



Network of Aquaculture Centres in Asia-Pacific

Aquaculture: With Special Reference to Developments in Asia.3 ***Frontiers (New) of Asian Aquaculture***

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Topics

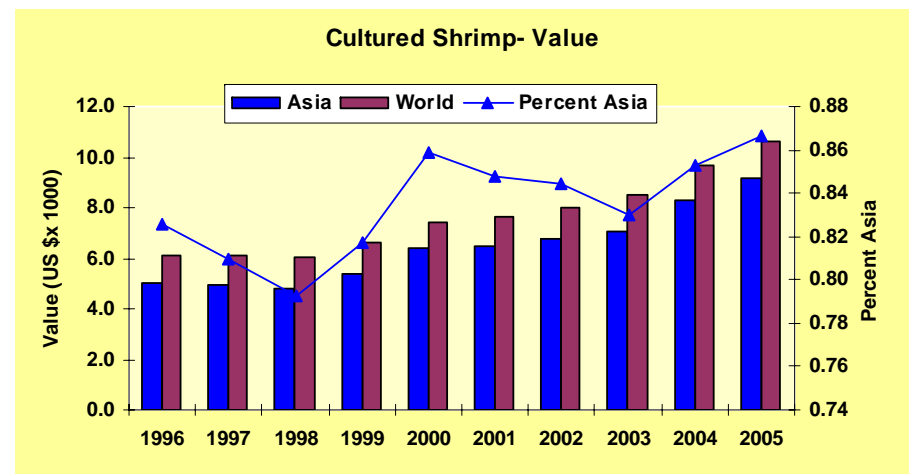
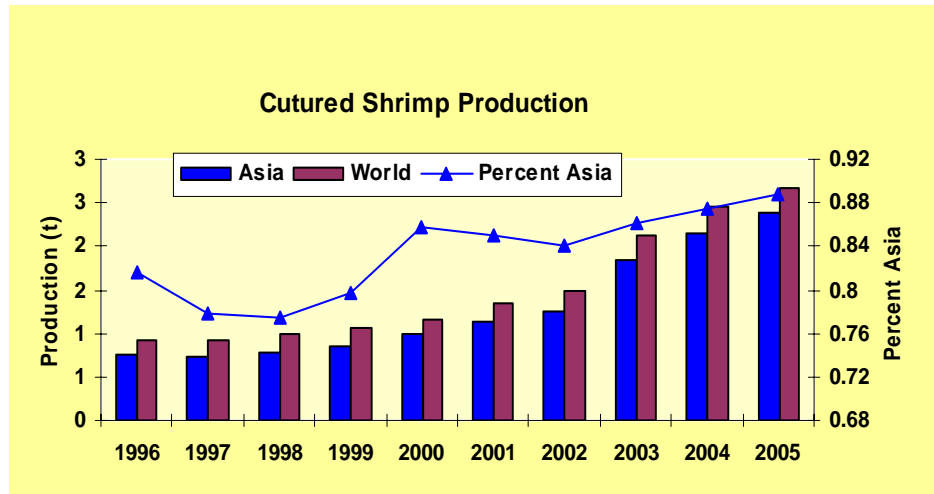
- resume of what had been discussed
- The (new/ major) developments in Asian aquaculture
 - Shrimp farming
 - Problems
 - Solutions
 - Catfish farming in Vietnam
 - Carp farming in Myanmar
 - New export markets
 - Integrated developments
- Overall contribution to food security, GDPs, poverty alleviation





Shrimp farming: development trends

- Triggered off by development of hatchery technologies
- Relatively quick return for investment
 - Very early investments and rapid growth
 - 1984 to 1995: 16.8% / year (Subasinghe *et al.*, 1998)
 - Most traded aquaculture commodity
- Possibly the most controversial
 - Global attention on:
 - environmental issue
 - Socio-economic issues
- Went through “boom and bust” cycles
 - Diseases (YHV, WSV etc.)
 - US\$2 billion lost (Lundin, 1997)
 - New solutions





Shrimp farming: problems encountered

- Quick return
 - Unplanned investments/ growth
 - Use of high stocking densities
 - Excessive feeding
 - Hatchery temperatures raised, etc
- Environmental issues
 - Destruction of mangroves
 - Data controversial
 - Almost a non-issue at present
 - Mangroves unsuitable for shrimp culture
 - Collection of shrimp fry (wild)
 - For every kg 10 kg of mortality of other organisms
 - Effluent discharges
 - Land tenure
 - Major national issues
 - E.g. India; Supreme Court decree
 - Conflicts with agriculture (salination issues)
- End result: severe disease problems
 - Yellow spot virus
 - White spot virus
 - Vertically transmitted
- Difficulties in obtaining disease free broodstock (even to date)



This is our land: A boy from the village holds the largest net which the aquaculture farm built to keep the villagers out. Inside this fence is an area where villagers usually perform the last rites for the deceased. Now, this cannot be used by the community.

If you go through police records, Kolathur would appear to be a village of criminals. The village is situated on banks of Buckingham canal in Kancheepuram District in Tamil Nadu. Just in the last two years, more than 40 young men from this non-descript village of 4000 on the East Coast Road connecting Chennai and Pondicherry have been charged by the police with various mild to serious offences. Villagers say the charges are false and motivated. The real crime, they say, is that they had the audacity to fight against the pollution caused by a shrimp farm owned by a politically well-connected entrepreneur.

Kolathur is a Dalit village. Dalit, which literally means "broken," is a self-descriptor used by communities belonging to the lowest castes in India's meticulous and still extant caste hierarchy. Historically enslaved and victimised by untouchability in its various forms, Dalits in India are fighting a remarkable battle against discrimination. While open discrimination and untouchability may have been reduced over the last century owing to the outlawing of such actions, Dalits remain an oppressed community, landless and at the mercy of landlords and market forces. Even today, Human Rights Watch observes, police use violence and threat of sexual abuse to "inflict political lessons and crush dissent within the community."

Having no land to their names, Kolathur villagers lose their livelihoods as sharecroppers the minute their masters sell the land they

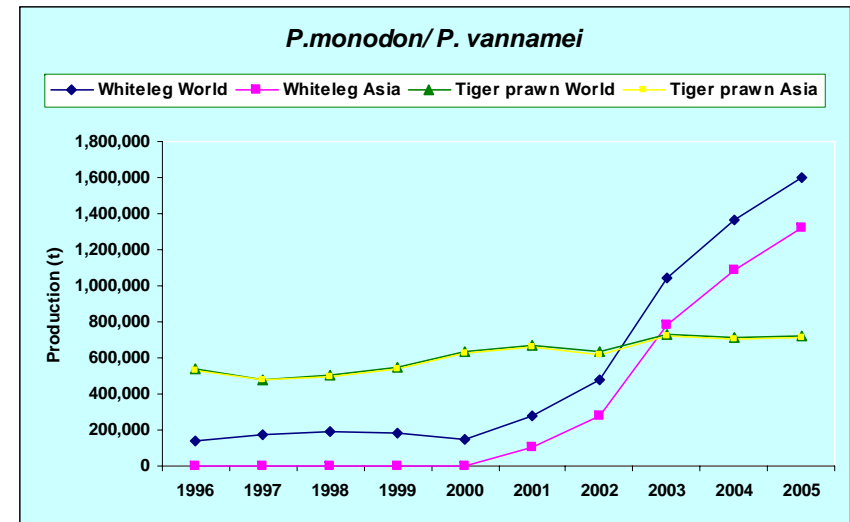
Still controversies about on land tenure/ shrimp farming in many developing countries





Shrimp farming: solutions?

- Reaction to major ysv, wsv outbreaks
 - Some nations introduced *Penaeus vannamei* (white legged shrimp)
 - Others still continue with the indigenous *P. monodon* (tiger shrimp)
 - S.American species
 - Grows faster; but smaller harvesting size
 - 2.5 to 3 cycles per year
 - Column feeder; better FCR
 - Market price lower
- Long term environmental impacts (e.g. biodiversity) of the introduction unclear



- Within a period of 5 years Asia produces $>1.5 \times 10^6$ t of the exotic *P.vannamei*
- Also signs that *P.monodon* is having a resurgence
- Will it be 7-8 year cyclical event of dominance of each of the species
- Is *vannamei* the long term solution??
- A success story of an exotic?





Shrimp farming: solutions?

- Technical solutions
 - Specific Pathogen Free (SPF) broodstocks
 - PCR testing of post-larvae
 - Adoption of BMPs
 - Less profits but higher sustainability
 - Higher market value for produce



From rehabilitated/ BMP ponds in Aceh



BMP- Shrimp: India





Shrimp farming: Issues unsolved/ remaining

- Development of SPF stocks for different species does not necessarily warrant “global” introductions

Sustainable aquacult

A different form of dumping: The need for a precautionary approach for yet another new species for shrimp farming in Asia

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Dumping, in aquaculture terms, occurs when exporters flood a market with a low priced cultured commodity, at a price which is either below the price in its home market or is below its cost of production. Cases in point are the well publicized (and sorely contested) anti-dumping cases against exports of tra (*Pangasianodon hypophthalmus*) and basa (*Pangasius bocourti*) and the export of shrimp from Asian and Latin American countries into US markets. In general, with regard to this form of dumping, which is essentially a trade and fair pricing issue, producing countries have a forum to turn to settle disputes which is the WTO - at least when they are members of the WTO.

What is pointed out in this article is not in respect of commodities as mentioned earlier but a new form of 'dumping' which could occur with widespread introduction of new species. The term 'dumping' is justified because the commercial transactions associated with such introductions in the region often do not take account of the potential environmental and biodiversity costs, and therefore an environmental subsidy is being provided by the host nation for the environmental impacts that may result.

The senior author recently attended the Indonesian aquaculture meeting, Indo Aqua 2007, Bali, Indonesia, and was surprised and perturbed by the promotion of *Penaeus stylirostris* as a new species for aquaculture in the region, as means of counteracting the emerging problems with *Penaeus vannamei*. Mention of this new species is also appearing in some trade magazines.

The controversies are well known with regard to the introduction into certain countries of *P. vannamei*, a species that is alien to Asia, as a means of reviving the shrimp aquaculture sector that was based on the indigenous *P. monodon* which unfortunately succumbed to various disease problems. Even to date, in spite of the very high production of *P. vannamei* and the economic returns thereof, certain countries in the region

such as India and Vietnam (in the southern region) have endeavored to revive the culture of *P. monodon* through the adoption of improved farming practices, and resisted the introduction of *P. vannamei*. The positive impacts of the former and the benefits it has brought to small scale shrimp farmers in such countries (Briggs et al. 2004) are well documented, although farmers of both *P. vannamei* and *P. monodon* are facing considerable problems due to downward price pressures associated with large volume *P. vannamei* production. All this is essentially history and whether *P. vannamei* impacts on biodiversity in Asia is yet to be seen and or proven, although there is evidence that the species is present in the wild and the long-term impacts can not be predicted at this stage (Senan et al. 2007).

It is a trend in the shrimp sector to produce specific pathogen-free (SPF) broodstock and post larvae. Such developments have primarily taken place in the West through years of enduring and carefully managed scientific research, and such stocks, including exotic species such as *P. vannamei*, have been introduced to many Asian countries. In theory, post larvae produced under strict biosecure conditions using true SPF broodstock have a higher probability of leading to a successful crop. However, this has not happened in many countries. Use of local pond-raised brood stock as 'SPF' stocks and their subsequent proliferation has led to several problems, including poor growth and increased occurrence disease outbreaks.

For obvious reasons, introductions of the so-called true SPF broodstock has also not always happened and is evident by the fact that in many *P. vannamei* culturing countries of the region, Taura syndrome caused by Taura syndrome virus (TSV), has been officially documented. In recent years, another exotic viral disease caused by infectious myonecrosis virus (IMNV) has also been reported from

The shrimp farming sector in the Asia-Pacific region is one of the most lucrative of all aquaculture sectors. The sector went through a difficult period when over intensification, environmental degradation and other factors led to the emergence and establishment of many viral diseases in *Penaeus monodon*, the backbone of production in the past. To keep the sector alive, some nations introduced the exotic *P. vannamei*, and the use of specific pathogen-free (SPF) broodstock was seen as a means of combating these disease problems. However, many of the viral diseases that had affected *P. monodon* were also found to affect *P. vannamei*, and to rub salt into the wounds, new viral diseases that were never present in the region have also begun to appear. Despite this experience, there is now advocacy towards introduction of yet another exotic species, *P. stylirostris*, for which SPF broodstock have been developed. Again introductions seem to be poised to occur without any consideration of the long term effects on biodiversity, disease risk or other potential environmental impacts. This article calls for a precautionary approach and proper analysis of risks before, rather than after, the potentially damaging widespread new shrimp introductions.

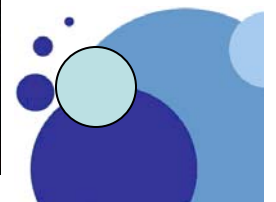
the region (NACA/FAO 2006). These disease problems only confirm, yet again, that introductions, especially of exotic species for aquaculture, always carry a risk of also introducing exotic pathogens, in addition to possible impacts on biodiversity in the long term (Fiegel, 2006). The region which had to cope with WSSV for a long time has now to deal with two more dangerous exotic viruses, which have the potential to inflict long term damage on the shrimp industry. The cryptic nature of





Catfish farming- Vietnam: developments

- A rapid development
- Originally:
 - Small sector
 - Based on wild caught young in Cambodian waters of Mekong
 - Cambodia banned collection of young: 2 species
 - *Pangasianodon hypophthalmus* (formerly *Pangasius sutchii*)
 - *Pangasius bocourti*
 - Induced breeding developed
- Restricted to the Mekong Delta; S.Vietnam
- Now a 700 million US\$ export industry
 - Expects to reach US\$ 1 billion in 2007
 - Employment to over 16,000 people





Catfish farming-

- Each small scale farms
 - Cage & pond culture
 - Shift towards pond culture
 - family managed/
operated
 - Intensive operations
 - High SDs
 - Intensive feeding
 - “farm-made and / or
commercial pellets
- Almost total produce:
 - Processed
 - exported

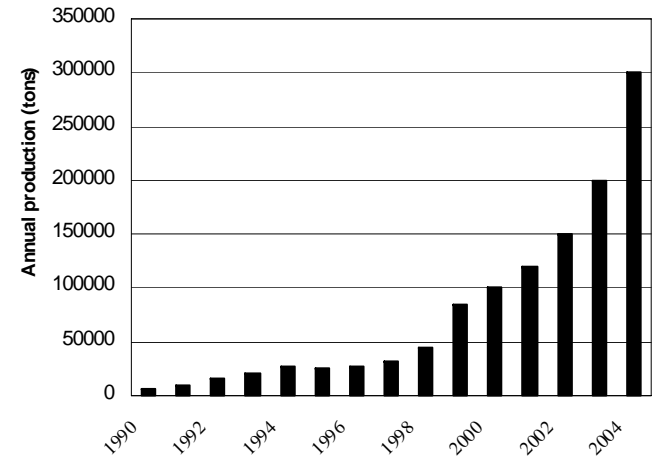
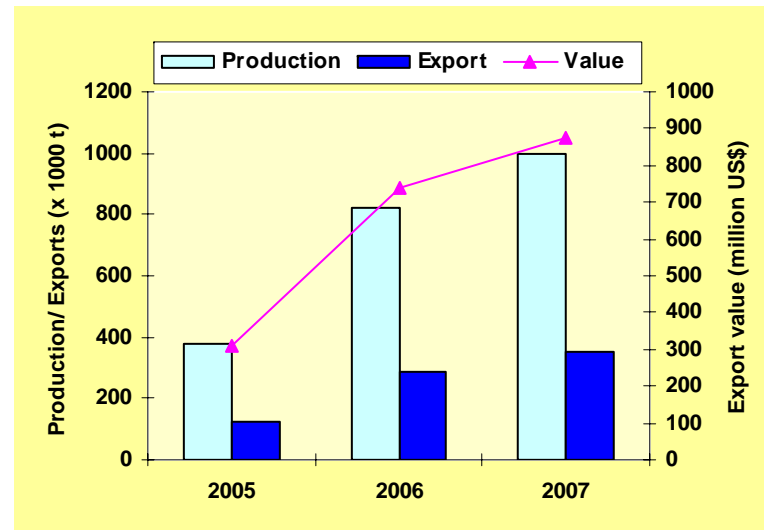


Figure from Le et al. 2006





Catfish farming-





THE CATFSIH PRODUCTION CYCLE IN 2005 (from Le *et al.*, 2006)

Total Production: 350.000 tones

- Ponds : 70 %
- Cages : 15 %
- Pens : 15 %

1.5-2.0 billions of larvae produced in hatcheries

Feed for catfish:

- + 400,000 t home made feed (FCR: 2,8-3.0) (60 % rice bran + 40 % trash fish)
- + 300.000-350.000 t commercially manufacrued feed (FCR: 1,5-2.0) (25-30 feedmills)

Export
(20-25 frozen factories)
300,000 tons

Local market
50.000 tons

Processing by-products

- human consumption
- oil extraction
- fish meal

By-products
200,000 tones

Frozen Fillet: 100.000 tons

Export to USA, Europe, Asia and other countries

16,000 workers are directly involved in the production, including 6,000 in seed production, growing out and 10.000 in fillet processing in frozen factories.



Catfish farming: problems of sustainability (?)

- Intensification
 - Disease outbreaks
 - Feed ingredients:
 - large volumes of trash fish/ low value fish in farm made-feeds
 - Added environmental problems with moist diets
- Cage culture:
 - Cage material costs
 - High density of cages; water circulation hindered
 - Lower Conversion efficiencies; higher feed costs
- Decreasing profit margins
- Trade problems (deal later)
- Pluses- reuse of processing waste for fish meal/ feeds



3 t/ha/yr production is not uncommon



Harvest transported alive in boats for processing





Tilapias in Asia

- In Asia only two cichlid species occur naturally

- *Etiloplus suratensis*
- *E. maculatus*; commonly known as chromids



- Tilapias have been in the Asian region for over half a century
 - Over 10 species introduced since late 1940s
 - Two well established: *Oreochromis mossambicus*, *O. niloticus*
- They are alien to Asia





Tilapias in Asia

- There is little to doubt that tilapias are a very successful group in the region:

- *production viewpoint*

- *Aquaculture*

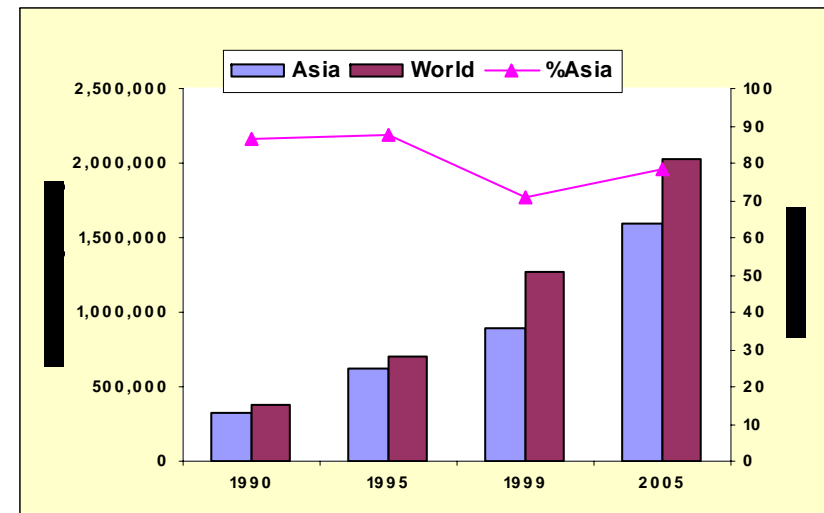
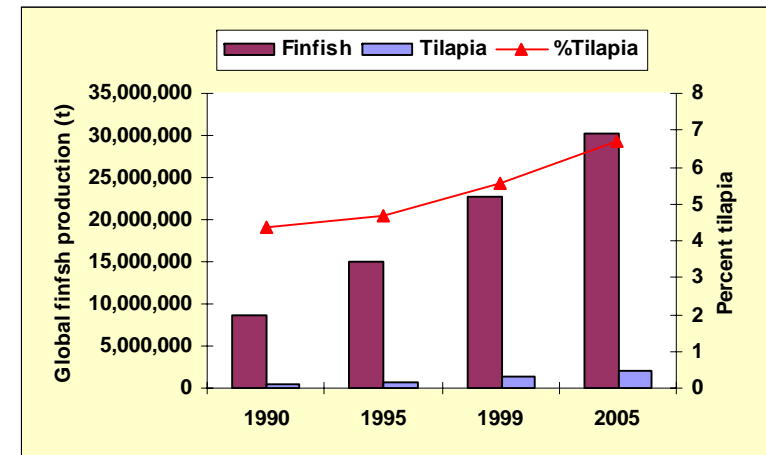
- *Tilapias account for about 7 % of cultured finfish*

- *Capture fisheries*

- *Asia leads in tilapia production of the world*

- *provides*

- *affordable source of animal protein*
- *Impacts rural communities*





Tilapias in Asia

 *provides an affordable source of animal protein to rural communities*

 *Poor man's protein*

 *Mostly in rural areas*



Sri Lanka

Day's animal protein supply of the family



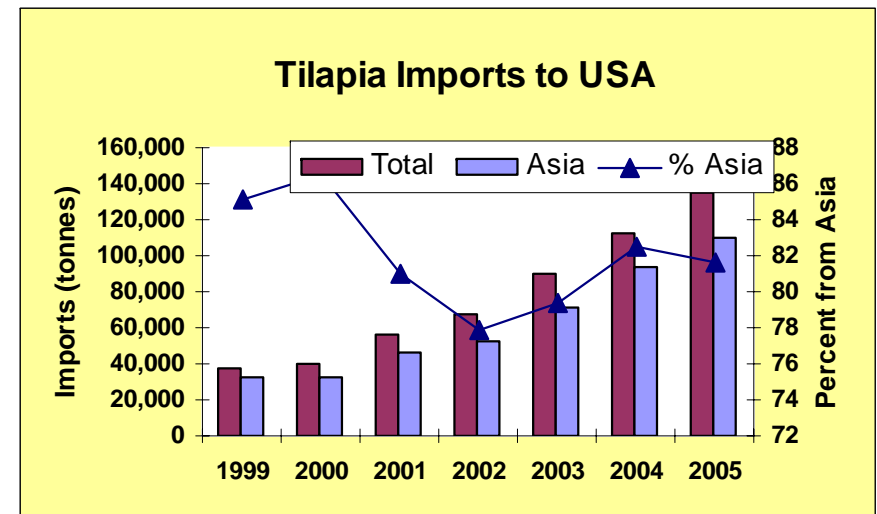
Sarawak





tilapias are a very successful group in the region:

- **Socially-**
- *Provides many livelihoods*
 - *in aquaculture*
 - *farm hands and ancillary services*
 - *Processing*
 - *6-10 tonne/ one person*
 - *>80,000 persons*





tilapias are a very successful group in the region:

- **Socially-**

- *Also in capture fisheries*
 - *Over 10,000 fishers in Sri Lanka*





Tilapias and its success in Asia

- **Why has it been so successful from a *production viewpoint***
- **Does the success in production by itself make it a successful alien species overall?**





Success of Tilapias in Asia: **Why has it been so successful from a *production viewpoint***

- **Tilapias are physiologically very “robust”**
 - **High level of tolerance to temperature, salinity, DO, pH etc.**
 - **High level of tolerance to most diseases**
- **Capable of tolerating many environmental conditions that are not easily tolerated by indigenous species**
- **It has a relatively high dress weight ratio**
- **Has acceptable taste to most consumers**
- **Can be processed in a number of ways**
- **Aquaculturally:**
 - **It can be cultured in various forms**
 - **Simple reproductive cycle; insignificant larval mortality**
 - **Easily weaned to artificial diets**
 - **Needs less protein compared to most other intensively cultured species**
 - **Needs relatively less technical and management skills**





Does the success in production aspects by itself make it a successful alien species overall?

- a species success is not determined by production alone
- It is equally important for the species to
 - maintain environmental integrity
 - have minimal influences on the indigenous flora and fauna, on habitats and
 - have minimal direct / indirect influences and long term influences
 - genetic diversity
 - biodiversity





The alleged detrimental influences reported in Asia arising from the introduction of Tilapias

Country/ habitat	Purported negative affect	Effected by	Authority
Philippines; Lake Buhi	Near extinction of the endemic goby, sinarapan, <i>Mistichthys luzonensis</i>	<i>O.mossambicus</i>	Baluyt, 1983; Aypa, 1993
Indonesia; Lake Toba	Decline of indigenous cyprinid <i>Lissochilus</i> spp.	<i>O.mossambicus</i>	Baluyt, 1999
Bangladesh; Kaptai Lake	Decline in indigenous major carp catches	<i>O. niloticus</i>	Hussain, 1996
Sri Lanka; reservoirs	Decline in freshwater turtles <i>Lissemys punctata</i> , and <i>Melanochelys trijuga</i>	High fishing pressure on tilapias	Pethiyagoda, 1994





Have tilapias been harmful; ecologically etc.?

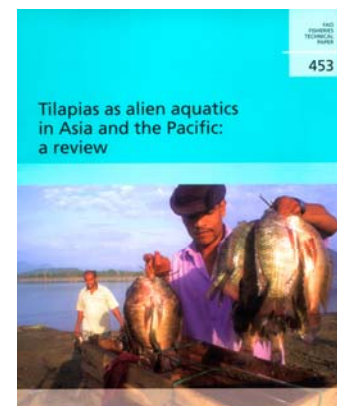
- **There is no objective evidence available to show that tilapias have negatively affected**
 - **Biodiversity**
 - **Genetic integrity of indigenous stocks**
- **tilapias are “blamed” for the above**
 - **because it happens to occupy**
 - **habitats that have been degraded from human activities**
 - **consequently have made these unsuitable for indigenous species**





Alien species: the tilapias

- Often purported to have brought about loss of biodiversity
- recent review
 - De Silva, Subasinghe, Bartley & Lowther (2004)
 - suggests that there is no objective evidence to indicate that tilapias have affected biodiversity in the region
- authors suggest that
 - general habitat destruction from anthropogenic activities
 - make unsuitable for indigenous species
 - establishment of tilapias





Are tilapias invasive in Asia?

- Tilapias have features that are expected/typical of an invasive species:
 - **Physiological “robustness”**
 - **Non-catholic feeding habits (those species that are introduced into Asia)**
 - **Ability to live in/occupy diverse environments/habitats**
- **However, in the region:**
 - **Tilapias are unlikely impact on genetic diversity of indigenous stocks (directly),**
 - **Indirect impacts not recorded**
 - **no evidence of tilapias being invasive of pristine waters**
 - **Invasiveness of tilapias is almost always limited to**
 - **habitats that have been degraded by human activity and /or**
 - **waters that have a very poor finfish fauna with unoccupied vacant niches**





What should be the position/ status of tilapia in Asia?

- Tilapias in Asia:
 - Contributes significantly to food production
 - Provides an affordable animal protein source to poor communities
 - Impacts on rural communities/ livelihoods
 - Sought after for industrial aquaculture ventures
 - a much sought after commodity by importing nations
 - general social and industrial acceptance as a desirable species



Indonesia



Sarawak



Thailand



Sri Lanka





Tilapias in Asia

- Over > 6 decades in the systems
 - Not been invasive
 - Contributed significantly to
 - Food fish production
 - Affordable & main animal protein in some Asian nations
 - Food security for rural poor
 - Export earnings
 - Positive socio-economic impacts
 - the science of aquaculture
 - Example for genetic improvement of tropical aquatic species- GIFT



Not always a “poor man’s fish”





New developments: case of Myanmar- a development to cater to a niche market

- The great bulk of cultured fin fish production

- Carps

- Chinese and Indian major carps
- Translocated through out Asia
- Feeds low in the food chain
- Fast growth rates
- Number of species could be grown together-
polyculture
- Induced breeding techniques well developed
- Mostly extensive to semi-intensive culture
- Considered to be not high value commodities
- Primarily for local consumption: poor man's fish





Case of Myanmar-

- Over the last five years Myanmar taken the initiative to:
 - Develop rohu (*Labeo rohita*) culture to cater to expatriate Indian & Bangladeshi communities
 - Initially in Middle East
 - Now extended to Europe
 - Government incentives
 - Land leases
 - Bank loans
 - Tax benefits





Case of Myanmar-

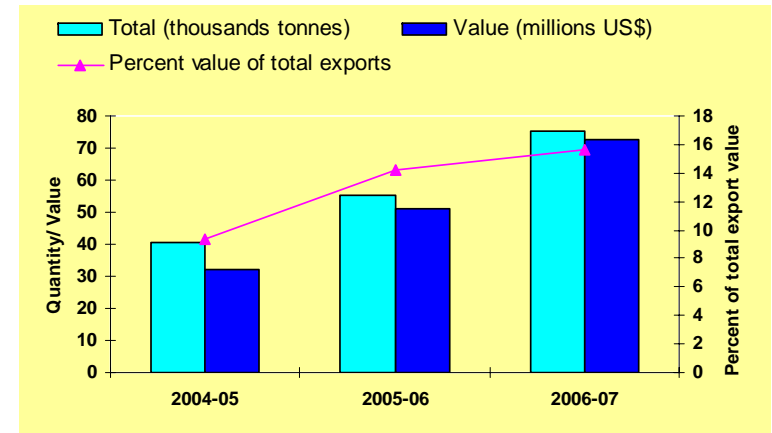
- Integration of farm activities
 - Hatchery/ fry to fingerling & grow-out separate businesses
 - Simple technologies adopted
 - Large grow-out ponds
 - Medium stocking densities
- Development of
 - Feeds
 - Processing sectors
 - Year round production
 - Processing waste recycled
 - feeds





Case of Myanmar-

- Within a 5 year period export income from a single species $>60 \times 10^6$ US\$
- Unit profit <0.15 US\$/ kg
- Created
 - $>10,000$ employment opportunities
 - New market trend (s)





Case of Myanmar-

- Now extending to catfish cage culture
 - Myanmar many advantages
 - Large water resources
 - Water quality relatively good
 - Limited industrial effluent discharge
 - Governmental incentives
 - Would Myanmar overtake Vietnam in catfish culture?



Enclosed cages



High SD: intensive feeding



Harvest – alive for processing





Other emerging species/ trends: Mangrove crab culture

- Table size; > 400 g
- Soft shell; 60 -80 g
- Constraints
 - Still mostly dependant on wild seed
 - Life cycle(s) closed but not fully commercialized
 - Feeds; primarily trash fish/ low value fish





Other emerging species/ trends: marine fin fish

- Species such as
 - Grouper (*Epinephalus spp.*)
 - Cobia (*Rachycentrum canadum*)
 - Snappers
- Growth of 10% per annum
- Value 4% per annum
- Fastest growing sub-sector in the region
- High market value





Other emerging species/ trends: marine fin fish

- Caters also to the live fish restaurant trade

Culture:

– + impacts

- This trade dependent almost entirely on cultured fish
- Reduction in wild catches
 - Minimized habitat destruction
 - Minimized use of destructive fishing methods
 - Contributed to conservation of biodiversity





Other emerging species/ trends: marine fin fish

- Success mainly due to:
 - Closing of life cycles
 - Still survival up to fingerling averages 12 to 15 %
 - High fecundity and average large broodstock size compensates
 - Improved hatchery techniques
 - Improved husbandry
 - Improved marketing (including live fish transportation)





Other emerging species/ trends: marine fin fish

- Major constraint(s)
 - Heavy dependence on trash fish/
low valued fish as primary food
source
 - Environmental degradation due
to above use
 - Unpredictable market trends
 - “Niche market” reacts to global
calamities
 - Hatchery techniques not adopted
in some remote regions
 - Still some dependency on wild
seed stocks





Conclusions – Part 2

- Asian aquaculture
 - Contributing increasingly to the GDPs of countries
 - By pass the contribution from fisheries in most
 - Fisheries trade is on the increase
 - Overall contribution to aquaculture based on a few species groups
 - Very rapid and large developments in some commodities
 - Over short periods of time
 - Combated disease problems
 - More emerging species
 - Cater to niche markets
 - Aquaculture developments becoming increasingly
 - socially responsible
 - Environmentally conscious
 - Contribute to environmental and conservation of biodiversity
 - Market conscious/ meet consumer demands





Fish make many a person smile in Asia

Thank You All



Indonesia



Lao

