might increase their knowledge and skill and may create opportunities of employment and increase income earning for improving their participation in the family decision making process which in turn empower the rural women in their family and society. With the support of local and national governments, NGOs and international organisations, the participation of rural women in aquaculture can be increased through well-planned projects which put emphasis on manpower development at the grassroots level. It may also necessary to establish institutional and policy support, financial support as well as extension services to women for active participation in aquaculture activities.

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# Strengthening capacity of small holder ASEAN aquaculture farmers for competitive and sustainable aquaculture

Globally aquaculture is recognised as the most rapidly growing food production sector with an average growth of 8%. More than 90% of the global aquaculture production is contributed by Asia and more than 90% of this production is reported to be produced by the small scale aquaculture farmers. However, globalisation is changing the way commodities are traded and small farmers are largely unorganised, sometimes being illiterate or not adequately literate enough to deal with the increasing restrictions being imposed, they are confronted with many challenges. The ASEAN foundation has the mission of helping farmers of ASEAN countries to improve their livelihoods by improving not only husbandry practices, but also enhancing their entrepreneurship that would help them to improve their livelihoods.

In ASEAN countries, aquaculture is an important activity and millions of small farmers are engaged in this activity to earn their livelihood. Fish being a major animal protein source in ASEAN countries, greater importance is attached to ensure healthy fish and its products availability to all sections of the population. Recognising the importance of aquaculture in the region the ASEAN Foundation has supported the project "Strengthening the capacity of small holder ASEAN farmers for competitive and sustainable aquaculture" through NACA to accomplish the ASEAN vision of 2020. The project has the objectives to improve the competitiveness of ASEAN aquaculture small holders in the domestic, regional and global markets, to improve sustainability of their farming systems, to make them adopt responsible farming practices and improve their profitability.

Five ASEAN countries, namely, Cambodia, Indonesia, Philippines, Thailand and Vietnam were chosen as the representative countries for implementation of the project. Following the inception workshop, based on the interest expressed by each of the countries, following five commodities have been chosen in five different countries

In Cambodia, snakeheads contribute to the food and economy of people immensely. These group of fishes were cultured in cages and ponds for several decades by feeding them with small fishes. In 2005, Cambodia, banned the culture of this species as all farmers were using seeds collected from wild and fed them with fresh fish caught from wild. In order to develop better feed management practices and explore the culture of snakeheads using other feed resources, Cambodia has chosen snakeheads as the commodity.

Indonesia has made a very good progress in breeding of groupers and sea bass and several small farmers are engaged in culturing these species both for local as well as export market. As the livelihood of several farmers is dependent on the culture of these species, Indonesia preferred to work on groupers and sea bass as the commodities.

Tilapia being the most rapidly growing and widely cultured commodity, Thailand expressed its interest to work with farmers engaged in farming of tilapia in cages as well as ponds. Among the 573,090 farms engaged in fish culture, nearly 39% of the farms are actually involved in tilapia culture and tilapia farms are growing at an average of 5% per year.

Sea weed cultivation has contributed immensely in providing livelihoods to several farmers in Philippines. It is reported that there are over 160,000 families engaged in sea weed cultivation and the country has earned over 72 million USD in export during 2005. However, with the increasing quality requirements in the international markets, farmers are facing many challenges in the declining environmental qualities that are contributing for the increasing crop failures and declined profitability. To address these problems Philippines decided to work with farmers engaged in sea weed farming.

Vietnam has demonstrated its entrepreneurial approach in developing market for various aquatic products. The country is earning over 4 billion USD from aquatic products export and shrimp constitutes a major component of the export. Although, shrimp farming is continued to be practiced widely in the country, like in many other countries, the activity has been affected by the disease problems. Hence, Vietnam chose to work with shrimp.

## Needs assessment

Each of the participating country carried out detailed needs assessment of the farmers dealing with the commodities they had identified. Focus group discussions, structured surveys and the secondary information collection from various agencies involved with the commodity in each country provided the issues that need to be addressed to build the competitiveness of farmers. However, there were common elements in all the commodities and these remained same in all countries, irrespective of the commodities.

As the farms are generally small and the scale of operation being limited, to reap the greater benefits from the markets, farmers need to be organised. This will help to increase volume of commodity availability for the buyers and also get the best possible price. When the farmers organise themselves in to groups, efficiency of the service delivery can be increased and farmers can also procure various materials in bulk. The benefits are many, but the challenge is to organise them in to groups and ensure sustainability to the group with good leadership.

Lack of capital is an issue in all countries and in respect of all commodities. The availability of capital at the right time to the farmers with easy terms of reference is the major problem. Although banks in all the countries have priority to lend money to farmers, the procedures involved being complex, farmers tend to borrow money from other sources with high interest rates when possible or otherwise, they restrict their activities.

Market access is frequently an issue. Farmers do not have the right information on the market in almost all countries, though in some countries like Thailand, there is not so much difference between the farm gate price and price of fish in the wholesale market. In general, farmers become obligated to middlemen who finance the culture operation when farmers need money and at the end, buy the product with bigger discounts coupled with several other extraction methods. In some countries like Indonesia, the price of groupers between farm gate and the retail market is nearly 100%. Farmers can derive enormous benefits by organising themselves into groups to obtain the best price.

Excepting for the local farmer to farmer exchanges of information that have been occurring more informally, farmers are confronted with the challenge of obtaining the necessary market information and technical issues that are essential to be successful. Existing traditional government support systems in most countries, though they make an effort to reach the farmers, because of the inherent problems, have not able to provide the required level of information that is required by farmers who are also widely scattered and unorganised.

Most importantly changing export market requirements on various sanitary measures being imposed by importing countries are hardly understood by farmers. They need education on better farming practices that are environment friendly and help to produce commodities that are healthy for acceptance in the international markets.

## Training of trainers program

Based on the needs assessment carried out by all the participating countries, a training of trainers program was designed taking in to consideration of several needs brought out through the study. The training not only looked at greater depth on the technical necessities identified, but also helped train participants on how better management practices that can be evolved for each of the species that are being dealt with by different countries. Examples were drawn from the practical experience of NACA in developing such best management practices for shrimp in India and Indonesia and pangasius in Vietnam were shared with the participants. In all the species cultured, the biggest technical problem confronted by the farmers is the disease. As better management practices aim in part to reduce the risk of disease, participants were given examples from shrimp on how the most dreaded viral diseases can be prevented by organising farmers into groups, obtaining healthy seed from the hatchery through adoption of strategies that include even the selection of brooders and checking their health, followed by checking of

the larvae by using advanced techniques like nested PCR, ensuring stocking of seed by the group of farmers at a time, taking precautionary measures in case of outbreak of disease to prevent its spread, etc. In India, Indonesia and even in Vietnam this disease problem could be prevented by the adoption of the above stated better management practices.

Feed is the major input cost in all the aquaculture systems. With the increasing feed cost and the declining feed prices, if the farmers do not adopt proper feeding practices, profitability declines drastically. It is because of this farmers not only need to have good knowledge on feeding practices, but also have the ability to produce homemade feeds that can reduce the costs substantially. Commercial companies have now come up with feeds that are specific to species and have succeeded in improving food conversion ratio by improving the quality of feed. However, as the cost of the feed of these commercial feeds is always on increase, wherever possible, farmers can produce homemade feed to reduce cost of production. Water quality is another major factor that has been affecting all cultured organisms and suggestions were made on how to maintain good quality water.

Market issues being a key factor, participants were educated on dealing with volatility of the market and planning their culture taking in to consideration of market targeted and produce products that can fetch the best price in the market. In order to have information on markets as well as other aspects of technology, information technology plays critical role. Examples from India, Indonesia on how the farmers have been able to use the information technology to address various problems was presented. In addition, a detailed account on using different internet communications to obtain technical information and solve were demonstrated. In India, shrimp farmers have been able to organise themselves and establish direct link with buyers in USA and this has helped farmers to get premium prize for the shrimp produced by small farmers.

Organising farmers into groups and the enormous benefits that they can derive from disease prevention, production of quality product through mutual sharing and caring, access to markets, information and even credit, impressed the participants. The guidance and support necessary for the farmers in the early stages for the formation of groups and adoption of democratic process to develop their own rules and regulations through participatory process and election of office bearers were identified as the key factors for the success of the organisation. Gender being a key issue, participants were enlightened on how a gender balanced approach can empower both men and women in the community. The Thailand Department of Fisheries being recognised for its role in addressing gender issues was used as an example on how the sustained efforts can bring solutions to the major problems.

The training program also provided an opportunity for the participants to present their findings and the strategies they wish to adopt to address the problems confronted in respect of the commodities that they are dealing. A plan of work on how they will proceed in respect of developing training manuals for each of the commodities was discussed and agreed upon.

Participation of the ASEAN Executive Director in the closing ceremony and his eloquent presentation on how ASEAN is aiming to bring common vision among the ASEAN countries and also assisting large number of farmers who form back bone of the ASEAN economy helped participants to understand the importance of the work they are carrying out. He appreciated the progress made by the project and indicated that if the project outcome demonstrate the greater benefits, the Foundation will explore ways to support the activities to get the desired output. Hence, he requested the participants to make use of the knowledge attained to address the problems encountered in the field and aim at getting the results that would be worthy to scale up.

## Development of training manuals

Based on the knowledge gained and the skills acquired in the training of trainers workshop, participants worked in close partnership with various stakeholders and have prepared the draft manuals necessary for each commodity. The manuals specifically aim at addressing the issues identified by farmers and build their capacity to evolve better management practices, besides addressing other issues through group approach. Using these draft manuals as the basis trainings have been conducted in all the five countries. The training manuals are expected to be revised based on the input provided by farmers to make them user friendly.

## Training of farmers in different countries

### Seaweed cultivation

As already stated, large number of farmers are engaged in sea weed cultivation in Philippines. Farmers are able to make good profits when they are able to harvest crop successfully and get good price in the market. The major problem of farmers is only getting good information on the market price, but also getting credit during the culture operation to meet the livelihood expenses. Maintaining the quality of the harvested sea weeds through proper drying process is another major problem. Further when the seaweed are infected with the disease, getting the disease free planting material has been a major challenge.

Taking the above points in to consideration, training manual has been designed to evolve best management practices that can help farmers to produce good crop of sea weeds and obtain the best price in the market. In a five day training program held in November, 2009, with the participation of fifty farmers, they learnt about the best farming practices with the involvement of trainers from the processing sector, researchers dealing with the sea weed diseases, extension specialists, etc. After two days of class room discussion, farmers spent time in the field to learn about the practical aspects of seaweed cultivation and processing.

These farmers have been organised in to groups and assisted to use the knowledge and skills acquired in the field. As the MCPI Corporation involved in seaweed processing is also involved in the project, it is hoped that the farmers would get the best benefit from the industry perspective.

## Snakehead culture

Farmers on the Great lake of Cambodia have initiated the cultivation of snakehead *Channa striata* in cages using homemade feed. Fisheries Administration has granted permission for the farmers to conduct the experiment with a view to evolve new culture methods that will help to reduce the usage of trash fish. Farmers are now using trash fish unsuitable for human consumption along with large quantity of good quality rice bran rice bran and silk cotton leaves powder. The proportion of these feed ingredients would vary based on the cost and availability in the market. Farmers have reported good growth of fish on the feed and the trials are in good progress. Although pellet feed specifically designed for snakeheads is now marketed, it is yet to found acceptability by farmers because of cost and food conversion efficiency.

It is also important to record here that farmers have been able to breed the snake head successfully and produce small amount of seed. Farmers are confident of producing the seed locally, if the government lifts the ban on its cultivation and allow people to cultivate.

Training for two batches of farmers comprising twenty farmers from Siem Reap and another twenty from Pursat province has been planned. In the training conducted in Siem Reap in Dec, 2009, farmers shared the knowledge they have generated in seed production and growing fish successfully using the home made feed. Experts in the training assisted farmers to understand the developments made in the production of seed, nutritional requirement studies and how to make made feed can be prepared using different feed resources.

In the group discussion held involving both husband and wife of the cage farmers, they identified lifting of Government ban on cultivating snakehead as the most urgent necessity. In the absence of such a rule that facilitates them to carry out the culture, farmers are subjected for exploitation. In addition, farmers recognised credit availability as the second urgent necessity to enable them to withstand the financial shortages and plan marketing of fish when the price would be high.

Farmers have agreed to establish themselves in to a group and work collectively to develop best aquaculture practices for the culture of snakeheads. Based on the results obtained, the government will be appraised with a view to also farmers to undertake culture of snakeheads using homemade feed.

## Groupers and sea bass cultivation

Twenty farmers involved in grouper and sea bass farming participated in the two day organised in Lampung in the Marine Fish Culture Station in December 2009. Farmers discussed the best ways to cultivate fish in cages to meet the market standards. Although at present they use largely trash fish for cultivation, they are gradually realising the benefits of using pellet feed, mainly to prevent disease problems. As the culture period for groupers take long time, small farmers are facing the problem of credit and they often depend on the middlemen to borrow the required amount under an agreement that grown up fish would be sold. Because of these obligations, farmers do not get the best price they deserve to get and hence the need for them to get organised themselves in to group and initiate saving related activities was discussed.

These trained farmers are expected to be given follow up support to establish the group and help them carry out the activity. As there is huge difference in the farm gate price and the international retail price, it is hoped that farmers would be able to benefit largely from such an effort.

## Tilapia cultivation

As the farmers in Thailand are facing major disease problems in the cultivation of tilapia both in ponds and cages, the training focused on building the capacity of farmers in preventing disease problems in tilapia cultivation by adopting good practices. When the disease occur, steps that need to taken to prevent the spread of disease were taught to farmers. Lead farmers who participated in the training provided inputs on the design of the training manual to their requirements. Farmers have indicated that the manual, in addition to being a reference material, it should serve as record book. Farmers have also suggested to produce the posters on various aspects of culture of tilapia so that they can utilise the same in training farmers. Existing training materials in the Department of Fisheries would be modified to suit the necessities.

Extension specialists also trained lead farmers on the effective communication methods to help farmers have the required level of confidence in the field.

## Shrimp cultivation

Some of the self organised groups in Vietnam have been successful in growing shrimp successfully without any disease problems. These farmers have evolved the good practices that will help in the disease prevention and even in case, there would be a disease outbreak, sufficient measures have been developed to prevent the spread of the disease. As the farmers are organised in to group and follow well established norms like stocking healthy seed and all stocking almost at the same time in an area, use of pellet feed instead of trash fish or use the well proceed homemade feed, prevent unnecessary exchange of water, dissemination of information to all other farmers in the area in case of the disease outbreak, etc.

In contrast to the above, in several areas, farmers not being organised are confronted with many challenges with frequent crop failure or very low yield. For example, farmers in Ninh Binh Province are faced with such crop failures and an effort is made through this project to educate farmers on how the problem could be eliminated by following the best practices. In the training, farmers were educated on the need for group formation since the spread of disease will be rampant, if there is no coordination among farmers. Starting from preparing pond properly to stock seed, obtaining tested and disease free seed for stocking, feeding either pellet feed or well cooked homemade feed to prevent the virus introduction through uncooked trash fish, periodic checking of the seed for health and on how to manage the disease in case of disease occurrence, etc were taught to farmers.

A large number of women participated in the training program along with men. In the group discussion, men and women identified the activities they can carry out efficiently. Further, women were also categorical in stating that all the activities men can do, they also can do in shrimp farming. As the work is divided between men and women, each continue to

specialise in their area of operation, but if necessity demands, each can carry out all the activities. However, it was identified that both men and women should be trained to enable them to carry out the activity in the family as a team.

Following the training, based on the expressed desire of farmers, a field trip for the selected group of farmers was organised top see the shrimp farming activity in Ham Ninh commune in Quang Binh province. The farmers could see themselves on how the shrimp farming can be carried out successfully by getting themselves organised into a group. Each farmer in the group is successfully harvesting two crops of shrimp with tiger shrimp cultivation being taken up high saline season followed by the white leg shrimp in the monsoon season. Farmers could learn about the type of coordination needed in shrimp farming to prevent disease and how quality inputs can be obtained by organising in to groups.

Farmers have planned to form group in Ninh Binh province and undertake shrimp farming following the good practice of Ham Ninh commune. Farmers from Ham Ninh Commune have promised to help the farmers in Ninh Binh to establish the farmer groups and initiate the activity. All this would depend largely based on the leadership and it is hoped that, having seen the success with the follow up support, they would initiate the activity on the similar lines.

The Vietnam team has also developed a good pictorial guide on the benefits of forming farmer organisation. This manual would be useful to all countries in educating people on establishing farmer groups.

## Conclusion

The project has been able to accomplish most of the anticipated outcomes owing to the active interest and support extended by the participating countries. As all the commodities identified by different countries are significantly important from the trade, the project has focused on building the capacity of people in meeting the market requirements both domestically and internationally. Access to information is key not only for the successful culture of the aquatic products, but also for profitable marketing. Since buyers require the product in bulk, if farmers become organised, they can have better bargaining power.

In the coming months, project is expected to provide support for the formation of groups and help them begin best aquaculture practices. All these experiences will be shared among all the ASEAN countries in the workshop scheduled to be held in August in Vietnam.

# Carp seed production at rural front in Orissa, India

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The availability of quality seed is prerequisite for rapid expansion and growth of aquaculture. However, uncertainty in timely seed supply is one of the major constraints. Considering its significance constant efforts have been made to produce large quantity of carp seed every year in increasing trends. For instance, the total fry production in India was estimated at 632 million in 1986-87 which had increased to 18.5 billion in 2002-2003 and in 2005-06 it was over 22.6 billion. Quantified data on larger size fingerlings and/or yearlings are not available, although it is much needed for grow out culture.

Fish seed production includes egg to spawn production for 3 days, spawn to fry nursing for 15-20 days, fry to fingerling rearing for 60-90 days and fingerling to yearling rearing for 8-9 months. Thus the carp seed may be categorised at its final size into spawn (6-8 mm size), fry (20-25 mm size), fingerlings (100-150 mm size) and yearlings (100-200 g weight).

*Mass production of carp eggs in a spawning pool.*

The distribution system of carp seed is complex and dynamic. Though some of the entrepreneurs produce and supply the fish seed to end users often as a part of complex networks, their supply remains erratic in other part, particularly in rural sectors[1]. The gap between demand and supply of quality seeds, by and large, remains a daunting task in rural aquaculture development. This can be mitigated, if village farmers produce quality carp seed in their ponds to not only make the access of locally produced and nursed quality seed to the fish farmers but also stimulate and support neighbouring farmers to adopt fish culture within their situation. Earlier studies indicate that paucity of carp spawn compelled village farmers to stock their ponds with riverine fish seed[2] and due to lack of technical support and basic infrastructure facilities; carp breeding was rarely adopted by farmers[3]. In view of this various attempts have been made to demonstrate carp breeding[4-8], spawn to fry rearing and fry to fingerling rearing[6, 9-22] and fingerling to yearling rearing[21]