Policy Brief

Impacts of climate change and adapting bio-security measure for aquaculture in northern Vietnam

Executive summary

"Impacts of climate change and adapting bio-security measure for aquaculture in northern Vietnam" project has main objective to assess the impacts of climate change to aquaculture in Northern Viet Nam, and propose adapting measures for sustaining aquaculture development and improving biosecurity. A GIS model has been built to assess the impacts of climate change to major aquaculture system. Impact of climate change on biodiversity of the pathogens of major aquaculture species, impact of climate change on food safety of cultured aquatic organisms; and current use and recommend prudent practice of probiotic and antimicrobial in aquaculture have been studied. Capacity building focuses on coaching and funding research for 4 MSc and 2 PhD students. Also, in this project, policy recommendation for central and local governments; climate change adapting measures for aquaculture farmers, local authorities, and other identified stakeholders, demonstration farms have been developed, introduced and disseminated.

1) Introduction

"Impacts of climate change and adapting bio-security measure for aquaculture in northern Vietnam" project is a non-refundable grant project from The Ministry of Foreign Affair of Denmark. The project focused on main aquaculture areas in the northern Vietnam. It has implemented from December 2011 to October 2017 including extension time. Total grant budget is DKK 4,774,689. Responsible organization is Research Institute for Aquaculture No.1, Danish partners is Department for Veterinary Disease Biology, Faculty of Health and Medical Sciences, University of Copenhagen, UC-HEALTH.

Detail objective of the project are: 1) Assess the impact of climate change on infrastructure, environment and biosecurity of major aquaculture systems of northern Vietnam. 2) Propose and disseminate mitigation measures of climate change for major aquaculture systems in northern Vietnam to authorities, farmers and other stakeholders.

2) Background

Viet Nam is ranked 5th in the world among countries expected to be most affected by climate change. A 1-meter rise in sea level would affect approximately five percent of Viet Nam's land area and eleven percent of the population. Models forecast that this might happen by the end of the next century, and may be even much sooner. Vietnam's aquaculture sector has rapid developments and today the industry generating more than 3 billion US$ for export annually and providing protein for the people. Aquaculture often located in near shore areas or next to rivers or other water ways that might change as a consequence of climate changes. However, the potential impacts by climate change have not yet been identified.

Climate change caused unpredicted severe weather, environment degradation that lead to high mortality of aquaculture species caused by various pathogens. Sea level rise will cause flooding, resulting in loss of tidal aquaculture and coastal areas of Viet Nam. Aquatic animal species are poikilothermic and hence any changes in habitat temperatures will significantly influence metabolism and growth rate, total production, reproduction seasonality and possibly reproductive efficacy, and susceptibility to diseases and toxins. Climate change-induced temperature variation will therefore have a strong impact on aquaculture activities and on their productivity and yields. Increased use of chemicals to control diseases and associated contaminations, contamination and increased risk for transmission of human pathogens. Climate changes may be associated with increased disease problems of the cultured aquatic organisms and lead to increased use of antibiotics and other chemicals to control such diseases.

From a microbiological perspective, climate change including increased surface run-offs exacerbates eutrophication that can potentially increase the frequency of harmful algae blooms, particularly of toxic species. Furthermore, an increase in water temperature promotes the growth of a number of human pathogens normally present in aquatic environments, e.g. Vibrio bacteria like Vibrio cholerae and Vibrio vulnificus leading to an increased risk from handling or consuming fish grown in these waters. Increased

surface run-off will also imply increased fecal pollution of waters used for aquaculture and therefore be associated with higher risks for transmitting pathogens like Salmonella, to the produce and consumers worldwide.

To obtain a basic understanding, to address emerging biosecurity problems and to guide a sustainable aquaculture planning, there is a need to investigate and assess different scenarios of climate change to important areas and aquaculture species. The following main work packages were proposed and implemented:

1. Climate change impact to major aquaculture systems

In this work package the following activities have been done: 1) to further build the current aquaculture maps of the North of Viet Nam which will contain attribute information of areas, cultured species, intensity, investment levels, weather characteristics, water quality, hydrography, topography; 2) to model the different levels of impact of climate change on different aquaculture areas in the North of Viet Nam; and propose potential adapting measures.

The aquaculture maps ware built based on the existing national based maps. Aquaculture thematic layers were updated with information from local authorities through field surveys. Maps were built in ArcGIS 9.x and MapInfo 9.x software using standardized map building methods. Remotely sensed images of various types were obtained from different sources of the government and research institutes that contain the temporal information on vegetation cover, physical infrastructure, land use and other.

Time series of mentioned data have been used to forecast physical changes due to extreme weather conditions by comparing data before and after such events. Topographical data allowed identifying of improved drainage systems to handle surface water run-off to reduce the risk of destruction of infrastructure.

The prediction model was built based on the degree of vulnerability of the aquaculture areas (with the above maps attributes) at each defined level of climate change. The adapting measure models will be built based on the optimization of the adapting investment cost and revenue of the species of each aquaculture area. A Vietnamese PhD student had been engaged in this work package.

2. Climate change and fish biosecurity

In this work package the following activities have been done: 1) Identify the impact of climate change on biodiversity of the pathogens of major aquaculture species; 2) Describe the impact of climate change on major aquaculture systems resulting in food safety hazard; 3) Describe current use and recommend prudent practices of probiotic and antimicrobial use in aquaculture.

To investigate the possible impact of climate change on biodiversity of the pathogens of major aquaculture species, data on distribution and frequency of fish diseases recorded by RIA1 during the last decade were reviewed and analyzed. Main factors that may cause the disease outbreaks and how they are related to climate change were analyzed. Food safety aspects have been studied in this part.

As climate change is expected to lead to changes and possible increased usage of antimictrobials and other chemicals in aquaculture, a research for this subject was carried out with survey on the current use of such substances in aquaculture. Adapting measures will be suggested based on the optimization of cost and benefit of each solution which will also take in to account the environment protection aspect. A Vietnamese PhD student will be engaged in this work package.

3. Policy recommendations, demonstration farms, adapting measures, dissemination

Policy recommendations were developed consider the following: Identification the policy issues; Research relevant background and context; Consideration of alternatives; Consultations with experts and stake holders; Selection of the best policy option; and preparation of policy recommendation. Demonstration training will be carried out at pilot sites as well as at locations with successful climate change adaptation cases. Adapting measures were documented under form of manual which easy to disseminate to the related stakeholders. Dissemination has been done using different methods: meeting/workshops, printed manual and report, project website, newspaper and other media types.

3) Results

Climate change impact to major aquaculture systems

Set of GIS maps have been developed and published online at http://ica.ria1.org/maps, including: Maps of major aquaculture system in northern Vietnam were developed in 2013. A set district-leveled GIS map with scale of 1:5000 of major shrimp areas in Quynh Luu, Nghe An was developed in 2014. A set district-leveled GIS map with scale of 1:5000 of marine cage farming areas in Cat Ba, Hai Phong was developed in 2015.

The model was developed and result showed that coastline is the most affected area by the impacts of climate change, while the western mountain is slightly influenced. In the coastal zone, more dependency on aquaculture has been observed, compared to the western side. The basin of the river is under great impact due to floods and heavy storms in rainy season. Floods, sea level rise and storms are major factors which affect aquaculture systems. On the other hand, low education, poor social services and weak financial capability are factors which can be improved to cope with impacts from biophysical factors. This assessment model allows quantizing all input parameters in the spatial dimension, therefore supports geographical outputs of the results. Further modifications can be made to upscale or downscale the analyses. Also, more parameters can be fed into the model to simulate complexity of the factor interactions in reality.

Research of dependency on aquaculture highlighted that the educational background of farmers explain their engagement in aquaculture better than how long they have worked as aquaculture farmers. Freshwater fish farmers were shown to rely less on aquaculture as it is only generating a supplementary income. In contrast, the shrimp farmers are not only those having the highest share of income from aquaculture but also earning their main living from aquaculture. The fact that both shrimp and fish farmers have diverse source of income shows the unstable or risky nature of aquaculture livelihoods in the study area. The findings suggest that policies promoting aquaculture should focus on training of farmers whilst acknowledging that a diverse income portfolio increases livelihood resilience to external shocks such as extreme weather events, diseases and fluctuating market prices.

Bio-security of aquaculture in the context of climate change

Farmers appeared to have little awareness and concern about the disease aetiology when applying specific antimicrobials. Up to 50% of the shrimp farmers used up to 20 different disinfectants, e.g. chlorine-based compounds, to disinfect water in storage ponds, often without knowledge of the type of disinfectants and their mode of action. A variety of probiotics, vitamins, minerals and herbal extracts were routinely used by mainly shrimp farmers to enhance shrimp immunity. There is an urgent need to provide aquaculture farmers access to diagnostic and independent disease control advisory services and quality medicated feed, since the current indiscriminate use of antimicrobials and other compounds are inefficient, costly, and hazardous to the aquatic animal and farmer's health, the environment and food safety.

There were poor quality of antimicrobial products and inadequate labelling has negative impacts on effective disease treatment; contribute to development of antimicrobial resistance, and the use of such products is associated with food safety and occupational health hazards. There is an urgent need to strengthen diagnostic services, legislation and control of antimicrobial products in shrimp aquaculture and educate farmers on prudent antimicrobial use practices.

Capacity building

4 MSc with project funding have been graduated. 2 PhD students are progressing well and very close to the completion of the PhD. All project funded students are became the key staffs or researchers in aquaculture climate change related field. All of them have been promoted to higher important position in their organization.

Policy recommendation

A comprehensive policies recommendation was proposed and can be summarized as the following main points: 1) New construction and deployment of aquaculture planning taking climate change into consideration. 2) Enhancing awareness and training for the project team involved formulation and implementation of policies for fisheries development as well as local officials, communities and farmers associated with content cope with climate change. 3) Enhancing training and technical qualifications aquaculture cope with climate change. 4) Develop mechanisms to integrate, coordinate and respond to

climate change linked to the development of aquaculture policies of provincial and local. 5) Improvement of current policies of risk mitigation in agriculture and aquaculture against climate change and natural disasters. 6) Develop policies to support scientific research and extend the greenhouse gas reduction activities in aquaculture. 7) Develop policies to promote the breeding research, technical improvements, seasonality aquaculture cope with climate change and rising sea levels appropriate to each eco-region. 8) Additional studies evaluated the impact and determine measures to respond to climate change on aquaculture of each specific culture of each region, sub-region, and type of farming. 9) Capacity building environmental monitoring and medical alert, disaster prevention service of aquaculture.

Adapting measures

Adapting measures have been developed and grouped into the following solution themes: 1) Planning, strategies, policies solutions. 2) Science and technology solutions. 3) Infrastructure investment and improvement solutions. 4) Ecosystem conservation solutions. 5) Livelihood solutions. 6) Strengthening capacity solutions.

Demonstration farms

A research was carried out and the results was 6 demonstration farms (two shrimp farms, 2 tilapia farms, two marine fish farms) was selected, documented and used as demo cases of adapting climate change aquaculture farms. Study tours and on farms workshops had been implemented on the selected farms.

4) Conclusions

The project results had been disseminated to the related stakeholders: a set of update aquaculture maps in Northern Vietnam had been installed and effectively used, a free online version also available for public users. GIS model had been transferred to local authorities for reference in their decision making process. Impact of climate change on biodiversity of the pathogens of major aquaculture species, impact of climate change on food safety of cultured aquatic organisms; and current use and recommend prudent practice of probiotic and antimicrobial in aquaculture have been studied. Research papers had been published on international peer review journals. Capacity building focuses on coaching and funding research for 4 MSc and 2 PhD students. Also, in this project, policy recommendation for central and local governments; climate change adapting measures for aquaculture farmers, local authorities, and other identified stakeholders, demonstration farms have been developed and disseminated.

5) Implications

The project brought significant impacts to beneficiaries: 1) Research and management capacity of RIA1, IEBR, local authorities of Nghe An, Hai Phong and Quang Ninh provinces in the field of climate change have been strengthened. 2) Maps, model have been effectively used by all stakeholders. 3) Policy recommendations have an important reference role to the policy makers to adjust the coming policies. Adapting measures have been positively received and applied by farmers and local authorities. Demonstration farms have been developed and introduced brought new idea and awareness to farmers.

6) Recommendations

Further researches on automated aquaculture mapping, aquaculture climate model development, validation are needed to provide more reliable, accuracy information and options for decision makers. Further researches on alternatives to antimicrobial disease treatments should be investigated to improved farm biosecurity. There is an urgent need to strengthen diagnostic services, legislation and control of antimicrobial products in aquaculture and to educate and allow farmers access to quality drugs and independent advices on prudent antimicrobial use practices. Policies promoting aquaculture should focus on training of farmers whilst acknowledging that a diverse income portfolio increases livelihood resilience to external shocks such as extreme weather events, diseases and fluctuating market prices.