# Extension in shrimp health management: experiences from an MPEDA/NACA program in Andhra Pradesh, India

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Asia is the major supplier of black tiger shrimp (*Penaeus monodon*) to the world seafood market. The majority of Asian shrimp farmers are small-scale holders operating low input and low output farming systems. Disease is regarded as the major bottleneck for successful and sustainable shrimp farming in many parts of Asia. White spot disease (WSD) caused by white spot syndrome virus (WSSV) alone has been responsible for significant social and economic damage to the shrimp farming sector since 1993, and is a major source of risk to the livelihoods of small-scale farmers investing in shrimp farming. Addressing shrimp disease risks among these stakeholders is essential, but much ignored requirement, to sustain the livelihoods of small-scale farming communities in many of Asia's coastal regions.

In India, a new initiative on shrimp disease control was started in 2000 by the Marine Products Export Development Authority (MPEDA), Ministry of Commerce and Industry, Government of India with technical assistance from the Network of Aquaculture Centres in Asia-Pacific (NACA). This article describes the main activities and outcomes from this 3-year "Shrimp disease control and coastal management" program.

## Shrimp disease risk factor study

Following some preliminary consultations with farming communities and planning work in 2000, a detailed study was conducted on shrimp disease problems during 2001. The study, involving 365 ponds in West Godavari and Nellore districts of Andhra Pradesh state, used an epidemiological approach to better understand the key risk factors contributing to shrimp disease outbreaks and low pond production,

*Members of the Sri Subrahmanyeshwara Aqua Club, Mogalthur with MPEDA/NACA study team*

*Left: Mr. Gubbala Narayana Murthy is the active and dynamic leader of the Sri Subrahmaneshara Aqua Club*

*Below: Technical assistants interviewing a farmer* with an emphasis on the economically serious "white spot disease". The outcomes of the study provided better understanding of risk factors for white spot disease outbreaks, and factors causing unusually low pond productivity, and recommended management strategies (so called "better management practices" – BMPs) to reduce the identified risks. Towards the end of 2001, results were discussed widely with farmers and other agencies in Andhra Pradesh and some consensus was reached on the study findings and their practical application to improve performance of shrimp farming systems of Andhra Pradesh.

## Farm level demonstration of "better management practices"

During 2002, demonstrations were conducted on five selected private farms, involving 10 ponds, in three villages in West Godavari and Nellore. NACA and MPEDA provided technical assistance to demonstration farmers for on-farm testing of BMPs, and supported monitoring and evaluation to understand benefits and constraints. The demonstrations were also used to more widely disseminate information on risk management strategies to farmers. Although the adoption of BMPs did not completely eliminate shrimp disease problems, the outcomes as judged by participating farmers and the MPEDA/ NACA study team were very promising. Adoption of pond level risk management practices led to improvements in both profits and productivity. In demonstration farms, returns shifted from a loss in 80% of ponds in 2001 to a profit in 80% of ponds in 2002. During District level workshops in November 2002, with over 470 farmer participants from Nellore and Bhimavaram, farmers responded positively to the findings, and requested urgent support for more demonstration activities, and initiatives to extend the concept of BMPs to the wider farming community. The 2002 demonstrations further provided valuable insight into factors influencing adoption of BMPs by farmers, with farmer knowledge, willingness and capacity to adapt BMPs to on-farm conditions and

### Farmers and farm types

The village demonstration was conducted in Padamattipalem area of Mogalthur village. From an initial field survey during January 2003, a total of 256 aquaculture ponds spread over 125 ha of land belonging to 98 farmers were identified. Out of these, 58 farmers with 108 ponds spread over 58 ha volunteered to work with the study team and came together to form the "Sri Subrahmanyeshwara Aquaclub" to implement BMPs through a cooperative approach. The farmers involved were mostly small-scale farmers, with on average 2 ponds of one ha water spread area. Improved traditional farming with low investment ($ 1000/ha/ crop) is practiced with an average stocking density of 25000 PLs/ha. To sustain livelihoods and maximize incomes, farmers also follow crop rotation, with paddy and/or finfish

**Box 1: Mogalthur BMPs: Pond bottom and water preparation**

1. Sludge removal and disposal away from pond site
2. Ploughing on wet soil if the sludge has not been removed completely
3. Water filtration using twin bag filters of 300 micron mesh size
4. Water depth of at least 80cm at shallowest part of pond
5. Water conditioning for 10-15 days before stocking

**Box 2: Mogalthur BMPs: Seed selection and stocking practices**

1. Uniform size and colored PLs, actively swimming against the water current
2. Nested PCR negative PLs for WSSV (using batches of 59 PLs pooled together. If test turns negative it means that the prevalence of WSSV infected PLs is less than 5% in that population at 95% confidence)
3. Weak PL elimination before stocking using formalin (100 ppm) stress for 15-20 minutes in continuously aerated water
4. On-farm nursery rearing of PLs for 15-20 days
5. Stocking during 1st week of February to 2nd week of March
6. Stocking into green water and avoiding transparent water during stocking

**Box 3: Mogalthur BMPs: Post-stocking and grow-out**

1. Use of water reservoirs, and 10-15 days aging before use on grow out ponds
2. Regular usage of agricultural lime, especially after water exchange and rain
3. No use of any harmful/banned chemicals
4. Using of feed check trays to ensure feeding based on shrimp demand
5. Feeding across the pond using boat/floating device to avoid local waste accumulation
6. Regular removal of benthic algae
7. Water exchanges only during critical periods
8. Weekly checking of pond bottom mud for blackish organic waste accumulation and bad smell
9. Regular shrimp health checks, and weekly health and growth monitoring using a cast net
10. Removal and safe disposal of sick or dead shrimp
11. Emergency harvesting after proper decision making
12. No draining or abandoning of disease affected stocks

*Manual removal of sludge*

*Well prepared pond*

financial resources all contributing to outcomes. Based on the findings from 2001 risk factor study and the 2002 demonstrations, BMPs were further modified and were published in a "Shrimp health management extension manual" (MPEDA/NACA, 2003). The manual is freely available for download at www.enaca.org/shrimp and www.mpeda.com.

## Village demonstration

During 2003, MPEDA and NACA responded positively to the farmers requests and supported an extension of the technical assistance, for further demonstrations in one village in West Godavari. The objective was to promote adoption of BMPs across a wider number of farmers to create a visible and quantifiable impact on the village community. A further objective was to support the village to organize a "self-help group" (aquaclub) for organization among farmers in the village to collectively address common shrimp health and farm management problems.

The core NACA/MPEDA team lived in Mogalthur village during an entire cropping cycle, promoting adoption of BMPs, supporting farmers to establish the "aquaclub", facilitated weekly farmer meetings, and organised "service provider - farmer" contacts and exchange of information thus trying to build up mutual trust among the these parties. At the same time, the team established a monitoring program and at the end of the 2003 crop evaluated with farmers the outcomes of the village demonstration, to better understand the benefits and constraints to adopting better health management practices.

crops during the rainy season. The main shrimp cropping season is from March to July.

## Health management practices

Shrimp health management practices were developed in consultation with local farmers, based on general BMP principles derived from the 2001 risk factor studies and 2002 demonstrations.

### Pond bottom and water preparation

During January and February 2003, pond bottom preparation and water conditioning prior to stocking was strongly emphasized. The BMPs are summarized in Box 1. At this time, support was also provided in crop planning.

### Seed selection and stocking

Seed quality and the pond environment at stocking has a critical influence on crop outcomes. In this area farmers had previously paid little attention to PL quality, and most had never had the opportunity to select quality seed. Farmers used to purchase seeds from traders or local nurseries, which are often poor quality. The team assisted the farmers to organise into small sub-groups of 5-10 members to visit the hatcheries and select better quality seed. PCR testing and on-farm nurseries were also promoted. The BMPs are summarized in Box 2.

### After stocking

After stocking, and during grow-out a range of BMPs were promoted, as shown in Box 3. Particular attention was given to maintain healthy blooms, and exchange of water when required. Feed management was made more efficient through use of check trays

*Removal of weak and dead shrimp seed while stocking*

**Table 1: Evaluation of BMP adoption: Criteria for grading**

| Grade | Criteria |
|---|---|
| A | • Good follow up, most BMPs implemented<br>• Timely implementation |
| B | • Moderate follow up<br>• Some delays in implementation |
| C | • Limited follow up, few BMPs implemented<br>• Long-term delays in implementation |

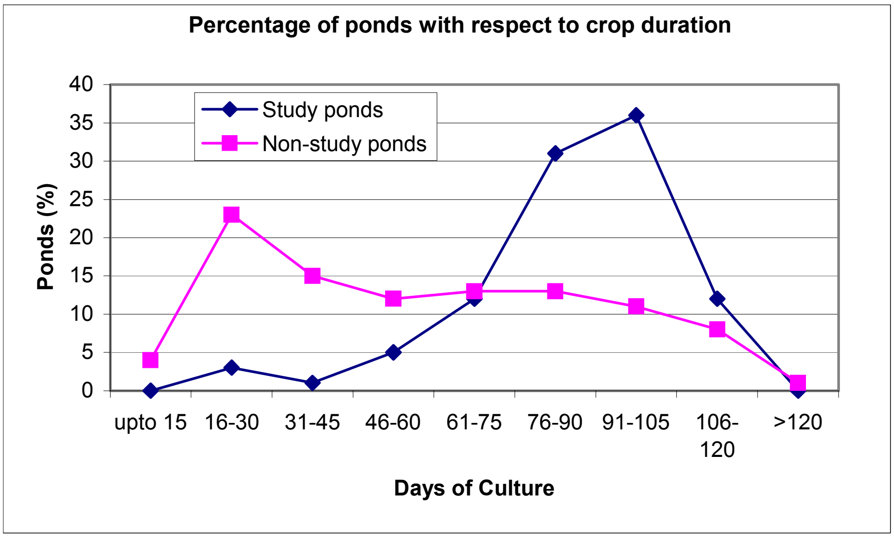


**Table 2: Evaluation by study team - Percentage of ponds in each grade**

| Grades | Before stocking | After stocking |
|---|---|---|
| A | 53 | 24 |
| B | 34 | 34 |
| C | 13 | 42 |

**Table 3: Crop outcomes (average values)**

| Outcomes | Demonstration ponds | Non-demonstration ponds |
|---|---|---|
| Crop duration (Days) | 87 | 63 |
| Production (kg/ha) | 318 | 133 |
| Mean body weight (g) | 18 | 12* |
| Survival rate (%) | 58 | 32* |

* The analysis doesn't consider 51 ponds, which were drained without any shrimp harvest

(each more than one square feet area) to reduce FCRs, save money for farmers and reduce organic wastes leading to water quality problems and excessive pond bottom sludge. Previously, farmers were using traditional small earthern bowls (each less than half a feet in diameter) as check trays which were not effective in estimating feed consumption. After formation of the aquaclub, farmers also agreed to observe more sanitary practices after disease outbreaks.

## Adoption of Better Management Practices

To assess the impact of demonstration program, BMP adoption and crop outcomes were compared in demonstration and non-demonstration ponds in nearby villages. In total, data were collected from 164 ponds in 20 villages including Mogalthur village in July 2003.

The findings show that BMP adoption rates in demonstration ponds were much higher than those in the non-demonstration ponds of surrounding villages. Adoption rates for some key BMPs like sludge removal, water filtration using twin bags of 300 micron mesh size, PCR testing, stocking on farm nursery reared seeds, demand feeding using check trays and emergency harvesting of disease affected stocks were 99%, 89%, 98%, 83%, 88% and 100% respectively. In non-demonstration ponds the adoption of these key BMPs was significantly low, at 62%, 15%, 18%, 23%, 10% and 69% of farm ponds respectively. In spite of active promotion, several BMPs were not easily adopted. For example, farmers faced difficulties in maintenance of 80 cm water depth due to land topography and the capital investment required to deepen and repair ponds. Stocking during the recommended period was followed only in 38% ponds, due to difficulties in procuring the required quantities of quality PLs, which passed initial selection process including PCR screening. Weak PL elimination and use of water reservoirs were new management approaches in the region that farmers were particularly receptive to.

To assist in evaluating outcomes, the study team gave farmers evaluation grades on an A-C scale as shown in Table 1. Evaluation grades were given at the time of stocking. Grades after stocking were given on weekly basis and then mean values for the entire crop duration was considered in a final grade.

These grades represent the skills and attitudes of farmers towards


**The manual is freely available for download from www.enaca.org/shrimp or www.mpeda.com**

*On-farm nursery*

implementation of BMPs. The results (Table 2) show that more farmers were active in adoption during pond preparation stage. Following stocking, farmers were less active in their approach, perhaps due to overconfidence, thinking they had prepared the pond very well and stocked good quality seeds. The gradings were subjective. More farmers in B and C grades after stocking was due to delayed or inappropriate follow-up of BMPs over the cropping period. For example, a farmer might have kept check trays in his pond but he may not have used it for regular feed checking and meal adjustments. For many farmers, the BMPs were new and they were in a learning stage. As crop outcomes also relate to pond management after stocking, the evaluation emphasizes the need for active adoption of BMPs through the crop cycle.

### Crop outcomes

The outcome from the demonstration was very favorable, as judged by farmers and the study team. Average crop outcomes in study and surrounding ponds are given in Table 3. All the considered four crop outcomes – days of culture, productivity, shrimp size and survival - were significantly ($p < 0.05$) better in demonstration ponds than the non-demonstration ponds. Many of the non-demonstration ponds crashed with disease early in the season, whereas nearly 75% of demonstration ponds sustained the crop until 80 days. Stocking density in both the groups was on average 25,000 PLs/ha. Even though shrimp disease outbreak could not be completely prevented, with problems emerging due to poor weather in mid July, negative impacts of disease were reduced significantly leading to better harvests from demonstration ponds than non-demonstration ponds.

The success of the demonstration ponds compared to non-demonstration ponds is also clear from the intense interest and requests from farmers in nearby villages to join the demonstration program.

In demonstration ponds, crop outcomes also varied depending on the extent of adoption (Tables 4 and 5). Better adoption of BMPs, both before and after stocking was significantly ($p < 0.05$) associated with higher production and higher survival rates. When the crop outcomes for different grades were compared for before and after stocking stages, it suggests that farmers who continued to actively adopt BMPs after stocking could significantly improve their crop outcomes. When the demonstration and non-demonstration ponds were compared, the average crop outcomes of even the C grade ponds (for both before and after stocking stage) were better than those from non-demonstration ponds. This indirectly suggests that adoption of even some basic BMPs like sludge removal, PCR screening, and weak PL elimination can improve crop outcomes in surrounding non-demonstration ponds.

## Lessons learned

The outcome in 2003 was an active club that met regularly and promoted widespread adoption of the BMPs among its members, generating intense interest among neighboring villages. At the end of the 2003 crop, participating farmers recorded significant benefits from adopting BMPs and the aquaclub formation. Although shrimp disease was not eliminated, demonstration ponds had significantly increased production and better quality product (as reported by study farmers) compared to surrounding ponds and villages. The demonstration provided better understanding of the constraints faced by farmers in adopting BMPs.

Not all the farmers could take up all the BMPs. This is due to skills and attitude and willingness of farmers towards implementation of BMPs, traditional culture practices and experiences, some what lost faith in good crops due to many years of uncertainty, and financial and social constraints. Some simply did not have the funds to invest in pond improvements for example. The experience suggests a need to carefully develop locally specific BMPs with farmers (based on general BMP principles) tailored to the farming systems (based on stocking densities, ability to maintain water reservoirs, source water quality etc) and investment capacity of individual farmers.

The well-coordinated collective approach and positive outcome among aquaclub members has evoked keen interest amongst farmers in surrounding village and the study team has received several popular requests to bring new villages into the program during 2004.

### Aquaclubs for extension?

Adopting BMPs is only one part of the Mogalthur story. The other is the formation of the aquaclub. In general, services to shrimp farmers are poor in Andhra Pradesh. The small-scale nature of shrimp farms, scattered locations across poor basic infrastructure, combined with limited existing extension capacity, make any traditional extension effort very difficult. Can the formation of self help groups, or "aquaclubs", combined with a major extension effort for the BMPs, be a model for wider improvements in farming practices?

The formation of Sri Subrahmanyeshwara Aquaclub in study area has shown several benefits to the farmers in the village. Information exchange and sharing of knowledge on BMPs among farmers within the club during weekly club meetings was a prime benefit, seen with increasing farmer numbers attending weekly meetings during the crop cycle. Many of the small-scale farmers in Mogalthur had not even visited the hatcheries over 15 years of shrimp

*Measuring the water depth - at least 80cm is needed*

*Training the farmers on check-tray feed monitoring*

*Weekly farmer meeting*

farming experience. The organization of the small sub-group of farmers for screening and selecting quality seeds from hatcheries was therefore a major outcome well received by farmers. One sub group of farmers went further, and organize a group "on-farm nursery" assuring themselves better quality juveniles at cheaper prices than local nurseries, where quality and infection is a major concern. There was also a good response from club farmers to cooperate in water supply and draining especially during disease outbreaks thus reducing risks of disease spread. With an organized group, better responses were observed from owners of shrimp hatcheries, processing plants, feed manufacturers, concerned government agencies to the concerns raised by the club members. Neighboring village farmers started participating in weekly club meetings to share their experiences with club farmers and have shown interest to develop similar clubs in their areas. While there is some way to go, the results show that extension through farmer clubs could be one important strategy for motivating, and bringing farmers together to disseminate extension messages and discuss solving of common problems.

Although there was no advantage for farmers in marketing their harvests during the demonstration period, considerable interests were shown by local purchasers in procuring the shrimps from club farmers, where farmers were not using any banned chemicals. Some farmers in small groups collectively sold their small quantities of shrimp together. The better organization of marketing around such aquaclubs is a potential future direction that may lead to better market incentives and access for small scale farmers.

## Where to next?

The study has shown that it is possible to reduce risks of crop losses from shrimp disease and improve productivity and profitability of shrimp farms in the study areas of Andhra Pradesh through:

- Providing access to science based information on BMPs;
- Providing technical support that enables farmers to adapt BMPs to their own circumstances
- Promoting the concept of self-help groups (aquaclubs) to facilitate cooperation and communication to collectively address health management issues.

Very preliminary estimates from 2002 indicated a net improved economic return in ponds adopting BMP at Rs 30,000/ha in Bhimavaram. Even though returns in 2003 were more moderate due to lower shrimp prices, if such returns could be scaled up over time to even 50% of the ponds in this district, an economic boost of Rs 300 million in West Godavari might be achievable. Even a moderate gain in profitability spread more widely across the 120,000+ ha of active shrimp farms in India, could lead to substantial benefits to shrimp farming communities, suggesting investment in a major extension effort could be well justified. Economic returns from technical improvements also open opportunities for cost-recovery as well as for sustaining farming groups and extension systems.

One of the salient features of the BMPs is the emphasis on avoiding antibiotics, and other banned chemicals. Aquaclubs adopting BMPs therefore have a further potential advantage – they produce quality shrimp without harmful residues. This advantage could open the way for organization of trace-ability and possibly certification in line with international trends and requirements. The aquaclub approach where farmers work together indeed may be the only way of supporting small-scale farmers to access international markets, with increasingly stringent requirements for trace-ability and food safety.

## Conclusion

The experiences of Mogalthur are heartening: while much remains to be done, the results clearly show that better organized farming communities, and adoption of basic health management practices have considerable potential to benefit small-scale farming communities. The challenge now is to extend this approach widely across the coastal farming communities of India, linking a better organized small-scale farming sector, perhaps organized around "aquaclubs" and better market access. The opportunity exists for a potential

*Cooperation amongst farmers for grading the harvested shrimps* transformation in the sector in the coming years. Can it be done?

### Acknowledgments

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## Central Institute of Brackishwater Aquaculture (CIBA), Chennai, organizes an *Expert Consultation on Rapid Diagnosis of Shrimp Viral Diseases* in cooperation with ACIAR and NACA

It is now well established and widely accepted that PCR screening of broodstock and/or seed for WSSV can be effective in reducing the risk of disease outbreaks and there has been a significant level of adoption of this technology for viral screening in some Asian countries, including India and Thailand. However, in many cases, disease on farms continues to impact very significantly on production, even when PCR-screened seed is used prior to stocking. There appear to be several reasons for the continued occurrence of disease on farms

During the MPEDA/NACA technical assistance on *Shrimp Disease and Coastal Management*, concern was raised about the reliability of PCR test results and the need for standard or harmonised procedures for white spot syndrome virus (WSSV) testing that would deliver a more consistent message to shrimp farmers in India. In June 2002, the Central Institute of Brackishwater Aquaculture (CIBA) of the Indian Council of Agricultural Research (ICAR) in cooperation with ACIAR, NACA and MPEDA, organised an *Expert Consultation on Rapid Diagnosis of Shrimp Viral Diseases.* The expert consultation was attended by representatives of research institutes, universities and the private sector in India and researchers from Australia and Thailand.

The objectives of the CIBA consultation were to: examine current PCR techniques and procedures (and other rapid diagnostic techniques) in use in shrimp culture in India; identify limitations and constraints in use of PCR and rapid diagnostic techniques as part of shrimp health management procedures; introduce recent regional developments in PCR and rapid diagnostic techniques and their potential application in India; develop practical recommendations for effective use of PCR and rapid diagnostic techniques in shrimp health management procedures; and to identify research needs for viral disease diagnosis and shrimp health management in India. The outcomes provide an important “road map” for effective use of diagnostic tools for shrimp viral diseases in India, and enhancing regional cooperation in development of shrimp disease diagnostic techniques. The need for more reliable PCR screening and better information for farmers was specifically identified as a priority by the consultation, as was the potential for voluntary inter-laboratory calibrations to harmonize PCR testing sensitivities with linked technical and theoretical training for PCR laboratory technicians. Further details of the outcome of the expert consultation are available at www.enaca.org or may be obtained from the Central Institute of Brackishwater Aquaculture (CIBA) at www.ciba.nic.in (ciba@tn.nic.in).

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**Breeding technique of Malaysian golden arowana**

added at every water change (1%) until the condition improved. Infection with anchor worm parasite Lernaea causes the fish to rub its body against the side of tank and lose appetite. The parasites can be removed manually and the infected fish were also treated with Diptrex® at 0.5 ppm (mg/l).

## Conclusion

Breeding of Arowana in earthen pond is commonly practised by commercial ornamental fish farms in Malaysia. To start the business the breeding operation needs a large amount of money for the cost of capital such as buying the broodstock and building new infrastructures

The FFRC Batu Berendam has developed a breeding technique for Arowana in enclosed concrete tank. To start the breeding operation requires an estimated cost of around RM 150,000-100,000. This is affordable by breeders in the Malaysian community and can be operated as concurrent activity for side income. The breakthrough achieved by FFRC shows that the technique is also suitable for small scale and backyard industry.

The technique was introduced to interested farmers in Malaysia through transfer technology programme and the responses from farmers are very promising with first harvests after two years operation. This shows that the Arowana seed production in concrete tank technique is workable and practical.

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