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Community-based climate change adaptation and disaster risk mitigation in the Mekong Delta by the transdisciplinary approach

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ABSTRACT

The article is based on data from the research program "Greater Mekong Sub-region Flood and Drought Risk Management and Mitigation Project (ADB-GMSI)" jointly implemented by the Asian Development Bank (ADB) and the Ministry of Agriculture and Rural Development, and the Vietnam Institute of Water Resources Research in Tien Giang and Dong Thap province. The results show that, in recent years, due to the increasingly severe global climate change, the intensity of various types of natural disasters occurs more frequently, irregularly and with greater intensity. This has greatly affected the production, daily life and properties of the people in the vulnerable areas. To reduce the impact of various types of disasters on people living in vulnerable areas, it is necessary to combine two types of solutions in disaster prevention, namely construction solutions and non-construction solutions. In which, non-construction solutions play a very important role, namely, people living in communities are considered as the main actors in preventing and mitigating disaster risks occurring in the community.

Keywords: *climate change, disaster risk, drought, flood, saltwater intrusion and river bank erosion*

1. Introduction

Climate change is one of the great challenges of mankind in the 21st century. It is directly affecting socio-economic and environmental life globally. In recent decades,

climate change has caused dangerous natural disasters such as sea level rise, tsunamis, droughts, storms, floods and extreme weather that have caused great economic losses and human life in many places in the world. Recent studies have shown that the cause of climate change is human activities that affect the climate system and cause the climate to change. Therefore, people need to take practical actions to prevent such changes with appropriate human activities. Therefore, people of many countries around the world have put “fighting climate change and reducing disaster risks” as the top urgent issue in the world today (Matter Taylor, 2020).

Vietnam is considered as one of the countries seriously affected by climate change, in which the Mekong Delta is one of the three most vulnerable deltas due to sea level rise. In recent years, the climate of the Mekong Delta has been changing in a bad way, with irregular rainfall, high tides that make salt water penetrate more and more groundwater and erosion, salinization, etc. Vulnerable communities include: farmers and fishermen who have little choice (To Quang Toan, 2016). It can be seen that the impacts of climate change and climate change scenarios in the Mekong Delta are clear and we need to have appropriate response measures for this area.

Recognizing the impacts of climate change, in recent years, the Government has implemented the National Target Program to cope with climate change and community-based disaster risk reduction management. In which, people actively and participate in the identifying and analyzing the disaster risks, planning, implementing, monitoring and evaluating activities to reduce vulnerability and strengthen the community's ability to cope with and adapt to the impacts of natural disasters. In this article, we will analyze and evaluate climate change adaptation and community-based disaster risk management in the Mekong Delta in a cross-sectoral approach. Based on collected information and data sources from Community-Based Disaster Risk Management (CBDRM) activities under the Project " Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project (ADB-GMS1)" is funded by the Asian Development Bank (ADB), the project is owned by the Ministry of Agriculture and Rural Development and implemented by the Vietnam Academy for Water research implementation together. The project is implemented in 50 communes of 19 districts in two provinces of Tien Giang and Dong Thap, however, this article only uses data sources in Tien Giang province with three districts including: Cai Be, Cai Lay, and Go Cong for analysis.

2. Research methods

2.1. Approach methods

The term transdisciplinarity appeared in 1970, the Swiss psychologist - Jean Piaget was the first to introduce the term transdisciplinarity (López-Huertas, 2013; Nicolescu, 2010; Padurean & Cheveresan, 2010), According to him, transdisciplinarity is the most complex and abstract synthesis, surpassing multi-disciplinarity, pluri-disciplinarity, cross-

disciplinarity, and interdisciplinarity, moreover, it is “an all-disciplinary and interdisciplinary combination in a training/innovation system on the basis of a generalization theorem (going down from the objective level) and an emerging epistemological paradigm” (Jantsch, 1972a.). “Transdisciplinary research can be characterized by a common orientation that transcends discipline boundaries and by an effort to provide continuity of research and knowledge... with an emphasis on inclusiveness, context, and frameworks of reference. projection of research and knowledge; penetrating the boundaries of concepts and disciplines; expand the boundaries of disciplines to promote understanding of implicit assumptions...” (Mahan, 1970). So, “Transdisciplinary research is an integrated process in which scientists and people with practice skill from both the sciences and nonacademic fields work together to build and use new conceptual and methodological approaches to synthesize and extend specific perspectives, theories and methods, and transform strategies to have innovative solutions for scientific issues and specific social problems” (Vu Manh Loi, 2017).

In this study, we will analyze climate change adaptation and community-based disaster risk mitigation in the Mekong Delta in a cross-sectoral approach. Under this approach, scientists, policy makers and communities living in vulnerable areas will identify the potential for exposure, the level of risk, and the community's capacity to respond. minimize damage to people's lives as well as property. Because transdisciplinary research helps to involve research subjects in research on an equal footing with the scientist or the community being involved in project activities as an equal member. Before analyzing the transdisciplinary approach, we will briefly present the advantages and disadvantages of the scientific approaches that scientists often use in their research, including: (1) *Specialized research, basic research*; (2) *Multidisciplinary research*; (3) *Interdisciplinary research*; (4) *Transdisciplinary research*. Specifically:

– *Basic research has been existed for a long time. Recently, specialized research was mainly done with little or no reference/participation from other disciplines.*

– *Multidisciplinary research approaches a problem from the perspectives of multiple disciplines, but each discipline operates in a self-isolated way with little cross-disciplinary integration, or synergies in research results.*

– *Interdisciplinary research refers to a coordinated and integrated form of coordination among researchers from different disciplines. (Vu Manh Loi, 2017).*

We find that, when approaching in the direction of multidisciplinary research and community interdisciplinary research, community representatives in the activity of “Vulnerability, Capability Assessment (VCA)”. Both these approaches show that the role and power of researchers (Academy) and participants (Nonacademy) are not equal in the research process. Scientists carry out their research from the stage of posing research problems, collecting information, processing data, analyzing data and writing scientific reports. The participants or stakeholders (Nonacademy) only participate in

providing information according to the issues that the researcher has prepared and they have little opportunity to present other related issues happening in the community.

Therefore, stakeholders (Nonacademy) can participate more deeply in the research, especially from the stage of problem-posing research, building research tools, collecting information, and using research results. This will help connect scientific research with reality and view research results as a tool to verify and understand the complexity of the research problem through indigenous knowledge. To do that, a more appropriate approach is needed, which is a transdisciplinary research approach.

Why we have applied a transdisciplinary approach to climate change adaptation research and community-based disaster risk mitigation management in the Mekong Delta? In this project, in addition to cooperate different scientific disciplines (Academy), we also cooperate with stakeholders or non-scientists (Nonacademy), includes: the technical sciences (irrigation, agriculture and agricultural planning researchers) and the social sciences (Sociology, Ethnology and Community Development) along with other managers and residents in research communities. In the project team, scientists and stakeholders participate in the project as equals, as partners from start to finish. Specifically, scientists, managers, and people participate from the stage of problem-posing, building tools for data collection and data analysis, writing reports and completing reports from comments of people in communities.

Firstly, at the stage of problem-posing research, the research team and the people raised the status of climate change and the types of natural disasters that often occur in the community as well as its effects on life, production and people's activities in the past 5 years.

Secondly, researchers and stakeholders create a file to collect accurate information related to climate change and natural disasters occurring in communities such as: causes of different types of natural disasters in the community, the seasonal schedule in each ward/commune community in the years; the impacts caused by natural disasters in the community in the past 5 years such as: agricultural production, animal husbandry, fisheries, facilities, people's lives and health, disaster map, vulnerable groups.

Thirdly, providing plans to cope with and mitigate risks caused by natural disasters in the community, in which construction and non-construction measures must be combined in parallel in the community.

Finally, writing reports and developing disaster risk prevention plans in ward/commune communities year by year to have a more effective response to climate change.

2.2. Methods of information collection

In this project, we carry out the implementation in three different phases, a period of 12 months with the following main contents:

Phase I: Identifying research areas and collecting basic information in the communities such as: (1) Socio-economic information (population, land use situation, education,

main economy activities, income level, infrastructure, transportation system, means of communication, etc.) (2) Livelihood activities; (3) Characteristics about geographical location and hazards in each locality; (4) Information on vulnerable households and groups (number of poor households, female-headed households, lonely elderly households, children, disable people, etc.); and (5) Information obtained from government agencies, schools, research centers and secondary data in reports, maps, etc.

Phase II: Developing research issues and collecting information related to climate change and disaster risks in each community. At this stage, we use a qualitative method of collecting information including: in-depth interviews and group discussions with leaders at the provincial, district, commune and people's levels for the people to conduct disaster assessment, vulnerable state of the community, capacity and awareness of the people about disaster risks, provide response solutions to mitigate the damage caused by natural disasters.

Phase III: Analyzing data, reporting disaster and each community's resilience and disaster mitigation management capacity. After the report is sent back to the communities, the scientists work with the people in each community to discuss the issue and jointly develop a community-based disaster risk mitigation and prevention plan. This plan is considered as a guide on how to prevent disaster risk when a disaster occurs according to the characteristics of each community.

3. Results and discussion

3.1. Reality of natural disasters in the Mekong Delta

Research on climate change and natural disasters in Vietnam has been conducted since the 90s of the last century. It shows that, in addition to objective factors from nature, the main cause is from people (Nguyen Duc Ngu, 1991; Nguyen Trong Hieu, 1993). However, this issue has only really been paid attention after 2000, especially from 2008 up to now. Research works have also gradually deepened into the physical nature and evidence of climate change. The results of these studies show that Vietnam's climate has shown clear signs of change.

Over the past 50 years, the average annual temperature has increased by about 0.5°C nationwide and the rainfall tends to decrease in the North and increase in the South (Ngo Van Tan, 2013; Ministry of Natural Resources and Environment, 2009, 2013). These are the causes of natural disasters such as storms, floods, saltwater intrusion, riverbank erosion, which greatly affect production, houses, land and people's lives, especially vulnerable communities.

Our research results show that people in the Mekong Delta are quite aware of climate change and disaster risks in the communities where they live. This is shown in the group discussions in all 21 wards/communes of Cai Be, Cai Lay and Go Cong in Tien Giang

province, where people clearly identify the extent of different types of disasters occurring in their locality in the last 5 years (Table 1).

TABLE 1. Showing the level of impact of different types of natural disasters in the last 5 years.

| Natural disasters | Cai Be district | Cai Lay district | Go Cong town |
|--|-----------------|------------------|--------------|
| Flood | *** | ** | |
| Storm | | * | ** |
| Drought | ** | ** | *** |
| Saltwater intrusion | | ** | *** |
| River erosion | ** | ** | ** |
| Other natural disasters (tornado, thunder) | * | * | ** |

** Shows the impact rate of each type of disaster on the research community.*

*Source: Synthesized data of natural disaster in communities of 3 districts/towns in Tien Giang. Greater Mekong Subregion Flood and Drought Risk Management and Mitigation Project (ADB-GMS1) is implemented by the Asian Development Bank (ADB) and the Ministry of Agriculture and Rural Development, the Vietnam Institute of Irrigation Science * Shows the slight impact of each type of disaster on the research community.*

*** Shows the severe impact of each type of disaster to the research community.*

**** Shows the extremely severe impact of each type of disaster on the research community*

Due to the different geographical locations, the areas affected by different types of natural disasters. Go Cong town is an area bordering the sea that is often massively affected by natural disasters such as: drought, saltwater intrusion, storms and river bank erosion. Especially, saltwater intrusion and drought are two types of natural disasters are supposed to seriously affect to production and daily life of people in this area. Because the area is an island district, at times of drought and water intrusion, people do not have fresh water for drinking, living and production. In contrast, Cai Be district is an upstream area bordering Dong Thap province, which is often affected by floods and river bank erosion. For the area in the middle area like Cai Lay district, although it is affected by many types of natural disasters, it is at a moderate level, and there are no serious natural disasters.

In addition, the types of natural disasters occurring in the surveyed areas showed that in recent years the frequency and extent of impacts have been more frequent and tend to last longer. This was shown clearly in the late of 2015 and in the beginning of 2016 salt-droughts happened in some localities, in which the most affected areas were the communes of Go Cong district that made crop production decrease more than 20%, production costs increase, many livestock die and become ill due to lack of drinking water. People faced many difficulties in daily life due to lack of fresh water for eating and bathing.

“That salt-drought (late 2015 and early 2016) affected to people so much. The trees have dried up, the rice productivity has decreased by nearly half. Especially, areas located near the riverbank or areas with the leakage of the saltwater from the sluices, it can lead to a spoiled crop. To families who grow fruit trees such as longan, mango, orange, and green-skinned grapefruit, etc to sell for the Lunar New Year and full moon in January have been affected by saltwater intrusion earlier than usual, due to lack of water, or saltwater intrusion, so their effort have been fruitless. (A comment in a group discussion in Long Hoa commune, Go Cong, Tien Giang)”

In addition, erratic weather changes are not only reflected in drought and saltwater intrusion in coastal areas, but also cause erratic floods and rains that do not follow the laws of nature like before. Therefore, farmers can not control productivity as well as the crop, so livestock and crops are severely affected.

“The dike system is built by sandbags and people work in agricultural production with of 3 rice crops. This year, the flood comes earlier than usual and the flood flow is more complicated, so people can't handle. Flood happens when rice is in the process of growing. This makes many households fruitless. Floods not only affect rice but also fish farming of households in this area. Fingerlings and fish for meat of many households were also washed away. Many families become fruitless because they are subjective and do not respond in time during the rainy season, especially aquaculture households. (A comment in a group discussion in Thien Tan commune, Cai Be district)

In addition to the damage caused by floods and saltwater intrusion, river bank erosion also significantly affects production, livestock or property (houses, land, and objects) as well as threatens people's lives in the Mekong Delta. Among the surveyed localities, Cai Be and Go Cong districts are massively affected by riverbank erosion.

“In the past, many households living along Vam Co River developed fish farming and planting trees very well. However, in recent years, due to landslides, many households faced many difficulties. Especially in hamlet 4, many households used to have a lot of land for gardening, so they planted many kinds of trees like custard-apple, green grapefruit. Because of the river bank erosion, now there is no land for gardening, except for the house. When we sleep at night, we worry about our house because it can sink anytime. A few months ago, the commune government campaigned for relocation to another place. (A interview with PCT in Tan Trung commune, Go Cong town, Tien Giang province).

3.2. Causes and effects of natural disasters in the Mekong Delta

Previous studies have shown that the Mekong Delta is an area heavily affected by climate change and natural disasters. A study about adaptation to climate change through migration of the International Organization for Migration supposes that the Mekong Delta is one of the areas at risk of being affected by environmental change in Asia and the world. Many environmental challenges occur simultaneously and have synergistic effects in this region. Because of the dependence on specific agricultural

production such as rice, fish and fruit and the underdeveloped industry and services in many places, the Mekong Delta becomes particularly vulnerable to environmental change for agriculture. These changes include sea level rise, saline intrusion, flood and riverbank erosion. More than a half of the population in the Mekong Delta live in areas with no more than 2m above sea level, and the number of people living in the river at risk of seasonal flooding is much more. (Han Entzinger & Peter Scholten, 2016). In our study, while the downstream areas affected by drought and saltwater intrusion, the areas in Cai Be district are affected by upstream floods. According to the survey results in 2017 and 2018, the flood also had more complicated and unexpected changes. Therefore, to farmers do not have timely response plans would have a large loss of rice and aquaculture production. (see the discussion).

“Recent years, because there are many erratic weather changes, some years there is no flood, some years the flood comes early and complicated. Especially in 2018, the flood water came very quickly and 15 days earlier than previous years, so people are very passive. Moreover, the dyke system is made of soil and made by people around their own land area; farmers produce 3 rice crops each year. When the flood comes earlier than usual and the flood flow is more complicated, people can not handle and crops are ruined. (Group discussion in Thien Tan commune, Cai Be district)”

In addition to natural causes, there are some types of natural disasters are caused by humans and make its impact more and more serious. According to people's opinion, in addition to objective factors such as climate change and sea level rise that cause riverbank erosion, there is the main cause caused by humans. One of the causes is that people develop sand uncontrollably and fill small canals that make the flow of the river change. In particular, another cause that also causes a double impact on river bank erosion is that some countries in the upper Mekong River have built a hydroelectric dam system upstream. In the rainy months, they flush flood that create double effect (It means flood water plus water source of hydropower dam create a stronger flow, make the possibility of river bank erosion stronger).

“The landslide and subsidence of the riverbank are caused by the sand dredgers. These dredgers make the river deeper, the water flowing. In addition, the construction of hydroelectric dams in the upper Mekong River is also a big cause that greatly affected to people. In the rainy season, in order not to break the hydroelectric dam, they have to flush the flood and plus with rain water, it will make the flow faster that lead to landslides and subsidence. Moreover, the construction of hydroelectric dams is also the cause of saltwater intrusion. In the dry season, when the amount of water is accumulated, the river water level is low, while sea level rise will overflow inland causing salinization for fields” (Group discussion in Ward 4, Cai Lay Town, Tien Giang).

From the above research results, it shows that climate change has had a great impact on the lives and production of people in the Mekong Delta. In particular, drought, saltwater

intrusion, floods and riverbank erosion tends to be stronger and more irregular. This has made the people of the Mekong Delta lose their homes, lose productive land, labor productivity low and the land tend to get worse and worse, especially in agricultural and fishery production areas.

3.3. Community-based disaster risk mitigation measures

From the above research results, it is shown that climate change and natural disasters greatly affect production, property, and daily life of people in the Mekong Delta. Therefore, how to reduce the impact of natural disasters on people living in vulnerable and disaster-prone areas is the main task of this research program. The results of the research team's discussion with people in 3 districts (Cai Be, Cai Lay and Go Cong town) in Tien Giang about mitigating disaster risks need to rely on communities with two main solutions, namely: construction solutions and non-construction solutions.

According to people, in order to prevent natural disasters, the state and people need to build suitable works for each type of disaster separately. To drought and saltwater intrusion, it is necessary to build the sluices to prevent the saltwater in the river's gates to regulate freshwater and saltwater in the dry season. In the process of construction of the sluice, there should have consultations in the community because only people living in that community understand clearly the geography and soil characteristics and know which areas are necessary for putting the sluices for their production activities. This will help irrigation planners and policy makers avoid unnecessary mistakes when carrying out construction of irrigation works (see the group discussion).

“It can be said that among all kinds of natural disasters occurring in the commune, drought and saltwater intrusion have the greatest impact on people here. In the dry season, trees cannot grow without water. In recent years, the government has also built a few sluices to prevent saltwater and regulate water, so it helps to reduce a lot of damage to production. Not all sluices work well because engineers (come from another places, not local people) surveyed and built sluices, they did not discuss with local people where they should put the sluice, where they should not put one. When they finished, sluices could not only prevent salt water but also affect the transportation travel of local people here. In addition to building sluices to prevent saltwater and regulate fresh water, the state should also use funds for dredging canals and killing water hyacinth so that in the dry season the canals can hold water. The people learn from the 2015-2016 drought, they actively digs a pond in the garden to store water for the dry season months to water the plants” (Group discussion in Long Hung commune, Go Cong town, Tien Giang province).

The implementation of annual dredging of canals is to create good conditions for storing water before the dry season that make people more active. Besides, households also have to build reservoirs in their fields and gardens. To the families grow fruit trees, making of reservoirs is quite effective for their garden in case of the saltwater

preventing sluices systems are closed. Because there are still the water source for irrigation in reservoirs, ponds and lakes in their garden, it can provide a quantity of water so that people can endure the dry season.

Simultaneously with solutions to build the saltwater prevention sluices system or a closed dyke system, non- construction measures are considered to be very important by people in communities in the current climate change context. In which, changing farming practices and livestock breeds are vital conditions for vulnerable communities due to climate change and frequent natural disasters. Each locality has its own unique characteristics, so people offer different adaptation options. Specifically, the communes in Cai Be district are often in floods, so people think that instead of producing three rice crops, they should make two rice crops or one rice crop and one shrimp/fish crop that can create higher economic efficiency.

“Here everyone builds dikes around their fields to make 3 rice crops, but it's also very precarious. If there is an appropriate amount of water, people can have a good harvest. If the flood comes early (before the harvest), they are fruitless. Therefore, it is necessary to combine a rice crop with a shrimp crop like the districts in Dong Thap. It can create high economic efficiency without building dikes, just cover nets around the field to raise shrimp.” (Group discussion in Thien Tan, Cai Be, Tien Giang province)

Areas affected by salt-drought such as Go Cong and Cai Lay also believe that it is necessary to change the type of rice with better drought tolerance or fruit trees with better drought tolerance than those are planted now. For example, in Cai Lay area, people are growing durian, with high productivity and economic efficiency, but in recent years, the drought has caused the durian tree to die mass due to the poor salt tolerance of this tree. Therefore, people planted jackfruit with better salt tolerance. Go Cong area is considered to be the place most affected by salt-drought, the people in these areas actively plant trees with good salt tolerance such as: *annona muricata* grafted with root of *annona glabra*, *malpighia glabra*.

“The whole district of Cai Lay is considered the capital of durian. The productivity of durian planted in this district is very high. The price of durian is also about 50,000 VND / kg. If each household owns 0.7 ha, they can have a good income from durians. But in recent years, it has been raining and sunny erratically, the dry season comes earlier and lasts until the end of May, so durian harvest is worse. People here have changed to grow Thai jackfruit with the price of about 10,000-15,000 VND/kg, in spite of with lower price than durian, the jackfruit tree's tolerance to drought and salt is better” (Group discussion in Ward 4, Cai Lay town, Tien Giang province)

“The commune has also established a goat cooperative farm with about 30 households. Their standard of living is also better because goats are easy to feed. (Goats do not need a great mount of food and they can also drink brackish water). Other animals in the dry season are easy to die, or have diarrhea such as pigs, chickens and ducks.

People in hamlets living near saltwater rivers have started to grow annona muricata because this tree has very good salt tolerance and the price is quite high, so people's life has been greatly improved” (Group discussion) in Long Hoa commune, Go Cong town, Tien Giang province).

On the other hand, when it comes to minimizing damage caused by natural disasters, people of all communes/wards believe that it should be implemented the 4 on-spot method (on-spot command; on-spot force, on-spot means and materials; on-spot logistics) rely on the community to promote the highest efficiency in the current disaster prevention.

Thus, we can say that, in order to mitigate disaster risk in the context of climate change like today, it is necessary to implement both construction and non- construction solutions. In the process of implementing these measures, it is necessary to focus on the people and the community where projects are implemented. Because only people living in this area can understand clearly their own geographical features, soil as well as socio-economic conditions of their locality, they can come up with appropriate plans in managing and mitigating disaster risks in their own communities. Therefore, after the end of the research activities, the participating community members can become "on-site commanders", leading the community to make disaster prevention plans for their communities year by year. In particular, people in each community can proactively come up with plans as well as organize proactively disaster prevention in their community.

4. Conclusion

From the above analysis, we would like to show some conclusions in applying the transdisciplinary approach to community-based disaster risk mitigation and management as follows:

Firstly, The Mekong Delta is one of the most vulnerable regions in the world due to environmental degradation and the consequences of climate change. This is an area with a high population density, fertile soil and resident's dependent on agriculture and fishing. Climate change in recent years has been complicated, causing more and more types of natural disasters such as drought, saltwater intrusion, floods and riverbank erosion, which tend to be stronger and more irregular.

This greatly affects to the daily life and production of the people in the Mekong Delta, such as significantly reduced crop productivity, death of livestock due to diseases which make people's life more difficult. Although people are aware of the types of natural disasters in the communities that often occur in their communities, they still depend on the ability of the state and local authorities due to the current limited economic conditions, capacity and methods of disaster prevention, there are still many limitations. Therefore, this makes the impact of natural disasters on people's lives even more serious.

Secondly, when we apply the transdisciplinary approach to community-based disaster

prevention, it will bring certain effects in promoting the strength of the community in community-based disaster prevention and control. Thanks to the transdisciplinary approach, people in the communities can take part in the project from the beginning. They can state the problems that they are facing in the community such as the causes, limitations and strengths of the community, so they can propose effective disaster prevention plans to mitigate the damage.

Finally, through the transdisciplinary approach, researchers and people in communities write down disaster prevention plans for each community. Local governments and people can be more proactive in disaster prevention and consider disaster prevention as the responsibility of each individual living in the community, not the sole responsibility of the government or local government.

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