Aqua Climate

2009

Perception of climate change impacts and adaptation of catfish farming in the Mekong delta, Vietnam

Focus group discussions and stakeholder workshop Report

Kasetsart University

Perception of climate change impacts and adaptation of catfish farming in the Mekong delta, Vietnam: Focus group discussions and stakeholder workshop Report 2009

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1. Executive summary

Stakeholders including catfish farmers in general expressed that climate change is a serious threat and needs to be addressed in an integrated manner. The main changes they observed were: shift in weather patterns (higher temperatures), early rains, floods, saline water intrusion and frequent typhoons. Suggestions from farmers to address extreme weather events included, producing good quality fry, developing new culture systems, building dykes, livelihood diversification, training and awareness workshops and financial support to farmers. To sustain catfish production in the Can Tho Province is highly important for the large number of farmers dependent on aquaculture for their livelihoods. There seems to be willingness amongst stakeholders to co-operate in their efforts to address future threats from climate change. The intention to co-operate needs to be strengthened by improving the existing institutional and policy frameworks.

2. Introduction

2.1. Catfish farming in the Mekong Delta (MKD), Vietnam

The Mekong Delta of Vietnam has a high potential for development of both Agriculture and Aquaculture. The Delta experienced rapid development of aquaculture since the early 90s, given the demand in the domestic and international market. In 2004, the MKD contributed to 300,000 tonnes of the total 315,000 tonnes of Tra catfish production of Vietnam (Mofi 2005). The Ministry estimated and emphasized in the Decision No. 224 that by 2010 the aquaculture would contribute to 2.0 million tonnes and provide jobs 2 million people. Out of this, the Ministry estimated about 1 million tonnes from catfish farming alone. Catfish farming (Figure 1) developed on a commercial scale in the Can Tho province since 2000. Between 2005 and 2008 the production doubled in the province, although the area under catfish farms increased only by 10% during the same period. Catfish farming is mainly practiced in deep ponds and at extremely high density, production per hectare per year can be very high.

Figure 1. Catfish farm at Thot Not District, Can Tho, Viet Nam in the study area.

2.2. Recent climate change in the Mekong Delta (MKD), Vietnam

Viet Nam's topography, climate and long coastline makes it particularly vulnerable to climate extremes and natural disasters. Analysis by Dasgupta et. al. (2007) suggests that Viet Nam is one of world's top five most vulnerable countries to sea level rise and the most vulnerable to climate change impacts in South East Asia. In 2006-2007, Vietnam experienced typhoons, floods and droughts in an unprecedented manner causing severe losses to property and infrastructure. Both, agriculture and aquaculture sectors suffered seriously due to the extreme weather events impacting livelihoods of a large number of small farmers and the poor.

However, the delta region is highly vulnerable to various problems, especially climate changes and extreme weather events. The present study is being undertaken in Can Tho province in the MKD to study the impacts of climate change on aquaculture. Most serious problems are from changing weather patterns, early rains, higher temperatures, floods, typhoons and salt water intrusion due to sea level rise. At the same it is dominated by small scale farmers who are vulnerable to changes in the climate and extreme weather events.

A majority of the small farmers are likely to be affected by climate change in the MKD. Currently, farmers are practicing some adaptation measures. However, these are not adequate enough to protect them from the likely risks due to extreme climate events that they are currently facing. The Government of Vietnam, at the national level, has initiated planning for adaptation in various sectors. Integrating efforts, knowledge and resources of different stakeholders is the need of the hour to achieve sustainable aquaculture in the MKD.

2.3. Background to the project

The project on "*Strengthening Adaptive Capacities to the Impacts of Climate Change in Resource-poor Small-scale Aquaculture and Aquatic Resources-dependent Sector in the South and South-east Asian Region*" also known as "AquaClimate" aims to strengthen the adaptive capacities of rural farming communities to the impacts of climate change.

Focus will be on specific farming sectors in the countries of Vietnam, India, Sri Lanka and the Philippines and mapping the farmer's perceptions and attitudes towards climate change impacts and their adaptive capacities to address the impacts. The project is developing future scenarios of climate change impacts based on the current trends, assessing the potential adaptive measures for different aquatic farming systems and developing and prioritising better management practices, suggesting Codes of Practices and improved methodologies for such systems. The project is also developing guidelines for policy makers to help in framing appropriate regional adaptation strategies and associated policy developments. Interaction with stakeholders including small farmer organizations, managers, policy makers and researchers in the region to gain from their experiences, jointly develop scenarios and adaptation strategies is part of the project strategy.

Outputs of the project are recommendations that address the environmental and social changes (and conflicts) likely to arise from climate change impacts on the respective farming systems, improve management/governance mechanisms and decision support systems, build capacity and strengthen institutional partnerships and alliances.

End users of the outputs from the project are farmers, policy makers, Local Government Unit (LGUs), academe, producer organizations, regional organizations and NGOs.

Other case studies in the project include:

- Milkfish farming in the Philippines
- Improved extensive shrimp farming in Vietnam
- Improved extensive shrimp farming in India

The project is implemented by international and national partners, with each international partner bringing different areas of expertise and having different areas of responsibility within the project.

The coordinating organisation of the AquaClimate project:

- Network of Aquaculture Centers in Asia-Pacific (NACA) – Bangkok, Thailand

The international project partners for the study are:

- Bioforsk – The Norwegian Institute for Agricultural and Environmental Research- Norway
- Faculty of Fisheries, Kasetsart University, Thailand
- Akvaplan-niva AS – Tromso, Norway

The national partner for the Philippines case study is Can Tho University and Research Institute for Aquaculture no.2.

3. Objectives

3.1. Objectives of the AquaClimate project

The broad objectives of the AquaClimate project are:

1. Assess the impacts of climate change on small scale aquaculture sector (environmental and socio-economic) in selected areas and aquatic farming systems.
2. Assess vulnerability of different aquatic farming systems to climate changes.
3. Explore potential adaptive measures for different aquatic farming systems.
4. Prioritise better practices for the most “adaptive” aquatic farming systems.
5. Develop future scenarios for small-scale aquaculture systems in the south and south-east Asian region (up to 2020).
6. Propose risk-mitigating strategies compatible with the scenarios.
7. Determine awareness/knowledge level, perceptions of risks, and attitudes of farmers towards perceived risks from climate change.
8. Determine risk-management behaviours and strategies of farmers to climate change induced risks.
9. Develop guidelines for policy measures and decision support tools.
10. Benchmark adaptive capacities of small farming households.
11. Develop wider awareness of the results by publishing and disseminating through various sources and networks.

3.2. Objectives of Focus group discussions

1. To map farmers perceptions and experience about climate change and impacts on small scale catfish farming systems in particular
2. To assess of the vulnerability of the catfish farming production system to climatic changes and events

3. To estimate the economic losses for the farmer due to these climate changes
4. To map the adaptation measures that farmers/communities respond with, when exposed to climate change
5. To identify agencies and their assistance to the farmers for dealing with impacts from climate changes

3.3. Objectives of the Stakeholder workshop

The main purpose of the workshop was to map stakeholder's perceptions about climate change and its impacts on catfish farming in the Mekong delta, Vietnam. The specific objectives of the stakeholder workshop were:

1. To identify climate changes that stakeholders perceive are most serious for catfish farming.
2. To identify the most serious impacts, on catfish farming, and farmers
3. To identify most relevant adaptation measures, feasibility and implementation means to strengthen adaptive capacity of the catfish farming industry and reliant communities.
4. To identify the main institutional and policy measures needed

4. Methodology

4.1. Study area

The transect of catfish study area was selected from upstream, middle and downstream zones of low Mekong River, Vietnam, which include representative provinces for catfish culture in the Mekong Delta such as An Giang and Dong Thap (upstream), Can Tho and Vinh Long (middle), and Tra Vinh and Soc Trang (downstream) (Figure 2). Where An Giang and Dong Thap are impacted by annual flooding from July to October; Can Tho and Vinh Long are also impacted by flooding and sea level rise (SLR); Tra Vinh and Soc Trang are affected by saltwater intrusion and SLR. The largest areas of catfish culture are in upstream area; Dong Thap (1,449 ha) and An Giang (1,185 ha). Catfish culture areas in other provinces of the study area are: 821 ha in Can tho, 390 ha in Vinh Long, 158 ha in Tra Vinh, and 96.5 ha in Soc Trang (DARDs of An Giang, Dong Thap, Can Tho, Vinh Long, Tra Vinh and Soc Trang provinces, 2009).

4.2. Participatory approach

Mapping impacts and vulnerability, devising adaptation strategies at the national and local levels, strengthening stakeholders' capacity and institutions to manage risks from the climate change, are now a matter of urgency. This cannot be done without actively involving stakeholders and analyzing stakeholder perceptions towards climate change. AquaClimate project will put emphasis on stakeholder participation in all phases of the project through various methods including stakeholder workshops, focus group meetings and key stakeholder interviews. This will enable to map the stakeholder experiential knowledge and develop effective adaptation strategies.

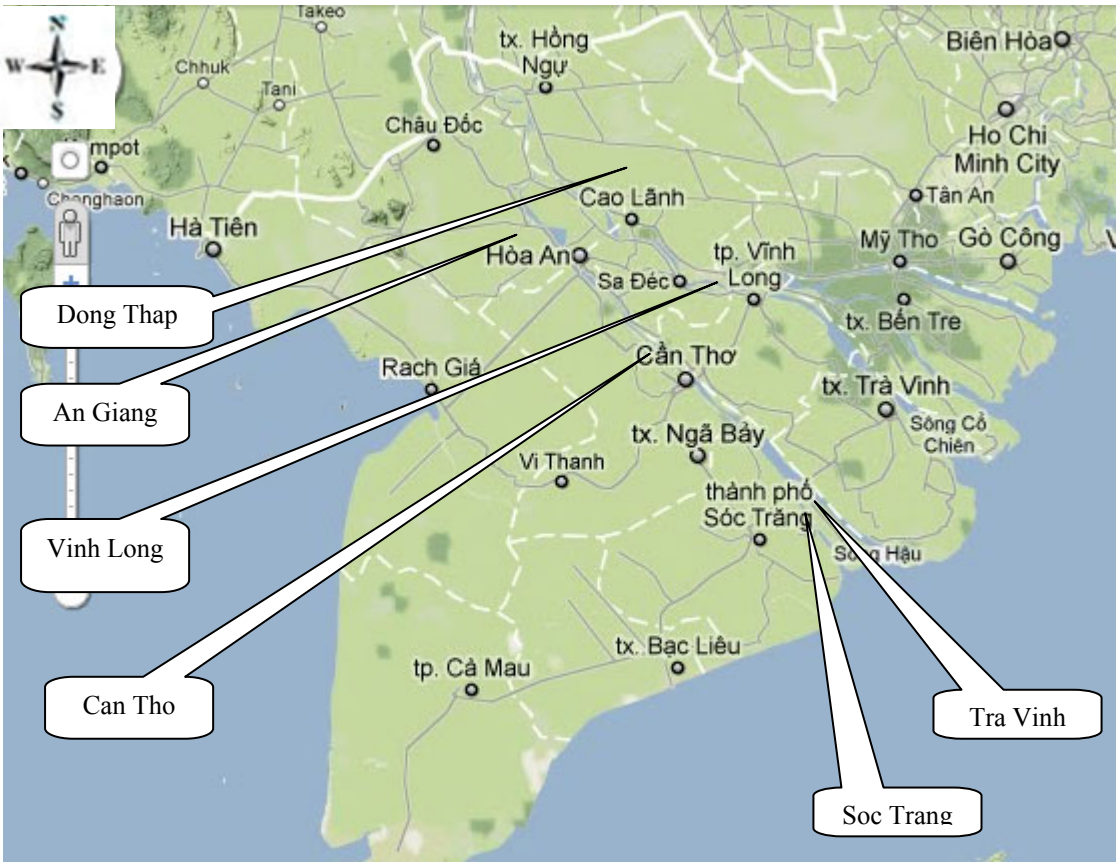

Figure 2 Map of the study area

4.3. Focus Group Discussion

For the socio-economic vulnerability assessment, focus groups together with individual farmers' surveys will be used to gather data necessary for the analysis. The size and selection of the focus groups is important, and the purpose of the study will guide the selection of the focus group members. The normal recommended size of a focus group is 8-10.

Focus groups can generate a lot of relevant information during the discussions. To begin with, adequate background information was provided to the focus groups about the project, purpose of the meeting and expectations from the meeting. The participants were given freedom to express themselves, disclose their practices and ideas, both positive and negative. Least interference by scientific personnel is recommended to allow free expression of opinion. The group responses are taken as collective opinion. Preferably the focus group meetings should take place close to the farmer's farms in a comfortable setting where farmers feel comfortable to express their opinions freely. For the present study, this was not possible due to time constraints and the focus group meeting was held in a meeting room at Can Tho University. However, every effort was made to ensure that the participants felt comfortable and were willing to share their opinions freely.

A brief presentation was given about the project and the expected climate changes in the Mekong Delta area.

The total number of participants was 28 people from different provinces and stakeholders, which included An Giang (1), Soc Trang (1), Can Tho (8), private companies (4), Research Institute for Aquaculture No. 2 (4), Scientists from CTU (7), and international specialists (3) (Annex 1)

The participants were divided into 2 groups: farmers and managers/planners. For each group, sub-groups were created. There was a reporter, translator and facilitator for each group. Translator was needed to help local participants and international specialists to understand each other in group discussion.

Process:

Farmers were divided into groups of 3. Each group of three had to discuss among themselves and present their findings to the others at each step of the process.

Step 1. Identify the climate changes observed by the farmers based on their experience

Step 2. identify the impacts of those climate changes

Step 3. Action taken by the farmer to deal with or rectify the problem

Step 4. Estimate of costs to deal with or rectify the problem

Step 5. Which agency could help the farmers in future climate change impact problems?

4.4. Stakeholder workshop

In terms of participation, 43 members representing 15 different agencies took part actively in the one day workshop. These included agencies from the different relevant provincial government agencies consist of Aquatic seed production Center of Can Tho (1), Division of Aquatic Resource Management of Can Tho, An Giang, Dong Thap and Vinh Long provinces (5), Agriculture and Aquaculture extension center of Soc Trang province (1), district level (4), total of 5 representative farmers, Catfish farming Cooperative, catfish fingerling Union, fisheries service companies (8), , RIA 2 (4), DRAGON Institute (1), and College of Aquaculture and Fisheries (8), and international specialists (6) (Annex 2).

The stakeholders were divided into three groups, each group consisting of 13-14 stakeholders, based on their occupation, in order to map the differences in perceptions related to climate change. The different groups were:

- Group I – Mostly catfish farmers.
- Group II – Dominated by managers from various government agencies.
- Group III – A mixed group consisting of representatives from commercial companies, scientific staff and other stakeholders.

Each group was guided by facilitator to keep the discussions focused on the topic. During the discussions, the group members sat in smaller sub groups of 3-4 stakeholders each. This was to facilitate active participation of all stakeholders in the discussions. Each sub group was given different color cards to write down perceived observed climate changes, their corresponding impacts and any adaptation measures. These were then further grouped and ranked by stakeholders based on the importance and seriousness. The stakeholders later identified the most relevant agencies that should be responsible for implementing the adaptation measures and the time period over which they should be implemented.

In the group discussions the stakeholders shared their experience and knowledge with other participants with enthusiastic interaction and lively discussion. Stakeholders perceived climate change

as a serious threat and expressed that adaptation measures should be developed by scientists and government agencies taking into consideration the local ecological and socio-economic situation.

In the concluding session the three groups presented the main summary of the group work. The summary of these group discussions is presented in section 3.

5. Results

5.1. Focus Group Discussion

5.1.1. Perceptions of climate changes and their impacts

The participants identified a number of changes in typical climate that they were already observing. There were as follows:

- Increasing changeable weather patterns
- Higher river and canal water level increase and more frequent floods
- Rainy season starting earlier
- Increasing salt water intrusion
- Increase in the number of hot days and longer hot season
- Increase in the number of cold days
- Increasing incidence of sudden heavy rain
- Increasing incidence of storms and typhoons

These changes provided impacts mainly to farm production. The participants described measures that they were already taking and potential solutions to be able to adapt to the changes. They described who could be responsible for undertaking the adaptation measures and the timescale required for successful implementation.

The climate changes described are based on the participants's perceptions and need to be checked against metrological records and the adaptation measures used and suggested are based on their ideas and there is a need to check the scientific basis for those measures.

5.1.2. Increasing changeable weather patterns

Participants were observing irregular and changeable weather patterns particularly in the level of sunshine and rain in the periods between the dry and rain seasons.

These impacts led to the fish becoming stressed and losing appetite resulting in slower growth.

Measures already taken by the farmers and suggested measures included:

- Improved feed nutrition to be able to improve growth rate such as adding Vitamin C and digestive probiotics to the diets
- The use of lime on the slopes of the dikes and the liming of pond after draining. They suggested developing a work plan for liming
- Adding salt to the pond water to help stabilise water quality

However they also need additional support as follows:

- Advice and help from Scientists and research institutions
- Advice from the fishery managers at District and provincial level
- Free seed from the Provincial Government hatcheries

These measures are able to be implemented in the medium term between 3 to 5 years.

5.1.3. Higher river and canal water level increase and more frequent floods

Participants are observing increasing river and canal water levels particularly during July to December. This was observed in 2006 and 2007.

The impacts of increased water levels that the farmers are experiencing include the following:

- Stronger water flows leading to dike erosion but also leading to improved fish quality as there is a higher rate of water exchange.
- Damage to pond facilities
- Change in water quality such as low pH and higher turbidity levels leading to increased disease outbreaks
- Loss of fish due to escapes
- Higher disease incidence generally
- Higher capital costs due to the need to repair and upgrade dikes (estimated cost at 20 million Dong/ha for a private company to undertake)
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Measures already taken by the farmers and suggested measures included:

- Upgrading of the pond dikes
- Increasing the height and strengthening the sluice gates
- The construction and use of sedimentation ponds to improve water quality
- Addition of salt, Chlorine and Copper Sulphate to the pond water
- Addition of lime to the pond walls
- Improve fish feed nutrition with the addition of Vitamin C
- Reduce the cost of feed by including snail meal as an ingredient to the home made feed
- Plant trees on dikes to strengthen them

Participants are able to undertake some adaptive measures which are within their control but they will have to rely on additional external support as follows:

- Advice and help from Scientists and research institutions
- Need a University Research Centre specialising in Disease diagnosis and treatment
- Research and development by scientists on improved fish medication and fish vaccines
- Research and development by scientists on improved fish medication and fish vaccines
- Need hatcheries to supply fry and fingerlings free of disease
- Advice from the fishery managers at District and provincial level
- Advice and training from chemical and drug supply companies on appropriate chemicals to use
- Investment by the Department of Planning to improve the water supply and drainage infrastructure
- Investment by the Irrigation Department to improve the irrigation system
- Need an improved river level rise and flood forecast system by Department of natural Resources and Environment
- Need an improved early warning broadcast system by TV stations
- Need mass communication by Department of Communication and Education

- Need investment by Government to maintain, heighten and repair the main river and canal dikes (Department of Environment and Natural Resources, Department of Agriculture and Rural development, Institute of Irrigation at Provincial level)
- Need the establishment of more Environmental Police Units as has been established for Can Tho City.

5.1.4. Rainy season starting earlier

Participants are observing that the rainy season is starting early (such as in 2008.

The impacts of early rainy season that the farmers are experiencing include the following.

- Fish lose appetite leading to reduced growth rate
- Fish become stressed leading to up to 30% mortality
- Production costs are higher due adaptation measures that have to be taken.

Measures already taken by the farmers and suggested measures included;

- Use of better feeds for example a quality feed costs 7,500 D/kg compared to normal cost of 7,000 Dong
- Improve the nutrition quality of the feed by adding Vitamin C
- Purchase better quality seed which have better growth rate and less disease
- Use probiotics in the pond to stabilise water quality
- Pump sediment from the pond after stocking fingerlings
- Pump sediment from pond regularly (at least 3 times) before harvesting
- Change the crop calendar to take into account the weather changes
- Share experiences and solutions between farmers

Most of these measures are able to be carried out by the farmers themselves and they are able to cope and adapt to this weather change.

However they also need additional support as follows:

- Advice and help from Scientists and research institutions
- Advice from Chemical and drug companies
- Improve seed quality from Government and private hatcheries

5.1.5. Increasing salt water intrusion

Participants are observing increasing saline water intrusion into catfish culture areas.

The impacts of increasing saline intrusion that the farmers are experiencing include the following:

- Loss of production area
- Lower productivity from the ponds
- Fish have lower appetite leading to slower growth.
- Increased incidence of disease
- Poorer flesh quality (lower white meat ratio)
- Poorer water quality for catfish

Measures already taken by the farmers and suggested measures included:

- Exchange water daily
- Use probiotics to improve fish health

- Use better quality feeds to improve growth rate
- Harvest earlier to avoid the higher salinity
- Change to a different species

However the farmers also need additional support as follows:

- Advice and help from Scientists and research institutions
- Need for better aquaculture planning and aquaculture zoning by the Department of Agriculture and Rural Development
- Need a study on potential new salt tolerant species for culture
- Need to genetically select catfish for salt tolerance (long term - 2015 development by RIA2 and BSC2)

5.1.6. Increase in the number of hot days and longer hot season

Participants are observing increasing number of hot days, hotter days and a prolonged hot season.

The impacts of hotter weather that the farmers are experiencing include the following:

- Increased water temperature in the ponds leading to abnormal fish behaviour
- Increase water temperature in the ponds leading to increase in Bacterial and viral diseases
- Change in water quality particularly high Ammonia levels
- Decrease in fish growth rate
- Higher production costs due to the adaptation measures that they have to implement

Measures already taken and suggested measures included:

- Treating the water before pumping into the pond
- Exchange a greater amount of water each day but not more than 30% per day otherwise it stresses the fish
- Remove the sediment from the pond more frequently
- Use lime

Most of these measures are able to be carried out by the farmers themselves.

5.1.7. Increase in the number of cold days

Participants are observing increasing number of cold days particularly from August. This was observed in 2006 and 2008.

The impacts of cold temperatures that the farmers are experiencing include the following:

- Changes in pond water quality
- Build up of toxic substances in the pond.
- Increase in bacterial disease outbreaks
- Increase in parasite problems
- Lower fingerling survival being reduced from 90% to 70% survival
- Reduced Food conversion rate by 0.1:1
- Increased operational costs due to increased expenditure on medication (Normally 300VND/kg which is increased to 500 to 1,000 VND/kg)

Measures already taken and suggested measures included:

- Increase water exchange in the ponds by pumping

- Siphon the bottom of the pond more frequently
- Improve the nutrition quality of the feed
- Use chemicals (probiotics) to absorb the toxic substances

Most of these measures are able to be carried out by the farmers themselves. However also needed is additional support as follows:

- Advice from commercial chemical and drug supply companies
- Need research to improve quality of fingerlings
- Need research to develop strain of fish with high environmental change tolerance

5.1.8. Increasing incidence of sudden heavy rain

Participants are observing increasing periods of heavy rain and increasing frequency of sudden heavy rain.

The impacts of increased water levels that the farmers are experiencing include the following:

- Pond water temperature decreases rapidly.
- Increase in bacterial disease
- Increase in parasite problems
- Reduced fish appetite leading to slower growth rate
- Reduced flesh quality (more yellow flesh – market price of 13,200 VND/kg than white flesh market price 14,200 VND/kg)
- Increase in water pollution in supply water due to agricultural pesticide runoff (particularly in 2007)
- Increased production cost due to increased chemical and medication used (additional 100 VND/kg)
-

Measures already taken and suggested measures included:

- Add vitamin C to the diet weekly
- Add probiotic to the pond water to stabilise water quality
- Use sorbitol

Most of these measures are able to be carried out by the farmers themselves. However the also need additional support as follows:

- Develop and produce vaccines against the major diseases. This should be funded by the government and undertaken by RIA 2 but will be long term before results (probably 2015)

5.1.9. Increasing incidence of storms and typhoons

Participants are observing increasing number of storms and typhoons. Typhoons typically occur in November in the Mekong River delta area.

The impacts of increased number of storms that the farmers are experiencing include the following:

- Destroy the irrigation water supply and discharge system
- Create high canal water levels
- Cause escape of fish from the ponds by escapes
- Reduced production.

Measures already taken and suggested measures included:

- Strengthen pond dikes

5.2. Stakeholders Workshop

5.2.1. Farmers group outputs

Farmers identified irregular weather patterns (higher temperatures), early rains, floods, salt water intrusion and typhoons as the most serious climate events impacting cat fish farming. More incidences of fish diseases, e.g. syndromes of white spot in the organs (*Bacillary Necnosis* of Pangasius-BNP) and red spot disease due to changes in weather patterns and flooding seems to be the main concern of the farmers, besides reduced area for catfish production caused by flooding and saline water intrusion. According to their past experiences, flooding brings about a significant change in water quality and turbidity, which they attribute as the main reason for disease outbreak.

Some of the adaptation measures that farmers were practicing to address the climate change impacts included:

- Adding lime and salt to maintain pH of water and prevent disease outbreak
- Adjusting crop calendar to avoid seasons with salt intrusion.
- Increasing the height of dykes as part of the annual pond maintenance.

Not all farmers were able to mobilize the additional investments to take up the necessary measures in time.

5.2.2. Managers group outputs

The managers perceived sea level rise as the most serious threat from climate change effects. According to them, it results in salt water intrusion specifically into areas where the Mekong tributaries are closer to the sea, thereby, reducing the area for aquaculture. The group felt that increase in salinity as a result of sea water intrusion will affect the biological characteristics of the freshwater species in the Mekong River.

Managers, like farmers, also perceived flooding as a serious threat to cat fish farming, caused due to intense rainfall leading to fish diseases that significantly reduces the production and income of farmers. The destruction of irrigation system was also associated with the frequent flooding.

Seasonal change (change in seasonal pattern i.e. early rains and floods, and higher summer temperature) was seen by all the three groups as a threat, causing fish diseases and reduced growth rate. All the three groups attributed fish diseases and reduced growth specifically to flooding and bad water quality.

Typhoons were also seen as a threat which destroys the irrigation systems and causing serious losses in production.

One of the stakeholders mentioned that a study is being conducted rearing fish at 3ppt salinity. However, the following problems were encountered: slower growth rate, lower fish quality and higher

cost of production. Priorities of climate changes issues that were identified by the group of managers are summarised in annex 3.

5.2.3. Mixed stakeholder group outputs

The main concern in the group was the increase in temperature and water quality changes leading to fish stress and disease, reduced growth rate, yellow colour (jaundice) flesh (catfish flesh is usually white and yellow colour is not preferred by consumers) in the fish and increased production costs. Changes in the rainy season pattern and stormy weather were also seen as threats.

Similar to the managers, the mixed group of stakeholders viewed sea level rise and changes in water flow leading to reduced areas for catfish culture and reduced water quality as one of the major climate change concerns that needs to be addressed.

Some of the adaptation measures already being attempted by members of the group were:

- Using chemicals to prevent white flesh from turning to yellow colour
- Using probiotics to address water quality problems, and changes in culture system
- Treating disease outbreaks with vaccination and antibiotics
- Reducing stocking density, improve feed quality

6. Discussion

6.1. Climate change impacts perceived by farmers and other stakeholders

The perceived impacts of observed climate changes cover physical, chemical, biological and economic impacts and are summarised below.

6.1.1. Physical impacts

Physical impacts perceived by the participants were:

- Increased water flows leading to dike erosion but also leading to improved fish quality as there is a higher rate of water exchange.
- Damage to pond facilities
- Loss of production area (saline intrusion)
- Damage to the irrigation water supply and discharge system

6.1.2. Chemical impacts

Water quality is the main chemical impacts perceived by the participants. The impacts of climate change to change in water quality were listed below.

- pH decrease
- Turbidity increase
- Salinity increase
- Ammonia levels Increase

- Build up of toxic substances in the pond
- Increase in water pollution in supply water due to agricultural pesticide runoff

6.1.3. Biological impacts

Perceived biological and environmental impacts were grouped below.

Catfish Behaviour

- Abnormal fish behaviour

Stress of Catfish

- Fingerlings and fish become stressed leading to increased mortality

Survival rate of Catfish

- Survival rates of fingerling being reduced from 90% to 70% mainly because of escape of fish from the ponds by escapes

Increase in incidence of disease

- Increase in Bacterial and viral diseases
- Increase in parasite problems

Feeding and growth rate of Catfish

- Fish lose appetite leading to reduced growth rate
- Reduced Food Conversion rate by 0.1:1

Flesh Quality of Catfish

- Poorer flesh quality (lower white meat ratio)

6.1.4. Economic impacts

Economic impacts perceived by the participants are listed below.

Productivity

- Lower productivity from the ponds

Capital costs

- Higher capital costs due to the need to repair and upgrade dikes and sluice gates

Operational costs

- Production costs are higher due adaptation measures that have to be taken.
- Increased operational costs due to increased expenditure on medication
- Increased production cost due to increased chemical used
- Lower market price due to lower flesh quality
- Loss of fish due to escapes

6.2. Adaptation measures

The farmers perceived that they are able to adapt to most of the presently observed climate changes but at higher capital and production costs which is causing a lower income from catfish farming and lower profitability for the small scale producers.

Their main adaptation measures included:

6.2.1. Measures for physical impacts

Improve Engineering aspects

- Upgrading of the pond dikes
- Increasing the height and strengthening the sluice gates
- Plant trees on dikes to strengthen them

6.2.2. Measures for chemical impacts

Use of chemicals to stabilise water quality

- The use of lime on the slopes of the dikes and the liming of pond after draining. They suggested developing a work plan for liming
- Adding salt to the pond water to help stabilise water quality
- Addition of Chlorine and Copper sulphate to the pond water
- Addition of lime to the pond walls
- Use probiotics in the pond to stabilise water quality
- Use probiotics to improve fish health
- Use sorbitol

Improving water quality

- The construction and use of sedimentation ponds to improve water quality
- Pump sediment from the pond after stocking fingerlings
- Pump sediment from pond regularly (at least 3 times) before harvesting
- Exchange water daily
- Exchange a greater amount of water each day but not more than 30% per day otherwise it stresses the fish
- Treating the water before pumping into the pond
- Increase water exchange in the ponds by pumping
- Siphon sediments from the bottom of the pond more frequently

6.2.3. Measures for biological impacts

Improved seed quality

- Purchase better quality seed which have better growth rate and less disease

Improve feed nutrition quality to be able to improve growth rate and health status

- adding Vitamin C to the diets
- adding digestive probiotics to the diets

The reported use of chemicals or probiotics to combat yellow flesh colour appears to be a sub-optimal adaptation measure as it is recognised that yellow flesh colour is caused by nutritional deficiencies. A more appropriate measure may be the use of a high quality diet.

6.2.4. Measures for economic impacts

Improve feed nutrition quality

- Use of better feeds for example a quality feed costs 7,500 D/kg compared to normal cost of 7,000 Dong for better growth rate and better production

Decrease in feed cost

- Reduce the cost of feed by including snail meal as an ingredient to the home made feed

6.2.5. Other measures

Change management practices

- Change the crop calendar to take into account the weather changes
- Change to a different species
- Harvest earlier to avoid the higher salinity

Exchanging experiences and solutions

- Share experiences and solutions between farmers

6.3. Responsible agencies

In many cases, the adaptive measures could be undertaken by the farmers themselves. However there are issues outside their control where they believe they need assistance from

- Government (Central, Provincial and District)
- Private commercial companies
- Universities and Research Institute assistance

6.3.1. Government (Central, Provincial and District)

- Advice from the fishery managers at District and provincial level
- Free seed from the Provincial Government hatcheries
- Need hatcheries to supply fry and fingerlings free of disease
- Improve seed quality from Government hatcheries
- Investment by the Department of Planning to improve the water supply and drainage infrastructure
- Investment by the Irrigation Department to improve the irrigation system
- Need an improved river level rise and flood forecast system by Department of natural Resources and Environment
- Need an improved early warning broadcast system by TV stations
- Need early warning mass communication by Department of Communication and Education
- Need investment by Government to maintain, heighten and repair the main river and canal dikes (Department of Environment and Natural Resources, Department of Agriculture and Rural development, Institute of Irrigation at Provincial level)

- Need the establishment of more Environmental Police Units as has been established for Can Tho City.
- Need for better aquaculture planning and aquaculture zoning by the Department of Agriculture and Rural Development

6.3.2. Private commercial companies

- Need hatcheries to supply fry and fingerlings free of disease
- Improve seed quality from private hatcheries
- Advice and training from chemical and drug supply companies on appropriate chemicals to use

6.3.3. Universities and Research Institute assistance

- Advice and help from Scientists and research institutions
- Need a University Research Centre specialising in Disease diagnosis and treatment
- Research and development by scientists on improved fish medication and fish vaccines
- Need a study on potential new salt tolerant species for culture
- Need to genetically select catfish for salt tolerance (long term - 2015 development by RIA2 and BSC2)
- Need research to improve quality of fingerlings
- Need research to develop strain of fish with high environmental change tolerance
- Develop and produce vaccines against the major diseases. This should be funded by the government and undertaken by RIA 2 but will be long term before results (probably 2015)

7. Conclusions and recommendations

Overall, stakeholders perceived climate change as a threat to aquaculture in general and catfish farming in particular. Though farmers have started to adapt to the extreme weather events, their socio-economic context makes them vulnerable to climate variability. Stakeholder's priority was to improve the adaptive capacity through strengthening the current culture systems, producing good quality fry, funding support in the event of losses, training and supporting small scale farmers with necessary resources.

Stakeholder's suggestions for future

1. Both farmers and managers would like to see an improvement in the irrigation supply canal system to bring freshwater to the pond area in the long term.

2. Managers felt a need:
   - for improvement of the farming and building dykes to protect farms from floods
   - for developing effective vaccines and drugs that can treat the diseases
   - for improving the quality of the fingerlings and make them available to farmers.
   - zoning aquaculture areas
   - more research on suitable species that can be grown in saline water.
   - training of farmers to promote awareness and improve adaptive capacity of farmers.

The Department of Agriculture and Rural Development in Can Tho is currently organizing 20 SQF 1000 training workshops to catfish farmers training courses in 2009

3. The mixed stakeholder group felt a need for:
    - Selective breeding to address the problems of reduced fish growth rate (refer Sang et. al.,2007; and http://www.mrcmekong.org/programmes/fisheries/cc_vol13_2_Sep07.htm)
    - Improving technology and farm management to control production costs

8. References

Chambers, R. 1997. Whose reality counts? Putting the first last. ITP, London, UK.

DARD of An Giang, 2009. Annual report on aquaculture and fishery development and management in 2009, and action planning for the development of aquaculture and fishery in 2010.

Dasgupta, Susmita, Laplante, Benoit, Meisner, Craig, Wheeler, David and Jianping Yan, "The Impact of Sea Level Rise on Developing Countries: A Comparative Analysis" (February 1, 2007). World Bank Policy Research Working Paper No. 4136 Available at SSRN: http: //ssrn.com/abstract=962790

Grimble, R.; Chan, M.K.; Aglionby, J.; Quan, J. 1995. Trees and trade-offs: a stakeholder approach to natural resource management. International Institute for Environment and Development, London, UK. Gatekeeper Series 52.

Grimble, R.; Wellard, K. 1996. Stakeholder methodologies in natural resource management: a review of principles, contexts, experiences and opportunities. Paper presented at the ODA NRSP Socioeconomic Methodologies Workshop, 29–30 Apr, 1996, London, UK.

Pretty, J.; Guijt, I.; Scoones, I.; Thompson, J. 1995. A trainer's guide for participatory learning and action. International Institute for Environment and Development, London, UK.

MoFi (Ministry of Fisheries, Vietnam), 2005. Summary of the Annual Reports (1997-2005). Ministry of Fisheries, Hanoi,Viet Nam. 195 pp.

Nguyen Van Sang, Nguyen Van Hao, Dinh Hung, Pham Din Khoi, Bui Thi Lien Ha, Vu Hai Dinh and Nguyen Dien. 2007. Selective breeding for growth and fillet yield of river catfish (Pangasianodon hypophthalmus) in the Mekong Delta, Vietnam". Aquaculture Asia Magazine, April-June, 2007, pp 26-27.

Annex 1. Focus Group discussion participants (21/06/2009)

No.	***Name***	***Position***	***Organization***
1	Luong Thi Bao Thanh	Farmer	*An Giang* province
2	Nguyen Minh Khai	Agriculture and fisheries extension of *Soc Trang* province	*Soc Trang* province
3	Le Chi Dung	Farmer	*Con Khuong* village – *Can Tho* city
4	Pham Truong Yen	Vice Director	Aquatic seed Center of *Can Tho* city
5	Le Ngoc Dien	Vice Head of fisheries Agency	Division of aquatic resources management , *Can Tho* City
6	Phan Van Phai	Farmer	*Song Hau* farm – *Can Tho* city
7	Le Thuan Nhan	Technician	*Song Hau* farm – *Can Tho* city
8	Nguyen Huynh Nhat Quang	Officer	Fisheries service station in *O Mon* – *Co Do* district, Can Tho
9	Tang Minh Ky	Officer	Fisheries service station in *Tho Not* – *Vinh Thanh* district, Can Tho
10	Nguyen Tien Diet	Technician	Veterinary of Department , Can Tho
11	Cao Anh Tuan	Head of technology division	*Viet Thang* pellet feed Company
12	Nguyen Hong Phong	Technician	*Co No* company
13	Tran Cap Tang	Technician	*Hung Vuong* company
14	Nguyen Quoc Nguyen	Technician	*Co No* company
15	Phan Thanh Lam	Head of Inland Capture Fisheries Division	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
16	Tran Quoc Chuong	Researcher	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
17	Vu Vi An	Researcher	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
18	Đoan Van Bay	Researcher	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
19	Udaya Sekhar Nagothu	Senior Scientist	Bioforsk, Norway
20	Jocelyn M. Hernandez-Palerud	Aquaculture Consultant	Akvaplan-Niva, Norway
21	Patrick White	Senior Consultant	Akvaplan-Niva, Norway
22	Lam Truong An	Aquaculture Master student	*Can Tho* University
23	Pham Minh Đuc	Lecturer	*Can Tho* University
24	Truong Hoang Minh	Lecturer	*Can Tho* University
25	Nguyen Thanh Phuong	Dean of College of aquaculture and fisheries	*Can Tho* University
26	Bui Minh Tam	Lecturer	*Can Tho* University
27	Đang Thi Phuong	Lecturer	*Can Tho* University
28	Đao Minh Hai	Project assistant	*Can Tho* University

Annex 2. Stakeholder workshop participants (20/6/2009)

No.	***Name***	***Position***	***Organization***
1	Pham Truong Yen	Vice Director of Center	Aquatic seed production Center of *Can Tho*
2	Le Ngoc Dien	Vice Head of fisheries Department	Division of aquatic resources management, *Can Tho* City
3	Nguyen Van Yen	Farmer	*Vinh Long* province
4	Nguyen Van Ngo	Head of fisheries Department	Division of aquatic resources management , *Dong Thap* province
5	Tạ Van Thao	Vice Head of fisheries Department	Division of aquatic resources management , *Vinh Long* province
6	Nguyen Ngọc Hai	Head of Catfish farming cooperative *Thoi An*	*Thoi An* Village, *O Mon* district, *Can Tho* city
7	Tran Van Hoang	Fingerling Union *Hoang Thanh*	Fingerling Union, *An Giang* province
8	Tran Anh Dung	Head of fisheries Department	Division of aquatic resources management , *An Giang* province
9	VoVan Đe	Farmer	*Thot Not* district –*Can Tho* province
10	Đặng Văn Nhân	Farmer	*Thot Not* district –*Can Tho* province
11	Pham Minh Chi	Fisheries service station	*Hong Ngu* district - *Đong Thap* province
12	Lê Xuan Sinh	Socio-economic specialist	*Can Tho* University
13	Lu Tuan	Head of fisheries service station	*O Mon– Co Do* district
14	Cao Anh Tuan	Head of Technology division	*Viet Thang* company
15	Nguyen Đinh Tho	Sale division	*Cargill* company
16	Nguyen Khai Đinh	Vice director	*Vemedim* company
17	Pham Thanh Huong	Officer	Division of aquatic resources management , *Can Tho* City
18	Nguyen Huynh Nhat Quang	Officer	Fisheries service station in *O Mon – Co Do* district
19	Nguyen Tien Diet	Technician	Veterinary of Department, Companny,
20	Ngo Minh Dung	Sale division	*Quang Minh* Company
21	Huynh Van Gon	Sale division	*Cargill* company
22	Nguyen Minh Khai	Staff	Agriculture and Aquaculture extension Center of *Soc Trang* province
23	Lu Tri Tai	Commercial and technical division	ERTD company
24	Nguyen Thanh Tam	Consultant	HTT company
25	Tang Minh Ky	Officer	Fisheries service station in Thot Not –

			Vinh Thanh district
26	Vu Ngoc Ut	Aquaculture specialist & member of climate change research institute, CTU.	*DRAGON Institure,* *Can Tho* University
27	Phan Thanh Lam	Head of Inland Capture Fisheries Division	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
28	Tran Quoc Chuong	Researcher	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
29	Vu Vi An	Researcher	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
30	Đoan Van Bay	Researcher	Inland Capture Fisheries Division – Research Institute for Aquaculture 2
31	Udaya Sekhar Nagothu	Senior Scientist	Bioforsk, Norway
32	Varunthat Dulyapurk	Associate Dean	Faculty of Fisheries, Kasetsart University, Thailand
33	Sirisuda Jumnongsong	Lecturer	Faculty of Fisheries, Kasetsart University, Thailand
34	Methee Kaewnem	Assist Prof.	Faculty of Fisheries, Kasetsart University, Thailand
35	Jocelyn M. Hernandez-Palerud	Aquaculture Consultant	Akvaplan-Niva, Norway
36	Patrick White	Senior Consultant	Akvaplan-Niva, Norway
37	Pham Minh Đuc	Lecturer	*Can Tho* University
38	Truong Hoang Minh	Lecturer	*Can Tho* University
39	Nguyen Thanh Phuong	Dean of College of aquaculture and fisheries	*Can Tho* University
40	Bui Minh Tam	Lecturer	*Can Tho* University
41	Đang Thi Phuong	Lecturer	*Can Tho* University
42	Đao Minh Hai	Project assistant	*Can Tho* University
43	Tran Xuan Loi	Lecturer	*Can Tho* University

Annex 3. Priorities identified by manager group during the Stakeholders workshop

PRIORITY	**1**				**2**				**3**		**4**		
ISSUE	Sea level rise				Flood				Seasonal change		Typhoon		
IMPACTS	Salt water intrusion	Reduced area for aquaculture and production	Change in biological characteristics	Change in river flow	Fish disease	Decline in production	Destroy irrigation system		Fish disease	Reduced growth rate	Destroy irrigation system		Production loss
Cross-cutting Issue: Low economic returns, higher operating cost													
ADAPTATION AND MITIGATION MEASURES	Construction of irrigation system, dike, dam, sludge gate	Aquaculture zoning	Study new species	?	Produce fingerlings without disease	Study chemical and vaccine	Improve farming system	Improve irrigation system	Produce vaccine	Improve seed reproduction	Improve infrastructure	Aquaculture zoning	Improve farming system
Crosscutting Adaptation Measure: Predict Impacts, Use Mass Media													
RESPONSIBLE AGENCY	DARD	DARD	RIA 2, Institute, University	?	Can Tho University	RIA 2	Farmer	MARD (Ministry of Agriculture and Rural Devt)	RIA 2	Research Institute, University	Dept of Planning and Investment	DARD (Dept of Agriculture and Rural Devt)	Farmer
TIMELINE	NOW	NOW	2005		NOW	NOW	2010	2020	2015	NOW	2020	NOW	2010

The Technical Report presents detailed results from the project activities for all interested parties.

The Technical Reports are also available online:
www.enaca.org/aquaclimate

About AQUACLIMATE
Aquaclimate is a three year project coordinated by the Network of Aquaculture Centres in Asia-Pacific and funded by the Ministry of Foreign Affairs, Norway, through the Royal Norwegian Embassy, Bangkok, Thailand.

Title of project: Strengthening Adaptive Capacities to the Impacts of Climate Change in Resource-poor Small-scale Aquaculture and Aquatic Resources-dependent Sector in the South and South-east Asian Region

Start date of project: March 2009 Duration: 36 months