ISSN 0859-600X

Volume XVIII No. 2 April-June 2013

AQUACULTURE ASIA

Fish Farmer Field School, Indonesia

Ornamental fish for self-help group, India

Spirulina aquaculture

Lactic acid bacteria

Aquaculture Asia

is an autonomous publication that gives people in developing countries a voice. The views and opinions expressed herein are those of the contributors and do not represent the policies or position of NACA.

Editor

Simon Wilkinson
simon@enaca.org

NACA

An intergovernmental organisation that promotes rural development through sustainable aquaculture. NACA seeks to improve rural income, increase food production and foreign exchange earnings and to diversify farm production. The ultimate beneficiaries of NACA activities are farmers and rural communities.

Contact

The Editor, Aquaculture Asia
PO Box 1040
Kasetsart Post Office
Bangkok 10903, Thailand
Tel +66-2 561 1728
Fax +66-2 561 1727
Website http://www.enaca.org

Submit articles to:
magazine@enaca.org

Printed by
Scand-Media Co., Ltd.

AQUACULTURE ASIA

Volume XVIII No. 2 **ISSN 0859-600X**
April-June 2013

Workshop on Mainstreaming Gender in the Network of Aquaculture Centres in Asia-Pacific

The 4th Global Symposium on Gender in Aquaculture and Fisheries was held in conjunction with the 10th Asian Fisheries and Aquaculture Forum, from 1-3 May in Yeosu, Korea.

NACA took advantage of the presence of a number of gender in aquaculture experts to hold a workshop on mainstreaming gender within the organisation, supported by NORAD. This activity was conducted in response to a 2012 decision by the NACA Governing Council to mainstream gender within the NACA work programme.

The workshop made the following recommendations:

- NACA should develop a thematic gender gap report for Asia-pacific aquaculture, drawing on regional expertise, which should summarise existing gender initiatives in member countries and identify areas that need more attention, with a view of raising awareness of existing activities and raising NACA's profile as a champion on gender in aquaculture.
- NACA should prepare and disseminate clear messages in plain English on why women are important in aquaculture highlighting problems and solutions to enhance the participation of women in aquaculture and to encourage relevant organisations and policy makers to work towards these goals.
- NACA should develop a project targeting women entrepreneurs in aquaculture at the small-medium enterprise level, within the Sustainable Farming Systems Programme.

NACA has undertaken to implement these recommendations and is discussing resource mobilisation with partners and donors to initiate a concerted and expanded work programme on gender issues in aquaculture.

The report of the symposium, which includes a summary of the gender mainstreaming workshop, is available for download from the Gender in Aquaculture and Fisheries website:

http://genderaquafish.org/gaf4-2013-yeosu-korea/special-session-4th-global-symposium-on-gender-in-aquaculture-and-fisheries/

NACA would like to thank the workshop Chairs Dr Meryl J Williams (mentor to NACA on gender issues) and Bodil Maal (Senior Gender Advisor, NORAD), the participants and NORAD for financial support.

Further developments will be posted on the NACA website, www.enaca.org, in due course.

Fish Farmer Field School: Towards healthier milkfish / shrimp polyculture and fish farmer empowerment in South Sulawesi

Ben Brown

CTA, Mangrove Action Project - Indonesia; Founder, Blue Forests. Email: seagrassroots@gmail.com

'Tambak' is the common Indonesian name for a brackish water fish pond, classically supporting a polyculture of milkfish (Chanos chanos) and brackish water shrimp. There is historical evidence of 400 year old tambak in South Sulawesi, naturally constructed in the lower meanders of river estuaries. Not until 1964, in response to increasing demand from Japan for shrimp (a result of post-World War II affluence) did large-scale expansion and intensification of culture occur in tambak. In 1984/85, the Indonesian central government developed policies to ramp up expansion and intensification, through the INTAM program, which targeted twelve provinces in Indonesia. Much of the increase in tambak coverage took place in mangrove forests, as both mangroves and tambak require tidal flooding and adequate drainage.

Tambak can be a massive feature in the coastal landscape, understood by anyone flying into a major deltaic city in Indonesia such as Jakarta, Surabaya, Lampung or Makassar. The 16,000+ hectare tambak complex owned by PT CP Prima Genjot (a subsidiary of the Thai conglomerate Charoen Pokphand) in Lampung is the largest contiguous aquaculture complex in the world, having displaced a mangrove system itself worth an estimated USD 436 – 574 million when one considers the value of mangrove goods and services (Sathirathai and Barbier, 2001).

As mangroves were replaced by tambak, a new set of social, economic and environmental problems arose. Services once provided by mangroves, such as flood control, salt water buffering, and natural primary productivity were lost. Mangrove detritus (leaf-fall, dead roots and twigs) provides a food source for numerous plankton, animals and bacteria, which drives the near-shore or coastal food chain. Especially notable was the reduction in beneficial animal plankton, including copepods, which are an important food for shrimp and juvenile fish.

Measuring shrimp fry as part of weekly field school studies

Experimental ponds built for farmer field school - donated for use by participants.

Lacking the basis of natural primary productivity, fish farmers must resort to external sources of nutrients to drive food production. Two of the most expensive purchases for fish farmers include both fish feed and fertiliser. With regards to feed, the majority of fish feed for milkfish and prawn production in Indonesia is imported. To "increase competitiveness" of aquaculture product exports, milkfish and prawn feed enters the country tariff-free, a policy which in practice reduces the likelihood of domestic production of these inputs. Resultantly, fish farmers become fully reliant on external, imported resources.

With regards to fertiliser, traditional milkfish farmers historically applied organic sources of nitrogen to develop an algal mat on the tambak bottom, algae being the main food source for milkfish. However, semi-intensive and intensive ponds required higher levels of production, so government aquaculture extension agents promoted the application of urea (along with TSP, industrial feed, antibiotics and pesticides) in an aquacultural intensification effort known as the "Blue Revolution" (see boxed text). Continued use of and reliance on industrially produced inputs have numerous downsides for rural fish farmers. On average, fish farmers in South Sulawesi have increased their use of urea 10-fold over the past decade, reaching heights of one tonne of urea per hectare at a cost of US$ 200. Less than half of urea is actually nitrogen (46%), with the other half composed of filler, useless as a fertiliser, which can be harmful to beneficial biological, chemical and physical properties of the pond substrate. One member of a fish farmer field school in South Sulawesi

Tilapia poisoned intentionally in preparation for conventional fish farming.

likened these additives to cement, hardening pond bottoms, and killing off beneficial bacteria and other organisms which would normally enhance a ponds ecology and productivity.

Due to the high cost of imported fish feed, Indonesian farmers sometimes use expired noodles and crackers as a replacement, which have little nutritional or protein value. Resultantly, farmers are finding themselves continuously facing low growth rates coupled with high incidence of disease and mortality.

Since the late 1990's, indeed, tambak farmers in South Sulawesi have found themselves at constant risk of losing much or all of their harvest to death and disease, without fully understanding the reasons why.

Research from the 1990's revealed a pair of common shrimp viruses afflicting *Penaeus monodon* (tiger prawn) the most commonly cultured shrimp. The government's eventual response was to promote alternate species of shrimp, which in recent times includes promotion of the use of *Litopenaeus vannamei*, a white shrimp native to the Pacific coast of the Americas from Mexico to Peru, which is often claimed (incorrectly) to be "disease resistant". The introduction of vannamei, as it is locally known, has actually introduced additional diseases to Indonesian waters, such as Taura syndrome virus.

The answer to shrimp disease is not likely the introduction of genetically "resistant" stocks but rather related to environmental factors. Several authors have expressed that ecological collapse is likely in mangrove areas, where more than 20% is converted for other uses such as aquaculture development (Saenger et Al, 1983;Primavera, 2008). Yet the twelve provinces mentioned as targets for aquaculture development in the INTAM program already experienced an average of 60% conversion of mangroves to aquaculture during by 1982, with half of those provinces having already experienced 80-99% conversion. (Silvius et al., 1987).

The continued unbalanced use of exotic species and external, industrial inputs in this system, without a move back towards naturalness (a mosaic of land uses include native habitats and development of organic aquaculture practices) can only lead to further degradation of ecological links, reduced productivity, and increased incidence of disease.

Since the spread of the above mentioned viruses, rearing shrimp has high risk of mortality. Still, many fish farmers try to achieve higher production, by adding more urea to their ponds, up to one tonne per hectare per cycle.

Haji Haruna has farmed fish in Bontomanai Village, Pangkep District, South Sulawesi for the last 40 years. He says the last 15 years have been difficult. Like his neighbours, he had continued to increase use of urea (about ten times as much in ten years) without notable increase in yields, and with high risk of losing the crop to disease. A few years back he experienced a three year period where his crop failed entirely and he made no income from fish farming. He suspected overuse of urea was harming his pond, either the water quality or substrate. He began, on his own, to use chicken manure instead of urea, and could once again grow fish and shrimp in his ponds. He joined a fish farmer field school two years ago (in 2011), and has continued use of organic inputs only. He is happy that he can farm again, while all other

Imported feed used in conventional milkfish/shrimp polyculture.

Above, below: Part of a field day - where fish farmers answer questions posted around their ponds.

neighbouring farmers who still use urea and other industrial inputs have experienced high and even total mortality in the past two years.

Fish Farmer Field Schools

Unregulated, uncontrolled use of industrial fertilisers, synthetic feed and pesticides can have negative impacts on yields of aquaculture products, and more generally environmental and human health (both consumers and producers) when used irresponsibly. These issues gave birth to the development of Fish Farmer Field Schools, with the overall goals of providing opportunities for fish farmers to develop critical thinking skills through hands-on trials and analysis, and to develop improved methods for sustainable aquaculture production.

“A Farmer Field School for Aquaculture,” was suggested by A. K. M. Reshad Alam and Kevin Kamp in “Utilising Different Aquatic Resources for Livelihoods in Asia: A Resource Book.” (IIRR, 2001).In it Alam and Kamp sketch out a transformative process to re-empower fish farmers adhering to the following principles:

- **Extensionists must believe that farmers can be experts**. Without this fundamental belief in the capabilities of farmers, it is unlikely that a program to enhance their abilities will succeed.
- **Rethink technologies and practices**. Focus learning efforts on understanding the basics of aquatic ecosystems.
- **Make the invisible visible**. Develop methods that will allow farmers to actually see, feel and hear what is going on under the surface of the water.
- **Provide opportunities for farmers to put concepts together**. Develop possible practices and technologies and test them with the farmers as a group. Encourage farmers to set the research agenda. This may mean ensuring a number of small pits, ditches or ponds are available. Planning, implementing, monitoring and evaluating together can be a powerful experience for farmers and can provide them with valuable skills. Group work also acts as an information, education and communication tool. More people will be reached by this method and will want to take part in the learning process.

More field day questions.

Beyond the Blue Revolution

Aquaculture intensification in tropical developing nations, beginning the 1980’s is frequently referred to as the “Blue Revolution,” the goals of which were the development of a “critical source of high-quality animal protein, essential to feed growing human populations in light of stagnating or declining marine stocks.” The contribution of aquaculture to the total quantity of fish available for human consumption grew from 12 per cent to 22 per cent between 1984 and 1993 and was presumed by CGIAR to increase to more than 50 per cent of the total value of the global food catch between 1995 -2010. In many ways this Blue Revolution was analogous to the Green Revolution in agriculture. As the Green Revolution was acclaimed as the means to end world hunger, the Blue Revolution was promoted as a way to increase incomes and the available supply of affordable food among the poor in the third world.

Yet Susan Stonic (2000), in “Stoning the Blue Revolution” points out “The potential of aquaculture to improve the nutrition and incomes of the poor has been impeded by the emphasis on the cultivation of high-value, carnivorous species destined for market in industrial nations. The primary motives are generating high profits for producers and input suppliers and enhancing export earnings for national treasuries. This is particularly true of industrial shrimp farming-the cultivation of shrimp in brackish water ponds along estuaries and other coastal zones. Goals of broadening the economic base of rural areas, generating local employment, and enhancing food security are minor compared to the overarching objectives of shrimp farming.”

When pulling back to look at the global fisheries perspective, we see that aquaculture provides nearly 50% of the world’s supply of seafood employing an estimated 24 million people (FAO, 2012). Capture fisheries, providing the other 50% of world seafood, is considered as stagnant from a production standpoint, (ibid) but still accounts for the employment of at least 200 million people who depend directly upon coastal and oceanic fishing for their livelihoods and another 60-80 million involved in post-harvest processing (USAID, 2012). As the production of the capture system relies on healthy coastal resources (75% of nearshore fisheries in the tropics being linked to mangroves habitats), we see that the only way for both systems to not only co-exist but thrive, is through improved management; which needs to simultaneously ensure sustainable production of existing ponds, reduce the risk of degrading or converting productive natural systems, and involve not only the formal fisheries sector but rural and vulnerable fisherfolk as well.

The role of a participatory aquaculture extension approach, such as fish farmer field schools in helping to achieve a sustainable balance cannot be under-estimated. Such an approach has proven scalable on land (millions of rice farmers having participated in farmer field schools across the world), and has the capacity to achieve those broad goals of equity and food security mentioned above. From what we are learning at the most local of levels - the field schools themselves - is that farmers are encouraged by early results, are adopting and disseminating learned practices, and are continuing to experiment. It may well turn out that the balance between mangroves and aquaculture is achieved by the practitioners themselves, and isn’t that the way it should be.

- Develop strong management tools that farmers know how to use. Farmers need tools to quickly and easily monitor the "health" of the pond, the results of which will encourage and support management decisions.

- Enhance farmers' expertise to ensure the sustainability of aquaculture and institute a process by which farmers take the lead in innovation and development of new technologies. The role of the extension worker will be to support the farmers' learning opportunities on a regular basis.

However, in practice, a farmer field school approach has only been commonly adapted to fish/rice polyculture, and seldom to brackish water systems. With over 450,000 ha of tambak in Indonesia, and more than half of them abandoned or unproductive, it seems clear that a new approach to extension is needed. This is especially important to avoid continued expansion of new tambak in order to achieve short-term economic targets, a strategy recommended by the Indonesian Ministry of Fisheries if intensification efforts fail.

Fish Farmer Field School trials in South Sulawesi

As part of the five year Restoring Coastal Livelihoods Project in South Sulawesi, Mangrove Action Project - Indonesia, in partnership with the Provincial Departments of Agriculture and Fisheries, has run 71 Coastal Field Schools with 1,600 coastal villagers from four districts. Several of these field schools have tambak-based farming systems as their central theme, with the dual objectives of 1) building critical thinking skills among fish farmers and, 2) developing improved methods of brackish water milkfish/shrimp polyculture emphasising locally produced, organic inputs. During a fish farmer field school, farmers learn principles of sustainable aquaculture and factors that ensure long-term success of their agronomic practices. The Restoring Coastal Livelihoods Project runs from 2010-2014 and is supported by CIDA, OXFAM-GB, with implementation by OXFAM-GB, Mangrove Action Project - Indonesia and Yayasan Konservasi Laut.

The focus in the RCL project has been on use of organic fertilisers in order to improve the biological, physical and chemical quality of the pond bottom and water column. Farmers undertake studies to compare the effects of organic versus non-organic fertilisers on pond bottoms, and undertake studies on the effects of "living" pond bottoms on their fish yields.

During a fish farmer field school, the management of a pair of 0.5 ha ponds, experimental and control, are compared side by side. Experimental ponds are prepared by scraping their existing substrates (heavy in non-organic residue) and dried for a week. The substrate is then turned with use of a hand-tractor, and then fertilised with 120kg of organic compost, made by the group themselves from local materials.

Collecting samples for copepod observations.

The pond is flooded slowly to 50-75 cm depth, after which an additional 130kg of organic compost is added, this time mixed with 10 litres of homemade effective microorganism solution, to speed up decomposition.

Fertilisation of the pond supports the growth of an algal mat, which acts as the primary food source for grazing milkfish throughout the production cycle. After a week, 10,000 milkfish fry and 2,000 shrimp fry are added. Additional fertilisation of 250 kg of organic compost takes place during the second and third month.

Control ponds are also scraped and fertilised with urea and triple super phosphate (TSP). Stocking densities are identical to the experimental pond.

Over an entire production cycle, a number of studies are performed. Growth of the fish and shrimp is monitored over time. Simple water quality tests are performed, including turbidity readings (using a Secchi disk or turbidity tube), temperature, and qualitative oxygen readings based on fish behaviour. Other physical changes in the pond are noted.

Specialised studies are also undertaken. These include simple soil tests on the substrate, predator prey studies in aquaria, and feed trials. A range of curriculum modules have been developed by the farmers and trainers themselves, which may be used as a special study topic throughout the season. These modules are being compiled, and made available to aquaculture extension agents through training of trainer programs, for future up-scaling. The key to a fish farmer field school is that the farmers themselves are at the centre of all lessons, developing the experiments and tests, undertaking the research, analysing the data, reflecting on their experience and applying their knowledge to the continued management of both the tests ponds as well as their own ponds.

Preparing effective micro-organism solution.

Results

The tables (next page) depict the results of a pair of typical 0.5 ha trial ponds managed during fish farmer field school (control: non-organic, and experimental: organic). Both ponds were considered by fish farmers to be representative of a successful crop. The organic pond outperformed the neighbouring non-organic pond in terms of survivorship, yield and duration of grow-out period.

A new hope

IbuSaharia, a fish farmer from Pitusunggu Village, Pangkep had lost all hope of continuing to raise fish and shrimp in her family's ponds. When she heard that her village was hosting a fish farmer field school, however, she was eager to sign up for the season long course. Her husband was not initially enthusiastic about her joining the course, and throughout the field school commented that she was wasting her time making organic fertiliser and effective microorganism solution. Much to her husband's surprise, after only four months of endeavour, the family was able to harvest shrimp and milkfish again from their own ponds, at a higher yield than they had ever experienced.

Fish farmer field school participants have been noticing similar results across the districts of Barru, Pangkep and Maros. They are more confident than before that they can make a living again from aquaculture, and are becoming aware that they need to restore some of the original functions of a natural environment, which in the future may include increasing mangrove coverage, to restore a more ecological balance in the agro-ecosystem. The table below is a summary of fish farmer observations regarding their previous, non-organic aquaculture system and the use of organic inputs in shrimp/milkfish polyculture.

Looking ahead

What next? If we look back at the way rice farmer field schools began and accelerated in Indonesia, we see that there is still the need for many individual fish farmer field school trials, successes and failures. Although initial work is encouraging, it is just a small drop in a very large bucket; a complex of ponds of measuring at least 450,000 hectares.

Linkage with the government will be essential for the future scaling-up of the endeavour. Currently, government aquaculture extensionists (PPL) with fisheries background, lack the set of skills and experiences needed when facilitating participatory processes. They can be helped by their fellow extensionists from the Department of Agriculture (PHT and PPL) but also by a growing core of fish farmers themselves who are learning to become field school trainers. Pak Syukri, a Bugis fish farmer field school alumni from Boddie Village, Pangkep District, South Sulawesi was recently invited by the East Kalimantan Fisheries Department to lead a 10 day training for fish farmers and extensionists, many of whom originated from South Sulawesi as well. That government extensionists are engaging fish farmers to lead training is an encouraging sign that collaboration and communication are the order of the day.

Over the next ten years, we may map out some larger goals and objectives of fish farmer field school:

- Fish farmer empowerment.
- Gender equity in aquaculture production.
- Food security.

Table 1: Analysis of successful organic and non-organic milkfish/prawn polyculture in Pangkep District. 1 USD = Approx IDR 9,000.

Item	Non-organic	Organic	Notes
1. External labour 50 are (0.5 ha) @ Rp 75.000/month Note: Labour of the owner's family not considered in this calculation	600,000	300,000	Harvest of organic shrimp/milkfish = 4-5 months. Harvest of non-organic shrimp/milkfish = 8-10 months
2. Shrimp fry 10,000 @ Rp 25	250,000	250,000	10 day old fry
3. Milkfish fry 2,000 @Rp 40	80,000	80,000	
4. Fertiliser	510,000	500,000	Organic 500 kg x 1000Rp Non-organic: Urea 2 – 50kg sacks x 100,000, TSP 3 – 50 kg sacks x 110,000
5. Pesticide	90,000	30,000	Organic: Uses homemade 15 litres of effective microorganism bacteria Non-organic: 2 cans of Akodan- 35 – Endosulphan (broad band insecticide) @ 30.000, 1 can of Dursban (Chlorpyrifos – highly toxic for aquaculture; ordered for phase-out by USEPA) @ 30.000.
6. Feed	165,000	70,000	Organic: rice bran 30kg x 1000Rp, golden snail (*Pomacea canaliculata*) 40 kg x 1000 Non-organic: Commercial pellets
Operating costs - 0.5 ha	1,695,000	1,230,000	
7. Shrimp yield per cycle (kg)	50.0	95.5	Organic: Approx mortality = 25 % Non-organic: Approx mortality = 50 %
8. Shrimp value per cycle (Rp.)	3,500,000	6,685,000	70,000 Rp/kg
9. Milkfish yield per cycle	545	557	From ponds with low mortality (1-5%)
10. Milkfish value per cycle (Rp.)	8,175,000	8,355,000	15,000 Rp/kg
Total value of fisheries products	11,675,000	15,040,000	
Profit per cycle	9,980,000	13,810,000	Organic: 4-5 month harvest Non-organic:8-10 month harvest
Cycles per year	1	2	Depending on water availability
Potential annual profit per hectare	**19,960,000**	**55,240,000**	Profit does not consider labour provided by pond owner/family

Table 2:Physical farmer observations between the non-organic and organic systems

Fish farmer observations	Non-organic system	Organic system
Resilience to virus and disease	Low	High
Cost of fertiliser	High	Low
Total requirement of fertiliser	Increasing	Will decrease over time
Mortality	High	Low
Smell of milkfish	Muddy smell	No smell
Taste of milkfish	Good	Very Good
Storage/freshness	Rots more quickly	Keeps longer
Brightness of scales	Duller	Bright
Flesh of milkfish and shrimp	Not Dense	Dense

- Community education.
- The protection of human health.
- Ecosystem improvements.
- Policy Reform.

These multiple objectives have arisen from a growing recognition - among governments, NGOs, donors and fish farmers themselves - of the interdependence of different aspects of development, and the need to put people at the centre of the development process.

References

Food and Agriculture Organization of the United Nations (FAO). 2012. "The State of World Fisheries and Aquaculture" (FAO Fisheries and Aquaculture Department, FAO, Rome).

IIRR, IDRC, FAO, NACA and ICLARM. 2001. "Utilizing Different Aquatic Resources for Livelihoods in Asia: A Resource Book." International Institute of Rural Reconstruction, International Development Research Centre, Food and Agriculture Organization of the United Nations, Network of Aquaculture Centers in Asia-Pacific and International Center for Living Aquatic Resources Management. 416 p.

Primavera, Jurgenne and J.M.A. Esteban.2008. "A Review Of Mangrove Rehabilitation In The Philippines: Successes, Failures And Future Prospects." Wetlands Ecol Manage DOI 10.1007/s11273-008-9101-y

Saenger, P., E. J. Hegerl, and J. D. S. Davie. 1983. Global status of mangrove ecosystems. IUCN Commission on Ecology Papers No. 3. Gland, Switzerland. 88 p.

Sathirathai, Suthawan and Edward Barbier. 2001. "Valuing Mangrove Conservation in Southern Thailand. Contemporary Economic Policy. Vol 19, No. 2, April, 2001, 109-122.

Silvius, M.J., Steeman, A. P.J.M., Berczy, E. TR., Djuharsa, E. And Taufik, A. W. (1987). The Indonesian Wetland Inventory. A preliminary compliation of information on wetlands of Indonesia. PHPA-AWB/INTER-WADER, ESWIN, Bogor, Indonesia.

Stonich, Susan C., and Conner Bailey.2000 "Resisting The Blue Revolution: Contending Coalitions Surrounding Industrial Shrimp Farming." Society of Applied Anthropology, Human Organization, Washington.

USAID SPARE Fisheries & Aquaculture Panel. 2012. "Review of the Status, Trends and Issues in Global Fisheries and Aquaculture, with Recommendations for USAID Investments."

Government invited for ceremonial harvest.

Taking turbidity with a secchi disk.