

## **Policy briefs of the project No.11. PO2-VIE “Better use of nutrition resources for sustaining aquaculture production in Central Vietnam under climate change condition”**

### **Executive Summary**

The main objective of the Project is to contribute to the sustainable development of coastal aquaculture in Central Vietnam under climate change conditions through better use of available nutritional resources. With the above objectives, the project activities include four main work-packages: i) Analysis of coastal aquaculture systems in some central provinces, ii) Development of a cost-efficient pelleted diet for a selected carnivorous fish, iii) Study the feasibility of farming models of non-feed based species and integrated multi-trophic species, iv) Communication and dissemination. For development of a cost-effective formulated diet for juvenile permit (short fin pompano), a diet containing DP of 392.7 g/kg and DE of 18.8 MJ/kg (DM), corresponding to a DP/DE of 20.9 g/MJ is suggested as an optimal feed for growth and feed efficiency for juvenile permit, this was obtained by use of high quality ingredients, a partly substitution with vegetable based proteins of local origin was possible but increased the feed conversion ratio. Results of the project also showed possibility to renovate abandoned earthen shrimp pond for nursery hard shell clam to provide seed for local farmers. Culture techniques for selected commercial macro algae species, *Kappaphycus alvarezii*, was improved by selecting the right mesh size of protecting net and by co-culture with Seabass (*Lates calcarifer*), a predator of seaweed grazer. The study on current aquaculture systems in Central coastal region of Vietnam has characterized and proposed adaptive strategies for aquaculture including impact of climate change factors. The implementation of this project, has considerably strengthened the research capacity of the responsible institute – Aquaculture Research Sub-Institute for North Central (ARSINC).

### **Introduction**

The Project "Better use of nutrition resources for sustaining aquaculture production in Central Vietnam under climate change condition" (BCA) is funded by the Danish government. The Project is managed by Aquaculture Research Sub-Institute for North Central (ARSINC) of the Research Institute for Aquaculture No.1 (RIA-1) as the responsible institution in collaboration with Institute of Aquatic Resources (DTU Aqua), Technical University of Denmark. The Project was formally approved by the Danish and Vietnamese authorities on October 03<sup>rd</sup>, 2012 for implementation during 10/2012 to 10/2015 and was later extended to 30/9/2017. The Project sites are at ARSINC and some coastal districts of Nghe An, Ha Tinh and Khanh Hoa provinces. The overall objective of the Project is to contribute to the sustainable development of coastal aquaculture in Central Vietnam under climate change condition through better use of available nutrition resources. More specifically, the project objectives are i) to develop cost-effective grow-out pelleted feed for commercial, carnivorous fish species and by application of non-feed based and integrated multi-trophic aquaculture models in response to the impact of climate change in Central Vietnam, and ii) to propose and disseminate adapting aquaculture options to authorities, farmers and other stakeholders in response to climate change context. The project has four main work-packages: i) Analysis of coastal aquaculture systems in central region, ii) Development of cost-efficient pellet diet for the pompano fish, iii) Study the feasibility of farming models of non-feed based species and integrated multi-trophic species, iv) Communication and dissemination. Results obtained in this project has contributed to better use of nutritional resources for sustaining aquaculture production in the Central coast of Vietnam.

## Background

Vietnam is ranked among the five most vulnerable countries to the impacts of climate change by a variety of international sources. A report has forecasted, that by the end of the century, rice production will decline dramatically and rising sea levels could submerge tens of thousands of hectares of cropland, forcing thousands of families in coastal areas to be relocated and threatening the livelihood of more than 12 million people in Vietnam (ADB, 2009)<sup>1</sup>.

The aquaculture sector in Vietnam has grown rapidly during the last decades and played an important role in livelihood activities, food security, and earning foreign currency. However, the sustainability of coastal aquaculture in Vietnam is under threat by impacts of climate change, including the increasing extreme climatic events such as storms, heavy rainfall, and flooding, resulting in damaged infrastructure (i.e. aquaculture cages and ponds, fishing boats, housing, dikes, soil erosion) and loss of aquaculture and agriculture crops, income and livelihoods. Coastal aquaculture in the Central region is currently dominated by farming of shrimp and medium-high valued marine carnivorous fish such as sea bass, grouper, cobia, pompano, and black sleeper. Already some incidents have attributed to climate changes; such as a case of serious disease outbreaks in shrimp associated with prolonged abnormal hot weather in the Central coast during 2010 causing massive mortality in shrimp farming, especially in Hue province. Another important, though indirect, impact of climate change on aquaculture in this region is an observed reduction in trash fish supply; the food used when farming carnivorous fish. As a result, coastal aquaculture based on trash fish supply as feed will likely become unsustainable. A variety of adaptive measures proposed by FAO (2008)<sup>2</sup> could be used to sustain coastal aquaculture in the region facing climate changes; such as developing aquaculture plans for various coastal ecosystems, improving farm management capacities, introducing alternative aquaculture practices including feed sources and better environmentally adapted species. However, will the alternative options provide feasible livelihoods for the local farmers? These alternative options must be tested and evaluated including the social impact, before being disseminated to the region. It is the purpose of the present project - from a nutritional resource point of view- to try some of the above suggested adaptive measures for alternative livelihoods of local farmers in the region.

The project methodologies for work packages are described as below

### *Analysis of current aquaculture systems in Central coast region*

A Vietnamese-Danish working group was formed to outline the frame of the study and carry out relevant surveys and contacts. The project analysed coastal aquaculture systems in the Central coastal region including current culture practices, current use of feed for coastal aquaculture, farmer's livelihoods and their vulnerability to climate change incidents, and possible adaptation measures of livelihoods (WP1). In addition to the aquaculture systems appraisal, common socio-economic research methods was used including participatory livelihood assessments, standardized surveys and semi-structure interviews. The results was

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<sup>1</sup> Asian Development Bank, 2009. The Economics of Climate Change in Southeast Asia: A Regional Review. ISBN 978-971-561-787-1. Publication Stock No. RPT090153.

<sup>2</sup> FAO, 2008. Climate change for fisheries and aquaculture. Technical report background document from expert consultation. Rome, 7-9.2008. pp 1-18.

also to be used in policy recommendation for promising adaptation measures that are tested and evaluated in the project.

#### *Development of cost-effective diets for permit*

Development of cost-effective diets for permit (short fin pompano) was based on requirement of dietary protein, lipid and DP/DE ratio, as these are fundamental as biological markers for any research in aquaculture nutrition. In addition, partial replacement of fish meal and fish oil with alternative local ingredients of plant or animal origin was investigated for further improving sustainability including reducing feed cost. The developed cost-effective diets were tested for validation of economical aspect of the diets and for optimizing farm management techniques. In addition to growth performance, quality of the fish was examined in terms of proximate composition (i.e. fat content and fatty acid composition). An essential part of research capacity building will be the successful PhD education of a staff from ARSINC.

#### *Application of non-feed based and integrated multi-trophic aquaculture*

Information on recent findings by research together with the findings from the baseline survey (WP1) were utilized to develop possible culture models for on-farm testing of non-feed based and integrated aquaculture. This approach helped shortening the research time and the successful models can readily be disseminated to local farmers. Brackish water ponds were used for development of integrated culture models since they dominate the coastal aquaculture of the region. The main species used for the model trials were tiger - or white leg shrimp, carnivorous fish (i.e. seabass, pompano), omnivorous fish (i.e. salt tolerant tilapia), and 'extractive' species (i.e. seaweeds). Models combining species at different trophic levels with different systems (i.e. polyculture or sequential integration) were tested.

The obtained results and improved technology should be adapted to management and investment capacity of local farmers to generate income. The adapting and demonstration of procedures are - and will be conducted jointly with extension workers from the local Department of Agriculture and Rural Development.

### **Results**

A cost-effective formulated diet was developed for juvenile permit (short fin pompano). The diet containing dietary digestible protein (DP) of 392.7 g/kg and digestible energy (DE) of 18.8 MJ/kg (DM), corresponding to a DP/DE of 20.9 g/MJ is suggested as an optimal feed for growth and feed efficiency in juvenile permit. In additional, replacing 50 % dietary fish meal protein by soybean meal did not effect growth, feed utilization, fish nutritional composition and blood bio-chemical parameters of the fish. Likewise, substitution of fish oil with 50-100 % soybean oil in the experimented diets did not affect on whole body composition (protein, lipid, ash and moisture contents) of fish. Results of the this project showed that fish fed experimental diet (BCA diet) had comparable or even better growth and feed utilization than commercially available feed (two type of commercial diets) which were formulated for other marine fish species. Results of the project also showed, that it is possible renovate abandoned earthen shrimp pond for nursery hard shell clam to provide seed for local farmers. Culture techniques for selected commercial macro algae species, *Kappaphycus alvarezii*, were improved by selecting right mesh size (2 cm) of protecting net and by co-culturing with Seabass (*Lates calcarifer*), a predator of seaweed grazing fish. Based on the results of the study on current aquaculture systems in Central coastal region of Vietnam, adaptive strategies for coastal aquaculture system to various aspects including climate change factors were proposed for this region. Training courses on adaptive aquaculture techniques were organized for farmers. The reviews on known

environmental effects of trash fish- traditional diet in fish farming revealed that the environmental impact whether using trash/food fish is not the main issue, but merely the use of trash fish as a feed resource in fish production. This is because of malpractices in the fishing effort with overfishing and especially that of using too fine meshed nets and it will lead to unsustainable conditions.

Research capacity of ARSINC was improved in terms of human resources and research equipment. Both the director and vice-director of ARSINC were educated and obtained PhD and MSc degrees, respectively. In addition, two more ARSINC staff were also educated and obtained their MSc in this project. Research facility such as experimental tank system with bio-filter and feed pelleting machine were implemented at ARSINC. This will help ARSINC strengthen research capacity in the field of aquatic nutrition and feed development. Twelve scientific papers, of which 3 international peer reviewed papers, were jointly published.

### **Conclusions**

Overall, the findings in this project contribute to better use of nutritional resources for sustaining aquaculture production in coastal areas of Vietnam in the context of climate change. The results will help developing cost-effective formulated diets for permit, which hopefully will improve aquaculture of this species in Vietnam. Other research results related to improved non-feed based aquaculture and integrated farming contribute to adaptive aquaculture techniques and models to farmers.

### **Implications**

The results of this project implicated that nutritional resources can be better used for sustaining aquaculture production as adaptive strategies in responsible to climate change condition. Research capacity built for ARSINC through this project will contribute to sustainable development of aquaculture in Central Coast of Vietnam. Generally, the results of this project show there should be more specific policies to support coastal aquaculture development in sustainable way in adaptation to the impacts of climate change.

### **Recommendations**

This project contribute for development of formulated diet for permit juvenile. The future research focus on development of grow-out diet this species. Other findings on improving non-fish based aquaculture techniques such as nursery techniques in abandoned shrimp pond should also be adopted and disseminated in other location which has similar situation. Suggested adaptive strategies for coastal aquaculture system in Central Vietnam to various factors, including impact of climate change evidence listed in the project reported should be considered by policy makers for better response to sustainable development of coastal aquaculture.