

# **Development of Alternatives to the Use of Freshwater Low Value Fish for Aquaculture in the Lower Mekong Basin of Cambodia and Vietnam**



## **Feed Technology and Policy Development for Fisheries Management**

Technology Adoption and Policy Development/Activity/ 09TAP03UC and 07TAP01UC

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### **ABSTRACT**

The fisheries resources in Cambodia and Vietnam is faced with drastic decline due to the rapid increase in population and illegal fishing activities - many captured fisheries resources have been largely overexploited as well as the increasing competition and conflict between the use of low value/trash fish for feeding and human consumption. The project entitled “Development of Alternative to the Use of Freshwater Low-Value Fish for Aquaculture in the Lower Mekong Basin, Cambodia and Vietnam: Implications for Livelihoods, Production and Markets” will focus on the balancing of social, economic and environmental/natural resources needed between human consumption and aquaculture feeds based on the development of feed and feeding strategies for other fish species. The cost-effective and high-performing compounded AquaFish Snakehead Formulated Feed (ASFF) was developed to have less reliance on using small-size fish and which would have lower environmental impacts. Up to 40% of small-size fish/trash fish were replaced by new AquaFish Snakehead Formulated Feed, other plant ingredients replaced for fishmeal and enzyme or attract supplementation in diet for optimum growth and survival of the snakehead. However, this new CRSP formulated feed technology was less adopted by snakehead farmers in Cambodia than in Vietnam due to some extent.

### **INTRODUCTION**

Mekong River is one of the most productive aquatic resources in the world. Mekong River is the main source of fisheries resources in Cambodia and Vietnam. Particularly in Cambodia the seasonal and permanent wetlands cover more than 30% of Cambodia. The fisheries sector has for many years contributed significantly to the employment and livelihoods of the poor, to food security, and to GDP and foreign exchange balance. Cambodia’s fisheries provide full-time, part-time and seasonal employment for up to 6 million people and the fisheries sector contributes very significantly to domestic food security, providing over 81.5% of the animal protein in the national diet and also forming a critical source of essential vitamins and micro-nutrients.

In addition, the capture fisheries production in Cambodia is estimated to be worth around US\$200-300 million per year at the point of landing and fisheries harvesting, processing and trade contributes 8-12%

of GDP. The value of fish exports has been estimated to be as high as US\$100 million per year (SPFF 2010-2019).

Fish are also part of Cambodia's cultural heritage. The complex and enduring linkage between fisheries and many aspects of the region's history, as shown by the archaeological finds of fish processing and trade through the region and the incorporation of fish scenes into the historic temples of the country, demonstrates the continuity of the importance of the sector both domestically and throughout the South East Asia region. The aquatic environment and the associated rich diversity of species also constitute a very important part of both the national and global natural heritage.

However, the fisheries resources in Cambodia and Vietnam is faced with the drastic decline of fisheries resources due to the rapid increase of population and illegal fishing activities, many capture fisheries resources have been largely overexploited and, as a result, development of aquaculture has been encouraged to provide the protein, income, employment and export earnings to substitute the natural fisheries resources. In Cambodia, for example, freshwater aquaculture production has increased rapidly over the last two decades, with an average growth rate of 16.3%. In 2004, aquaculture represented 8.3% of total inland fisheries production (So, et al. 2005). In Vietnam, the annual growth of aquaculture has been about 10-13% during the last decade. The Mekong Delta region of Vietnam often contributes about 55-60% of the total aquatic production and more than 60% of total aquatic production for export of the whole country (Sinh 2005). Such a development trend implies that sufficient feed for aquaculture production will be available. One source of feed is low value/trash fish<sup>1</sup>. There is a general lack of accurate information on how much low value/trash fish is presently used in Cambodia and Vietnam, but a conservative estimate of 25% for livestock and aquaculture feed has been put forward (FAO-APFIC 2005). The uses of low value/trash fish are diverse and include: (1) local consumption (e.g. fresh, dried); (2) direct feed (e.g. livestock, high value species aquaculture); (3) fish meal production (e.g. poultry, aquaculture); and (4) value-added products (e.g. fish sauce).

There is increasing demand and trade in the region for low value/trash fish for both aquaculture and animal feeds. In Cambodia, for example, it has been estimated that at least 62 freshwater low valued or small-sized fish species are used to feed inland aquaculture. These fish species represent both adult species that are commonly used as food fish, and also juveniles of commercially important fish species. Cage culture uses as much as 50% low value/trash fish in the total feed (So, et al. 2005). In Vietnam, at least 11 species of freshwater, and increasingly a number of marine, low value/trash fish are used to feed inland aquaculture. The price of low value/trash fish has tripled since 2001 and it is predicted to continue to rise as aquaculture expands (FAO-APFIC 2005). The use of artificial fish-based feeds and/or fresh fish resources have further increased pressure on wild fish stocks. Inevitably, a dangerous spiral has evolved where the demand for low value/trash fish for aquaculture feed has supported increased fishing pressure on already degraded resources. It is predicted that as aquaculture grows, it will be difficult to meet the demand for low value/trash fish. There is a general concern that the rapid expansion of aquaculture may ultimately be constrained by the dependence on low value/trash fish and fish meal, popularly referred to as the "fish meal trap". The Asia-Pacific countries may need to increase imports of fish meal from the global market for the aquaculture industry, or replace these with other feed materials. There is a need to address the increasing demand for low value/trash fish by aquaculture by improving feeds for aquaculture through changing over from direct feeding to pellet feeding and reduction of fish meal content by substitution of suitable ingredients in pellets.

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<sup>1</sup> Low value/trash is defined as fish that have a low commercial value by virtue of their low quality, small size or low consumer preference. They are either used for human consumption (often processed or preserved) or used to feed livestock/fish, either directly or through reduction to fish meal/oil (FAO-APFIC 2005).

There is also increasing conflict between the use of low value/trash fish for feed and for human consumption. In some cases, such feeds are comprised of fish species traditionally used as cheap food for people and this allocation of fish resources to aquaculture may result in negative impacts of food security and livelihoods. It is the economics of the different uses of low value/trash fish in different localities that direct the fish one way or the other. There are also trade-offs between direct food benefit and the indirect employment and income generation opportunities afforded by feeding to aquaculture. It has been argued that it would be more efficient and ethical to divert more of the limited supply to human food, using value-added products. Proponents of this suggest that using low value/trash fish as food for domestic consumers is more appropriate than supplying fish meal plants for an export, income-oriented aquaculture industry, producing high-value commodities. On the other hand, food security can also be increased by improving the income generation abilities of poor people, and it can be argued that the large volume of people employed in both fishing and aquaculture has a beneficial effect. This raises some important questions regarding the social, economic and ecological costs and benefits of aquaculture, its sustainability and future trends.

In relation to the above-mentioned challenging issues, the project entitled “ Development of Alternative to the Use of Freshwater Low Value Fish for Aquaculture in the Lower Mekong Basin Cambodia and Vietnam: Implications for Livelihoods, Production and Markets” was implemented. The focus of this project is equally on the aquaculture of carnivorous fish and the management of lower value/trash fish.

The objectives of this investigation aimed to (1) apply the research results and disseminate appropriate technology to the end-users of aquatic resources and aquaculture practitioners, (2) train farmers in the project sites on farm made feeds and benefits of using alternative feed technology, (3) improve feeding practices and promote adoption and change behavior over alternative feeds, and (4) provide scientific-based strategy and information for policy makers to develop policy on aquaculture and aquatic resource management.

## **METHODOLOGY**

This is an activity type of investigation to disseminate information and technology to the end users in form of workshops, conference organization, outreach documents and training sessions. However, the information and technologies can be sent effectively to the farmers, unless we understand on what’s the problems encountered by farmers, what’s information/technologies farmers needed to overcome the problems, and what is the best way to educate them to solve the problem. Therefore, The Participatory Rural Communication Appraisal (PRCA) was conducted to understand the general characteristic of the farmers in the project sites to develop effective communication channel. Seven provinces, namely Prey Veng, Kandal, Kampong Cham, Kompong Chhnang, Pursat, Battambang, and Siem Reap province were selected for the targeted project sites to transfer the AquaFish Snakehead Formulated Feed.

Two types of data were gathered, primary and secondary data. Primary data was collected through interpersonal interview by using the structured questionnaires which designed to understand the general characteristic of the respondents and the most effective communication channel. Secondary data was collected by reviewing related literatures relevant to fish process technologies and existing practical aquaculture technologies which have been successfully implemented by AIT Aquaculture Outreach Program and JICA Aquaculture Development Program in Cambodia. The review aimed to use the technological know-how and knowledge on local fermented feed made for small scale aquaculture development practiced in Cambodia to transform into the printed media for dissemination.

Orientation within the investigation team members was conducted to internalize the team members to be aware of the project document and understand the requirements needed to be accomplished by the members in the process of project implementation.

Inception workshop was conducted at IFReDI to provide awareness to the government fisheries officers, NGOs representatives, local communities, and other relevant stakeholders on AquaFish CRSP Project implementation, especially, to the other relevant stakeholders whose work related to aquaculture development sector as well as to hold consultation among the participants for their suggestions and recommendations.

Consultation meeting with different team members from three investigations in IFReDI was conducted to provide opportunity to all members implementing the AquaFish CRSP projects in IFReDI to be aware of the process and procedure and also the goals and objectives of the whole project. The consultation established a link of each investigation in terms of its activities, planning, and implementation.

Orientation meeting of all US PIs and HC PIs was conducted in Phnom Penh City. The orientation brought all the US PIs and HC PIs to fully understand the process and procedure of the project implementation. Several issues were discussed during the orientation such as: the activities plan, procedure, time frame, budgetary, and reporting system of each investigation, and set out the mechanism for improving communication within the project teams. It was recommended to use Yahoo Messenger or Skype as communication channel among the team members.

Consultation meeting with local fisheries authority was conducted at commune council, in the Lvea Eam District, Kandal Province to explain the main objective of the investigation and overall project implementation arrangement.

Focused group discussion was conducted to generate information among the snakehead fish culture to obtain first hand information on the nature of snake fish culture and problems that farmers encountered during the culture period such as fingerlings, feed, feeding strategy, as well as disease occurrences.

Consultation meeting with commune council leader, village leader, local fisheries officers and fish farmers was conducted to create criteria for selecting farmers for adoption pilot. Thirty (30) poor and active farmers were selected for CRSP home made feed adoption pilot.

## **RESULT**

The main objective of the investigation is to transfer information, technologies and know-how from research results of the project to the fish farmer and end-users of aquatic resources users in both Cambodia and Vietnam. The Investigation was implemented and achieved the following result:

### **1.1 Institutional Capacity Building:**

Conducted two trainings to build the capacity of the team members, (1) Training on “Development of Questionnaires and Design” and (2) Training on “Data Encoding and Analysis”. The team members were trained on the job to design questionnaires and do pre-testing of data collection method as well as encoding collected data into data form of SPSS computer program. These trainings were designed to strengthening and improving the institutional capacity of the Inland Fisheries Research and Development Institute staffs to learn from the data collection to data entries and analysis.

### **1.2 Awareness Raising and Technology Transfer:**

1.2.1 **Awareness Raising:** carried out public awareness activities in the form of Inception Workshop, Impact Assessment Seminar, Information/Communication Monitoring and Evaluation Workshop, and Poster on Freshwater Small-Size Fish Species in Lower Mekong Basin Cambodia-Vietnam.

- **Inception Workshop:** Conducted inception workshop at IFReDI to provide awareness on AquaFish CRSP project activities. More than 40 participants from both national and provincial government fisheries officers, NGOs representatives, local communities, and other relevant stakeholders participated. The workshop aimed to provide awareness and hold consultation among the participants, particularly the stakeholders whose work related to aquaculture development sector as well as to receive their suggestions and recommendations.
- **Impact Assessment Seminar:** organized seminar to provide awareness to fisheries officers, researchers, local authorities, fish farmers, as well as policy makers to understand the impact of using trash fish for snakehead culture and the reduction of utilization of trash fish by substituting with the rice bran and cassava meal 20-40% with the CRSP formulation of home-made feed. The workshop provided awareness-raising on the important role of small-size fish in daily protein intake of local people and the competition between the human being and the aquaculture industry in Vietnam. The workshop also informed on the diversity of freshwater small-size fish species in Lower Mekong Basin Cambodia and Vietnam. This investigation raised awareness on new alternative snakehead formulated feed developed by AquaFish CRSP.
- **Information/communication monitoring and evaluation workshop:** Conducted workshop on Information/communication Monitoring and Evaluation to 41 participants from different stakeholders such as target snakehead fish farmers, local fisheries officers, and researchers to understand the effective use of printed media as channel to transfer information and technology to targeted farmers.
- **Poster:** Published 5,000 copies of 1<sup>st</sup> series Poster on Freshwater Small Size Fish Species in Lower Mekong River Cambodia-Vietnam (Photo 7. Poster). The message in this poster is to provide awareness to the audiences on Freshwater Small-Size Fish species diversity in the lower Mekong River Cambodia and Vietnam.

**1.2.2 Technology Transfer:** Two forms of communication channel, Interpersonal and Printed Media (Poster/Leaflet), were used to transfer technology to the fishermen and other aquatic resources users in the targeted project sites.

- Organized training on Farmer Field School (FFS) to the key fish farmers of the seven provinces of targeted project sites. The training provided opportunity for the fish farmers to get hands on to how to make traditional fish feed by the most successful fish culture farmers in Kandal Province. 26 key fish farmers participated in the training, of whom 11 are female.
- Organized Training of Trainer (ToT) to 21 participants, (3 participants from each province), from seven targeted province project sites. The training designed to build the capacity of the trainees to become a Trainer and also the Extension Worker in order to train other farmers who are interested in adoption of alternative feed for their fish culture. These 21 Trainers/Extension Workers will play a very important role in the dissemination and transferring of AquaFish Snakehead Formulated Feed developed by Investigation III to the fish farmers in Project phase 2 after this new Formulated Feed is confirmed and adopted by pilot farmers.
- Organized training on “Fish Feed Technology” and “Snakehead Alternative Feed” to 30 selected fish farmers for technology adoption pilot. The training was designed to educate

the farmers to understand and have the know-how on CRSP home-made feed for snakehead fish and feeding methodology.

- Organized training on “Logbook Fish Measurement” to 30 selected fish farmers’ pilot for feeding and grow rate record keeping.
- **Poster:**
  - Published 20,000 copies of 1<sup>st</sup> and 2<sup>nd</sup> series Poster on Freshwater Small Size Fish Species in Lower Mekong River Cambodia-Vietnam. The message in this Poster is to provide awareness to the audiences on Freshwater Small-Size Fish species diversity in the lower Mekong River Cambodia and Vietnam.
  - Published 10,000 posters on “How to Make and Use of AquaFish CRSP Home-Made Feed for Snakehead” and distributed to selected fish farmers and snakehead fish farmers in 6 provinces around the great lake and along the Mekong River.

**1.2.3 Institutional Research Collaboration:** This project “Development of Alternative to the Use of Freshwater Low Value Fish for Aquaculture in the Lower Mekong Basin Cambodia and Vietnam: Implications for Livelihoods, Production and Markets” provided opportunities for international travels to participate in international conferences and workshop which this opportunity has not only built institutional and staffs capacity but also established networking and linkages between and among the research institutes, universities, and development institutions around the world.

## DISCUSSION

The main goal of this investigation is for sustainable freshwater aquaculture development and innovative fisheries management systems in the Lower Mekong basin region of Cambodia and Vietnam. This main goal takes into account that the main driver of this project is the continued expansion of aquaculture and its dependency on capture fisheries for low value/trash fish for feed. It also takes into account that: capture and culture fisheries continue to play an important role in the food security, poverty alleviation and economies of both countries; the strong interdependency between capture fisheries and aquaculture; management of these two sub-sectors cannot be carried out in isolation of each other; there is increasing local and intra-regional trade for low value/trash fish products; and there is increasing competition and conflict between the use of low value/trash fish for feed and human consumption.

Balancing of social, economic and environmental/natural resource needed between human consumption and aquaculture feeds are based on the development of feed and feeding strategies for other fish species, further on-farm trials of feed formulations, policy and technology for trade and value-added product development for low value/trash fish, development of farm made feeds, improved management strategies for capture fisheries, and policy development for sustainable aquaculture and capture fisheries.

Investigation 09TAP01UC in the first phase of this project (*Implementation Plan 2007–2009*) had problems due to underestimating that the new technology for snakehead formulated feed will be developed by the first year of the project implementation. But the development of AquaFish Snakehead Formulated Feed took longer time than our expectation. This investigation in the second phase of the project (*Implementation Plan 2009–2011*) is continued to develop the new technology for snakehead formulated feed with cost-effective and high performing compounded feeds that had less reliance on using trash fish and which would have lower environmental impacts. The study designed to determine the capacity of trash fish that could be replaced by new AquaFish Snakehead Formulated Feed, other plant

ingredients replaced for fishmeal and enzyme or attract supplementation in diet for optimum growth and survival of snakehead.

The new AquaFish CRSP developed technology for snakehead formulated feed was commercialized by more than 10 snakehead feed producers in Mekong Delta Vietnam with remarkable results, proven and adopted by the farm trials and farmers pilot adoption as well as snakehead farmers in general.

Thirty (30) snakehead farmers were trained on new CRSP AquaFish homemade feed in Lvea Em District, Kandal Province in Cambodia for farmer adoption pilot. The farmers can replace their trash fish by rice bran and cassava up to 30-40%. However, the farmer adoption rate was high during the first month after stocking fish and most of snakehead farmers stop feeding their snakehead with CRSP home made feed after three months due to: (1) their fish getting big after three months and can eat trash fish with grinding, (2) the cost of rice bran and cassava the same as cost of trash fish, and (3) homemade feed pay more cost on gasoline for engine to grind and labor cost to mix the feed.

On the other hand, the new CRSP AquaFish Snakehead Formulated Feed and Homemade Feed were publicized for broader fish farmers, aquaculture practitioners, and commercial uses through printed materials such as poster, leaflet, trainings, extension workers as well as workshop to disseminate this new CRSP AquaFish Snakehead Formulated Feed technology to peer and relevant researchers to achieve the overall objective to transfer the adoption of new feed technology to the end users.

### **CONCLUSION**

The project addressed a critical gap in terms of institutional capability of Inland Fisheries Research and Development Institute (IFReDI) to implement information and communication interventions targeted at specific users of fisheries resources who are causing fisheries resources degradation problems that affect fisheries and aquaculture productivity, profitability, and food security. The project has built not only institutional and staff capacity but also established networking and linkages between and among the research institutes, universities, and development institutions around the world.

The project addressed urgent fisheries resources degradation problems which are related to improper uses of feed technology in aquaculture development and other agricultural activities around the Great Lake, in particularly, and in the Lower Mekong River Basin Cambodia and Vietnam, in general. More than 20,000 of farmers are aware of Freshwater small size fish species diversity through the publication of poster. The project provided awareness on the importance of balancing use of freshwater small size fish in the Lower Mekong River Basin in Cambodia and Vietnam. The project has established effective linkages between researchers and communicators. The research results were applied to develop appropriate technologies to disseminate technical information and provide awareness and better understanding of the importance of low value fish, feed meal technology and feeding practices to the fish farmers which significantly reduce dependence on capture trash fish for feed and feeding in aquaculture activities.

The project produced more impact and benefit to farmers and users of aquatic resources after the new AquaFish Snakehead Formulated Feed and homemade feed has been tested, proven, and adoption by farm trials and farmer adoption pilot. The adoption of new CRSP AquaFish formulated feed and homemade feed led to reduction of the utilization of small size fish for snakehead culture in both Cambodia and Vietnam.

### **ANTICIPATED BENEFITS**

These investigations provided direct and indirect benefit to different stakeholders such as: group of fish feed producers, fish farmers, aquaculture specialists, extension workers, and the people who live in

Mekong Delta. Especially, women, children, and elders whom often involved in fish made feeds and fish feeding practices.

More than 1,000 fisheries officers, NGOs representatives, local authorities, and other stakeholders worked related to aquaculture, fish farmers, and fishermen in the lower Mekong basin of Cambodia and Vietnam were aware and informed on the project implementation. Moreover, 47 of fish farmers in Cambodia were trained on farm made feeds, feeds and feeding strategies and 21 of key fish farmers were trained in a training of trainers to become extension workers. More than 20,000 farmers were aware and gained knowledge on species diversity and composition of freshwater small size fish in Mekong River Basin of Cambodia and Vietnam through the CRSP Poster. More than 10,000 fish farmers and aquatic resource users received relevant information and appropriate technologies on CRSP AquaFish Snakehead Formulated Feed and homemade feed technology. However, the new CRSP AquaFish formulated feed and homemade feed technology will continue to be widely disseminated to other fish farmers, aquaculture practitioners, feed makers, and other aquatic resource users in Cambodia and Vietnam even though the project finished.

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