TOWARDS SUSTAINABLE AQUACULTURE

CHENMMEENKETTU

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RESEARCH FOUNDATION
for Science, Technology and Ecology

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Preface

In 1994, while M.C.Mehta the Supreme Court lawyer and I were attending a meeting of the Advisory Committee on the Environment of the University Grants Commission, M.C. asked if I would help with the scientific analysis and environmental impact assessment for a case he had been asked to file, by the veteran Gandhian Shri S. Jagannathan. Jagannathanji and his wife Smt. Krishnammal Jagannathan had been leading a "satyagraha" against the shrimp farms that had started to come up all along the coasts of Tamil Nadu, Orissa, Andhra Pradesh and other Indian states. He wanted to support the grass-roots struggle with public interest litigation, to bring to visibility the ecological and social havoc being caused by the shrimp industry. When I heard Jagannathanji at a meeting on coastal ecosystems, I immediately thought of how he was leading a **"Chipko of the Coasts"**, just like Shri Sunderlal Bahuguna and Shri Chandi Prasad Bhatt had been involved in the "Chipko" of the Himalaya.

With my commitment to do ecological research for people' movements, I immediately volunteered to do a rapid environmental impact assessment (EIA), and used every trip to South India to visit the coastal regions and work with the Gram Swaraj Movement in Tamil Nadu and PREPARE in Andhra Pradesh. On the basis of these visits and in partnership with the local NGOs a quick report on the EIA of aquaculture was prepared under the title "The Violence of the Blue Revolution". The Public Interest Litigation was filed and the grass-roots resistance to the shrimp industry continued to grow in Tamil Nadu, Andhra Pradesh and Orissa. Jagannathanji was arrested and we mobilised to have him released.

In May 1995, we convened a meeting in Chennai (Madras) to form the **"People's Alliance Against the Shrimp Industry (PAASI)** — a group dedicated to deal exclusively with the mushrooming prawn farms across the coastal lines. The meeting was hosted by Jacob and Daisy Dharmaraj of PREPARE. Jagannathanji came from Tamil Nadu, Banka Behary Dasji of Orissa Krushak Mahasangh came from Orissa, Nalini Naik came from the National Fisherfolks Forum in Kerala, Claude Alvares from the Goa Foundation in Goa. Representatives also came from movements in other Asian countries affected by the shrimp industry — Khushi Kabir of Bangladesh and S.M. Idris, Martin Khor and Meenakshi Raman from the Consumer Association of Penang and Sahabat Alam Malaysia.

At the RESEARCH FOUNDATION we continued the analysis of the social and ecological impact of aquaculture in Orissa, Andhra Pradesh, Tamil Nadu, Kerala and Karnataka.

"Towards Sustainable Aquaculture: Chenmmeenkettu" is our contribution to finding alternatives to destructive aquaculture, to ensure sustainability and protect people's livelihoods. Like other contributions of the RESEARCH FOUNDATION, this analysis has been guided by the philosophy and methodology of participatory action research.

The combination of action at the grass roots, legal action in courts and scientific studies by institutes within and outside the country proved powerful enough to counter the power of the nexus between international financial institutions, national and global corporations and politicians which had propelled the gold rush for shrimp aquaculture.

On December 11, 1996, a Supreme Court Bench headed by Justice Kuldip Singh ordered that "all aquaculture industries/shrimp culture industries/shrimp culture ponds operating/set-up in the coastal regulation zone as defined under the CRZ Notification shall be demolished and removed from the said area before March 31, 1997".

Some of the directions given by the Supreme Court are as follows :

- No aquaculture industry whether it is intensive, semi-intensive, extensive or semi-extensive will be permitted. The only activity which will be permitted is traditional and improved traditional.
- Aquaculture activity/aquaculture ponds will be covered by Clause 7 of the CRZ Notification. Therefore, no such activity will be permitted within the limits indicated in the notification.
- All aquaculture industries/ponds will be demolished and completely removed by 31st March 1997. The police authorities of the area will ensure compliance of the directions given by the Supreme Court. Compliance report will be filed by April 97.
- Even the existing traditional/improved traditional within a CRZ notification will have to take permission from the said authority for its continuance.
- The workers of these aquaculture industries will be paid retrenchment compensation plus six years wages.
- The farmers of the area will be compensated for the losses suffered by them.

This far reaching judgement was given by the Supreme Court bench while noticing, "the 'Dollar' based argument advanced before us. It was contended before us by the learned counsel appearing for the shrimp aquaculture industry that the industry has achieved singular distinction by earning maximum foreign exchange in the country. Almost 100 per cent of the produce is exported to America, Europe and Japan and as such the industry has a large potential to earn 'Dollars'".

The court thus upheld the value of life above the value of dollars earned from shrimp exports.

This was the basis of the petition filed by Shri S. Jagannathan, and the interventions made by other groups and the grass-roots actions throughout India's coast where aquaculture was devastating people's lives and livelihoods.

"Chenmmeenkettu" is dedicated to the struggles of millions of fisherfolk and farmers who have harvested fish and farmed sustainably over centuries and whose resistance has called a halt to unsustainable fish farming.

It was the alliance of diverse grass-roots groups with public interest oriented legal and scientific organisations, which has opened up new hope and possibility for justice and sustainability, in the management and use of coastal ecosystems in a period of globalisation.

On behalf of the RESEARCH FOUNDATION, I would like to express my deep appreciation to the PAASI Network — Jagannathanji, Banka Behary Dasji, Dr. Jacob Dharmaraj and Dr. Daisy Dharmaraj, Claude Alvares, Nalini Naik, Purabi Pandey and to Supreme Court Advocates: M.C. Mehta, Indira Jai Singh and Sanjay Parikh.

Working together in solidarity has been a fulfilling and inspiring experience. We hope that those striving for sustainability and justice in other regions of the world will also draw inspiration from people's activism and judicial activism in India.

Vandana Shiva

"Satisfaction lies in the effort not in the attainment. Full effort is full victory."

— ***Mahatma Gandhi***

Dedication

To the toiling fisherfolk and farmers of this country. For the valiant struggle they have put in to sustain our rich aquaCULTURAL/agriCULTURAL biodiversity.

Acknowledgements

This book would not have been possible without the help from numerous farmers, fisherfolk, and others both in India and abroad. In particular we wish to thank :

- the Halan family, Banka Behary Das and Ramesh, Ashok Panigrahi, Dutta Bhanj, Sankhanad Behera, Kalinga Karnadhar, J. K. Bajaj, G. Venkataramani, G. Uma, Nanda Kumar, Mohan Kumar and Anthony, Jacob Vadakkancherry, Sharatchandra, Dinesh Kumar, Sri. Jagannathan, Smt. Krishnammal Jagannathan, Drs. Jacob and Daisy Dharmaraj, Mr. Elangovan, Sasi, Padmini Krishnan, Purabi Pandey, Sanjay Parikh, Indira Jaising,

- the farmers and fisherfolk of Balasore, Chandipur, Gola, and the area surrounding Lake Chilika in Orissa, Vypeen and Kannur in Kerala and Karnataka, and

- the members of the People's Alliance Against Shrimp Industry (PAASI), the staff of the M.S. Swaminathan Foundation, Malayalam Manorama, and the College of Fisheries in Mangalore.

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Monocultures Vs. Diversity :
Two Paradigms of Biological Production

Diversity of cultural and biological bountifulness is crucial, for the preservation and maintenance of an ecologically and socially sound society and economy. Cultural and biological wealth allows a society to utilise necessary resources required for everyday use without creating an imbalance in the local ecosystem.

The maintenance of this biological and cultural plenitude in India has largely been due to the people practising, maintaining and sharing their traditional knowledge of subsistence living with each other over the generations. A number of traditional practices have evolved with the passage of time, whereas other practices have remained untouched since time immemorial. India, like many parts of the world, has been introduced and exposed to new and innovative technological advances which have influenced and, in some cases, improved traditional technologies. However, there are many more instances where new technological advances have impaired and hampered the traditional way of life, further worsening the plight of the poor, creating situations far worse than those they originally faced.

In the past few decades, resource scarcity is being realised by both, the developed and the developing nations. While it is recognised that this scarcity has been created through overexploitation and overconsumption mainly by the developed world, the focus of research is being directed towards developing newer technologies to increase production — technologies that may address some aspect of the issue of overexploitation, but do not address the other aspects or the issue of overconsumption. This paradigm of research recognises only one yield, for example more grain, more shrimp, as having value both monetary and nutritive and is directed towards increasing this singular yield. Thus, new varieties are created through artificial means such as genetic alteration, or artificial inputs are increased to maximise yields of single crops, whether grain or shrimp. The use of genetic engineering and the maximisation of output of one part or function of single crop species are models not based upon the natural ecological order. But rather, they are conceptualised laboratory models where the consideration of a few variables provides short - term 'solutions', whose performance in the long term have dire impact, especially at the ecological and economic levels.

Green Revolution : The Gospel that Failed

'Modern Farming', an article in *The Economist* written after the Mad Cow Disease outbreak in the UK stated that we cannot afford to shift to sustainable food production systems because sustainability and productivity are conflicting objectives[1]. Further, according to the dominant paradigm of agricultural production, diversity goes against productivity, which creates an imperative for uniformity and monocultures. This has generated the paradoxical situation in which modern plant and animal improvement has been based on the destruction of the biodiversity, which it uses as raw material.

The dominant paradigm has always posited sustainability and food security as conflicting objectives. Thus, we are told, that without the Green Revolution there would have been starvation in the Third World; and without factory farming and its associated hazards there would be scarcity of milk and meat.

However, the 'high yields' of industrial agriculture are based on excluding the multiple yields obtained in diversity based systems[2].

The Myth of High Yields : More and More of Less and Less

The 'high yields' of "Green Revolution" agriculture and "Blue Revolution" aquaculture are in fact not high in the systems context of diverse species with diverse and multiple traits, functions and outputs. They are constructed as high in the context of one output of one species which has industrial and commerical value. Productivity of monocultures are low in the context of diverse outputs and needs. It is high only in the restricted context of output of 'part of a part' of the forest marine ecosystem or agricultural farm. Productivity is, therefore, different depending on whether it is measured in a framework of diversity or uniformity.

A recent article in *Scientific American*[3] has developed this diversity based approach and has shown how the economic calculations of agricultural productivity of the dominant paradigm distort the real measure of productivity by leaving out the benefits of internal inputs derived from biodiversity. As well as the additional financial and ecological costs generated by purchase of external inputs to substitute for internal inputs in monoculture systems.

In a polyculture system, five units of input are used to produce 300 units of food thus having a productivity of 1.5.

In an industrial monoculture, 300 units of input are used to produce a 100 units of food, thus having a productivity of 0.33.

The polyculture system which has been called 'low yielding' and hence incapable of meeting food needs is therefore, five times more productive than the so called 'high yielding' monoculture. Sometimes the output of monoculture production can be negative especially when costs of production are higher than the price of commodities.

This production system is then, sustained only through heavy subsidies, which include the hidden environmental costs.

It is these subsidies that have allowed ecologically and socially destructive corporate-controlled industrial agriculture to displace small farmers and ecologically sustainable, low-cost food production systems. It is also these subsidies which make low external input farming systems and organic farming apparently uneconomic since all the support and subsidies are directed to high external input monoculture systems.

Overall productivity and sustainability is much higher in mixed systems of farming, fisheries and forestry which produce diverse outputs.

Taking diversity into account makes productivity, food security and sustainability convergent rather than divergent objectives.

A typical mountain farm in the Garhwal region would have diverse crops such as wheat, barley, barnyard millet, finger millet, rice, foxtail millet, lentil, ginger, potato, mustard, pulses such as black gram, horse gram, and soyabean, and coriander. The seeds and straw form the internal inputs of the farming systems thus avoiding the costs of purchase of seed and external inputs such as pesticides and fertilisers. In addition, food security is assured by the diverse outputs to the farming family. Similarly, the spice gardens in the Western Ghats will have areca-nut, coconut, cardamom, sugarcane, paddy, black gram, green gram, cucumber, brinjal, cabbage, beetroot, bittergourd, and cashew.

As diversity is displaced by monocultures, internal inputs and self-consumption are replaced by external inputs and purchased foods.

The Green Revolution was heralded as the harbinger of freedom from hunger and targeted at Asian and African countries in the 1960s through 1980s. However, it has failed to keep its promise. Instead, it has led to over-stressed and degraded lands with a dependency on artificial fertilisers; a lowering of ground water levels; increased vulnerability to pests and concomitantly, increased dependency on pesticides; and has pushed small and marginal farmers off the land, and others into debt.

Agricultural systems in the dominant paradigm have been viewed only as producing commodities for the market based on purchasing inputs. However, agricultural production takes place in three economies:

a) the economy of nature or the internal input system
b) the people's economy of household food security, or the self-provisioning economy
c) the economy of the market, including local, national and global markets.

Globalisation of food and agriculture[4] is based on only seeing global aspects of the market economy. Although the growth of (c) is often based on the shrinkage of (a) and (b), and taking (a) and (b) fully into account reveals that monoculture systems are often 'poorer' in terms of the full range of outputs than diversity based systems. The wealth and sustainability of these biodiversity-rich farming systems has gone unrecorded because of the false correlation of monocultures with high productivity.

Since globalisation only focuses on single yield – the marketable grain or shrimp, growth is projected. Yet at the level of ecosystem and the farmers' economy, there is utter impoverishment and scarcity. People's economy and Nature's economy are both drastically reduced, biodiversity is severely eroded and household and community food security is undermined.

The Green Revolution has demonstrated its incapacity to address the problem of world hunger. Similarly, overexploitation of the deep-sea reserves of fish has resulted in increasing scarcity of marine resources as a source of food.

The Emergence of the Blue Revolution

Aquaculture, is a process of culturing various aquatic species, whether plant or animal, in a controlled environment with the objective of harvesting the species, once it matures and is fit for human consumption, both for profit and social benefit.[5] In this case, we are limiting the use of the word 'aquaculture' to the cultivation of prawns whether by traditional means of production, or intensive means of production.

One area that has been logically pursued as a result of declining marine resources is aquaculture. Aquaculture has been practised by coastal communities all over the world traditionally. Industrial aquaculture, or the 'Blue Revolution' as it is better known, is being promoted as the key to help revive depleting stocks of fish and relieve pressure from over stressed land and seas.

During the last decade, shrimp aquaculture has become a major component of fish farming both in terms of area and of market value. Though pushed by both national and international organisations as an answer to world food scarcity, particularly that of proteins; in reality, it contributes little to the nutritional needs of the world's population, being a luxury item that is consumed mainly by the rich in the developed world. Consequently, shrimp aquaculture is seen as a source of earning foreign exchange through exports.

Prawn Biology

Prawns (see Photo 4.i in Chapter 4, p. 67) belong to the grouping of crustaceans, the same family as lobsters, crabs and molluscs, all of which are bottom-dwelling species. Prawns can be found in most water types — fresh, brackish, and marine. There are basically two categories of prawn — fresh water and marine water. The *Peneaid* (shrimp) varieties are found in marine and brackish water, whereas *Macrobrachium* (scampii) prawns are found in fresh water[6]. There are more than a thousand varieties of these shrimp species found in both cold and tropical waters.

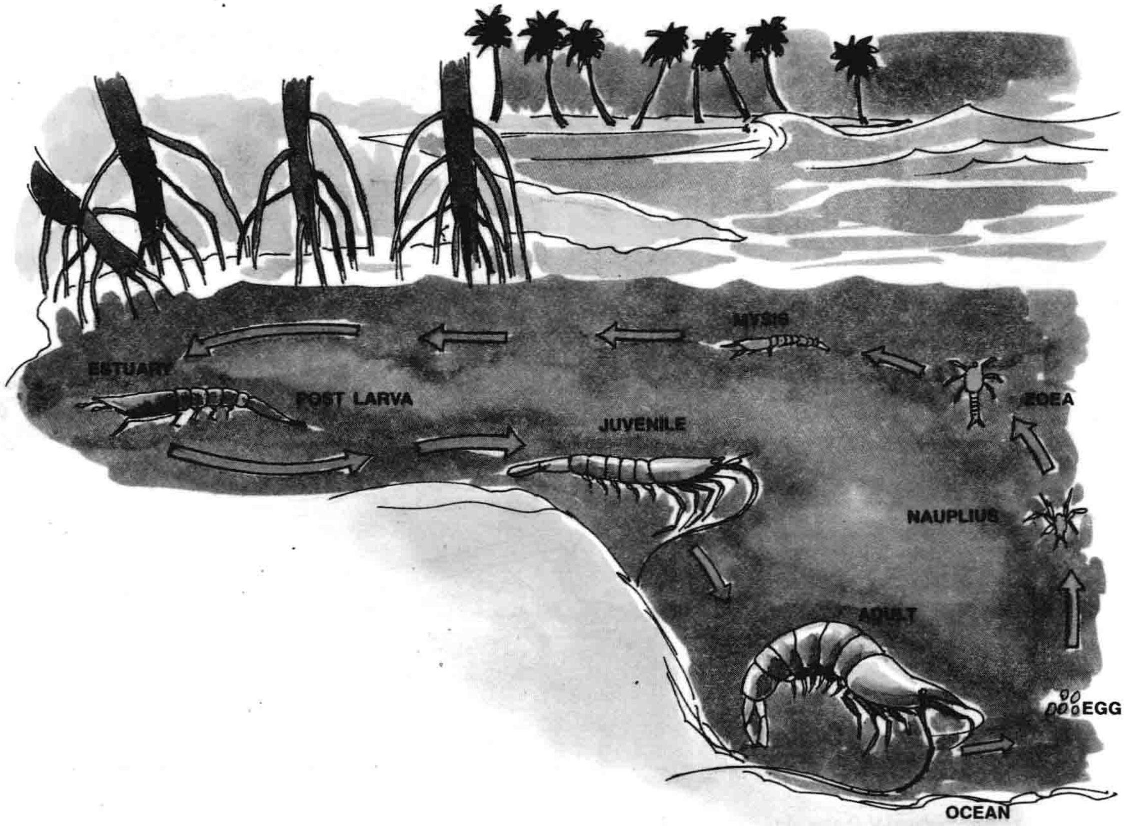

Illustration: 1.i Natural Peneaid Cycle

Peneaid prawns are estuary-dependent species, which breed at sea and grow during their post-larval and juvenile stages in the shelter of the mangrove areas. After spawning adult prawns remain on the reel, while the young and post-larvae move inshore to mangrove proproots to seek protection and food. Then they move upstream into low-medium salinity reaches. When mature, they move out from the low-medium salinity zones to estuary and reefs to spawn.[7] During their life cycle, (see Illustration 1.i), *Peneaid* prawns may inhabit and utilise more than 10 different types of critical habitats, in addition to their daily diurnal migration between numerous habitats.[8] Mangroves and wetland areas appear to be the most important in terms of habitat and shelter for shrimp. Several studies show a correlation between prawn yield and intertidal wetlands and mangrove areas worldwide,[9] thereby signifying the importance of these ecologically sensitive areas in the lifecycle of prawns.

Industrial Prawn Farming Cycle : Assembly Line Prawns

In industrial intensive shrimp cultivation, sites for prawn culture must be first selected, preferably close to a water source.[10] A pond of adequate size and depth is, then

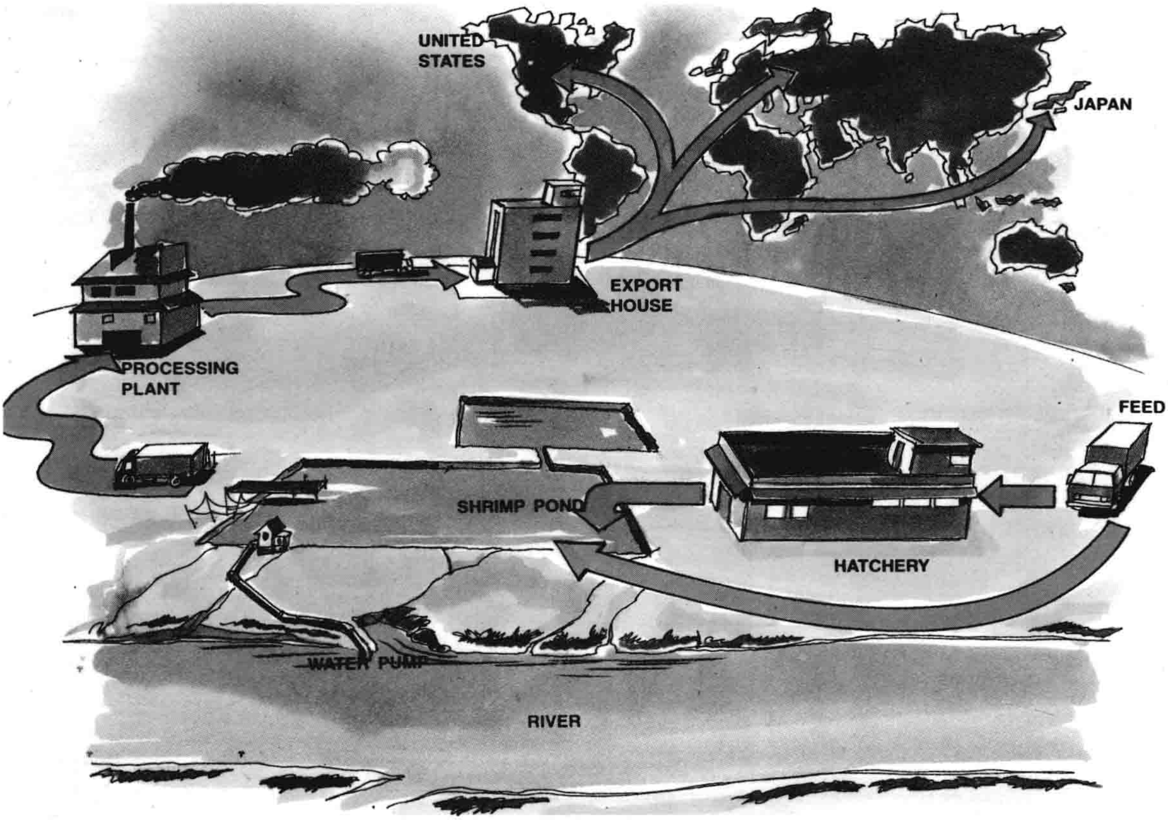

Illustration: 1.ii Industrial Prawn Aquaculture Cycle

constructed and prepared to house the shrimp. Shrimp seed must be acquired from hatcheries or estuaries to stock the ponds.

To induce spawning in shrimp for hatchery production, the eyes of the females are callously cut out. Shrimp culture is partly dependent on seedlings from brood stock in captivity (one-eyed female prawns), and partly on egg-bearing (gravid) females caught at sea which fetch high prices and partly on larvae and juveniles caught on the coast. The seed are then placed in the pond for 120-150 days, where they are fed and monitored, making necessary adjustments along the way. Once they reach maturity, the shrimp are harvested and trucked to a processing plant or shipped directly to their destination: *Japan, USA and Europe*. Illustration 1.ii, outlines the industrial shrimp life cycle.

Five Systems of Aquaculture

Fish, shrimp and other aquatic organisms play a key role in the dietary needs of coastal people. Little wonder, then, that aquaculture was practised centuries ago in many South-East Asian and South Asian countries. The methods utilised traditionally had low environmental impact, as cultivation was done in an ecologically sound manner, 'employing' many of the locals, with the knowledge of these traditional techniques being passed from one generation to the other.

Today, along with traditional aquaculture, we find extensive, modified extensive, semi-intensive and intensive methodologies being promoted and used to cultivate aquatic species in captivity. While traditional aquaculture and sometimes extensive aquaculture is based on diversity, semi-intensive and intensive aquaculture are based on monocultures. We will refer to these methodologies mainly in terms of industrial aquaculture.

Traditional shrimp farming system employs shrimp seeds that are trapped along with fish seeds during high tide when ponds become inundated by tidal forces. A number of aquatic species co-exist with the shrimp, thereby allowing the cultivation of species other than shrimp. In order to prevent shrimp from escaping fixed screens are placed in the sluice. The shrimp are harvested at frequent intervals. This method produces shrimp of varying sizes and shapes, producing an average of 0.5 tonnes/ha./year.

Extensive shrimp farming involves the construction of ponds that vary in size from 1 ha. to 5 ha. These farms are located in selected areas and are stocked with fast-growing shrimp seeds at low densities, from a few thousand to 100,000 seeds per hectare. Supplementary feeding is required, however, the quantity and frequency is not very high due to low stocking density and the close vicinity of tidal forces bringing in natural feed. The quality of water is maintained by the natural rise and fall of tides or through water exchange (5%) by a pump. The average production from this system is 1-1.5 tonnes/ha./crop.

Modified extensive shrimp farming has a greater stocking density than extensive farming about 120,000 seeds per hectare. There is supplementary feeding with an artificially formulated diet. Aerators are used along with water exchange between 7 to 9 per cent. Average production is between 1.5-2.0 tonnes/ha./crop.

Semi-intensive shrimp farming requires the construction of ponds ranging from 0.2 to 0.5 ha. in size. The ponds are stocked with fast growing hatchery seeds at a density range of 1-3 lakh/ha. Water quality is maintained by water exchanging 10-15 per cent daily, along with aeration of the pond with blowers/paddle wheels. The shrimps are fed with formulated feed. The average production in this system can be up to 5 tonnes/ha/crop.

Intensive system of shrimp farming involves the construction of concrete ponds of 0.03 to 0.1 ha. in size, with selective stocking of high quality shrimp seeds exclusively procured from hatcheries at a density ranging from 5-20 lakh per ha.. water quality is maintained by exchanging water over 30 per cent a day, and aerating the pond with mechanical aerators. Shrimp are fed on high energy food. Average production ranges from 10-20 tonnes/ha./crop.[11]

Table 1: Summary of Prawn Aquaculture Systems

CHARACTERISTICS	Traditional	Extensive	Modified Extensive	Semi-Intensive	Intensive
Pond Size	>5 ha	1 to 5ha	1 to 2ha	0.2 to 0.5	0.03 to 0.1
Stocking density	Natural, under 10,000/ha	Natural and Artifical 10,000	Majority artifical 10,000 to 18,000	Artificial 1 to 3 lakhs/ha	Artificial 5 to 20 lakhs/ha
Average Production annual	0.5 to 1 tonnes/ ha/year	1 to 1.5 tonnes/ ha/crop	1.5 to 2.0 tonnes/ ha/crop	Upto 5 tonnes/ ha/crop	10 to 20 tonnes/ ha/crop
Feed Source	Natural	Natural and Formulated	Formulated	Formulated	Formulated
Seed Source	Natural/wild	Hatchery/wild	Hatchery	Hatchery	Hatchery
Water Exchange	Tidal	Tidal and pumping	Pumping	Pumping	Pumping
Aeration and Water Exchange (%)	nil	2 to 4 times daily	4 to 6 times daily	6 to 10 times daily	> 10 times and oxygen injectors
Fertilisers	None	Organic and biodegradable	Organic and biodegradable	Organic and biodegradable	Organic and biodegradable
Diversity of crop	Polyculture	Occasionally Polyculture, majority monoculture	Monoculture	Monoculture	Monoculture
Disease and Viruses	Very rare to nil	Rare	Moderate	Moderate to Frequent	Frequent
Management	Minimal	Minimal with some skilled personnel	Skilled personnel	Skilled personnel	Highly skilled
Employment	No figure for employment, however 30-40% of operating budget is for labour	Up to 7 persons/ha 45 days per working cycle	Less than 7 persons/ha	1-3 persons/ ha employed for 26 days	1 person/ha, only 6% of the operating budget is for labour
Effluent treatment	Not required	Not required	Required	Required	Required
Environmental implications	•Self sustaining system •Yields 6 mths prawn/fish and 6 mths paddy in chenmmeen system	•Self sustaining with inputs •Requires land to be cleared •Only produces prawn	•System relies on inputs •Requires land to be cleared •Only produces prawn	•System relies on inputs •Self polluting •Only produces prawn	•System relies on inputs •Pollutes environment •Only produces prawn
Social implications	•Provides employment •Source of food	•Provides employment •Source of food if product not exported	•Product export, •Little employment	•Product exported •Mechanised •Little employment	•Product exported •Mechanised •Little employment
Viability of system	Productivity of system is continuous, if uninterrupted	Productivity of system is 15 to 20 years	Productivity of system is 15 years	Productivity of system is less than 10 years	Productivity of system is 5-10 years

Source : MPEDA, Waterbase 1993, Lin 1995, Primavera 1993, WWF/UNRISD 1996, Nijera Kori 1996.