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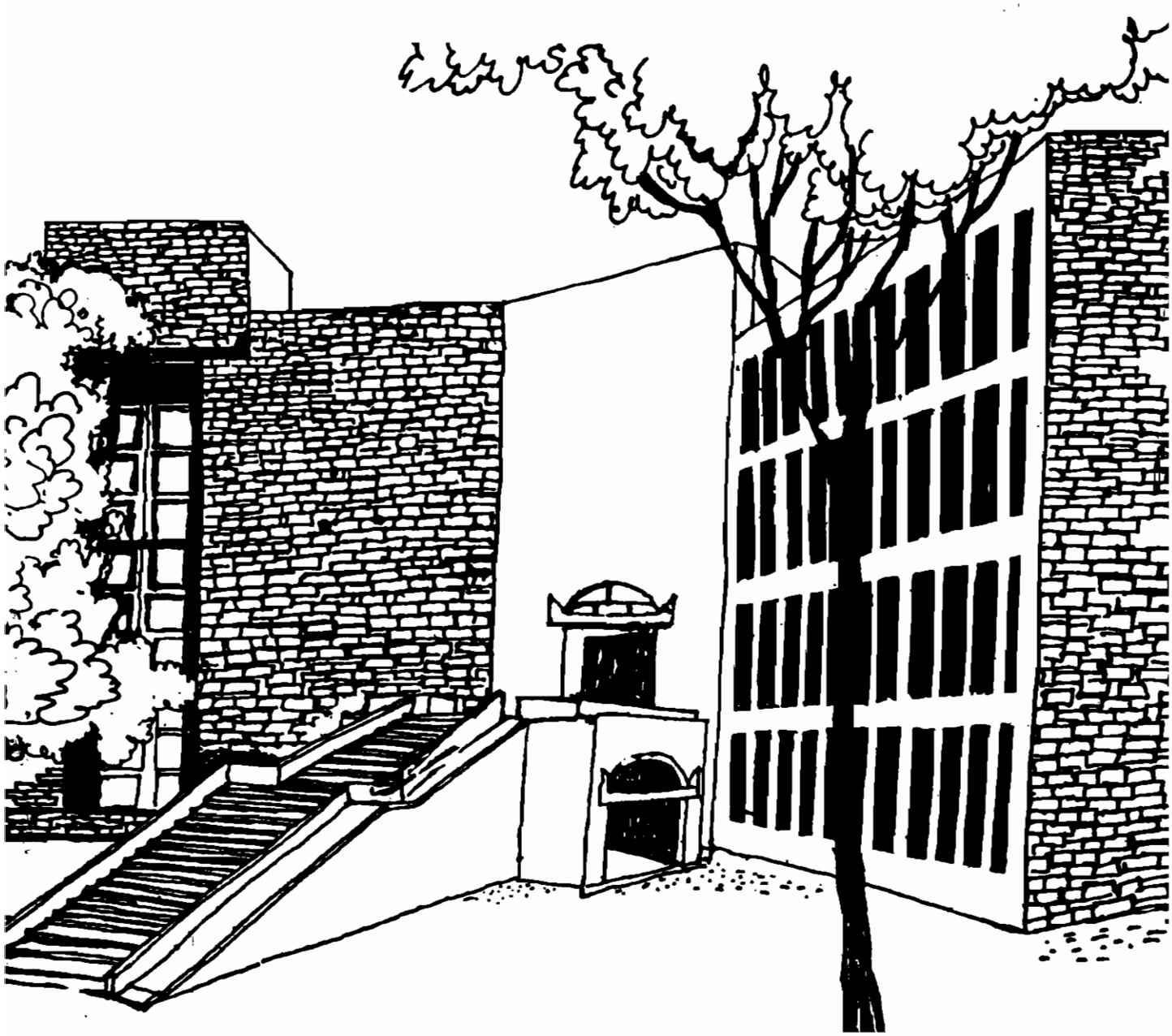

A MANAGEMENT PERSPECTIVE FOR SUSTAINABLE FISHERIES UNDER GLOBALISED MARKET CONDITIONS: THE INDIAN SCENARIO

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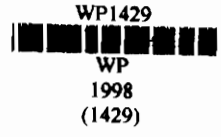
W.P. No.1429
February 1998



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A Management Perspective for Sustainable Fisheries Under Globalised Market Conditions:

The Indian Scenario

By

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December, 1997

ABSTRACT

India enjoys a vast and versatile resource base in respect of her fisheries. However, the country presently has reached a crossroad so far as sustainable tapping of this resource base is concerned. Defining sustainability not only in terms of economic viability but also in the context of ecological and social campatibility, the study looks into the problems and prospects of sustainable management of Indian fisheries. It analyse the various types of negative externalities arising out of a lack of clearly defined 'property rights' regime, both from within and from without. In doing so it examines the sustainability issues in respect of capture and culture fisheries exports and global competitiveness of fish and fishery products and fishermen's cooperatives. A future policy perspective is developed through comparing the Common Fisheries Policy of the EU and the existing National Fisheries Policy in respect of their capabilities in striking the necessary balance between economic needs and socio-ecological requirements. The study concludes by highlighting the need for evolving a network of brotherhood type organisations institutionalized at local stakeholders' level.

The authors would like to acknowledge the support and help provided by the Center for Management in Agriculture, IIM, Ahmedabad; the Directorate of Economics & Statistics, Ministry of Agriculture, Govt. of India; Fisheries Development Commissioner, Govt. of India; Aquaculture Foundation of India, Neelankarai; European Union , New Delhi; Fisheries Directorate, Govt.s of Assam, W. Bengal, Orissa, Andhra Pradesh, Maharashtra, Tamil Nadu & Kerala; Marine Products Export Development Authority, Kochi & Calcutta; NABARD, Bombay, Madras, Bhubaneswar & Guwahati; National Federation of Fishermen's Co-operatives Ltd. , New Delhi, National Co-operatives Development Corporation, Delhi, Calcutta, Madras & Bhubaneswar; International Collective in Support of Fishworkers, Madras; Minnota Aqua Foods Ltd., Visakhapatnam; NCC Bluewater Products Ltd.,Visakhapatnam; Neekanti Sea Foods Ltd., Visakhapatnam; Asian Seafoods Ltd., Visakhapatnam; Fishing Chimes, Visakhapatnam; Bay of Bengal Programmes (BOBP), Madras; S & S Industries and Enterprises Ltd., Madras; Hindusthan Lever, Madras; Southern India Aquarists, Madras; BENFISH, Calcutta; Central Fisheries Co-opeative Society, Bongaon; Mudiali Fishermen's Co-operative Society, Calcutta; Versova Fisheries Multi-purpose Co-operative society, Andheri (West); Masses Association for Self-Sufficiency & Economic Security (MASSES), Gudur. However, the usual disclaimers apply. This is the summary of a larger study on the same subject recently completed by the authors.

Background:

India being strategically located to harvest not only the resources of the Arabian Sea in the west, but also those of the Bay of Bengal in the east, is one of the very few countries of the world which has a vast as well as versatile fishery resources. From Himalayas to Cape, India has varying climatic conditions which provide different environments to culture tropical as well as temperate fishes. She is among the seven major fish producing countries in the world. Though India has a meager 4.3% share in world production as per the latest available figures (1992), the share been constantly improving . Though contribution of fisheries to Indian GDP and NDP at constant prices of 1980-81 has been a meager 0.79% and 0.74%, respectively in 1993-94, these figures two are moving on a slow upward trend. As per 1993 estimates, the size of fish farmer population - mostly small and artisanal fishermen – who were directly dependent on fisheries for subsistence and means of livelihood, was 5.8 million - that is, about 0.7% of the total population. Another 3 to 3.5 million people are believed to be engaged in fish processing and ancillary industries. While this sector is already serving the cause of poor, uneducated and socially backward fishermen communities and especially the women, it has further potential for generating employment for uneducated and the educated unemployed in the rural areas. It is estimated that whereas agriculture is capable of generating 180 crops days/ha/year, aquaculture can generate 600 crop days/ha/year - a total employment of 24 million in potential terms (Sakthivel, 1997a). Whereas the aquaculture industry is currently producing about 1 million tons per year at a value of Rs. 20,000 crores, the potential is thus believed to be 6 million tonnes in terms of production and Rs. 120,000 crores in value terms (Sakthivel, 1997b).

Indian fisheries seem to have a few other advantages. First, it is capable of providing a significant solution to the problem of malnutrition. With rapid growth in population, a large percentage of the country's population is undernourished for non-availability of sufficient animal protein at reasonable and affordable prices. This is happening at a time when a large chunk of our low-value fish catches, which could be used for large scale production of fish snack food are being thrown away in the sea. There is enormous scope for increasing India's dismal per capita consumption figure of fish - about 3.5 to 5 kg/annum, while the world average stands at 16 kg/year and the same for Japan stands at 83 kg/year.

Second, the projected global supply-demand imbalance to be filled in through aquaculture by large producers like India and China seems to have provided to Indian fisheries an enormous scope for expanding exports and thus encashing on this opportunity. All available evidences suggest an imbalance between world demand and supply of fish ever since the late 1980s, when the annual growth rate of fish catch came down to 1% from 6.5% observed during the two previous decades. The imbalance is likely to be greater if one takes into account the effect of increased per capita incomes and the world-wide change in tastes and preferences of the increasingly health-conscious population in favour of low-cholesterol and easily digestible protein in the form of fish and fish products (Dehadrai, 1996). The economic liberalisation of the economy, which coincided with a boom in the export market for Indian fisheries, has already resulted in a steady and a fairly steep rise in the quantity and value of exports. Aquacultural exports continue to be an 'extreme focus' sector during the Ninth Plan. It is believed that Indian fisheries enjoy strong competitive advantages not only because of bountiful and diverse natural resources, but also because of abundant skilled and unskilled labor generally available at comparatively lower wages (ASCI, 1996). Unless irresponsible trade union movement and popular legal interventions jeopardize this picture, this factor is believed to remain a major competitive strength of Indian exports.

In spite of the above-stated optimism, the fisheries sector has of late come to confront a large number of apparently complicated and insurmountable problems. First, the resources continue to be grossly underutilised in terms of both production and productivity - an issue which raises serious doubt about economic viability of fisheries enterprises in different segments of this sector. A major question in this context is whether government policy should continue to support fishery cooperatives, most of which have remained economically non-viable inspite of policy support Second, even when private enterprises are viable in certain segments of this sector, these seem to have come up against the interests of traditional

fishermen and other socio-economic groups, besides hurting the environment. People have even raised doubt about the wisdom of placing undue importance on exports, which may jeopardize domestic consumption. Doubts are also expressed about the global competitiveness of Indian fisheries in view of the increasing social and environmental concerns now-a-days being raised at both home and abroad. In other words, serious concerns are being expressed over the 'sustainability' of Indian fisheries under globalised market conditions, where sustainability means not merely long-term economic viability but also social and environmental compatibility.

Study Objectives:

The study has the following objectives:

(i) to critically examine the sustainability of fishery enterprises in general and of cooperative enterprises in particular in major segments of the fishery sector;

(ii) to critically examine the sustainability of Indian exports through assessing the domestic supply-demand situation for the country as a whole as well as for the major fish-producing states such that suitable policy alternatives as well as institutional arrangements can be created for satisfying the growing domestic demand for fish while at the same time maximizing the country's foreign exchange earnings through exports.

(iii) to examine global competitiveness of Indian shrimp in the face of mounting environmental and socio-economic concerns being expressed at both home and abroad about brackishwater aquaculture.

(iv) to identify the relatively unexplored but possibly sunrise segments of Indian fisheries, and

(v) to have a critical review of government policy and the legislative framework with respect to fisheries in order to arrive at a perspective plan for sustainable development of all types of fishery resources.

Study Design and Methodology:

For purpose of the study, sustainable development is defined as a process of simultaneously ensuring continuation of the economic, social and ecological bases of human life. So, by dividing fishery activities broadly into capture and culture types across marine, brackishwater as well as freshwater segments, the study has examined economic viability besides environmental and socio-economic compatibility of fisheries with other activities in the economy. In a property rights framework it has looked for institutional and technological options which can avoid the problems of negative externality effects either arising from within fisheries or arising from other activities towards fisheries. While analysis of economic viability of major segments of fisheries as well as the global competitiveness analysis of Indian shrimp are largely based on micro enterprise level primary data, analysis of the other components of the concept of sustainability and also fulfillment of the other objectives of the study have been conducted mainly on the basis of secondary source materials. In order to evolve a policy perspective, not only has Government of India's Fisheries Policy been examined and compared to the Common Fisheries Policy of the EU countries, but also the prevailing legal policy framework both preceding and following the famous Supreme Court judgement of December 1996 have been critically examined.

Sustainability of Capture Fisheries:

Marine Fisheries: The following stylized facts have implications for the economic viability of marine fisheries:

* The northwest and southwest coasts have proportionately much greater resource potential than the northeast and southeast coasts. Oceanic and 300-500 m depth level resources constitute a meager 7.7% of the total potential under the Indian EEZ.

* While Andhra Pradesh, Gujarat, Tamil Nadu and Andaman & Nicobar Islands enjoy the largest share of India's coast lines and Gujarat and Maharashtra share the largest proportion of the country's total continental shelf, the percentage shares of these states and union territories to total production are not commensurate with their resource bases - simply because neither the resource potential nor the efforts are uniformly distributed across the regions.

* As per MPEDA's estimates, Indian EEZ has a potential 0.488 million tonnes of tuna - yellowfin tuna, big eye tuna and skipjack tuna, distributed off the south-west and east coast with concentration around the coasts of Lakshwadweep, the Gulf of Manner and the Andamans. Due to limited operational range of our fishing fleet, tuna and cephalopods are believed to be under-exploited.

* Although figures indicating the extent of utilization are not available against the potential of various groups of marine fish, the general impression is that there is enormous scope for increasing the catch of perches (by about 50%), ribbon fish (by about 70%), carangids (by about 55%) and mackerels (by about 45%), besides tuna, (by about 89%). There is also huge scope for exploitation of some non-conventional marine resources like Bull's eye, Indian drift fish and Black raff, which are distributed widely within 50-200 m depth range and have high nutritive value (Sathiadhas et al, undated).

* However, Indian marine fish production seems to have reached the maximum sustainable yield level, which is defined as 50% of the resources. Obviously, there are reported cases of over-exploitation and depleting of stocks of certain species (ASCI, 1996).

* The share of marine fisheries in the total fish production of the country is going down considerably over time, from around 71.01% in physical terms in 1950-51 to about 54.70% in 1995-96 in spite of the fact that the marine fish production has been increasing in absolute terms till date.

* In India, marine fishing efforts are largely concentrated within the 0-50 m depth zone, where the shrimp population is the largest. The underexploited resources beyond 50 m depth are estimated to be 1.7 million tons, but the resources being thinly spread in this region, productivity is less than 1 ton per sq. km whereas the corresponding figure for onshore waters is as high as 11 tons. Moreover, a large percentage (as high as 85%) of the resources beyond 50 m depth are low valued materials. An important comparative disadvantage of Indian sea is that it has a large number of thinly distributed species, whereas the temperate regions have large volumes of a relatively few species. This makes catching them selectively without destroying commercially less important but ecologically important species an extremely difficult proposition.

* A case study (Zacharia *et al*, 1996) carried out in regions around Mangalore and Malpe in the state of Karnataka, situated on the south west coast of the country and producing a disproportionately higher share of the country's production in comparison to her share in the total coast line, raises questions about the sustainability of deep trawl fishing. The study distinguished between performances of single day fleet (SDF) and multi-day fleet (MDF). Whereas the SDF are characterized by old day traditional boats, MDF refers to the trawlers. The SDF operations found to be confined within 10-15 km from the shore for about 125-200 days per year. MDF on the other hand operates over a wider area for about 220-270 days annually. Although the study clearly suggests a higher net income per unit of MDF, it simultaneously reveals that catch rate in kgs per hour of fishing activities has been showing a continuously declining trend between 1988-89 and 1994-95 and that SDF enjoys a higher catch rate than its MDF counterpart. Further, whereas the MDF has been showing an almost continuous decline in catch rate, that for SDF is rather showing an upward trend (Table:1).

* Consequently,doubts have been raised about the long run commercial viability of deep sea marine fisheries. Studies show that it is not economically viable to fish in the EEZ beyond 50 metres depth as the fuel costs become prohibitively high (around 60-70% of the running costs) (ASCI, 1996).

TABLE 1 : TREND IN CATCH RATES FOR MFD AND SDF BETWEEN 1988-95

Year	Catch (tonnes)			Effort (10^3 hours)			Catch Rate (kg / hour)		
	SDF	MDF	TOTAL	SDF	MDF	TOTAL	SDF	MDF	TOTAL
1988/89	8868	22981	31850	1.78	6.37	8.16	49.84	36.04	39.05
1989/90	7643	13759	21394	1.73	4.32	6.04	44.22	31.87	35.39
1990/91	7753	18934	26687	1.71	5.75	7.46	45.40	32.94	35 .79
1991/92	10429	18629	29056	2.27	6.61	8.89	45.92	28.16	32.70
1992/93	16449	17209	33658	2.63	7.41	10.04	62.61	23.22	33.53
1993/94	9049	26396	35445	2.16	9.47	11.64	41.85	27.86	30.46
1994/95	11497	34073	45580	1.94	12.68	14.62	59.13	26.87	31.17

Source : Zacharia *et al* (1996), p 2

* As of the working of deep sea fishing in Vishkhapatnam, the fleet size increased from 59 in 1981 to 180 in another ten years. Total shrimp catch declined from 1649 tones to 1565 tones. Majoroty of the trawlers are in the red.

* Almost all the trawlers permitted by the government since 1978 to fish within Indian territories were found to be active in waters less than 40 fathoms (73 meter) deep. Around 50 such vessels were apprehended by the coast guards for fishing in shore. Their catch mainly comprised of typically in shore fauna.

* Once the government banned the chartered trawlers from fishing within the 40 fathom line in 1982-83, most of the foreign trawlers have gradually withdrawn their offers, implying a probable lack of interest in fishing in deep waters. (Pillai, 1995)

* Even at the international level, concerns have been shown about the sustainability of global fishing fleet, in view of their overcapacity (*Infofish*, 2/1993).

* It is believed that the traditional boats and mechanised crafts are quite capable of optimally tapping India's fishing resources in the upto 200 mt. zone. No big trawler is required for this segment. Large factory ships not only act as environmental predators but also deprive the common man of low-valued fish (Pillai, 1995).

The negative economic externalities generated in marine fishery sector are shown in Table: 2.

TABLE 2 : ECONOMIC EXTERNALITIES IN MARINE FISHERY SECTOR OF INDIA

Externalities	Manifestations	Remarks
Crowding	Overcapacity	Efforts of each fisherman reduces the stock of fish thereby requiring increased efforts from other fishermen.
Stock	Overexploitaion of the high price species.	Harvest activity of each fisherman reduces the stock of fish thereby increasing the cost of harvesting of other fishermen.
User cost	High cost of harvesting	same as above
Gear	Increased capitalization	same as above

The negative economic externalities generated a host of negative ecological and social externalities as brought out in Tables 3 & 4 respectively.

TABLE 3 : ECOLOGICAL EXTERNALITIES IN MARINE FISHERY SECTOR OF INDIA

Externalities	Manifestations	Remarks
Crowding	Hydrocarbon pollution in coastal waters due to intensive coastal fishing.	Possible cause for decline in fish population, loss in bio-diversity.
Stock	Possibility of extinction of certain high value species.	same as above
User cost	Higher cost of harvesting associated with lower catch rate leading to more intense effort	Harvesting beyond the sustainable yield.
Gear	Increased capitalization leading to greater effort	same as above

TABLE 4 : SOCIAL EXTERNALITIES IN MARINE FISHERY SECTOR OF INDIA

Externalities	Manifestations	Remarks
Crowding	Traditional fishermen outcompeted by trawl fishing.	Reduction in employment opportunities and income.
Stock	Infringement into other country's coastal waters due to intensive coastal fishing.	Detentions and arrests in other country
User cost	Higher cost of harvesting for traditional fishermen because of lower catch rate.	Harvesting beyond the sustainable yield, geopardising the socio-economic future of the traditional fishermen.
Gear	Increased capitalization leading to greater effort	same as above

However, one should mention the sunrise segments (promising areas having capabilities of being effectively tapped in the future), which should be accorded necessary priorities for development in the coming years:

* Mariculture involving sea farming of fishes, shrimps, oysters, mussels, clams, seaweed, sea cucumber and fishes in floating cages/rifts etc, which is growing annually at the rate of 5-7% around the world, is yet to come up in any significant way in India, although technologies are available to perform cage culture in the shallow inshore waters using small to large size cages at different scales of investment. India can learn a lot from the experiences of several European countries including Norway and several southeast and east Asian countries like China, Thailand and Japan, which have been culturing several fin fishes in floating net cages.

* Although seaweeds are important natural resources for food, feed, fertilizer and industrial raw materials having potential for socio-economic upliftment of coastal communities, India is yet to fully tap this potential. CMFRI and CSMCRI have evolved culture technologies for commercial species like *Gracilaria eduli*. Moreover, CMFRI has estimated that with an average yield of 3 kg/square meter in two crops the net profit per hectare comes out to be Rs.9000 (Sakthivel, 1997).

Riverine Fisheries: Like marine fisheries, riverine fisheries as well as fisheries in the large reservoirs and estuaries are also facing the same types of externalities, economic -- ecological and social, although in varying degrees. Follows below some of the stylised features in respect of the fishing activities in this subsector.

* Although states of UP (18%), Jammu & Kashmir (16.03%) Madhya Pradesh (11.92%, Punjab (8.81%), Andhra Pradesh (6.64%), Karnataka (5.19%), Tamil Nadu (4.28%) and Meghalaya (3.23%) have significant shares in the total length of rivers and canals of the country, these are not reflected in the shares total inland fisheries production not because rivers and canals constitute only a fraction of the country's inland water bodies, but more importantly because of a generally dismal performance of this segment of fisheries in terms of productivity. Srivastava et al (1991) have cited a number of direct and indirect

evidences for the low productivity of riverine capture fisheries. First, an earlier sample study put the direct yield figure at 1 ton per km. per annum. Second, inspite of increase in effort and improvement in years, the total catch of the commercial varieties of carps and cat fishes has been found by CIFRI to be declining, besides decline in both average size of catch and catch per unit effort. Third, the local fishing population has been found to be no more than one per cent of the total working population for no river system, which raises strong doubt about the dependability of this occupation. Finally, the number of persons engaged in fishing activity per km length of river has been found to vary between 3 and 26 - a fact again indicating low productivity. They have reached the conclusion that human intervention in natural spawning of valuable freshwater species has prevented tapping the full potential of riverine fisheries in India.

* It is believed that, with scientific management of plankton resources, stocking rate, methods of exploitation and conservation etc., especially in culture-based small reservoirs in the range of 1000 ha and less, productivity of Indian reservoirs, which is currently as low as 20 kg/ha/year on average, can be increased upto a potential level varying from 50 to 300 kg/ha/year depending upon size, nutrient base and geographic location. There are immense possibilities of integrated rural development especially through combination of agriculture and livestock farming systems and using large/pen culture in these reservoirs (Dehadrai, 1997). The cases of two man-made reservoirs in Himachal Pradesh - namely, Govind Sagar and Pong with established commercial fisheries under state management through one State Level Reservoirs Fisheries Development Committee, . which observe closed seasons, involve the local fisher folk in watch and ward and have also introduced a number of welfare schemes like subsidy for purchase of fisheing nets, and crafts, Saving-cum-Relief Scheme, Accidental Insurance Scheme, Risk Fund Scheme etc., are often cited as examples to be followed elsewhere.

* The reported annual yield of 105 kg/ha during 1995-96 from Govind Sagar, though more than six times larger than the national average, still falls far short of the potential. A careful examination of the fish landings from Govind Sagar and Pong reveals the following disturbing features. First, while total fish landings display an upward trend over the years in case Govind Sagar, the trend is a declining one in case of Pong; moreover, in both the cases there are wide fluctuations around the trend lines. Second, the fish price realised per kg has increased very slowly, especially in the former case, as compared to the rise in the price of fish that has taken place for the country as a whole for the same period. Third, fish harvested per licence has decined over the years in both the cases, probably indicating problems of stocking and/or overfishing. Finally, although total revenue per licence and average net monthly income of fishermen have increased in nominal terms for both the reservoirs, the achievements seem to fall far short of the desired levels when these figures are converted into real terms.

* The large number of irrigation tanks in the country, whether perennial, long seasonal or short seasonal, are ideal for 'stock and take' fisheries under suitable cultural practices, as the example of one long seasonal type Barur tank of 214 ha waterspread area located in the Dharmapuri district of Tamil Nadu seems to suggest. In the above-mentioned tank, fishing is done by 12 share fishing units belonging to one Kaveripatnam Fishermen's Cooperative (getting one-third share of the catches) using gill nets. The catches for this tank has been twice the figures for the earlier years inspite of almost the same stocking rate. It is believed that with pen culture of carp seeds in the margins of the tank and then release of the fingerling into the lake as they reach 10-12.5 cms. size, carp yield as well as the revenue can be increased substantially in this tank (Sreenivasan, 1997).

* A major advantage of inland capture-cum-culture fisheries in man-made reservoirs and irrigation tanks is that these facilities can be utilized to rehabilitate displaced families by encouraging the evictees to form cooperatives and then granting them fisheries rights in the reservoirs and irrigation tanks, as in the cases of Bargi and Tawa dams in Madhya Pradesh, rather than following the traditional practice of auctioning fisheries rights to contractors. However, this can act as merely a short-term or stop gap relief measure unless capture fisheries can be sustained through suitable scientific management and cultural practices.

In this segment of fisheries, we have broadly the same problems of decline in fish population, threat to bio-diversity, decline in income and employment potential for the fishermen community because of too many people chasing too few fish, as in the case of marine fisheries. Barring the exceptions of Govind Sagar and Mettur reservoirs and certain organised development work in certain reservoirs in Madhya

Pradesh, however, the reservoir fishery is not showing any sign of picking up. Here again the externalities arise because of the absence of a clearly defined property rights over the water bodies and the fish resources therein. The problems related to property rights are urgently necessary to be taken care of through crafting of suitable local level institutions on whom such rights may be vested and consequently, a capture-cum-culture orientation towards fishing activities has to be brought about of to ensure their sustainability.

Sustainability of Culture Fisheries:

Brackishwater aquaculture as well as freshwater ones fall under culture fisheries. It should be pointed out that the problems related to ambiguities in property rights are less pointed here than those observed under capture fisheries. Thus the extent of externalities generated from within this segment is considerably less. However, this segment is also observed to be suffering from various externalities generated in other sectors.

Brackishwater Aquaculture: The following stylised facts about brackishwater aquaculture in India have clear implications for sustainability of this segment.

* While the estimated potential area for brackishwater aquaculture is 1190 thousand hectares, actual area is a meager 70.70 thousand hectares constituting only 5.94% of the potential area. With the national average yield at 0.65 mt/ha/annum, the extent of utilization of potential is even more dismal.

* While about 70% of 5000 odd brackishwater aquaculture farms practice mostly traditional farming with low yields of 0.25 mt/ha/crop and only rarely modified extensive farming with provision for 10% water exchange and yielding about 0.5-0.8 mt/ha, only 25% of the farms follow semi-intensive culture with 10-40 per square meter density and 4-5 mt/ha yield rate per crop, and a mere 5% of the farms practice intensive culture. About 40% of the hatcheries are small, another 45% medium and only 15% large in terms of size. As much as 95% of the total production comes from a single species, shrimp/prawn - *P. monodon and P. indicus*.

* Inspite of her vast resources and the unique importance being attached to shrimp, India is producing only 10.24 % of the global production and farms only 22% of her total production of shrimp, while the global trend is towards greater and greater farming rather than fishing. In the major shrimp producing countries in the world, farms generate 40 to 95 per cent of their total production. Broadly speaking,

* The unplanned growth of this industry so far in India seems to have led to a lopsided growth of the infrastuctural facilities like hatcheries, feed mills etc. for this industry in the absence of a coherent government policy. In 1994 in view of seed shortage to the order of 4 billion led to sharp rise in seed prices from 20 paise to Rs.1.50 per piece and consequently a large scale smuggling of seed was resorted to with possible implications for virus attack for the whole industry (*Economic Times*, Feb. 27,1995). The quantity produced of feed mills is still not adequate for this industry resulting in the country importing annually about 15-20 thousands of shrimp feed from Thailand, Taiwan and Singapore (ASCI, 1996).

* The unplanned growth of the industry also manifested itself in the form of outbreak of one viral disease (called white spot disease), which led to sharp decline in shrimp production in 1995. ASCI (1996) has identified the key factors responsible for the outbreak of this white spot disease as (a) unregulated growth and poor pond design, (b) improper pond management practices including poor water quality management, (c) low quality feed and even overfeeding of shrimps, (d) illegal import of seeds and unusually high stocking density, and (e) pollution of inlet water by agricultural and industrial wastes. It is heartening to note that with a moratorium on shrimp production for a year, good management practices and setting up of 25-30% water spread area for construction of reservoir for treatment of incoming water as well as effluent treatment, quite a few of the shrimp farms have been able to avoid repetition of the experiences of 1995.

Chong (1995) argues that intensive aquaculture is self-polluting if carried out without sound management and crop husbandry practices, whereas it is self-cleaning at low intensity of production. Regarding the labour absorption capacity of intensive shrimp-culture Chong appears to be a bit pessimistic

as he argues that itis "limited to certain stages of the aquaculture development process, namely during land clearing, pond and farm - construction and not during the farming and harvesting processes. Labour cost as percentage of total cost of production is only 6-10%. Aquaculture is thus not the great employer it is made out to be". He further argues that "in many countries it has, in fact, impoverished and marginalised the weaker segments of the country's population, especially the rural poor. Public unrest and agitation in the rural areas of some countries, where the rural have-notshave been further 'disenfranchised', are symptomatic of the social costs of aquaculture" (p 10). Thus doubts may be raised about the ecological and social sustainabilities of intensive and even semi-intensive aquaculture in the absence of a proper policy framework that may do away with the negative externalities arising out of such practices even though there are found to be economically. The extenality matrix for brackishwater fishery is provided in the following table.

TABLE 5: EXTERNALITY MATRIX FOR BRACKISH WATER FISHERIES

Economic externalities		Ecological externalities		Social externalities	
Positive	**Negative**	**Positive**	**Negative**	**Positive**	**Negative**
Profitable to the farmers.	Threat of exclusion of the traditional fishermen.	N	Pollution of ground and sea water.	N	Marginalisation of the local fishermen.
Higher foreign exchange earnings for the country.	Threat of food security for the coastal population.	I	Salination of neighbouring agricultural land.	I	Social tension.
Generation of employment and income for the local population.	Conversion of land from other possible economic uses.	L	Conversion of land from other possible uses necessary for maintenance of ecological balance.	L	Conversion of land from other possible social uses.

* Sudden and rapid growth of coastal aquaculture in India has therefore intensified social and ecological conflicts of several types. First, the conflict between aquaculture and agriculture: in a number of places paddy fields have mindlessly been converted into aquaculture farm, giving rise to alleged problems of deterioration of water quality for agricultural operations, resultant decline in yield and even abandonment of paddy cultivation. Second, there are two reported cases of conversion of mangrove forestry area into aquaculture - one in Bhitarkanika sanctuary area in Orissa and the other in Coringa sanctuary area near Kankinada in Andhra Pradesh, posing serious threat to the fragile eco-system as well as the breeding ground of many marine and estuarine animals due to the effluents and industries located along the coast line. Third, alleged reports of drinking water sources being affected by depression in the water tables following heavy water demands of the shrimp ponds, and the consequent saline water-borne diseases and inconveniences of fisherfolks in transporting drinking water from far off places have put coastal aquaculture in direct conflict with the society. Fourth, the water intake structures constructed by aqua farms for pumping in sea water have also reportedly caused dislocation to the functioning of fishing boats engaged in capture fisheries near the shore. Finally, such activities are leading to reduction in fish catch and blockade of direct approach to sea shore.

* Economic viability of brackishwater aquaculture, however, does not necessarily demand intensive or semi-intensive operations. The Central Inland Fisheries Research Institute carried out an analysis of the economics of modified extensive brackishwater fish and shrimp culture in saline swamps, deltaic stretches and mud flats and observed it to be economically viable with the rate of return on investment at an enterprise level being estimated at 39.08%. An estimate based on primary information collected from several aquaculture unit in Andhra Pradseh also confirmed the economic viability of modified extensive brackishwater shrimp culutre. We shall take up the results obtained from such exercise later in the context of our discussion on global competitiveness of shrimp culture.

* What obviously is missing in the context of coastal aquaculture is a sound and rigorous government policy which can suitably balance and harmonise the claims and capabilities of man, technology and the environment. Unfortunately, any organisation like Center of Excellence for Aquaculture is yet to come up in India to perform this task and then to link through a satellite farming system the large number of small aquacultural producers to several large scale enterprises which can provide to the small and even currently isolated farmers the necessary training, extension, credit, seed, feed, harvesting, transportation, storage and marketing services.

* One should also refer to the immense possibilities of pearl and mud crab cultures that may be easily introduced in the brackishwaters without compromising with the ecological and social status quo. After the eventual destruction during the 60s of India's natural pearl oyster beds (supplying pearl oyster called *Pinctata Fucata*) in the Gulf of Mannar in the southeast coast and the Gulf of Kutch in the northwest coast, India became a regular importer of pearl to the tune of Rs. 10 crore per annum. The scientists at CMFRI have now developed technologies to culture this much sought after gem in tanks filled with sea water. Efforts are also on to produce test-tube pearls. The Kerala coast with heavy rainfall and variation in salinity has been found ideal for pearl culture. Crab farming has also several advantages over existing shrimp farming:

  * Crab farming is less capital-intensive.
  * It is also less labor-intensive than shrimp farming.
  * It does not require costly imported feed.
  * It can be organised profitably even in small water bodies.
  * It has a much shorter culture period.
  * Crab remains alive for several days out of water (Rohit and Muthiah, 1997).

The aquaculture industry,however could not be identified as the main culprit for coastal pollution. Citing from studies by the Union Department of Ocean Development, they argue that the 40 'hot spots' identified along the Indian Coast, all within the 5km of coastline are pockets mainly near industries and urban discharge areas. About 13 billion litre/day of sewage, 1/2 bullion cubic metre of industrial wastes are dumped in the sea affecting the normal process of life cycle in the sea. (AFI, 1995, P: 5)

Freshwater Aquaculture: The following stylized features are noted while examining the economic viability of this segment:

* Although the states of Orissa (13.56%), Tamil Nadu (12.60%), Andhra Pradesh (11.85%), Karnataka (8.30%), West Bengal (7.92%), Kerala (7.54%), UP (6.47%), Gujarat (5.95%), Madhya Pradesh (5.93%) and Maharashtra 4.67%) have significant shares in the total inland fisheries area excluding rivers and canals, none of these states except UP and West Bengal have relatively greater percentage shares in production greater than their percentage shares in the resources.

* The inland segment has a dismal national average yield figure of 0.30 ton /ha/annum, when actual production figures are related to potential inland area excluding rivers and canals. As per 1994-95 production estimates, the states/union territories having per hectare and per annum yield figures in ton higher than the national average level are: Punjab (3.43), Pondichery (2.10), Tripura (1.48), Goa (0.57), Jammu & Kashmir (0.54) and Arunachal Pradesh (0.45). There are quite a few states and union territories like Bihar, Himachal Pradesh, Karnataka, Madhya Pradesh, Meghalaya and Sikkim, where the average yield figures have either remained stagnant or even declined between 1992-93 and 1994-95. Obviously, there is enormous scope for improvement.

* A major breakthrough seems to have been achieved in India in the context of freshwater aquaculture in ponds and tanks. The major ingredients of the implied technology are: high stocking rate of fingerlings, frequent water exchange for removing the unutilized feed and excerta from the sytem, aeration for improving the dissolved oxygen level and supply of high quality formulated feed along side good water stability. At least four intensive freshwater aquacultural technologies are so far in the process of being standardized in India. The first one, already being practised on large scale by the Andhra Pradesh farmers to

intensify carp production from existing carp culture ponds and known as *Intensive Carp Culture without Water Exchange*, involves high stocking and feeding togetherwith aeration for improving the water quality and meeting the high demand for oxygen. The second technology, referred to as *Running Water Carp Culture*, is applicable for hilly areas. It involves diversion of flowing water from streams into specially designed ponds in wastelands, which are used for intensive carp culture. This technology, so far producing not so high yields, is now being perfected under model schemes in selected pockets of West Bengal and Himachal Pradesh. The third technogy called *Flow thru' System* with tremendous potential for application in areas with considerable network of canal or surface run-of, involves continuous renewal of pond water (as many as 70 times during 24 hours), which has yielded a productivity level as high as 2000 tons/ha/year in Japan. The Central Institute of Freshwater Aquaculture, Bhubaneswar has been working on a project to standardize this technology at a moderate yield rate of 300 tons/ha/year, while it has already achieved 10-15 tons/ha/year yield rate. The fourth technology is *Red Tilapia Culture*. This super-intensive sex-reversed all male hybrid tilapia culture is believed to have a potential of 300-600 tons/ha/year (Source: NABARD: *Intensive Fish Culture*).

* It has been observed that the intensive carp culture without water exchange is always economically viable at individual group enterprise level in states like West Bengal where a steady demand for fish already exists. For example, from information collected in respect of an individual level enterprise engaged in polyculture of carp, the net annual profit per hectare has been estimated to be Rs. 82950. The same for a group level enterprise came out to be Rs. 87675.

* Freshwater aquaculture contributed as much as 63 per cent of the global aquacultural production in 1994 (11.74 out of 18.55 million tonnes). While Silver Carp, Grass Carp and Common Carp together constitute about 58% of global freshwater aquacultural production and *Rohu*, *Catla* and *Mrigal* constitute another 12% in India, the leading freshwater aquacultural producers like China has a much more diversified species structure. For utilising varied aquatic ecosystems and also for catering to the needs of various regional markets, India needs to develop a diversified aquaculture with compatible fish species.

* Thanks to the thrust given to freshwater carp culture through establishment of 414 Fish Farmers' Development Agencies (FFDAs) at district, regional and state levels till date, about 0.425 million hectares of ponds and tanks have so far been brought under scientific management and training imparted to about 0.463 million fish farmers. Although there is considerable gap between potential and actual yield levels, average productivity in FFDA-supported ponds has gone up from 50 kg/ha/year in 1974-75 to about 2135 kg/ha/year by 1994-95 (Dehadrai, 1997).

* The country is yet to satisfactorily resolve the problem of scarcity of feed for aquaculture. Feed being 50-70% of the total cost of production, quality and cost of feed are important determinants of the economic success of fish farms. Since the food cycle of high-valued carnivorous fish demands about 40% animal protein with a food conversion ratio of 2:1, the country is likely to confront animal protein scarcity and get caught into a 'fish meal trap' unless it can promote non-conventional feed (Dehadrai, 1997). The traditional diets being costlier and costlier everyday, emphasis needs to be placed on several agro-industrial wastes and byproducts as non-traditional feed for fish, such as, distillary grain waste, dried brewer's grain, brewer's yeast, maize and wheat glutten, molasses and press mud, sunflower cake, rapeseed cake and cotton seed meal, thus replacing to some extent the traditional oil meals (Singh *et al*, 1997).

* Although no hard data are available on the direction and extent of trade in fish seed, it is found that the major seed-producing states are W. Bengal (55.87%), Assam (16.41%), Andhra Pradesh (4.81%), Tamil Nadu (3.69%), Madhya Pradesh (3.60%) and Bihar (2.21%). However, only the states of Assam, Himachal Pradesh, Nagaland, Rajasthan, W. Bengal and Arunachal Pradesh have percentage shares in national seed production larger than the respective shares in national inland sector fish production.

With freshwater fishery several rather unexplored but sunrise segments have been identified for future promotion. These are summarised below:

Weed Fish: In India, a spectrum of species unfortunately known as "weed fish", are found in the various natural resources of the inland sector which are quite capable of bringing fresh air to the fishery economy. But till now no thorough and constructive study has been performed to promote these "weed fish".

Conventionally, the term "weed fish" is used to include all species of apparently uneconomic and small sized fish which grow naturally or are accidentally introduced in ponds along with carp spawns. The general idea about weed fish is that they are uneconomic and harmful to IMC culture. Naturally, the scientists advise killing them using different methods before starting of carp culture. However, the fish farmers - particularly those in West Bengal - are generally unwilling to kill the weed fish, as these serve both commercial and delicacy purposes from the viewpoint of fish traders and the fish eating population. The main cause behind this different attitude towards weed fish is its high price in the domestic market. Most of weed fishes have a high fecundity rate and can breed in ponds and stagnant waters even in the absence of rain. Even some of them, for example, *Amlyopharyngodon mola* can breed eight times per annum even within their short life cycle. So, seed availability of these fishes is not at all a problem to the fishermen. Naturally, to them these automatically growing fishes are byproducts of fish culture, which help them reduce the production cost of IMC culture. Further, some of the weed fishes are highly nutritious (rich in minerals and vitamins) and some of them have even medicinal value. Some of larvicide weed fish are effectively used as biotic controller (e.g. *Aplocheilus panchax*, *Amblyopharingodon mola).* Unfortunately, these important facts are yet to be scientifically established and suitably documented.

Ornamental Aquaculture: In countries like the U.S., Europe, Japan, Singapore, Thailand, Taiwan etc., where people look upon breeding of ornamental fish and setting up of aquarium tanks at homes just similar to maintaing pets, ornamental fisheries are making rapid progress. Out of an estimated $4.5 billion world trade, the U.S. for example had a share of $54 million in 1995. In India, on the other hand, inspite of abundance of wild aquarium fishes in several of our rivers and streams as well as in the lagoons and coral reefs along the coast line and several of our islands, the vast resources have been tapped only to the minimum possible extent. Measures for promotion of this industry as well as for increase in exports of ornamental fish from India are necessary to be taken earnestly at this juncture. It should be mentioned that as a first step towards promoting ornamental fish exports, MPEDA has come up with a development assistance scheme.

Sewage Fisheries: As the CIFA scientists have demonstrated through a model treatment plant of domestic sewage from the city of Cuttack at a place called Matagujpur, which is developed against the historical background of sewage-fed fisheries in Calcutta, sewage is no longer just a pollutant, but also an important source of nutrient for aquaculture. It has been estimated that the country's daily sewage is capable of producing 90 tonnes of nitrogen, 32 tonnes of phosphorous and 55 tonnes of potassium worth Rs.0.61 billion (*Times of India,* Ahmedabad, February 22, 1995). However,in view of the public health concerns relating to consumption of sewage-grown fishes, there is need for further researches on possible biomagnification of heavy metals, pesticide residues and accumulated human bacterial pathogens if any, in the fish thus produced.

Integrated Fish Farming: Integration of aquaculture with livestock, poultry, paddy and horticulture not only achieves cost economies through recycling of energy nutients and organic materials, but also provides an environmentally sound and sustainable utilization of complementary land and water resources. The prominent integrated systems are as follows:

* CIFRI has scientifically perfected the age old practice of growing paddy alongside fish and prawns for varios situations covering more than 2.3 million hectares of low-lying areas in the country, where rice fields retain sufficient water even after the monsoon. Per hectare yield is reported to be 700 kg of fish for a 10- month period besides 1200 kg/ha *kharif* paddy and 4300 kg/ha *rabi* paddy (Sinha, 1997).

* High compatibility of ducks with fish stockings makes duck-cum-fish farming a very attractive proposition especially from the viewpoints of marginal and tribal farmers. This integrated system is reported to have produced a yield rate of 2230-3941 kg of fish , 14000-32256 eggs and 400-750 kg of duck meat from just one hectare farm (Sinha, 1997).

* As pig dung acts as a substitute for fish feed and pond fertilizers, integrated fish-cum-pig farming is found to be an excellent system for adoption. It yields 6644-7306 kg/ha fish togetherwith 5610-10950 kg of pig meat per annum (Sinha, 1995).

* The integration of mushroom culture on pond bunds with fish culture in ponds has also been found to economise on investment cost on fish because after harvesting of mushroom the compost of enriched nutritional value can be used for natural production of fish feed like planktons and other aquatic flora and fauna (Dash and Mahapatra, 1997).

Spirulina Cultivation as Ancillary Aquaculture Enterprise: This blue-green alga having the longest tradition of being utilized by the natives of Central Africa and America is a lower plant form which has been found to be an extremely useful bio-fertilizer for sustaining the tropical pathways in aquatic ecosystems with high food values. With the safety of *Spirulina* established even for human consumption, this 'wonder gift of nature' has been declared by the United Nations as the 'best food for tomorrow', though it is yet to be popularly adopted in India. However, studies at CIFA, Bhubaneswar have established higher fish growth rates with *Spirulina*-incorporated diets, besides confirming favorable effects in terms of disease resistance and improvements in organoleptic qualities of fish. Even individual village women can grow *Spirulina in* 100 square meter of cement vats. A central village unit can supply the nutrient inputs on a weekly basis and in turn collect the produce for marketing after sun-drying the wet bio-mass on polythene bags or spray-drying in mechanical units (CIFA: *Spirulina Cultivation as an Ancillary Aquaculture Enterprise*).

Low-cost Technology for Air-breathing Catfishes : Using feed combinations with non-protein nitrogen (namely, 15 N-Urea) is found to be capable of partially replacing the animal protein component in the diet as successful experiments conducted in shallow seasonal ponds of West Bengal with *Clarius batrachus* (Magur) and *Heteropneustes fossilis* (Singi) have demonstrated. It has enabled considerable cost reduction in catfish culture (Sinha, 1997).

Hilsa Culture : Following collapse of the Gangetic hilsa fisheries in the post Farakka Barrage period, CIFRI has apparantly succeeded in artificial fecundation of hilsa and then rearing the hatchlings in freshwater ponds (Sinha, 1997).

Freshwater Prawn Culture : Experiments conducted by CIFRI in the *beels* of West Bengal enabling prawn to grow at low input cost and high yield rate from 4 gram weight to 90 gram weight during a culture period of less than 90 days have brightened prospects of pen and cage culture of giant freshwater prawn (*Macrobachium rosenbergii*) in the grossly underutilized *beels* and *mauns* of the country (Sinha, 1997).

Capture & Culture of Edible Snails : CIFRI has developed a technology for rearing with high survival rate giant African snail (*Achatina fulica*), a delicacy in the West and a permanent foreign exchange earner, to marketable size after these are picked up from the nature. Raised on kitchen refuse, these snails are reported to attain upto 74 mm length and 61.5 gram weight in a period of 150 days at high stocking density (Sinha, 1997).

Rather than creating major ecological disorders itself, the freshwater fisheries sector suffers from ecological threats from extreme sources. Table 6 below, derived from Sreenivasan (1986) aptly summarises the threats to the freshwater fishery sector from other resource development activities. As this table shows, the sustainability issues in fishery are not dependent on whatever is going on in the fishery sector alone. Its sustainability is bound to be affected by decisions taken in other related sectors, just as it also in its turn can affect the sustainability of other sectors. A balance has to be struck between the requirements of all the sectors viewing all such sectors as complementary ones. Such complementarity can be brought about if and only if a holistic approach is taken in devising the necessary policy measures.

We may now summarise the spectrum of activities of the Indian fisheries sector. There are both capture and culture (even capture-cum-culture) components within marine and inland segments of fisheries, though technically the culture component is still an insignificant part within the marine segment and similarly the capture component is grossly underdeveloped within the inland segment. Brackishwater aquaculture within the inland segment is currently at the cross-roads with its future prospects depending critically on how well the legal and policy framework can enable this component to overcome its current hurdles. The ancillary activities, through theoretically catering to the needs of both the segments, is mostly geared towards meeting the export needs of marine fisheries.

TABLE 6 : IMPACT OF RESOURCE DEVELOPMENT ON FISHERIES

Type of resources development	Factors, structures involves	Effect on fisheries
Agriculture	Land use Multi-cropping Fertilizer, pesticide Irrigation, drainage Flow control, salinity control	Turbidity causes reduced photosynthesis, phytoplankton and low fish production. Eutrophication Toxicity: biomagnification Fish mortality increased
Forestry	Logging Fuelwood use Clearing Slash and burn cultivation Hill-slope cultivation	Increased turbidity: Increased water temperature Reduced bottom and drift fauna Destruction of fish habitats Impact on spawning of fishes and survival of spawn Decrease in stream productivity.
Energy	Hydroelectric power generation Dams	Water regulation and discharge, Fishing impediments | breeding and fish survival
Flood control	Dykes and control structures; pumps	Movement of fish impeded Fish population changed Reduced salinity
Navigation	Augment flow in canals Dredging Installation of jetties and other structures Navigation facilities	Regulation of flow rates Increase in turbidity Pollution
Urban water supply	Storage reservoirs	Fish population changes

The skyrocketting in the international price of shrimp coming in the wake of the beginning of the country's economic liberalisation process led to a mad 'gold rush' among the country's investors and farmers to go in for semi-intensive and intensive shrimp/prawn culture in the fragile coastal areas. The result has been a series of hurdles for this infant industry: a serious viral disease and numerous social and environmental conflicts finally reaching the highest lawcourt for a solution. The Supreme Court being overwhelmed by the environmental and other concerns of aquaculture has put a temporary ban on the industry. While the central government has been trying to overcome the hurdles for this industry through a petition to the Supreme Court for a recosideration of its judgement, on the one hand, and through bringing a fresh bill to the Parliament for enactment, most of the state governments are yet to come up with a coastal area development plan in response to the Supreme Court judgement. Even when a state like the state of Tamil Nadu has come up with a modified Coastal Aquacultural Act and even spelt out the desired values of the parameters governing coastal aquaculture , the thinking is still within the framework of the traditional and outdated system of command and control, which has thousands of loopholes in terms of implemetability. These issues are delat with at greater length in the context of policy prescriptions.

Sustainability of Exports:

On the subject of fish exports, the major questions confronting the country are whether India will have adequate exportable surplus of fish in the coming years and whether India's proclaimed competitive advantages in international trade in fisheries are getting adequately reflected in her export performances.

Performance of Exports: Though both quantity and value of India's fishery exports are smaller in 1995 as compared to 1994, the export quantity is found to have increased from 99306 mt in 1988 to 294264 mt in 1995, i.e., a growth of about 196% during a 7-year period, while in value terms exports have increased from $420.3 million to $1072.3 million during the same period, i.e., a growth of about 155%. During 1988

and 1993 (more recent figures are not available), India's share in world exports increased from 1.3% to 2.1%, although India's share is very low as compared to the corresponding figures of some of the neighbouring Asian countries like Thailand, South Korea, Indonesia and China. The most disturbing feature of India's export performance during 1988 to 1995 is the steady decline in unit value realisation from $4.23 per kg to $3.04 per kg . The following factors are generally held responsible for this decline:

- The change in the product mix of our exports - with the share of crustaceans (shrimp and lobster) declining from about 60 to 28 per cent in quantitative terms and from about 86 to 67 per cent in value terms between 1985-86 and 1996-97 - seems to be an important factor for this state of affairs. While unit value realisation for this composite category of exports seems to have steadily improved over the years, this is not true of the other groups barring frozen squid. During 1995-96 the category of frozen fish has the largest share in the total quantity of fish exports (45.74%), followed by the groups of frozen shrimp (27.88), frozen squid (10.82%) and frozen cuttle fish/fillet (8.40%) While the sea food industry around the world is undergoing a rapid change in favor of ready-to-cook and ready-to-eat convenience foods, India is still continuing to supply semi-processed products to reprocessors or institutions catering to establishments and wholesalers, and nearly 80-85% of such exports are made in block frozen bulk forms (ASCI, 1996).

- The change in the direction of fish exports is also partly responsible for the above-stated phenomenon. Over the years the Southeast Asian market with declining unit value realisation has come to steadily occupy the largest share of Indian exports (35.58%), with the share of the non-expanding European market displaying rising unit value realisation coming next (31.58%) and the steadily declining Japanese market inspite of its consistently larger and improving unit value realisation being relegated to a third place in terms of market share (17.10%). For the US, although unit value realisation seems rising, India's share of exports for this market is steadily decling. In the Middle-eastern market, neither unit value realisation nor the share of Indian exports is improving over the years. Yet another way to analyse India's performance in the export markets is to compare the share of India's exports going to each market with the actual share of each market in global imports (the latter representing the absorpion of global imports in each market). It is interesting to observe that India is putting proportionately larger share in SE asia, ME Asia and residual categories of markets, whose absorption capacity of imports are low and hardly expanding over time. At the same time India is progressively withdrawing from the steady Japanese market, with the difference between the Japanese share of world imports and the share of the Japanese market in Indian exports widening over the years. Barring 1994 India has maintained a fairly contant share of her exports for the European market, although this market's absortion power of world imports is dwindling. However, in the strongly quality conscious markets of both Europe and the US, the percentage shares of Indian exports are consistently less than those contries' respective shares in the world market. In these markets too, as in the context of the Japanese market, the gap between the two above-stated ratios are widening, indicating India's incapability of sustaining large, often expanding but highly demanding (in terms of quality) markets.

- Even in frozen shrimp, which constitutes more than 85% of the country's total volume of exports, India's position is getting eroded due to the increasing dominance of farmed shrimp from Thailand, Indonesia and Vietnam. Even though the absolute size of India's exports of shrimp has been steadily increasing in both quantity and value terms, India has achieved at most a marginal increase in her share of the world market. For shrimp, all the three markets - the Japanese, the European and the North American - hold considerable shares of the world imports. Nevertheless, India seems to be losing in terms of both quantity and value shares in all the three markets.

- The market for shrimp in particular gradually being converted into a buyers' market, more and more are being expected of the exporters in terms product varieties, sizes, quality, health standards and continuity in supply. It is reported that since Indian expoerters are not as good as the others in meeting standards of quality, freshness and packaging, the Japanese importers have been shifting towards the Vietnamese. It is also alleged that unlike their rivals the Indians lack a broad mix of products like regular block frozen, shell-on IQF, shell-on easy peeled, peeled tail on, peeled tail off and other speciality products. Regarding quality, while monitoring has been mandatorily introduced, peeling and pre-processing continue to be done under unhyginic conditions. The general lack of on-board handling and preservation, fishing gears, and facilities like landing sites and berthing harbours tends to make the product essentially unhyginic (ASCI, 1996).

Sustainability of Exportable Surplus: While the performance of India's fish exports is not as encouraging as it seems at first sight, a question is often raised in some quarters whether the overenthusiam over exports over the booming global demand for certain varieties of fish would not lead to a serious imbalance between domestic demand and supply of fish. Unfortunately, no serious and rigorous attempts seem to have been made so far to provide a suitable supply-demand perspective for future planning and policy making for the fisheries sector. The poor state of supply-demand projections for fish can be gauged from the fact that while the National Commission on Agriculture projected the supplies for the year 2001 at 6.75 million tonnes and demand within a range from 3.59 to 5.53 million tonnes, one earlier IIMA study projected the demand figure at 12.5 million tonnes and one Government of India Study Group put this figure as 6.2 million tonnes (Srivastava et al , 1991, p.24). It is not even clear whether the last two figures are inclusive/ exclusive of exports and the industry demand for wasted fish. In fact, most of the states do not have any supply-demand perspective. Even when it exists, in most cases the demand estimates are explicitly or implicitly based on some normative demand figures, while the supply estimates are based on rudimentary and often microscopic knowledge of existing resource use and productivity. It is in this context the present study has utilized the available data base to come up with a simple, positive and rigorous framework for making supply-demand projections for the domestic segment of the market. The precise steps followed in estimation of the supply side are summarised in Box 1, while the same for estimation of the demand side are given in Box 2. It may be noted that although rigorous demand functions could not be estimated for want of requisite data, attempts have been made to incoropate effects of income and (own) price changes through estimation of suitable elasticity coefficients from NSS data. The demand side as well as the supply have been put together under alternative assumptions in Table 7.

BOX 1: STEPS FOLLOWED IN ESTIMATION OF DOMESTIC SUPPLY FOR HUMAN CONSUMPTION

* Estimated domestic supply of fish net of export for each state based on data from *Handbook on Fisheries Statistics*, 1993 and from MPEDA, and using the following equation, as suggested by MPEDA:
  Net domestic supply = Inland sector production + Marine sector production - 1.35 x Exports (as actual export figures are net of 30-40% of wastage)
* Estimated annual compound growth (CAG) rate of net domestic supply for each state and the country as a whole.
* Projected net domestic supply for India and the states .
* Revised projected figures of net domestic supplies of fish available for human consumption using an adjustment index of 0.6, that is, assuming that 40% of gross supply is not suitable for human consumption.

BOX 2: STEPS FOLLOWED IN ESTIMATION OF DEMAND

* NSS statewise data (43rd Round) for 1987-88 used as base level demand.
* Statewise price and income (expenditure used as proxy) elasticities of demand estimated separately for rural and urban segments based on NSS data.
* CAG in real real per capita income estimated separately for each state based on national income statistics.
* CAG in fish price relative to all food prices for India as a whole estimated based on data from *Handbook on Fisheries Statistics*, 1993 and *Supplement on Fisheries Statistics*, 1995.
* Per capita monthly consumption of fish reestimated taking into account income and price effects.
* Projected rural and urban population figures based on census data.
* Projected annual demand for fish for each state and India .
* Projected demand figures adjusted for exogeneous upward shift in demand to the tune of 1%, 2% and 5% per annum .

TABLE 7 : PROJECTED NET SUPPLIES OF FISH IN THE DOMESTIC MARKET (THOUSAND TONNES)

States/UTs	Scenario 1			Scenario 2			Scenario 3		Scenirio 4	
	1993	2001	2011	1993	2001	2011	2001	2011	2001	2011
1 Andhra Pradesh	179.81	175.54	157.46	81.53	69.07	39.80	-8.13	-54.31	-28.28	-118.77
2 Arunachal Pradesh	-1.95	2.74	58.22	-2.59	-0.81	28.10	-4.96	23.03	-6.04	19.57
3 Assam	11.77	283.04	1706.16	-44.23	102.99	930.99	-47.25	747.86	-86.46	622.40
4 Bihar	-4.45	7.49	35.15	-70.08	-82.89	-99.67	-280.34	-340.36	-331.87	-505.24
5 Goa	73.01	171.03	482.17	34.35	87.05	260.65	54.36	226.90	52.13	203.78
6 Gujarat	566.65	1260.88	3411.50	335.57	750.73	2038.71	737.77	2022.92	734.39	2012.10
7 Haryana	17.42	31.82	66.62	9.36	17.60	37.69	14.40	33.79	13.56	31.12
8 Himachal Pradesh	5.64	16.39	59.23	3.09	9.44	34.99	8.57	33.92	8.34	33.19
9 Jammu & Kashmir	11.44	16.75	26.93	5.72	8.42	13.61	5.06	9.51	4.19	6.71
10 Karnataka	180.03	220.13	282.59	89.86	109.11	138.62	55.92	73.77	42.03	29.36
11 Kerala	45.05	699.11	3290.92	-152.80	194.69	1665.89	-332.05	1023.80	-469.53	583.96
12 Madhya Pradesh	17.47	7.57	-13.01	-4.82	-16.57	-39.68	-61.38	-94.30	-73.07	-131.71
13 Maharastra	276.32	255.53	195.68	119.84	86.02	8.33	-48.60	-155.76	-83.73	-268.17
14 Manipur	4.68	12.71	40.87	0.20	3.13	16.10	-4.51	6.79	-6.50	0.41
15 Meghalaya	-2.46	19.11	392.67	-3.88	7.34	227.83	0.29	219.24	-1.55	213.35
16 Mizoram	2.68	4.42	7.39	1.33	2.07	2.71	1.25	1.71	1.03	1.03
17 Nagaland	-0.41	2.97	32.71	-1.01	0.37	16.55	-1.86	13.83	-2.44	11.96

18 Orissa	116.92	372.32	1264.26	34.12	177.47	695.24	71.94	567.60	44.39	479.48
19 Punjab	15.00	82.44	661.92	8.60	48.92	396.34	47.74	394.91	47.43	393.93
20 Rajasthan	9.08	15.45	29.85	4.71	8.22	16.27	6.06	13.64	5.49	11.84
21 Sikkim	-0.02	0.13	0.98	-0.05	0.01	0.48	-0.11	0.33	-0.14	0.22
22 Tamil Nadu	282.06	256.74	215.14	134.39	109.54	68.53	7.47	-55.90	-19.17	-141.14
23 Tripura	-4.19	12.21	109.38	-13.53	-12.40	26.87	-44.68	-12.49	-53.11	-39.45
24 Uttar Pradesh	53.31	130.40	340.19	4.74	41.19	149.45	-38.62	52.16	-59.45	-14.48
25 West Bengal	267.30	845.64	2597.80	-31.20	251.75	1194.47	-309.41	510.41	-455.88	41.81
26 Andaman & Nicobar Islands	18.25	101.07	732.96	8.54	56.34	430.91	49.28	422.30	47.44	416.41
27 Chandigarh	0.04	0.24	2.03	0.02	0.14	1.20	0.13	1.19	0.12	1.18
28 Dadra & Nagar Haveli	-0.22	-0.33	-0.55	-0.23	-0.35	-0.59	-0.63	-0.94	-0.71	-1.17
29 Daman & Diu	11.37	25.68	70.72	6.00	14.01	39.48	11.60	36.54	10.97	34.52
30 Delhi	-0.49	-1.52	-4.16	-1.93	-3.94	-8.80	-8.74	-14.65	-9.99	-18.65
31 Lakshadweep	6.76	9.37	14.12	2.86	3.70	5.05	0.22	0.80	-0.69	-2.11
32 Pondicherry	33.94	72.22	183.44	18.52	40.29	104.12	34.89	97.54	33.48	93.03
33 All India	2238.13	5109.24	16450.89	604.78	2082.62	8441.23	-79.39	5805.75	-643.66	4000.41

Note: Scenario 1: No shift in demand, No supply adjustment;
Scenario 2: No shift in demand, but supply adjusted;
Scenario 3: 2% annual shift in demand and supply adjusted;
Scenario 4: 5% annual shift in demand and supply adjusted;

It may be seen from Table 7 that in 1993, the country had about 2.24 mt of excess supply. For the future years, even if supply figures are adjusted downward to leave out the non-consumable waste materials, the country as a whole does not confront any deficit in terms of domestic supplies, although several states do have deficits, which they usually meet through inter-state private trade in fish. So long as there is no upward shift in demand, the country would have enough surpluses to take care of state-level deficits and still enough to offer in the form of exports. But the moment we allow for even a meager 2% average annual exogenous shift in demand for fish, the country as a whole as well as a large number of states would fall in the grip of deficits in 2001. However, if supplies continue to grow at the currently prevailing rates, the country would not have to face any deficit in terms of overall availabilities in 2011, even if there is 5% annual increase in demand due to exogenous factors.

While there are several limitations of the present approach (listed in Box 3), the following points deserve special attention in the interest of raising enough surplus for exports after meeting the domestic demand. First, the scope for inter-state trade in fish being quite large not only at present but also in the years to come, there appears to be a strong case for regularising the trade channels through suitable investments in infrastructure including development of a cold chain system in the major fish trading routes of the country. Cooperatives still contributing a relatively insignificant component of the fisheries sector and more than that, the cooperatives being especially weak in the forward linkages including processing and marketing activities, there appears to be a strong need for an autonomous body like the National Dairy Development Board for this sector in order to supplement the international marketing efforts of MPEDA. The main job of the proposed body would be to establish suitable trade channels and make necessary investments in infrastructure. Allegations about private mafia being quite widespread and strong in most established markets and production centers, there is a crying need to liberalise producers - whether in the private sector or in the cooperative sector - from the clutches of the trading mafia.

BOX 3: LIMITATIONS OF DATA AND THE PRESENT METHODOLOGY

* NSS data separately for fish consumption are available for only one round (i.e. 43rd Round). Hence there is no way to gauge shift in tastes and preferences specially in relation to meat and egg.
* Consumer expenditure and income may not change proportionately, as assumed in the estimations.
* State-wise comparable price data for fish are not available to allow for improvement in the state level estimations of demand.
* In the absence of suitable data, alternative forms of demand function could not be tried.
* In the absence of suitable data on resource use across various types of water bodies, finer supply estimations based on projected resource use pattern and projected productivity growth could not be attempted.
* Instead of separately estimating compound annual growth rates of inland sector production, marine sector production and of exports based on available time series data, the study, given its thrust, has attempted to estimate domestic supplies net of exports in the first place, and then estimated CAG for the domestic supplies.
* The assumption of 35% wastage on exports and 40% on domestic supplies to meet human consumption, as suggested to the study team, appears arbitrary and hence needs further probing and improvement. In the absence of data on industry demand for 'fish wastes', this component of demand has not been modelled.
* The same trend growth rate in supply, as experienced over the last decade or so, has been assumed to be prevailing in the future years upto 2021. Loss of production due to encroachment of water bodies and environmental hazards - factors which are likely to figure prominently in the years to come, has been left out totally from the analysis.
* In the absence of detailed data on types of fish demanded and supplied across states, a disaggregated supply-demand analysis, which could have brought out many finer points and issues, could not be undertaken.

Second, there are many states, which in spite of their huge water bodies, are consistently deficit states in terms of fish supply. The entire north-eastern states offer a case in point. It is high time for these states to review and probably modify their existing leasing policies and open the fishery sector to private initative, if the existing cooperatives and the governmental bodies cannot deliver the goods. Availability of records on resources, resource use, production and productivity needs urgent attention for most of the states.

Third, for India to sustain fisheries production, it is necessary to stabilize production growth rates not only in the marine sector, which is already showing signs of a decline, but also in the inland sector, in view of the fluctuating growth rates.

Fourth, although Indian major carps (IMC) and common carps still constitute major shares of inland fisheries, rates of growth of these two segments are showing signs of concern in view of their importance to large segments of the fish-eating population. Research and extension support systems too seem to have recently developed an indifferent attitude towards IMC and common carps, in spite of early technological breakthrough in this segment.

Finally, a matter of much greater concern is the rapid decline and even negative growth rates in the catches of certain species of marine fish and very low growth rate of other species in the inland segment. This is not only going against the spirit of bio-diversity, but also damaging the prospect for an integrated management of fishery resources.

Global Competitiveness of Indian Shrimp: Based on the CMFRI experimental data as well as more recent data collected from several exporters from Vizag area in the state of Andhra Pradesh, the study arrived at the following economics of modified extensive shrimp farming (Table 8):

Table 8 : Economics of Modified Extensive Shrimp Farming

A. Output Side:

(1)	Output: @ 1.5 crops x 420 kg/acre:	630 kg.
(2)	Domestic Price: Rs.300/kg:	(A)
(3)	FOB Price Tokyo:$13.5(25 nos/kg)xRs.39.5 =	Rs.533.25
(4)	International Freight Charge (Vizag to Tokyo):	Rs.13/kg
(5)	Domestic Transport Cost & Port Handling Charges:	Rs.10/kg
(6)	Net International Price: Rs.533.25 - Rs.13 - Rs.10 =	Rs.510.25/kg = (E)

B. Cost Side (per acre):

B.1	**Farm Level**	Total	Tradeable		Non-tradeable	
			DP	EP	DP	EP
(1)	Annual Lease Value of Land:	Rs.10,000	-	-	10,000	10,000
(2)	Feed Cost (1050 kg/ha @1.2 conversion rate x 1.5 crops/year x Rs.35/kg +2.5): Rs.26,460		26,460	26,460	-	-
(3)	Other Raw Materials: Lime 300 kg/ha x Rs.6 + 2.5	= Rs.720	720	720	-	-

	Urea 250 kg/ha x Rs.2.5+ 2.5 = Rs.250	250	250	-	-
	Super Phosphate 250 kg/ha+Rs.1.5 + 2.5 = Rs.150	150	150	-	-
	Poultry Manure 100 kg/ha x Rs.2+ 2.5 = Rs.80	-	-	80	80
(4)	Seed Cost: Stocking Rate 46,000 x 1.5 crops x Rs.0.5 + 2.5	-	-	13,800	13,800
(5)	Fuel Cost: 720 litres x 3 water exchanges for 1.5 crops @ Rs.9/litre = Rs.19,440	19,440	23,328	-	-
	(Assumption: economic price of diesel is 20% higher than actual)				
(6)	Labour Cost: 2 family labour x Rs.1000/months = Rs.24,000	-	-	24,000	12,000
(7)	Depreciation on Farm Construction:Rs.1,00,000/ha x 5% depreciation + 2.5 = Rs.2000	-	-	2,000	2,000
(8)	Depreciation on Farm equipment: Rs.80,000/ha x 10% depreciation + 2.5 = Rs.3,200	3,200	3,200	-	-
(9)	Interest charges @ 15% on item (1) to (8) i.e., 1,00,100 @ 15% = Rs.15,015	-	-	15,015	15,015
(10)	Total farm-level input cost (items (1) to (9)) : Rs.115,115	50,220	54,108	64,895	52,895
(11)	Total Farm-level Input cost per kg.(assuming yield rates of 420 kg/crop/acre & 1.5 crops/year): Rs.182.71	79.71	85.89	103.00	83.96
B.2	**Processing Stage (cost/kg.)**				
(1)	Electricity charges for freezing: Rs.3.5 (Assumption: 71% is tradeable, 29% non-tradeable and economic price of tradeable is 80% of actual and the same for non-tradeable is 50%)	2.49	1.99	1.01	0.51
(2)	Other materials for maintenance:Rs.3.0	3.00	3.00	-	-
(3)	Ice-cost: Rs.2.0	-	-	2.0	2.0
(4)	Unskilled labour: Rs.2.5 (Assumption: Economic price of unskilled labour is 50%)	-	-	2.5	1.25
(5)	Skilled labour : Rs.1.5	1.50	1.50	-	-
(6)	Farm to processing unit transport: Rs.3.0 (Assumption: 65% is tradeable, 30% non-tradeable, economic price is 67% for tradeable and 50% for non-tradeable).	1.95	1.30	1.05	0.53
(7)	Packaging : Rs.6.0	6.0	6.0	-	-
(8)	MPEDA Cess: Rs.5.0	-	-	5.00	5.00

(9)	Marketing Cess: Rs.2.5	-	-	2.50	2.50
(10)	Depreciation Cost: Rs.1.0 (Assumption: Economic cost of indigenous equipment is 70%)	1.0	0.70	-	-
(11)	Interest charges @ 15% on items (1) to (10) under B.2, i.e. Rs.30 @ 15% = Rs.4.50	-	-	4.50	4.50
(12)	Total processing cost/kg: Rs.34.50	15.94	14.49	18.56	16.29
C. Production + Processing Cost (Rs./kg):		95.65 = (C)	100.38 = (G)	121.56 = (D)	100.25 = (H)

Note: DP and EP stand for domestic and economic prices, respectively. Notations A to H are explained in Table 9.

The above-stated data is presented below within the format of PAM under exportable hypothesis as follows:

Table 9: Policy Analysis Matrix for Indian Shrimp under Modified Extensive Farming

ITEMS	OUTPUT		INPUT	
	TRADEABLE	NON-TRADEABLE	TRADEABLE	NON-TRADEABLE
Domestic Value	A=300	B=0	C=95.65	D=121.56
Economic Value:				
a) at border price	E=510.25	—	G=100.38	—
b) at domestic opportunity cost	—	F=0	—	H=100.25

Table 9 yields the following measures of global competitiveness:

NPC = A/E = 300/510.25 = 0.59

EPC = (A-C)/(E-G) = (300-95.65) / (510.25 - 100.38) = 0.50

ESC = [(A-C) + (H-D)]/ (E-G) = [(300-95.65)+ (100.25-121.56)] / (510.25 - 100.38)

= 0.45

DRCR = (H-F) / (E-G) = 100.25/409.87 = 0.24

The above-stated results show that even with a modified extensive farming system based on collected seeds, Indian shrimp is quite competitive in the global market. In fact, its competitiveness position increases as we move towards more refined indices which takes care of taxes/subsidies on tradeable and non-tradeable inputs and eventually looks at the social domestic resource cost ratio. India needs to spend only Rs.0.24 on primary resources to produce one rupee of foreign exchange. This means that this production system, even in the absence of further byproduct use (say, through productive use of waste materials) and even after allowing for some provision for environmental management to avoid loss of bio-diversity due to large-scale capture of young and juvenile fish at the stage of seed collection, has enormous buffer to confront any kind of contingency – whether domestic or international. While modified extensive farming may not be as profitable nor as labor-intensive as semi-intensive or intensive farming, still this exercise shows that this method can be profitably used

by large numbers of even small and artisanal fishermen with very little training under adequate safeguards against environmental hazards (e.g., through multiplication of seeds through hatcheries). Indian fishing folks, unless they are lured by any motive for quick and super-normal profits, need not bring environmental disaster through shrimp farming.

Sustainability of Fisheries Cooperatives:

Although the cooperative form of business is looked upon as a vehicle for overcoming the structural limitations of the large size of backward, small and artisanal segment of fisheries, the commercial viability of this segment is generally doubted, especially if the government subsidies and support through various welfare schemes for the fishermen community are withdrawn. It is in this context the study found it important to determine whether the fishery cooperatives in general ought to be allowed to face natural death or some strategies can be devised such that at least some of these cooperative or cooperative-like organisations can be reoriented from pure welfare to commercially viable and yet environmentally viable propositions.

Treating fisheries as basically a weaker section activity, the NCDC has been providing fairly liberal assistance to fisheries cooperatives for the following purposes, the extent of resource support from NCDC to the states for the purpose of assistance to the societies varying from 25-50% in terms of subsidy and 50-70% in terms of loan for most of the schemes (depending upon whether the concerned state or union territory belongs to a developed or backward region):

* Purchase of operational inputs such as fishing boats,nets and engines;
* Creation of infrastructure facilities for marketing (transport vehicles, godowns, retail outlets, etc.);
* Establishment of processing units including ice plants, cold storages etc.;
* Development of inland fisheries, seed farms, hatcheries etc.;
* Preparation of feasibility reports;
* Appointment of experts under Technical and Promotional Cell Scheme.

Although no comprehensive data are available on the functioning of fishery cooperatives or on the refund of NCDC loans, the alarming state of affairs of the fishery co-operatives becomes amply clear from the average turnover per primary society (varying from 0.09 lakhs for Orissa and Tripura to 7.74 lakhs for Himachal Pradesh) and the average paid up share capital per member (varying from Rs.40 in Madhya Pradesh to Rs.1115 in Maharashtra) as per the published data from the Department of Agriculture and Cooperation, Government of India (as of March 31, 1993). Since aggregative data is quite scanty on the status of fisheries cooperatives in India, specific cases - namely, of FISHCOPFED, the national level apex body, all tiers of freshwater fisheries cooperatives from the state of West Bengal – the state most well-known for its relative success in this segment, and one noteworthy example of success in the marine segment from Maharashtra (namely, of one Versova Society) have been critically examined besides taking a broad overview of the existing cooperatives in several other states in order to get a close view of the functioning of these organisations. The stylized features observed are as follows:

* A very large percentage of the cooperatives especially at the higher tiers appear like 'parastatal' bodies established primarily for the distribution of government welfare benefits and lack commercial viability. The several (as many as four in some states) higher tiers and promotional agencies, without any functional role for themselves, have further compounded the problems of cooperatives. Currently, there are active cooperatives in the marine as well as freshwater segments, although a large number of them have also come up in the brackishwater segment. In view of the large-scale investment requirements for land development as well as technology development, many of these brackishwater fishery cooperatives have not even started functioning in spite of government allotment of land/water bodies in their favour. The commonly observed problems of the existing fishery cooperatives are in Table 10 .

TABLE 10: FREQUENTLY OBSERVED FEATURES OF THE EXISTING FISHERY COOPERATIVES

1. **Mission**:	Welfare objectives like fishermen's pension, housing, accident insurance, children's education, loan facilities to meet social obligations, cyclone relief etc. given precedence over the enterprise objectives. Such non-function and non-viable units often promoted through easy government waterbody leasing policy in favour of cooperatives.
2. **Membership**:	Low member stake in the organization and incidence of inactive members (often included by virtue of caste by vested political interests).
3. **Money**:	High dependence on government share capital contribution and government loans and subsidies; acute working capital shortages, poor accounting and financial management; sometimes dubious and short-term leasing policy further restricting scope for long-term financing from regular and commercial sources.
4. **Management**:	Restrictive legal provisions regarding elections, re-elections and audit, dominance of parastatal bodies through government representation and requirement of government's prior permissions on virtually every aspect of management and day-to-day functioning; lack of symbiotic relations with usually non-functional and non-viable higher-tier organizations; weak infrastructural support and weak forward linkages; weak interface with modern technology and almost non-existent advocacy activities.
5. **Manpower**:	Mostly managed by non-professional and frequently transferable government officials having little stake in the organization; dismal cooperative and business training, near absence of leadership promotion activities.

* In order to determine the potential for fishery cooperatives, it is necessary to look at the sub-system characteristics at three levels – production, primary processing and secondary processing-cum-diversification for each segment of fisheries, and to find out whether and under what circumstances a cooperative form of organization can offer a competitive edge over a private form of business (see Table 11). Such segments of fisheries as mariculture, semi-intensive/intensive brackishwater prawn culture, cold water fisheries, ornamental fisheries require large amounts of investment to start with and demand handling of a complex technology. These segments are yet to stabilise commercially and/or environmentally. Naturally, successfully running enterprises in these segments is no cup of tea for the cooperatives in general, not to speak of the cooperatives of average fishermen. Even otherwise, although fishery is in general a group activity, a cooperative action is neither necessarily called for, nor is such action likely to succeed automatically in all cases.

* It can be seen from Table 11 , although some of the features of the production subsystems are favourable for cooperative action in the brackishwater segment, the complexity of technology– especially in prawn culture, and the lumpiness of initial investments rule out cooperative action for all practical purposes. In marine fisheries, in freshwater ponds as well as in small reservoir fisheries, the chances of success of a cooperative form of organisation is high provided there is a proximate market and/or the organization is able to establish suitable strategic alliances with the private traders for marketing of the produce. This is one of the characteristics which distinguish a successful cooperative from a less successful/failed one. Another important feature of the success cases is that the concerned societies have also gained competitive strength from scale and/or scope economies in input purchases for their members (whether these inputs are in the form of groceries for their members or in the form of materials which go directly into the production

TABLE 11: PROSPECTS FOR COOPERATIVE ACTION IN FISHERIES

Subsystem Characteristics	Marine	Brackish water	Freshwater	
			Ponds & Tank	Lakes& Reservoirs
1. Production Subsystem				
1a. Indivisibility of efforts in production	M ↑	H ↑↑	L	H ↑↑
1b. Lumpiness of investments	M ↑	H ↑↑	L	L
1c. High incidence of small and scattered producers	H ↑↑	M ↑	M ↑	M ↑
1d. Imperfections in the primary produce market*	H ↑↑	M ↑	H ↑↑	H ↑↑
1e. Scale and / or scope economies in input procurement	H ↑↑	H ↑↑	L	L
1f. Complexity of technology in primary production	L ↑↑	H ↓↓	L ↑↑	L ↓↓
2. Primary Processing Subsystem				
2a. Need for instant storage and/or processing due to perishability	H ↑↑	H ↑↑	M ↑	M ↑
2b. Seasonality in production and consequent need for storage for prolonged processing	H ↑↑	L	L	L
2c. Bulkiness of raw materials and chance need for processing to reduce weight and/or volume	M ↑	H ↑↑	L	L
2d. Complexity of technology for primary processing	M ↓	H ↓↓	L ↑↑	L ↑↑
2e. Share of raw materials in the total cost of agroprocessed materials	M ↓	L ↓↓	H ↑↑	H ↑↑
3. Subsystem for Business Diversification and Further Processing for Value Addition and Byproduct Use				
3a. Scope for achieving member-centrality through business diversification	H ↑↑	H ↑↑	H ↑↑	H ↑↑
3b. Scope for tapping economies of scope through product diversification	L ↓↓	L ↓↓	H ↑↑	H ↑↑
3c. Cost and complexity of technology for value addition	H ↓↓	H ↓↓	Scope is Limited	
3d. Cost and complexity of technology for byproduct use	H ↓↓	H ↓↓	Scope is Limited	

Note: H, M and L stand for high, moderate and low, respectively. Single and double arrows stand for, respectively moderate and strong implications for cooperative action, whereas upward and downward directions of these arrow denote respectively favourable and unfavourable implications for cooperative action.

* This is not true in a state like W. Bengal where instant and widespread markets are available.

* Because of presence of an instant market even in remote villages, imperfections in the fresh fish market are considerably less in a state like West Bengal.

process). Interestingly, none of the successful societies has gone for highly sophisticated technologies either in production/catch of fish or in post-harvest operations, which are beyond the grasp and operational capability of their members.

* Although the characteristics like perishability, seasonality and bulkiness of a large varieties of fish favor the need for instant agro-processing at least through application of ice and storage, these do not necessarily favor cooperative action to start with. The experiences of the successful cases in this regard reveal that such societies have gone for ice factory and/or cold storage or sale of processed fish in polythene bag only at a relatively later stage when their core business has stabilized and the members themselves have gathered enough confidence and capability to manage the primary agro-processing activities. It appears that because of premature beginning of such activities with outside (e.g. government support in the form of liberal NCDC schemes cooperative ice factories, cold storages and processing units in most parts of the country are often found to be running under consistent losses.

* While the cooperatives ought not to jump into byproduct processing and sophisticated value added products at least in the initial stages, there is enough scope for and also no harm in practising diversification of activities even at the beginning. Given the intimate relationship between pisciculture and maintenance of suitable environment, there is immense scope for achieving a fair order of diversification in the product mix through members' needs in mind. The Mudiali Fishermen's Cooperative Society near Calcutta, for example, has experimented with undertaking horticulture, floriculture, animal husbandry and even selective farm forestry near the water bodies and thus tapping the economies of scope in the production process in the freshwater segment of fisheries. However, this is possible only under a favourable water body leasing agreements. At the same time, in order to meet the needs of the fishing community, who usually live in concentrated pockets, it is possible to go in for groceries-cum-departmental store. Clearly, such diversification of business activities can add to the risk-bearing capacity of the fishery cooperatives, and contribute to their overall financial viability and long-term sustainability.

Strategies for the Fishery Cooperatives of Tomorrow: Three broad strategies are proposed for promotion of genuine fishery cooperatives for the future. First, cooperatives of educated and unemployed youths, who can contribute significantly in terms of both funds and skill, need encouragement in all segments of fisheries and especially in those segments where capital and scientific skills are the two most critical and non-substitutable inputs. In fact, many private partnerships which have come up and successfully functioning in certain parts of the country (as for example noticed around Calcutta in course of the field work) come close to this notion of cooperatives. It is because of the fear of hijacking by the government department, many such small scale organizations have not dared to register themselves as cooperatives, irrespective of the attractions of various governmental schemes available to a cooperative form of organization.

The second strategy would be to promote model fishery societies of average fishermen only in selected areas and on pilot basis either with the help of the few good and existing societies or with the help of suitable NGOs having long-term commitment to this sector. This strategy is being followed by some self-help groups of women in the states of Andhra Pradesh, Tamil Nadu, Karnataka and Kerala, who are in the first stage trying to organize women's thrift groups with the help of fisherwomen folk and then gradually trying to inject better technology, better post-harvest management practices and better marketing through the women-folk (Jacob, 1991 and Patil 1991). R & D, extension and advocacy activities which are very critical at this stage for fishery cooperatives, must be provided by these autonomous promotional agencies. Given the fact that the existing and 'parastatal' higher-tier bodies have failed miserably in performing this task, the model primary societies must be given an option to join or not to join the existing unions and federations. Such model societies should have the liberty to form their own and suitable highertier associations. The promotional bodies should form spearhead teams to facilitate early growth of a handful of model fishery societies at least at the primary level in each relevant state.

Finally, until and unless these model societies gain in financial strength and build up skills and capabilities of their own, they should not go whole hog into marketing and processing. These societies should attempt to develop suitable strategic alliances with the private traders during this transition period and start building up their own capabilities, even though such alliances may mean potential loss of income to them for the time being. The introduction of beach level auction (or auction at the farm site, as some of

the inland fishery cooperatives in W. Bengal have been trying) or sale through enlisted wholesalers in established fish markets (as some of the Orissa societies have been doing) is a wise and welcome move in the spirit of such strategic alliances.

The Policy Perspective:

Unlike the traditional narrow view of fisheries, the present study, considers all types of aquatic flora and fauna to fall under the ambit of fisheries. Consequently, fisheries become coterminous with or even a subset of aquaculture. In fact, as we have already observed earlier, capture fisheries cannot be sustainable in terms of either of the three determinants of sustainability, i.e., economic, ecological and social unless fisheries are treated on broader platform. Unfortunately, the powers that be are yet to consider fisheries in such a holistic perspective and as a result the country is still in search for comprehensive guidelines in respect of a sustainable management of her aquatic resources. The vaccum thus created probably left no option for the Apex Court other than intervening in the functioning of the shrimp culture units in the country, much to the anguish of the different sections of the society having stakes in shrimp culture, i.e., the government, the business etc.

In view of the alleged threats to ecologically fragile coastal zones of the country by intensive shrimp culture and simultaneous lack of any legal or policy framework to ensure maintenance of ecological balance, the Court stopped all aquaculture activities barring the traditional ones with immediate effect and directed constitution of an authority under section 3(3) of the Environment (Protection) Act, 1986 and shall confer on the said authority all the powers necessary to protect the ecologically fragile coastal areas, sea shore, water fronts and other coastal areas using the 'Precautionary Principles' as well as the 'Polluter Pays Principles'. The Court also directed against conversion of agricultural lands, salt pan lands, mangroves, wet lands, forest lands, land for village common purpose and the land meant for public purposes for construction of shrimp culture ponds. It further ordered payments of compensation to the workmen employed in the shrimp culture industries which were to be closed in terms of this order.

The captains of aquaculture industry, however, are not convinced with the findings of the NEERI, which had apparently prompted Apex Court to pass its decisive judgement. They argue that the methodology followed and hence the conclusions reached by NEERI were questionable, as in the report there were:

1. no glossary of the technical terms with definition;
2. no schedules for collection of data;
3. no methodology of selection of samples and collection of data;
4. wild conclusions without supporting data;
5. wrong statements;
6. inflated and wrong estimates based on wrong premises; and
7. too short a period to study the condition of aquafarms and to study the social impact covering a stretch of about 2000 kilometres of a very dynamic environment. (AFI, 1995, p: 13)

The arguments and counter-arguments clearly point towards the requirement of a rigorous policy exercise for sustainable management of Indian fisheries. In the context of the present study, policy is used to mean a supporting framework that facilitates achievement of goals of a society composed of self-seeking individuals and/or enterprises as enumerated below, there is hardly any ambiguity or difference of opinions:

- ensuring a considerable proportion of the nutritional requirements of animal protein to the vast majority of the country's population through higher production;
- ensuring employment and income to a good number of the countrymen who are directly or indirectly dependent on fisheries for earning their livelihood;
- ensuring a gradually increasing flow of foreign exchange through stepping up exports of fish and fish products in the international market; and above all,
- ensuring the conservation of the bio-diversity such that the future generations never have to live in a world without fish and other associated natural resources.

In the context of the controls necessary to ensure sustainability of Indian fisheries, we observe that the goals are neither measurable (we are yet to know the dynamics of the fish system in a precise manner), nor has it been possible to identify the correct courses of action (as we shall see them while examining the National Fisheries Policy). We cannot set up a control regime dominated by market forces given the facts that

- there exists no clearly defined property rights in respect of capture fisheries ;
- even though some semblance of clear property rights are observed in the context of culture fisheries, there are certain grey areas where the property rights are neither clearly defined, nor vested permanently on the user;
- the large number of possible products from fisheries, are yet to be standardised to facilitate smooth operation of the market mechanism;
- activities in the fisheries segment generate negative externalitises;
- activities outside the fisheries segment also generate environmental threats for the activities related to fisheries.

These factors will lead to a 'market failure' problem and the goals cannot be achieved if we are to depend entirely on 'output control' through the market mechanism. At the same time, 'action' control in the form of hierarchical state, control may not also be effective. Collin's (1994) solution to such a problem runs in the form of 'premise' control, i.e., control through socialization - involvement of all stakeholders, which seems to provide the best way of handling the property rights issues in the context of sustainable fisheries.

The existing National Fisheries Policy (draft) prepared to cover the time period till the end of the 9th Five Year Plan requires a critical assessment against this backdrop. The objectives stated out in the Policy document are:

- Conservation of aquatic resource and genetic diversity;
- Enhancing production of fish and the productivity of fishermen, fish farmers and the fishing industry to contribute to the food and nutrition security for all Indians;
- Generating employment for coastal and rural poor;
- Improving the socio-economic conditions of the traditional fishermen and the fish farmers, and
- Augmenting the export of fish and marine products, duly taking into consideration the need for sustainable and responsible fisheries.

To achieve these objectives; the above-stated document prescribes a host of 'do's which are unfortunately not backed by any mechanism for their operationalisation . It merely looks into the necessities to ensure

* The welfare of fishermen and fisherwomen and safeguarding their interests.
* Improvement in the technological and asset base of the traditional fisher folk.
* An attempted integration of marine and inland fisheries and aquaculture in both freshwater and brackishwater.
* Empowering traditional fishermen to enable them to go for longer voyages into the deeper waters.
* Exploitation of the fisheries resources in different segments to their full potential.
* Solutions to pollution problems facing the inland as well as marine sources.
* Impact assessment studies of River Valley Projects on migration and breeding of fish.
* Diversion of species in brackishwater aquaculture keeping in mind the guidelines for maintaining coastal zone environment.
* Availability of suitable infrastructure for landing of fish, berthing, auction and disposal of fish, net mending ,repairing of boats, marketing, research and development.
* Co-ordination among the different Ministries, having relation with fisheries, and their policies.

In the absence of any mention about the methods of operationalising the concepts, the above-stated list of 'do-s' boil down to nothing more than pious wishes. And herein lies the problem with the existing policy framework. Absence of such an operational framework has led many policies in the past to fail in yielding desirable results on grounds of 'poor implementation', which seems to be the case with the present fisheries policy as well. To understand the features that make a policy framework easier to be implemented, one may concentrate on the salient features of the New Common Fisheries Policy framed by the European Union. The latest document on Common Fisheries Policy of the EU clearly points out that 'the objective (of Fisheries Policy) is to control the ecological impact of fishing, but not to eliminate it altogether. A balance has to be struck between the economic needs and protection of the environment'. The December 1996 judgement of the Supreme Court, on the one hand, and the policy framework set out for the fisheries sector in respect of the period of the 9th Plan, on the other, seem to have overelooked this aspect of balance necessary to be struck between economics and environmental protection. The salient features of the EU policy are as follows.

* In respect of fisheries, the EU document clearly deviated from the general principle of non-discrimination on grounds of nationality and laid greater importance to the social and economic interest of the coastal communities. Consequently, coastal belt upto 12 miles have been kept reserved for the coastal fishermen. However, small fishing boats from EU countries which have traditionally operated in the coastal areas of another country are allowed to continue. Moreover, the freedom outside 12 miles is also not total. Several restrictions are imposed in terms of location, season and the number and size of boats.

* In view of the fact that too many fishermen are chasing too few fish and that too many young immature fish are being caught, the protection of young fish stocks has ben attempted through a variety of technical measures like mesh size of fishing nets, minimum size or weight of fish landed etc. To manage the exploitation rates, the policy has devised the concept of Total Allowable Catch (TAC) for each stock after proper scientific assessment of the current level of fish stocks. The TACs are then divided into national quotas. However, necessary institutional arrangements for estimating TACs for all species in all regions are yet to be formulated in totality.

* The monitoring of conservation measures have been accorded top priority in the EU document and it follows the principle of subsidiarity whereby responsibility is distributed to the most appropriate level, be it community, national, regional or local. In addition, all links in the fisheries chain from producer to consumer, whether catches themselves, landings, transport or actual sales are monitored and documented to allow crosschecks.

* The policy framers clearly understood that 'fishing industry cannot be economically viable without efficient commercial networks and modern processing factories capable of ensuring the fish reach their ultimate customer, the consumer, in the best condition possible'. Thus common rules have been evolved to standardise a wide range of fisheries product. Such rules aim at stabilising the market, guaranteeing a steady supply of quality products, ensuring reasonable prices for the consumers and supporting fishermen's incomes. Thus the foundation of EU fisheries rests on 'common marketing standards, a common pricing system, producer organisations and a common trade regime with non-EC countries'. The concept of safety net prices play a considerble role in ensuring reduction in fluctuations in prices. Producers' organisations about 150 in number, play a significant role in marketing the products.

* The structural policies have been taken up to establish 'a modern, competitive fishing fleet and to remove excess fishing capacity ... to steer the industry towards activities compatible with the Community's long-term conservation strategy and to reinforce the social and economic development of coastal areas heavily dependent on fishing'.

* Considerable emphasis has been put to 'harness the sceintific and technological reserch and progress to the fishing sectors' special needs' to 'guarantee the future of fish stocks (and) encourage efficiency'.

- The two way relationship between fishing and environment has been clearly highlighted in the document and as we already mentioned earlier the thrust has been put on balancing the impact of one on the other.

Unfortunately, our national policy seems to have been formulated without going through such painstacking exercise of identifying the causative factors and subsequently developing the operational framework for regulating them to ensure the necessary balance. Although unquestioned imitation of the policy measures mentioned is not warranted, there should probably be no hesitation to move in that direction and thus to attempt conceptualisation of the operational framework.

To conclude, we observe that the management of fishery resources is yet to be vested in the hands of the actual stakeholders. Unfortunately, neither the judiciary nor even the bureaucracy are to be affected directly by any decision taken by them in the context of striking the necessary balance between economic needs and ecological balance in the context of fisheries in India. *A la* Collin (1994), it is high time that a network of stakeholders' organisations at different tiers are set up to look into the problems and prospects of management of fisheries in a proper perspective. To begin with, the Panchayati Raj institution legitimized through 73rd Amendment may be involved in the whole exercise and efforts ought to be made through all possible ways to augment their capabilities in handling the relevant issues within a decentralised and democratic structure.

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