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Aquaculture Systems of the Regional Aquaculture Lead Centre in Thailand

NETWORK OF AQUACULTURE CENTRES IN ASIA
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INTRODUCTION

The Network of Aquaculture Centres in Asia (NACA) is a coordinated and interlinked system of Asian fish culture institutions working in close cooperation on the development of technologies, personnel and information needed for achieving fish production increases through aquaculture in the Asia-Pacific Region. Collaboration among countries within the region has been recognised as an effective way of accelerating aquaculture development, while the approach of sharing responsibilities in research, training and

information dissemination would optimise the use of existing capabilities and facilities and minimize duplication of costly efforts.

Aquaculture technologies have been in existence for many years in Asia but these are mostly based on traditional and artisanal practices. Although institutional research inputs have been provided in attempts to increase yield, these are mainly directed at specific disciplines and not at a culture system as a whole. Besides duplication of research resources, specific technologies developed under different sets of conditions may not necessarily make a culture system a complete entity needed for implementing aquaculture extension and development programmes. Knowledge gaps still exist. It has been recommended that these gaps be filled through multidisciplinary and system-oriented research. This new approach in developing a culture system breaks away from the classical but more time-consuming and costly types of research in which specific technology within a system is developed disciplinarily and independently.

For these reasons, one of the objectives of NACA is aimed at developing aquaculture technology through system - and production-oriented, multidisciplinary research for adaptation and extension. While attention is given to adaptive research to achieve immediate impact, applied and even basic research may be conducted if a selected system so demands.

Aquaculture systems of regional importance have been identified for technology development through multidisciplinary research. Each Regional Lead Centre of NACA focuses its efforts on selected farming systems of its competence. These are:

RLCC (China)	:	Integrated fish-livestock-crop farming
RLCI (India)	:	Carp culture
RLCP (Philippines)	:	Shrimp and brackishwater finfish culture
RLCT (Thailand)	:	Pond culture of airbreathing catfish (Clarias batrachus) and snakehead (Channa striatus)
		Pond culture of giant freshwater prawn (Macrobrachium rosenbergii)
		Pond culture of Puntius gonionotus
		Cage culture of river catfish (Pangesius sutchi)
		Rice field culture of Sepak Sian (Trichogaster pectoralis)
		Culture of mussels (Perna viridis) and oysters (Crassostrea spp)

For the purpose of this working paper, the status of the aquaculture systems of the Regional Aquaculture Lead Centre in Thailand is briefly described.

1. CATFISH CULTURE

Two species of catfish are cultured in ponds in Thailand - Clarias batrachus and C. macrocephalus. Virtually all of the present production, between 8,000 and 10,000 metric tonnes/year, is due to C. batrachus. Prevailing farm gate prices are about $1.50 (U.S.)/kg.

Ponds range in size from 300 to 2000 m^2 and from 1.0 to 1.5 m in depth with the larger and deeper ones being relatively more common. Water is either introduced and drained through a simple channel and weir or it is pumped in and out. In a few locations adjacent to irrigation canals, water may be drawn in parallel from the main source which does not receive discharge from other Clarias farms. Elsewhere water is usually drawn from and discharged into a common canal which receives wastes from other Clarias farms upstream and serves a source water for downstream Clarias farms.

The culture practice is intensive. Stocking rates are commonly between 60 and 300/m^2 of fingerlings usually 2.5 to 5.0 cm in length. Rearing to a marketable size of 120 to 200 grams occurs over 3.5 to 5.0 months. Yields in a production cycle generally range from 3 kg to 12 kg/m^2 depending upon the mortality. The average cropping intensity in a calendar year is about 1.5.

Feeding is based on trash fish and rice bran and broken rice. A usual ongrowing diet is 4:1 minced trash fish and rice bran mixed together, cooked and fed as a paste. As a fattening diet, 8:1:1 trash fish, rice bran and broken rice is used. Vitamin and mineral premixes and even antibiotics are added in some cases. A relatively few operations use commercial pelleted feed.

Most of the Clarias seed fish is produced on special farms but some is also captured from wild stocks. Two kinds of seed farms occur. One breeds adults in relatively large ponds equipped with breeding pits from which fry are collected and sold. The fry are reared to fingerling sizes in the second kind of farm which sells the product to grow-out operations.

Clarias is marketed live. Most of the production is purchases by wholesalers at the farm site.

2. SNAKEHEAD CULTURE

Only one species of murrel, Channa (= Ophicephalus) striatus is farmed. The practice is intensive pond culture. Seed fish (2 to 3 cm) are stocked at a rate between 75 and 460/m^2. A rearing time of 7 to 10 months is required to grow marketable size fish of 700 to 1000 grams. Production ranges between 9 and 16 kg/m^2. One crop is grown per year. Present total yields of snakehead from pond culture may be about 3,000 tons/year.

Pond sizes are usually in the range 800 to 1600 m^2 with maximum depths between 1.5 and 2.0 m. Water, mostly obtained by pumping from nearby khlongs (canals), is supplied continuously. The peak harvest time is during April and May when prices are normally the highest. After a harvest mud and detritus is removed from the bottom of a pond which is then lined with sand before infilling and starting another crop.

Snakehead is fed a trash fish and rice bran diet in proportions ranging from 8:1 to 13:1. Antibiotics and other therapeutic drugs are sometimes added to the feed mixture. Fry are fed three times/day, fingerlings twice/day and larger fish only once/day.

Seed fish are obtained in wild capture operations. The highest demand for seed is usually during July and August.

Actual harvesting time somewhat depends upon the prevailing supplies of wild snakehead and market price. If wild fish are still abundant prices tend to be depressed and a fish farmer may choose to retain his crop until prices improve. Fish in excess of 1 kg, however, are not preferred and are sold below premium prices. The price for dead fish is 30% to 40% below that of live fish. Harvesting is usually completed over 4 or 5 days by seining and draining the pond. Most of the production is sold at the farm gate to wholesalers.

3. GIANT FRESHWATER PRAWN CULTURE

Giant Prawn culture is divided into two sections - the production of post larvae ("PL's") or juveniles as seed and grow-out production. Only one species, Macrobrachium rosenbergii, is raised. Some 100 million seed are presently being produced annually in both government and private operations. The yearly production of prawns is in the order of 300 metric tonnes which represents an income to the producers of about $(U.S.) 2.5 to 3 million.

Ripe, egg - bearing females are obtained from natural waters or from broodstock raised by the farmers themselves. Eggs are hatched and larvae are initially reared in brackish water which in some cases is transported to inland sites for the purpose. The containers for rearing larvae are varied and include custom-made concrete tanks, sections of concrete drainage pipes and earthenware jars. Normal water depths range from 25 to 75 cm and water changes vary from 10% to 50% daily depending upon the availability of seawater. Salinity is gradually decreased and adaptation to a freshwater environment is usually completed within 30 days. Larval feed includes Artemia nauplii, Moina spp., and prepared diets consists of mussel flesh, fish flesh, whole egg custard, egg yolk custard and soyabean curd, alone or in combination.

Individual grow-out farms vary from small backyard operations with single ponds of 1000 m^2 to 2000 m^2 to large commercial complexes with several ponds having a total area ranging from 1.5 to 40 ha. Most occur in the Central Plains area of Thailand close to Bangkok.

Ponds are formed by pushing excavated materials to the sides to form banks (= dykes). Most are equipped with screened pipe inlets and outlets; few have concrete sluice gates or monks. Inlets are often below pond water level and in many farms, ponds are supplied sequentially with water. Water is not normally filtered other than by screen, and it is taken mostly from irrigation khlongs (= canals) but also from wells, rivers and lakes.

Normally only evaporation losses are replaced with an occasional (e.g., bi-monthly) flushing of the ponds. Regular flow-through is not generally practised.

Ponds are stocked with post-larvae (usually within two weeks of metamorphosis) at the rate of 5/m^2 to 20/m^2. Management systems vary but typically ponds are seined after 6 months to remove marketable size prawns of 10 to 15 individuals per kg. Smaller prawns are either left in the same pond or placed in a new one. A further culling may take place before the pond is totally harvested by seine or draining after 8 months. Ponds are then dried, treated with lime at 1 ton/ha and with rotenone or similar chemicals before re-stocking.

Broiler chicken starter pellets are commonly used as feed but a variety of other feeds is also used, including chopped fish or fish meal with mixtures of broken rice and rice bran with or without vitamin and mineral premixes. Whole chickens originating as mortalities in poultry growing operations and calf bones with adhering flesh are also used in some cases as supplemental feed. The fish and rice mixtures are cooked. Food is normally presented twice per day depending upon demand.

Although annual production rates of 2180 to 2500 kg/ha/yr are achieved in some farms the average production rate is about 1250 kg/ha/yr.

Harvested prawns are marketed whole. Some are transported to selected market places by the farmer while some are sold at the farm gate to wholesalers who collect from a numberof farmers.

4. CAGE CULTURE OF PANGASIUS

About 400 tons of Pangasius sutchi are currently being produced per year in cage culture operations located chiefly in the Central Plains area of Thailand north from Bangkok. The cages made of wooden slats and having volumes of 15 m^3 to 20 m^3 are suspended in running water; they are frequently attached to floating homes. The dimensions of a typical 15 m^3 cage are: width - 2 m, length - 5 m, depth - 1.5 m.

Grow-out cages are stocked with about 50 fingerlings, 8 to 10 cm long, per cubic meter of cage. Mortality is relatively low and growth to a marketable size fish of about 1 kg takes approximately 15 months. Production in this time averages about 40 kg per m^3 of cage.

Feeds and feeding regimes vary, but a mixture of trash fish, rice bran and broken rice in the proportion 9:1:1 is commonly used as feed delivered at the rate of 2% of the body weight/day. Other feeds include waste vegetables and soya bean waste.

Seed fish are produced in both government and private hatcheries. Some brooders are produced in cage operations which rear the fish to a size of 3 to 5 kgs in 2 to 3 years before they ripen. Between 200 and 600 brooders may be reared in a 15 m^3 cage. Fish

tend to ripen concurrently at the lower stocking rate. Spawning usually occurs in the period January to March.

5. RICE FIELD CULTURE OF SEPAK SIAM

Trichogaster pectoralis, Sepak Siam, is farmed in extensive pond culture operations in converted rice fields. Almost all of this kind of aquaculture occurs in an area of sub-marginal rice lands extending about 80 km eastward from Bangkok close to the Gulf of Thailand. Some wild fish species are encouraged to enter the system or other species are even stocked. The present total production from these fish farms is about 22,000 metric tonnes/year with the catch composition by weight comprising:

Trichogaster	76%
Clarias	11%
Channa	7%
Carps	3%
Tilapia	1%
Others	2%

Three crops of fish are grown every two years; the annual rate of production of Trichogaster ranges from 0.7 to 1.4 tons/ha and of the other species from 0.3 to 0.6 tons/ha.

Individual ponds vary in size from about 1.6 ha to 6.4 ha. A preferred size appears to be about 3.2 ha., with many farmers claiming that predation is too high in smaller ponds and that attainment of complete harvest is problematical in larger ones. The ponds are created by constructing a perimeter dyke 0.8 to 1.2 m high and a trench around the inside the dyke that is 2 to 3 m wide and 0.5 to 1.0 m deep.

Grassy vegetation is allowed to grow on the central expanse of the pond before flooding. After about 30 days swaths are mowed through the vegetation and the cut material is heaped in rows. Shallow flooding then follows and Trichogaster brood fish (1 pair for about every 20 m^2 of pond area) are released into the system. Additional water is added which stimulates the brooders to spawn. Estimates indicate that fry densities of about 185/m^2 generally result.

Emergent aquatic vegetation is periodically mowed and the cuttings are left in the pond as green manure. Fresh water is regularly added to the pond; when available it is pumped from nearby khlongs (canals) and young fish of other specibs are frequently introduced at this time. Most of the farms develop water storage ponds (800 to 1200 m^2) which serve as source water during the dry season or when khlong water is unsuitable.

No outside feed is added. The fish depend entirely on food organisms and materials from within the pond.

Harvesting is accomplished by draining the pond and concentrating the fish in the perimeter trench where they are herded with seine nets to one or two central locations and dipped out. Species such as Clarias and Channa are sold live and fetch premium prices since consumers state a preference for them over the ones produced in intensive pond culture operations. Much of the Trichogaster is salted and sun dried. Some of the producers do this processing themselves while other sell the fish fresh. Most of the product is purchased by brokers at the farm site.

Although most of the water is drained from the ponds during harvest the bottom of the ponds are not usually dried thoroughly between crops.

6. POND CULTURE OF PUNTIUS

The Thai Carp Puntius gonionostus is raised throughout Thailand in ditch culture operations, in paddy fields and in ponds of various sizes. Much of the production is utilized directly for home consumption while some is bartered locally. About 2,000 tons/year from all sources enters the commercial market.

Most pond culture operations are extensive and commonly include other fish such as Common Carp and Indian Carp. Pond fertilization results in Puntius yields of about 2.4 tons/ha/yr, and supplementary feeding with meals made up of broken rice, rice bran and vegetable materials in the proportion of 1:2:4 results in yields up to 6.0 tons/ha/yr.

Puntius breeds readily in ponds and may spawn up to 3 or 4 times a year. Some operations depend upon the in situ production of seed while others use transplanted seed stock.

Operations specializing in the production of seed fish stock brooders, 300 to 400 grams each, in ponds that usually have been limed and manured beforehand. The stocking rate is one fish/m^2. Diet is an important factor in promoting ripening and meals such as the above are commonly used. Two crops of seed fish are generally produced per year - one around February and another during the following May or June.

7. MUSSEL CULTURE

Two species of mussels are cultured in Thailand - the Green Mussel (Perna viridis) (Mytilus sp.) and the Horse Mussel (Modiolus senhausensi). Most farming presently occurs on low gradient offshore areas with muddy or silty bottoms in the upper part of the Gulf of Thailand. Rearing takes place on stakes, set about one metre apart from one another in natural spawning areas, to which spat attach and grow. Once a culture has started some stakes may be re-located depending upon phytoplankton availability. No thinning-out is practiced during the growing period. A crop is harvested in about 8 months by pulling-out the stakes and re removing the mussels. Production is about 40 tons/ha.

Mussel spawning normally occurs in the period September - October. Harvest time is the following June or July at the beginning of the rainy season.

Most of the crop is purchased directly by brokers and wholesalers at the production locations.

8. OYSTER CULTURE

Three species of Crassostrea are cultivated in Thailand. Farming presently occurs in shallow coastal waters with muddy bottoms through several parts of the Gulf of Thailand and in only a few locations in the Andaman Sea. Concrete cylinders, blocks or rubble spaced about 2 metres apart are laid down in oyster spawning areas. Natural innoculation by spat follows; most occurs during September through November but some also occurs earlier. Oysters are harvested at 10 months of age when sizes of 6 to 12 cm are reached. About 4 oysters/100 cm^2 of substrate area are collected. Yields normal range between 1 and 3 kgs/m^2 of surface area of water in a production location. Prime harvest times are usually during June and July. Brokers and wholesalers buy most of the oysters directly from the producers