method to translate qualitative elements into quantitative elements. This paper presents a quantitative method of vulnerability assessment using the vulnerability index method. Research results show that climate change has caused damage to poor households in Ca Mau. This has provided further evidence for examining the vulnerability caused by climate change of poor households in Ca Mau. The vulnerability index of poor households in Ca Mau is 0.3528, indicating that the vulnerability of the poor households is not too high, only average. However, the vulnerability index of human capital and natural capital is relatively high, with most of the major components such as livelihood strategies, knowledge and skills of poor households, forest and other natural resources.

In order to ensure sustainable livelihoods for poor Ca Mau households, there should be close coordination among local authorities, supportive organizations and poor households themselves. Comprehensive solutions from resource extraction, resource efficiency and other sources of livelihoods should be implemented in a step-by-step
manner to improve the quality of human capital as well as diversify livelihoods to reduce sustainable poverty.

REFERENCES


