Responsible Fisheries Extension Series 6

Teaching **Not** To **F**(in)ish **!?** :

A Constructivist Perspective on Reinventing a Responsible Marine Fisheries Extension System

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Reinventing a Responsible
Marine Fisheries Extension System

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Foreword

The scenario of marine fisheries sector in India is causing concerns to all fisheries managers and end users. It is impossible to ignore the problems, which are being increasingly manifested. Severe depletion in the marine living resources, environmental pollution, issues of by-catch, discards, juvenile and destructive fishing are all pointing towards a bleak future. The livelihood security of the millions of our fisher folk, who in fact represent an "ecosystem people", depend not only on the robustness of the marine resource base but also on the sustainability of the management practices followed by them.

The concept of responsible fisheries endorses a precautionary approach to ensure sustainability of the resource in a system perspective. We have an immensely rich scientific database on the resource base attained over a period of over five decades, thanks to the commendable contributions of various research activities undertaken at the Central Marine Fisheries Research Institute. The potential of this knowledge base in guiding management actions needs to be effectively utilized.

Unlike the farming sector, the extension system in the case of marine fisheries sector is confronted with a number of epistemological and methodological problems. The need of the hour is to infuse new perspectives on re-inventing an extension system that can take a proactive role in creating an ethos of responsible fisheries among the stakeholders. The application of new theoretical developments in extension science like constructivism and social learning are of much relevance in this regard and there is a need to transplant these to the fisheries extension scenario.

This publication, aptly titled "Teaching Not To Fi(ni)sh ! –A Constructivist Perspective on Re-inventing a Responsible Marine Fisheries Extension System" is an attempt in this direction. The insights from the National Agricultural Technology Project (NATP) funded research project "Designing and Validation of Communication Strategies-A Co-learning approach" has helped Dr. C Ramchandran in venturing into this difficult area. I congratulate him for his courage and initiative. I wish that the extension paradigm suggested here would lead to a wider debate and consequent actions for its implementation.

Prof. (Dr.) Mohan Joseph Modayil
(Director)

Preface

Nations having access to oceans are blessed with the wealth of many added resources. Fisheries form one among the renewable, but not inexhaustible marine resources. Majority of fisher folk in India, who depends on these resources for their livelihood over generations could not still get the benefits of rapid technological advancements and economic development. The operational efficiency of complex and diverse capture fishing strategies led to implicit conflict in resource use among stakeholders of different sectors. Mounting competition and continuous technological up-gradation in open access multi - gear, multi- species marine fisheries paved the way for increase in gross production with reduction in catch rates and per capita earnings. Excess capacity of fishing fleets due to overcapitalization has not only led to disguised unemployment and diminishing returns but also threatens the extinction of certain distinctly precious resources beyond the sustainable level. The marginalisation further widens economic disparity and coastal distress warranting massive extension efforts in capacity building and empowerment of stakeholders for sustainable production and equitable distribution.

The dynamic fisheries extension tools and their multidimensional application on various issues are very important not only in the management and conservation of open access fishery resources for sustainable development but also for conflict resolution and maintaining congenial socioeconomic fabric of coastal communities. Behavioural aspects of stakeholders such as level of awareness, adoption, attitudes, aspirations, perception, motivation, extent of information dissemination and impact of technology diffusion on livelihoods, socioeconomics and empowerment options assign significance for arriving at appropriate management decisions. It is well known that the primary objective of providing feed back information from the clientele by extension mechanism gives the impetus for re-orienting and prioritizing need- based research and development in any sector.

The socioeconomic Evaluation and Technology Transfer Division (SEETTD) of CMFRI accord top priority for fisheries extension research and transfer of technology over the last two decades. The Division by way of the NATP/CGP II (209 00 000 11) Research Project "Designing and Validation of Communication Strategies for Responsible/Sustainable Fisheries –A co-learning approach" has put in consistent and concerted efforts to promote the ethos of responsible fisheries and conservation of resource among the stake holders through various extension interventions including the translation of FAO "Code of Conduct for Responsible Fisheries" in Malayalam and organizing awareness campaigns all along the coast .

The present publication by Dr. C. Ramchandran, Scientist (SS) is a landmark in this direction prepared on the basis of his varied field exposure on coastal scenario coupled with extensive exploration of contemporary literature on extension and fisheries. I would like to congratulate him for his committed efforts in bringing out this publication which will be highly useful to researchers, academicians, students, extension workers, farmers and those involved in fisheries development and extension education.

(Dr. R.Sathiadhas)
Head, SEETT Division

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Dr. C. Ramchandran

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CHAPTER 1

Introduction

Give him a fish
He will live for a day..
Teach him how to fish
He will live for ever.....

Does this Chinese proverb hold good these days? May be figuratively ...but no longer literally. Any one who is aware about the status of our seafood resources will definitely ask for a breather before giving an answer to this question. For a typical fisherman of today the days of abundance in our seas is fast becoming a thing of the past (see Box 1). This may sound too apocalyptic. But facts indicate that if we fail to respond to the warning signals proactively the story may not be different from what has already happened in other parts of the world.

Box - 1
The lost abundance of our seas!

The abundance of fish in the Indian waters did come to the notice of the early travellers like Pliny in the 1st century AD and some of the Arab traders in later centuries (7th & 8th AD). The teaming shoals of oil sardine, which migrate down the West Coast of India, helped the traders in finding their way to Kerala coast. *Friar* Odoric who sailed down the Southwest Coast of India in 1320 observed that:

"there are fishes in those seas that come swimming...in such abundance that for a great distance into the seas nothing can be seen but the back of fishes, which casting themselves on the shore ,do suffer men for the space of three days to come and take on as many of them as they please..."(Quote from Day, 1865)

Hard facts .....

a) Marine fisheries sector-a saga of growth!

It is true that our marine fishing sector has achieved tremendous growth during the last five decades. Apart from providing nutritional security to the fish eating population it plays a very significant role in the economy of our country. The foreign exchange contribution of the sector by way of seafood exports is to the tune of Rs 6300 crores now (compared to Rs4.5 crores realized in 1960-61).

The value of the domestic market for marine fish is estimated to be more than Rs 100 billion (Mohan Joseph and Jayaprakash, 2003). The sector which has an estimated total investment to the tune of Rs.45 billion offers direct livelihood options to around five million people out of which an estimated one million are active fishermen(Sathiadhas *et al*, 2003). The total number of people who make a living out of the sector indirectly (like those employed in ancillary industrial sectors like processing plants, transportation, marketing, value addition, export etc. and service sectors like fisheries-related administration, education, research etc.) is estimated to be in the range of 25-27 million.

b) Resource base –in Peril?

Research studies till date indicate that the estimated potential yield from our inshore waters (0-50 m depth zone), which is incidentally the most productive one, has already reached a plateau (Srinath,2003). Out of the total potential annual yield of 3.90 million t from the Indian Exclusive Economic Zone (EEZ) the inshore contribution is to the tune of 2.21 million t and the rest 1.69 million t is from the region beyond 50 m depth. Though there is a potential of 2.2 million tons left the major concern is the lack of scope for expansion in the inshore waters. The current level of production has almost reached the estimated potential.

	0-50m	50-200m	200-500m	Oceanic	Total
MSY(million t)	2.28	1.367	0.028	0.246	3.921
Current yield (estmtd)	2.21	0.5	-	-	2.7

But the question is *"Should we get concerned'?*

A cursory look at the trend in the marine production since 1947 as given below may not immediately reveal the hidden danger. The growth is phenomenal with the total production reaching 2.7 million tons from a mere 0.37 million tons in 1947.

But the annual relative growth rate given below tells a different story. The growth rate since 1981 has been on the decline. Most reasonable estimates indicate that the production is levelling off at 2.7 or 2.8 million tons.

Year	Yield (million t)
1947	0.37
1950	0.58
1960	0.88
1970	1.09
1980	1.25
1990	2.16
2000	2.69

(Source Ministry of Agriculture)

Growth rate	period			
	1961-70	1971-80	1981-90	1991-200
	6.6	5.8	3.73	2.01

(Source: Srinath,2003)

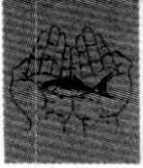
The decline in growth rate *per se* may not be sufficient to pass a judgment that there is a crisis looming because health of a fishery cannot be assessed on the basis of catches, (or more correctly landings) alone. But fisheries scientists take other measures, which are considered as warning signals to get a clearer picture. Some of them are i) a perceptible decline in catch rate (measured as Catch Per Unit Effort), ii) widely reported incidents of high fishing mortality due to wanton destruction of juveniles, discards and by- catches, and iii) deviations noticed in landing pattern i.e., changes in size composition and mean length at capture (For a comprehensive analysis see Devaraj and Vivekanadan,1999).

A recently published review (Mohan Joseph and Jayaprakash,2003) on the status of exploited fishes of India indicates that most of the major stocks of marine fish in Indian waters are either over exploited or facing the threat of overexploitation. The knowledge base developed by CMFRI on the level of exploitation on about 47 commercially important species is quiet revealing. Most of the fish stocks (55%) have reached optimum level of exploitation and many (30%) are over exploited(Table 1).

Table 1. Level of exploitation of marine fish stocks

Category	Level of exploitation in number of species		
	Under	**Optimum**	**Over**
1 Pelagic (N=24)	5	11	8
2.Demersal (N=12)	0	10	2
3.Crustacean (N=7)	1	2	4
4.Molluscan (N=4)	1	3	0

(Source : Mohan Joseph and Jayaprakash,2003)



The picture gets somber when it is juxtaposed with the fact that the current harvesting capacity of fishing fleets far exceeds the estimated biological sustainability of most commercial stocks (Table 2).

Table 2. Optimum and existing fleet size (1996-97)

Fleet	Existing (no.)	Optimum (no)	Excess (%)
Mechanised	46918	20928	55.0
Motorised	31726	12832	60.0
Non-motorised	159481	31059	81.0

(Source : CMFRI, 1997).

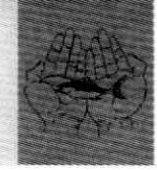
It is obvious that over-fishing is rampant in our waters. But due to the multi –species nature of our fisheries over-fishing has not manifested into dramatic cases of fishery collapses as it has happened in temperate waters. But there are cases of fisheries which are clearly on the verge of collapse. A case in point is that of marine catfishes in SW coast (See Box 2). Another recent case is that of unicorn cod (*Bregmoceros mclellandi*) whose catch has drastically declined from 6880 t/yr in 1950-54 to mere 604 t/yr in 1999-2003 (Pillai, in press).

The threat of over fishing is compounded by the loss of fish incurred through detrimental practices like juvenile fishing, discards and by-catch. No precise estimates are available on the loss of fish on these counts. However an estimated 0.3 million t is lost as discards by shrimp trawlers alone in India, causing a total loss of about Rs.800 million every year (global estimate is 27 million t out of the total catch of 96 million t).

Development of aquaculture (especially the intensive and semi-intensive type) is often cited as a counter measure to stop the likely drop in total fish supply. But there is increasing realization that while fish farming is a possible solution it is a contribution factor to the collapse of marine fisheries stocks by way of the huge quantity of wild fish utilized in the production of fish meal (Naylor *et al* 2000). It is estimated that for every 1kg of fish raised on compound feeds an average of 1.9 kg of wild fish is required. About 10 million t of marine fish is used as fishmeal inputs in aquaculture feeds globally.

Responsible fisheries, Extension and a search for a new logic…

From the resource point of view it is beyond doubt that the sustainability of our marine fisheries sector is under severe threat. It is imperative that we heed to the warning signals if we want to ensure livelihood security to the millions who depend on it. There now is a global consensus on the need for taking proactive measures in this regard. But the response



in our country so far has focused on implementation of regulatory measures by government caveats. It is being increasingly realized that marine fisheries management by administrative measures alone will not yield viable solutions. The marine fisheries scenario is dominated by the typical phenomenon of 80:20 divide. A minority has cornered the fruits of the sector leaving a large majority to get embroiled in the vicious cycle of penury and exploitation. To make matters worse the process of marginalisation faced by the small-scale sector, composed mainly by the artisanal fisherfolk, has been abetted by technological modernization and capital penetration. The inherent problems of entitlement and distributive justice are only to get aggravated by the irredeemable trends of resource depletion. It would be a Herculean task to bring such a huge sector, which is riddled with extreme degrees of socioeconomic polarization, under an effective mechanism of a "command and control regime".

Box - 2

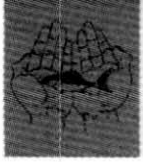
Fishery collapse in India?

The case of Marine Catfish in SW Coast

Marine Catfishes belonging to the family Tachysuridae were abundant till late seventies along the SW coast of India. Though it was a marginal fishery in earlier days the extensive use of purse seining resulted in its growth especially in Kerala and Karnataka. The yield attained a peak in 1981-82 with a total catch of more than 10000 t. But during 1982-89 period drastic decline was noticed for species like *T.dussumieri* at many centres along the SW coast. For eg. at Kochi alone the catch declined from 347.2 t in 1981 to 0.14 t in 1989 and at Calicut the decline was from 236.7 t in 1979 to 75.7 t in 1986. The catastrophe was due to the wanton destruction of gestating males during the peak seasons of December-March and September- November.

The catfishes have very peculiar biological characteristics. Their fecundity is low with only 40 to 180 per fish. To make good for this they have been bestowed with well evolved parental care of oral incubation. *T dussumieri* has a life span of about 8-10 years and is fully vulnerable to purse seine at the age of 5 when the species first spawn. This means that the impact of destruction of brooders in terms of further recruitment will be realized only after 4 or 5 years. Reading well these warning signals scientists of CMFRI had suggested measures like wilful avoidance of catfish shoals during January –March and September –October, limiting purse seine operations etc. to prevent its over exploitation. But the fishery collapsed and even today the catch has not shown any appreciable signs of recovery in SW coast.

(Source : *Bensam and Menon. 1994., Menon and Pillai. 1996).*



But do we have *alternatives*? It is here that the concept of Responsible Fisheries being advocated by Food and Agriculture Organization becomes relevant. It underscores that

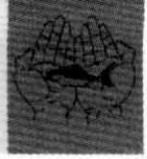
'the right to fish carries along with it obligations to do it responsibly". The point of departure it makes is in the conventional conceptualization of problems in marine fishing as mere resource issues. There cannot be fisheries management without the active participation of fishermen or rather the stakeholders of the system. *Humanizing the praxis of fisheries management* implies a very radical shift not only in the way we do fishing but also in the way we think about fishing.

It is on the assumed strength of the *resource logic* that the whole edifice of fisheries research and development has been built in our country. The logic has worked well in the case of agriculture and aquaculture. And we have had Green and Blue revolutions in our country. Essentially it involves a two-tier strategy of generation of technologies by a research system and their transfer to the client through an extension mechanism. But has it worked in the case of marine fisheries sector? It is not difficult to argue that this logic has played its role in marine fisheries sector also. Otherwise, one may ask, how would you explain the tremendous economic strides the marine fishing industry could make during the last few decades? Though a deeper analysis would make it difficult to give an affirmative answer in these lines, the bigger trouble with this logic is the belief that it can be safely used as a remedial strategy in the case of a sustainability-challenged resource base also. We can see this belief at work in oft- repeated statements like "extension is the weakest link in the marine fisheries sector".

The scope of this book is placed at this juncture. *Will the strengthening of an extension system help us in mitigating the problems we now face in our marine fisheries sector? If so, in what way?* This book is the culmination of a search for finding answers to these questions. This has been made largely based on the insights and field experiences gathered during the implementation of the NATP funded research project "Designing and validation of communication strategies for Responsible fisheries –A co-learning approach". It is to be admitted that no magical solutions could be discovered at the end of the journey, but only the realization that there is a need to redefine the extension system specifically for marine fisheries. The new thinking in extension science being built around the ideology of constructivism has been applied to suggest a new logic which has been attempted in the last chapter. In fact the purpose of the other chapters is to elaborate the contours of this new logic.

A word about the chapters...

After a discussion on the concept of sustainability and sustainable development a brief review is given on the genesis of basic concepts in fisheries science and the development of the



fisheries science in general. This is followed by an account on the management measures being adopted with a criticism on its logic.

A theoretical background on the concepts of extension as well as the ideology of constructivism is briefly outlined in the next chapter. The extension research system in the case of marine fisheries is a nascent one. The brief review, with special reference to CMFRI, tries to find out the direction it has so far taken in order to get a better perspective on the needed changes.

The case study on *Kadakkody*, given as annexure, tries to show the unique role of indigenous institutions and the various possibilities it offers to a reinvented extension system. The annexure on the time line on the developments in the fisheries sector in the world and in India mainly traces the historical course of technological change.

The title of the book owes its origin to the proverb given in the beginning of the chapter. It is interesting to note that the figurative meaning of the proverb has been used by development thinkers to emphasize the need for education / extension interventions to empower the marginalized. It is hoped that we will be able to maintain our seas robust enough to keep the saying true forever...

CHAPTER 2

Sustainable Development of Fisheries and Fisheries Science - an overview

.....We have here but five loaves and two fishes....

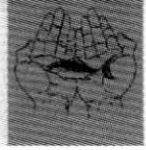
Mathew 14:17

.....we have enough to meet our need but not our greed...

Mahatma Gandhi

No other word has attained such popularity or even the status of a bandwagon in recent times than the word *"sustainability"*. The concept of sustainability was first introduced in the early 1980s by Lester Brown, founder of the World Watch Institute. He defined a sustainable society as one that is able to satisfy its needs without diminishing the chances of future generations.

A *Sustainable community* is one designed in such a manner that its ways of life, economy, physical structure and technologies do not interfere with nature's inherent ability to sustain life. Such communities evolve their pattern of living over time in continuous interaction with the living systems, both human and non-human. Sustainability does not mean that things do not change: it is a dynamic process of co- evolution rather than a stable state. Given that development of knowledge is our strategy for survival the capability to adapt to changed circumstances depends on our ability to make informed decisions after interpreting warning signals. An important problem here is that sometimes we fail to read the signals well in advance and take appropriate decisions. This could be due to either the entrenched power relations prevalent in the society or the force of habit nurtured by members of the society (See Box 3 for an illustrative case).



Box - 3

Norsemen in Greenland

By the 12th century the Norsemen who migrated to Greenland had established their agricultural settlements well. In 1127 they sent a live polar bear as a gift to the Nordic King and they got a bishop in return. By about 1500 when Greenland had become largely snow covered the only inhabitants were the Inuit Seal hunters. All that remained of Norse settlements were the ruins of their churches. Their tragedy was their failure to get their life style adapted to the change in climate. While they continued to graze their cattle under deteriorating conditions the Inuit succeeded in getting adapted to the changing conditions. This historical anecdote offers the following lessons

Lessons

1. Maintenance of an effective adaptive link with our biotope is a crucial societal challenge.
2. The adaptive link rests on individual and collective choices, which are historically shaped.
3. There is a possibility that we will make wrong choices.

(Source:Roling,1996)

The concept of sustainable development was put on the international agenda by the World Commission on Environment and Development (WCED), better known as Brundtland report, in 1987. Its report titled *"Our common future"* gave the oft-quoted definition of sustainable development, as *"development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs"*. It is to be noted that the concept of development itself is conceived in a different way here. Development is not merely economic growth but an improvement in quality of life. Thus it underlines the fact that human well-being depends on the maintenance of environmental functions which themselves, directly and indirectly contribute to human welfare.

The focus as well as the prerequisite for such a development is the stability and resilience of the ecosystem in which we live. So, it is essential to recognize the interdependence of human economies with their environment. This concern has been captured by FAO when it defined sustainable development as

" the management and conservation of the resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment of continued satisfaction of human needs for present and future generations. Such sustainable development conserves, land, water, plants and animal genetic resources, is environmentally non-degrading, technologically appropriate, economically viable and socially acceptable".

Growth with limits

In other words sustainable development is the process of "using, conserving, and enhancing the community's resources so that ecological processes, on which life depends, are maintained, and the total quality of life, now and in the future, can be increased." This is otherwise known as an *ecosystems-based view* of development. Our ability to design the future course of our development depends much on better scientific understanding of ecosystem functioning and change. The basic guiding tenet of such a perspective is that we can not progress linearly for ever but we can have growth with limits. Some of the key postulates of sustainable development are given below :

Key postulates of Sustainable Development

1. Outside of a few meteors and spaceships, the Earth is a closed chemical system, in which various reactions including those that maintain life are fuelled by sunlight
2. From within this essentially finite system, vast, unmeasurable quantities of diverse materials and processes (both living and non-living, complex and simple) are vital to human life, society and culture.
3. Most of these materials and processes (resources) occur independently of human actions
4. Nonetheless human activities affect (and even determine) the availability of certain materials and the functioning of certain processes
5. The accessibility and distribution of resources is unequal and depends on both human and non –human factors
6. The accumulation of resources by humans creates material wealth and political power
7. The entire complex of the above relationship is highly dynamic, in both time and space, involving many unmeasured and unknown factors.

(Source: *Frazier,1997*)

Sustainable development of fisheries

Putting fisheries development in the paradigm of sustainable development is not a difficult task at least rhetorically, given the well-known challenges that confront global fisheries resources. The two words that frequent fisheries-related literature in the last two decades are "collapse" and "crisis". The collapse of certain targeted fisheries like Cod fisheries in the Pacific Ocean, which happened as recently as 1990 might have been the immediate impetus behind such concerns. The fishing industry the world over is on the verge of a

crisis. Mc Goodwin, of Stanford University, in his book "Crisis in the world's fisheries-Peoples, problems and policies" published in 1990 has given a gripping account of the complexity of the problem confronting fisheries of the world.

It was during the early seventies that indications of a crisis in world fisheries were noticed. Till then our marine fisheries resources were considered as inexhaustible or limitless. After all, the world's total fish catch had steadily risen from a scant 2 million tons in 1850 to a phenomenal 55 million tons by the end of the 1960's, with little indication that any sort of upper limit was being neared. However the total catch levelled off at around 70 million tons in the early 1970's, and stayed around that level for the rest of the decade. As the world's population was increasing the per capita production of fish got decreased. More importantly, the catch per unit effort (CPUE) and the catch per unit investment(CPUI) showed a steady decline although there was tremendous increase in the number of fishing vessels as well as efficiency of fishing technology.

Now there is consensus on the following facts regarding the state of world fisheries (Stone, 1997)

1. Over all, the world's living marine resources are overexploited; in many major fishing areas a reprieve in the level of fishing would assure larger and more valuable fish supplies in the long run.

2. The system is uneconomical (when the social cost is also taken into account) and unsustainable. We are paying an unnecessarily high price in capture costs and environmental degradation, for a dwindling catch.

3. Conventional management measures (including time, space and gear constraints) have not proved themselves capable of stopping excessive fishing effort.

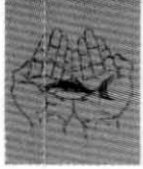
4. Increasing blame is being placed on overcapacity. As long as investment in harvest capacity is excessive (beyond the level required for efficient attainment of fisheries objectives) effective regulatory efforts are frustrated of both rule making and enforcement.

Sustainability and Modern Fisheries Management

a) Fisheries management

It is difficult to obtain clear definitions for the terms "Fisheries" and "Fisheries management". The ambiguity is probably due to the difference in position you take depending on whether you are a biologist ("ichthyo-centrism") or a social scientist ("anthropo-centrism"). For definitions of fisheries see Box 4.

Fisheries management is the "action of designing, justifying, and administering control of fisheries systems" (Hilborn and Walters, 1992). It deals with the interaction between the resource and its use. FAO recently came up with a working definition, which is more comprehensive. It is given below:



" Fisheries management is the integrated process of information gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and accomplishment of other fisheries objectives" (Cochrane,2002).

Box - 4

What do you mean by fisheries?

Is it a geographical location (North Atlantic fishery, Quilon bank fishery etc) or methods of fishing (Trawl fisheries, purse seine fisheries etc) or a particular marine species (shrimp fishery, anchovy fishery) or all put together?

At the most fundamental level fisheries are a *human* phenomenon. According to Lee G Anderson, an economist (1977) fishery is "a stock or stocks of fish and the enterprises that have the potential of exploiting them". Alexander Spoehr (1980) stresses that a fishery is a" socioeconomic technological system in interaction with a marine ecosystem". Another anthropocentric definition is by Raul Andersen (1982), which says " fisheries are activities through which people link themselves with aquatic environments and renewable resources".

Fisheries management –a Brief history

Fisheries management, as one informed by Fisheries Science, has evolved over the past four decades as an entity in its own right. The concept of Fisheries management is a post- World War II phenomenon. Before the war the main emphasis was on development and modernization, which resulted in a period of high exploitation and tremendous improvement in fishing technology, both harvesting and post harvest technologies.

Catch more care less..... Sea is limitless

The marine resources were believed to be inexhaustible. Sea for all practical purposes was considered to be limitless. This was not merely a layman's perception. Charles Lyle, an intellectual giant and mentor of Charles Darwin said in 1830 that *'even now, the waters of lakes, seas and the great ocean, which teem with life, may be said to have no relation to the human race-to be portions of the terrestrial system of which men has never taken, not can take possession" (quoted* in Pauly D,1996).

The eminent British scientist Thomas Huxley, a friend of Charles Darwin stated in 1883: *' I believe that the Cod fishery, the Herring fishery, the Pilchard fishery, the Mackerel fishery, and probably all the great sea-fisheries are inexhaustible; that is to say that nothing we can do seriously affect the numbers of fish".*

But with the advent of industrialization and increase in demand for animal protein by the burgeoning population marine fisheries underwent rapid changes. Marine fisheries, which remained as a local or regional enterprise venturing only the inshore waters, soon attained the status of "Industrialized Hunting and Gathering".

Crisis of Over-fishing and birth of Scientific Fisheries Management

The new technologies like internal combustion engines, improved vessel designs and more efficient gears to catch fish brought out a boom in offshore fisheries too. But this boom was short-lived. The problems of over fishing were soon felt by way of scarcities in certain marine fish, which had always been abundant and decline in the industry's profits (Over-fishing , by the by is not a modern day problem, see Box 5). As early as 1893, just ten years after Huxley's sanguine statement, a Select committee of the English House of Commons expressed alarm that both the size of the total catch and the size of the fish being caught were diminishing in the fisheries of North seas and North Atlantic. This led to the realization that the marine resources are no longer limitless. It was this moment that gave birth to modern fisheries science and the modern practice of marine fisheries management.

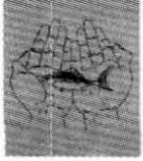
Box - 5

Over-fishing not a modern hazard!

One of the earliest documented instances of severe over fishing occurred nearly 3000 years ago along the Peruvian coast. The early Peruvians could build a civilization by 3000 BC relying almost exclusively on marine resources, as they apparently did not get the benefit of agriculture since the Peruvian coast is one of the driest in the world. But they had a very productive marine ecosystem. Their chief resource was shellfish that could be gathered close to the shore. The crises began around 1000 BC. A climatic catastrophe (like El Nino) caused rapid and widespread reduction in the shellfish resources. The people accustomed to relying heavily dependent on these resources probably attempted to exploit them at their usual levels, thereby causing a collapse. (Source: *Mc Goodwin,1990*)

Fisheries science

Everhart Harry and William Youngs (1953) in their book "Principles of Fishery Science" gave a definition of fisheries science as "application of scientific knowledge to the problems of providing the optimum yield of fishery products whether stated in tons of commercial products or in hours of angling pleasure'. Or in other words it tries to answer the question "How much fish we should catch so that there is enough left for future catch?". It is interesting to note that the notion of sustainability is a fundamental concern in fisheries science. In the fisheries science parlour this is known as the maximum sustainable yield or MSY. The efforts to find an agreeable answer to this enigmatic question form the crux of marine fisheries



science. It is this challenge that makes it both fascinating and frightening. As we will see later, biologists, mathematicians, economists and social scientists, addressed this challenge each contributing in their own way thus building the discipline of marine fisheries science. Perhaps, each contributing separately in the beginning and on a multi-disciplinary platform recently. But the challenge continues...

A brief outline of the development of scientific fisheries management would enable us to better appreciate how daunting the task is and how difficult is the plight of a fisheries scientist (see Box 6&7).

Box - 6

Plight of marine fishery scientists?

No other group of scientists confronts the issue of uncertainty in as daunting a fashion as by marine fishery scientists. G.L. Kesteven (1996) , an Australian fishery scientist chose to put his plight in this way

Drest in a little brief authority
Most ignorant of what he is most assured,
His glassy essence, like an angry ape,
Play such fantastic tricks before high heaven,
As make the angels weep.

According to M. Srinath, an Indian Fisheries scientist (personal communication) marine fisheries stock assessment, the basic challenge of fisheries science, is like ***searching a black cat in a dark room where there is no such cat.***

Uncanny politicians who find most advice of the scientist unpalatable exacerbate the plight of the scientist. Economic and social forces undermine their ability to prescribe and implement strategies and programmes that support sustainable fisheries "We often feel like ***we are rearranging deck chairs on the Titanic***"...say Knudsen and MacDonald of the American Fisheries Association. Many argue that **"Fish is 5% protein and 95% politics" (quoted** in a New Scientist editorial, 17 January 2004)

Biology to Stock assessment

What started as **fisheries biology** in its incipient days in the 1880s, as a new branch under marine biological science, fisheries science was soon transformed into a science of fisheries stock assessment, thanks to the tremendous progress it could make on the biology of fish, their distribution, life cycle (reproduction, migration, growth), behaviour etc as well as their environment, the basis of fish food, production of plankton and life cycles of other marine animals. But this treasure of qualitative information on these aspects alone was not sufficient to provide management advice in the context of over-fishing.

Box - 7

Ecological detectives?

"What sort of work you do?"

"...Well , I work with fish populations... The trouble with fish is that you never get to see the whole population. They are not like trees, where numbers could perhaps be estimated by flying over the forest. Mostly, you see fish only when they are caught.....So ,you see , if you study fish populations you tend to get little pieces of information here and there. These bits of information are like the tip of the iceberg; they are part of a much larger story. My job is to try to put the story together...I am a detective, really ...who assembles clues into a coherent picture...".

(From the book the *"The Ecological Detective* –confronting models with data" by Ray Hilborn and Marc Maugel (1997).

The development of fisheries science can be christened as a "search for the causes of over-fishing". The earliest explanations for over-fishing were given by two English scientists namely E.W. **Holt** and C.**Petersen** in the early 1880s. They are known as Propagation theory and Growth theory respectively (see Box 8 for details). In fact these theories laid the foundation for later developments in fisheries science as well as scientific fisheries management. The bone of contention was whether over-fishing was purely a biological phenomenon or a problem which is part biological and part economic. The latter point of view gained strength gradually, which in fact was an extension of Petersen's notion.

Whatever be the reason it was getting increasingly realized that the way to prevent the scourge of over fishing eating away the profit of the fishing industry was to curb the fishing effort. One of the first works to present in a formal way both the empirical evidence and the theoretical necessity for controlling fishing effort (in short a "theory of fishing") was the attempt by the famous British scientist Michael Graham whose book *"The Fish Gate"* published in 1943 is considered as a landmark in the development of fisheries management theory. He argued, "fisheries that are unlimited become unprofitable or inefficient". This is known as the *Great Law of fishing* (Gulland,1974) as it clearly stated the biological basis of fisheries management and the economic difficulties encountered by an unregulated fishery.

But the puzzle was how much effort would bring the maximum catch at the same time without affecting the sustainability of the stock adversely. This is the Maximum Sustainable Yield Concept (MSY) –the magical Rubicon of marine fisheries science. An important problem in this puzzle was to explain the relation mathematically between fishing effort and catch. In 1954 **Milner B Schaefer** succeeded in solving this puzzle using data for the Yellow fin tuna fishery in the eastern tropical Pacific. He estimated the proportion of stock or biomass that would be removed by a single unit of fishing, while also taking into account the intrinsic

ability of the stock to increase and the maximum size it could attain theoretically.

Though these attempts helped to describe the interaction between fish stocks and fishery quantitatively the real breakthrough came when two British scientists, **Beverton and Holt** published their book on population dynamics of the North Sea fishes in 1957(Christensen,1989). This book represented a giant step in fisheries science and became a basis of almost all fishery research and management in the last part of the century. The method suggested by Beverton and Holt enabled fisheries scientists to say something in numbers about what would happen to catches and biomass if the fishing fleet was to be reduced or increased by certain proportion. That was exactly what the policy makers wanted as a basis for making decisions, at least in the temperate countries.

Box - 8

Causes of over -fishing: *Propagation theory vs Growth theory*

In 1895,E.W .Holt , an English Biologist took the view (known as the *propagation theory) that* over-fishing was caused by taking spawning fish out of the sea. He insisted that fish should have a chance to spawn at least once before being caught. He suggested that by artificially producing and releasing eggs into the sea they could solve the problem of profit decline. But his fellow biologist C. Petersen contended this view by arguing that the main problem was taking fish that were too young and small. This is known as *growth theory.* He argued that the overall profitability could be secured if fish were permitted to grow before capture. After all consumers had a preference for larger fish which in turn could fetch better price per unit weight.

Holt's theory is still valid for management of a few species if their fecundity is critical. Petersen's growth theory was a point of departure as it was based on biological as well as economic considerations. It was his theory which formed the basis for many later attempts in formulating a comprehensive yield equation that would equate levels of fishing effort with such variables as natural recruitment, natural mortality and the growth patterns of age classes in a fish population. These attempts are together known as *Bio-Economic models* . Nevertheless, the practical application of the growth theory has remained elusive since precise determination of the optimum age for capture remains an unresolved problem. (Source : *McGoodwin,1990*)

Concept of Maximum Sustainable Yield (MSY)

The concept of MSY is considered as the Holy Graïl in fisheries science. It is defined as *"the maximum catch that can be removed over an indefinite period without causing the stock to be depleted, assuming that removals and natural mortality are balanced by stable recruitment and growth"* (Frose and Pauly,1997). In other words it is the largest catch that can be taken from a given fish stock, over the long-term without causing the population to collapse. This is the rate of

exploitation, which doesn't undermine the ability of nature to replenish the stock. Population biomass depends on growth, reproduction and total mortality. Total mortality is sum of fishing mortality and natural mortality. For a given level of fishing mortality to be sustainable there must be a balance between the mortality, which reduces the population biomass, and growth, which increases it. This is shown in figure 1.

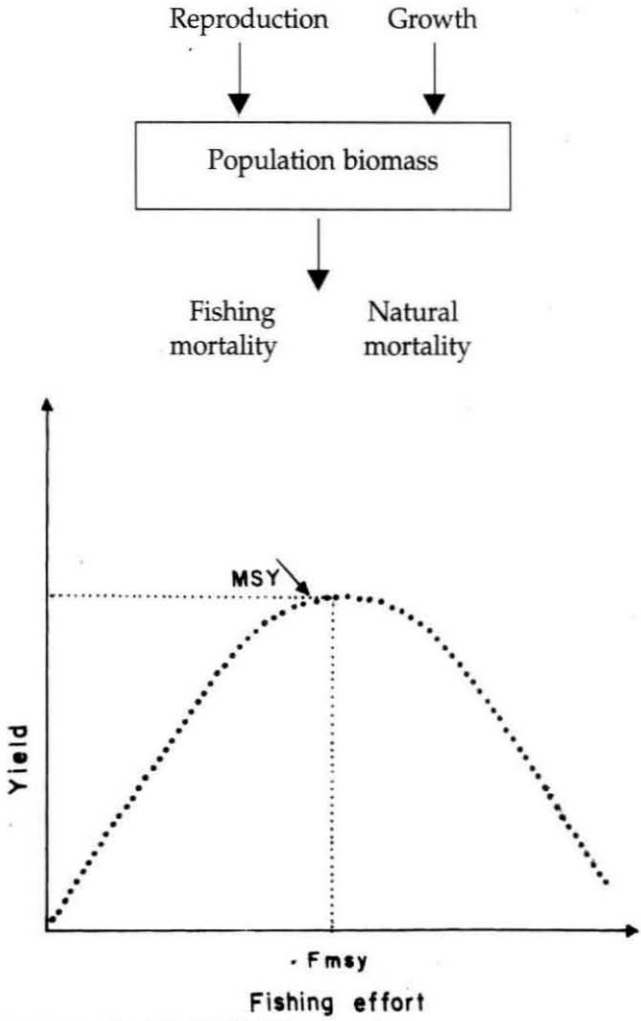


Fig. 1 Concept of Maximum Sustainable Yield

But this makes sense from a strictly biological point of view only. The model, which has been developed under single species context, has been the subject of serious debates among fishery scientists. The application of this model was attributed to be a major reason behind cases of dramatic fishery collapses like the Peruvian anchovy and the Canadian Cod (see Box 9&10).

MSY has been decried as a flawed model due to its unrealistic assumptions. For e.g., the model works on the basic assumption that there is an equilibrium (steady –state situation) in the catch and effort data of each year, and the catch is equal to the surplus production at that level of fishing effort. (Fishing effort is calculated in many ways like the number of boats, trips, fishing time, engine power, area swept by the net etc). In reality no fisheries work on this way. Another assumption is stability in the ecosystem, which is in fact an exception, rather than a rule in marine ecosystem. There are other problems also with this model. The catch and effort data are difficult to work with because advances in fishing technology as well as the behaviour of the shoal influence Catch Per Unit Effort (CPUE). For e.g., the tendency of the anchovy (see Box 9) to concentrate in pockets of cool water allowed fishers to maintain high catch rate despite sharp reductions in total stock size. The most embarrassing hitch with this model is that the only way to know the sustainable catch level is by exceeding it!

Box - 9

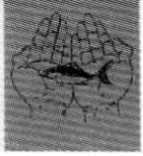
MSY and fishery disasters

a) Case of Peruvian anchovy

MSY has been implicated in some of the fishery collapses in the world. The case of Peruvian anchovy fishery in 1972 is a classical one.

Peruvian anchovy population is found in the Peru Coastal current that runs close to Peru and north Chile. The fishery accounted for about a quarter of Peru's foreign revenues. Anchovy (*Engraulis ringens*) are pelagic fishes feeding on phytoplankton and zooplanktons. The fishery scientists had calculated the MSY for anchovy as 11 million tones. After subtracting an average of 1.5 millions for sea birds it was set as 9.5 million tones. This was found to be quite reasonable since the Peruvian Government had brought in regulations from mid 1960s that limited the annual catches to 7.5 million tones . But it proved difficult to enforce the regulations as the fishing fleets and fishmeal plants were greatly over capitalized. By 1970 the annual target of 7.5 million tones could have been processed in less than 40 days. In 1972 there was a drastic decline in the catch during the otherwise peak season (March –April). Research studies indicated failure in recruitment (recruitment is the number of fish that survive to a catchable state in any one year) and a management panel recommended a halt to the commercial fishery. But some fishing was allowed in the southern part because the adult stock seemed to be reasonably healthy there. This was a false hope. The stock collapsed and the fishery failed bringing serious economic and social problems in Peru. The stock showed no signs of recovery till 1990. But now it is said to be on its way back to its former state.

(Source : *Jennings et al, 2000)*



Box - 10

MSY and fishery disasters

b) Case of Canadian Cod (Grand banks Cod *(Gadus morhua)*)

This is a comparatively recent disaster, which happened in 1992. But it has a long history of mistakes in fisheries management. When scientists began to manage the Grand Banks in the 1950s safe quotas were assigned to Canadian and foreign fleets. But the catch fell from 8,10,000 tonnes in 1968 to 1,50,000 tonnes by 1977. The Canadian government banned foreign ships and extended its jurisdiction 200 nautical miles offshore. Scientists of the Department of Fisheries and Oceans (DFO) set catch limits, calculated to allow stocks to recover, predicting catches of 4,00 000 tonnes by 1990. But catches never rose enough to allow Total Allowable Catch (TAC) greater than 2,60 000 tonnes. Then there was a discrepancy in the commercial data provided by the fleet, which suggested that there was twice as many fish as the research data did. The discrepancy worsened and DFO reported substantial decrease in the area fished and decline in catch. The industry stuck to its false impression. They blamed the scientists that they should have gone "where the fish are". The scientists advised a TAC of 1,25 000 tonnes well below the 2,60 000 of 1988. Then politics took a hand. The fisheries minister refused to anger the fishermen by slashing catches that much. The ministry set the TAC at 2,35 000 tonnes. The scientists lacked confidence in their own data and did not oppose it. In January 1992 DFO recommended a TAC of 1,85,000 tonnes and then cut that to 1,20 000 tonnes based on another cruise study. But by June 1992 the DFO recommended a ban of the fishery altogether. In 1993 a fishing moratorium was imposed. It caused loss of jobs to about 400000 people in Canadian maritime places. According to a report in *Nature* even after a decade long moratorium, the code population still remains historically low.

(Source : *Mac Kenzie,1995 and Olsen et al, 2004)*

The conceptual and practical problems implicit in the model were felt to be so irredeemable that it was accorded a public burial by a famous fishery scientist namely Larkin three decades ago (Larkin, 1977). But the recent interest in sustainability has made some scientists to have a re-look in the concept (Ludwig *et al* 1993).

The attractiveness of MSY is the ideal of taking as much as possible of a resource (maximum yield) essentially forever (sustained) and having a scientific stamp of approval to do so (Frazier, 1997). Despite the fact that MSY has been derided it could not be dislodged. It still remains the best starting point to understand the biology of fisheries exploitation and continues to be used as the reference point in fisheries management almost all over the world including tropical multi species context like ours. It is likely to continue its reign until fisheries scientists perfect better models like ECOPATH or ECOSIM.

Economists join the fray.....

The inadequacies of MSY prompted some fishery economists to put forward another, but related concept called ***Maximum Economic Yield*** (MEY). The pioneer of this concept was **H. Scott Gordon** who developed this model in 1954. The model is given in figure 2.

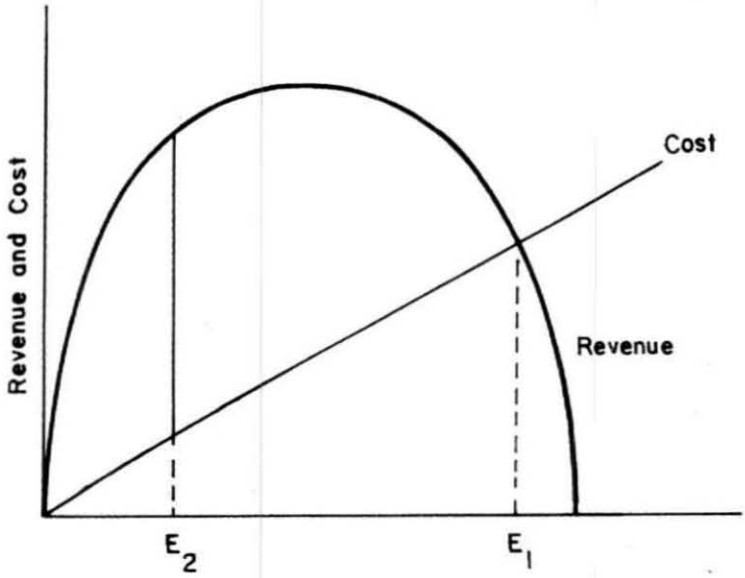


Fig. 2 Concept of Maximum Economic Yield

It could be easily seen that it is a modification of the MSY model or it is an economist's version of the MSY model. The yield curve is replaced by a revenue curve on the assumption that yield is proportional to revenue and the cost of fishing is proportional to fishing effort. An unregulated fishery (open access) would be expected to expand until the revenue =cost (point E1). This is obvious because fishers incur loss once the fishing costs exceed the income. The fishery would be most profitable at E2 where you have the highest difference between cost and revenue. The model suggests that as long as the fishery cost (harvesting and entry) is low the fishers tend to fish beyond the biological limits leading to depletion of the stock. The ultimate result is the fishery becoming economically inefficient, as there will be too many fishers chasing too few fish.

Thus Gordon could explain the reasons for low income of the fishers in an open access fishery; that an open access fishery would be expected to expand to a greater size than which gives the maximum profitability.

The problem with this model, like the MSY, is that we cannot use it to do any predictions. It is a static model. Though MEY can be taken as a cardinal objective of fisheries management the concept is useful only if we assume that the market for fish is stable. This is unlikely in

most fisheries. And for calculating MEY we need precise measures of the myriad costs and benefits involved in all fishing activity, which is a very formidable problem both methodologically and practically. Not only this, in actual practice this concept fails to prescribe solutions for the other management issues like access rights, distribution of economic benefits (equity) etc. Managing for MEY can cause undesirable environmental problems too. For e.g., in the case of high-value fishes MEY may require a level of fishing effort considerably above the level of MSY-at a point where the resource is nearly depleted. Other problems may rise such as excessively high production costs that are passed on to consumers. Pelagic fisheries in particular may suffer severe ecological problems under MEY. Catch rates may remain high while fish stocks are being seriously depleted. Thus fishers and managers may feel that their fishery is being soundly managed, but collapse can be round the corner.

Social scientists too....

The social scientists came out with another concept called ***Optimum Sustainable Yield*** (OSY). In theory OSY means incorporation of biological, social, political, and other variables perceived as desirable into a single objective function for managing a fishery. But OSY so far has remained more as an ideal, both in conception and application. Theorizing about how to optimize biological variables such as the quantity, and age cohorts of fish seems simple compared with theorizing about optimizing human variables such as the quality of life and the standard of living. Nevertheless, recent attempts like RAPFISH (Pitcher and Preikshot ,2001) indicate that this is not impossible.

An Indian epilogue....

In spite of the methodological hazards of quantification, the MSY is the dominant paradigm in marine fisheries science. And Indian fisheries scenario is also not an exception. Despite the challenge of the multi-species situation in our waters, Indian scientists have developed a very unique knowledge base on the level of exploitation of different marine species. No other tropical country can claim to have such a systematic data collection mechanism as it exists in India. The *Multi –stage Random Sampling* procedure developed and adopted by Indian scientists have been recommended as a model for other tropical countries too.

Nevertheless, scientists are well aware about the inadequacies of the model and Ecosystem based approaches are being attempted as an alternative. But they are yet to be operationailsed to be used as effective management tools. Though the applicability of MSY in formulating management measures has been subjected to much criticism it can be effectively used as a pedagogical tool in conservation extension mainly because of its simplicity. It is in this perspective that another dominant logic of fisheries management namely *tragedy of the commons* is discussed in the next chapter along with an overview of the management measures with specific reference to our situation.

CHAPTER 3

Marine fisheries management – Logic and Tools

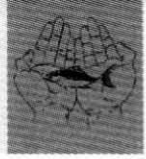
.....freedom in a commons brings ruin to all.....
Hardin,1968

Why there is over exploitation and over capitalization in marine fisheries? This is the bee in the bonnet of any one pondering over marine fisheries management. The simplest model that best explains this question is the **Tragedy of the Commons** model proposed by **Garret Hardin** in 1968 in a classic paper he published in *Science*. Hardin's model has become so paradigmatic that it is the dominant framework by which social scientists portray issues in utilization of natural resources. However, research by social scientists has recently challenged the wisdom of this model. Let us first see what the model is all about before taking up the criticisms levelled against it. Being a major heuristic tool in deciphering the logic of natural resource management, an examination of this model would give us valuable theoretical insights in building a constructivist perspective which is being attempted later in chapter 6.

The model

The idea that common ownership of resources is inherently problematic is not new. About 2000 years ago Aristotle articulated the notion when he said, "That which is common to the greatest number has the least care bestowed upon it..." (Cited in McCay and Acheson, 1987). Many scholars have examined the idea ever since. But it got popularity only after Hardin put the unforgettable name "The tragedy of the commons".

He used the word *tragedy* as explained by A.N. Whitehead (1948), an English Philosopher; 'the essence of dramatic tragedy is not unhappiness. It resides in the solemnity of the remorseless of working of things."



Hardin asks us to imagine a common pasture where all the herdsmen are allowed to graze as many cattle as they desire. "As a rational being, each herdsman seeks to maximize his gain. Explicitly or implicitly, more or less consciously he asks, "What is the utility *to me* of adding one more animal to my herd?" This utility has one negative and one positive component. The positive component is a function of the increment of one animal. Since the herdsman receives all the proceeds from the sale of the additional animal, the positive utility is nearly +1. The negative component is a function of the additional overgrazing created by one more animal. Since the effects of overgrazing are shared by all the herdsman, the negative utility for any particular decision-making herdsman is only a fraction of –1. Because each herder receives the profits from adding animals while the costs are shared, it makes sense for each herder to add more cattle. Even though doing so contributes to their collective ruin.

Adding together all the component partial utilities, the rational herdsman concludes that the only sensible course for him to pursue is to add another animal to the herd. And another; and another ...But this is the conclusion reached by each and every rational herdsman sharing a commons. Therein lies the tragedy "each man is locked into a system that compels him to increase his herd without limit –in a world that is limited. Ruin is the destination toward which all men rush, each pursuing his own best interest in a society that believes in the freedom of the commons. Freedom in a commons brings ruin to all". This has been interpreted as the "dilemma of the commons'. (The meaning of commons given in Box 11).

Box - 11

What are commons?

Commons or common property resources (CPR) are any natural resource from which individuals directly accrue benefits while sharing costs collectively. These resources share two characteristics namely ***exclusion*** *(control of access)* and ***subtractability***. It is problematic to exclude or control the access of a potential user from a common property resource. The physical nature of the resource is such that it is costly or virtually impossible to do this. Migratory or fugitive resources such as fish and wildlife, ground water, range and forest lands, and global commons such as high seas, the atmosphere and the geo-synchronous orbit etc pose problems of exclusion.

Next characteristic is **subtractability**. That is, each user is capable of subtracting from the welfare of others. This creates a potential divergence between individual and collective rationality in a joint use. For e.g., as the number of fishing boats increase, the catch per unit effort (which decides profitability) for each declines. On the basis of these two characteristics Berkes *et al* (1989) defined common property resources as a class of resources for which exclusion is difficult and joint use involves subtractability.

The individuals are in a situation in which a choice between cooperative and non-cooperative behaviour must be made. Hardin suggested that since individuals are usually selfish, they choose non-cooperative behaviour that maximizes their own resource use. Regardless of what others do, this is the most rational strategy. If every one else conserves, an individual can become quite rich through excessive resource use or, if everyone else maximizes his or her resource use, one individual benefits very little from conserving. This is also known as the **Prisoner's dilemma**. (See Box 12)

Box - 12

Prisoner's dilemma

Prisoner's dilemma is a model developed under Game theory to explain the behaviour of people in a situation where one's reward depends on the action chosen by the other individual(s). It captures the tension between the need to cooperate and the temptation to defect.

Individual 2

Individual 1	Cooperate	Defect
Cooperate	R1=3 R2=3	L1=0 T2=5
Defect	T1=5 L2=0	P1=1 P2=1

(R1 and R2=reward for mutual cooperation for individual 1 and individual 2, L1 and L2=loser's pay -off, T1 and T2=temptation to defect (not cooperate), P1 and P2= Punishment for mutual defection)

The matrix shows the reward for two options of either to cooperate or defect (i.e., grab today's catch before someone else does). The ideal option is for both to cooperate as each will gain a score of 3 each time the individuals interact. But it is clearly beneficial to defect while the other cooperates. The expected outcome is that both defect and each gains a score of 1. This is known as the *prisoner's dilemma* as the expected final outcome is not to cooperate, even when it is obviously beneficial to both the participants. But this happens only if there is no interaction between the individuals, like the case of long distance or offshore fishery. In the case of inshore fishery where individuals are more likely to meet regularly the situation is reverse.

(Source : *Jennings et al,2002)*

In the case of marine fishery this is easily noticeable. Being an open –access common property fishers are free to exploit it in such a competitive way that they go on fishing even beyond the biological limit of the resource. Since the access is free the action of any one individual fisher does not have a major effect on the dynamics of an exploited stock. There is little to be gained by some fishers trying to conserve fish because fish left in the sea will simply be caught by someone else!

Solutions to the tragedy

There are no technical solutions to this tragedy of the commons. According to Hardin there are only two collective solutions. One is privatization of the resource so that both benefits and costs of resource use accrue to individuals. And the other is strict control of the resource by the State.

But weaknesses of the model, which were brought by recent sociological research, has enabled us to think about some of the middle-of –the road solutions also. This include self management of the commons by the community of users who agree for imposing certain regulations in its access and extraction.

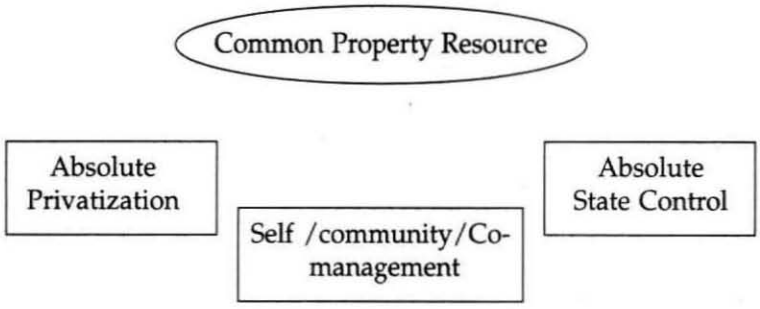


Fig. 3 Solutions to the tragedy of the commons

Weaknesses of the model

Some of the major defects of the assumptions behind the model brought out by recent sociological research are summarized in the table 3 below

Table 3. Weaknesses of the model

No	Assumption	Criticism
1	CPR is equated with open access	Open access means "no property rights regime" and hence overexploitation is inherent, but not necessarily so in CPR

2	Every individual is selfish and rationally utility-maximiser at the cost of the commons	Individuals often exhibit altruism instead of selfishness. Individuals seldom make choices only on economic rationality
3	Individual behaviour is unconstrained by existing institutional arrangements	In many communities there exist socially imposed norms to regulate resource use
4	All actors are independent and have mutual mistrust that others will capture the benefits	Local fishers often develop cooperative mechanisms out of realization of their mutual dependence
5	Individuals are unaware of the status of the resource	When the resource gets declining the individual users perceive the degradation
6	The issue of Property rights is the only cause for resource depletion	There are more complex socioeconomic causes (Industrialization, colonialism, modernization etc) Property is more of a social relation than a physical object
6	Privatization or state control are the only solutions	Privatization need not result in resource conservation in all cases

(Sources: *Jennings et al 2002, McGoodwin,1990, Berkes et al ,1989, Burke,2001, Sharma,1998)*

A sociological criticism

The fundamental assumptions of the model are subjected to a sociological criticism here to gain a better perspective on the dilemmas involved in adopting management measures.

a) Selfishness *vs.* Altruism

From a social science angle the most objectionable assumption is the cynical view regarding the psychological attributes of the fishermen. This view essentially assumes that as the catch per unit effort dwindles fishers inevitably develop a greedy, *"take all you can, and take it now"* attitude. But a number of studies have shown that it need not be so, especially for the small-scale fishermen. In a psycho-sociological study conducted in Western Puerto Rico Poggie (1978) found that small –scale fishers of very modest means score higher in *deferred gratification* than their non-fishing peers in the same community. He also found out that the deferred gratification orientation declined among those fishers who worked on large mechanized vessels. So, it is not the mentality of the fisher *per se* is the problem but a socioeconomic context, which is driven by market forces. The fishers who practice self-restraint through some traditional mechanisms are forced to abandon them when their survival is threatened. It could be by the entry of outsiders often aided by technology or by

the invasion of market forces unleashed by export orientation or a combination of all these factors (See the Case study on *Kadakkody* in Annexure 1 for an illustration).

b) Rational choice theory

The logic of the use of the commons is assumed to be based on the Rational –Choice theory. That is, individuals always make rational decisions in order to maximize utility. Rationality is defined as individuals pursuing what they value as effectively as they can, with the information they have available, and within the opportunities and constrains they face. In the case of the commons, simply because resource users are not aware of the collective environmental costs of resource use does not make them irrational. It simply means their resource use follows a rationale other than the logic of the commons-possibly the logic of consuming more of a thing for which they have a preference (Burke,2001).

c) Property regimes

The model takes property more as a physical object like a forest, fishing pond, or a pasture. By confusing the social dimension and the concept of property with a physical object it is then easy to equate "common property" with "open access" and to allege that everybody's property is nobody's property. Bromley (1991) has given four different types of property regimes to avoid confusion (See table 4 &5). So the bad outcome as per the model is not one of common property *per se* but rather a lack of control over access to the common. In other words it was due to the lack of a suitable management approach that the tragedy befalls. But it should be noted that open access problems could occur under any property regime, even private property. It often manifests as an enforcement problem (eg. Poaching in a private lake or the conflicts that occur between the shrimp farmers and fishing labourers in Kerala).

Table 4. Classification of Property –rights regimes

No	Type	Characteristic
1	Open access	Absence of well-defined property rights e.g., high seas fishery
2	Private property	Individual or corporation has the right to exclude others or regulating the use
3	Communal property	An identifiable community of users holds the resource, they can regulate /exclude its use e.g., shellfish beds, forests, irrigation/ground water source
4	State property	Rights to the resource exclusively with government, which controls access and level of exploitation

Table 5. Types of rights

1	Type	Authorizes
1	Access rights	To sanction entry e.g., Fishery or fishing ground
2	Harvest rights	To engage a specific level of effort or to take a specific catch
3	Management rights	To participate in management and governance of the fishery
4	Exclusion rights	To determine the qualifications necessary to access
5	Alienation rights	To transfer or sell

Management objectives

There are two fundamental problems which need to be addressed by any management regime in marine fisheries: one is **conservation**-deciding what quantity of fish can be sustainably harvested and the other is **allocation**- deciding who benefits, in what ways, and to what extent.

Thus the objectives of marine fisheries management are

1. *Ecological*-to protect the resource from over exploitation that jeopardizes future production
2. *Economic*- maximization of economic benefits to harvesters, processors, distributors, marketers and consumers
3. *Social*-provide employment, stability (social security, livelihood security etc) of coastal communities, and safety at sea; and
4. *Political*-avoidance of conflicts in resource use

Management Tools/strategies

The major strategies in fisheries management being adopted worldwide can be classified as given in Table 6. *Catch controls* limit the catch of individual fishers or the fleet as a whole. *Effort control* limits the number of fishers in a fishery and what they can do. *Technical measures* are meant to control the catch that can be taken for a given effort. *Social measures* are a selected combination of these measures adopted jointly by the community and the government, through an approach generally known as co-management.

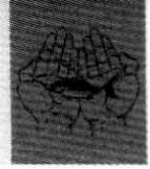


Table 6. Marine Fisheries Management measures

Catch controls/ Out put control	Effort controls/ Input control	Technical measures	Social measures
a) Quota system Total Allowable Catch (TAC) Individual Transferable Quota (ITQ) b) Catch limits	-Licenses -Effort quotas -Gear or vessel restrictions	-Time and Area closure -Size and sex selectivity	Self restrictions or Co-management

Most of these measures, especially those given under catch /effort control are predominant in the single-species context of developed countries. In the case of the multi-species context of tropical countries, like ours, the most commonly used measures are technical measures like closure of fishing seasons (time), demarcation of areas and mesh size regulations. These measures are discussed in detail after a brief outline on the catch and effort control measures.

1.Catch control/Output control measures

These measures are intended to control fishing mortality by limiting the weight of catch that can be taken from a specified stock /fishery. The most common management method is to impose an upper limit on the Total Allowable Catch (TAC), which is calculated for each fishing season in advance based on the criterion that fishing mortality should be at the level that allows MSY or related criteria. Once the TAC is set by scientists, it is divided among vessels based on type and efficiency and are called Individual Quotas (IQ). The sum of all IQs equals the TAC. The fishery is closed when the aggregate equals the TAC. The TAC system is reportedly successful in many developed countries like USA, New Zealand etc.. For e.g., the collapse of the Barents Sea capelin was averted after the introduction of TAC during 1986-1990. The main problem with IQs is that they increase the risk of fishers *high-grading* their catch (i.e., discarding smaller individuals of quota species in favour of larger high-value fish after landing). Another problem is the tendency of fishers to increase fishing capacity by circumventing the regulations.

Individual Transferable Quota (ITQ) system was introduced to solve these problems. This system gives property rights in the fishery and allows the fishers to trade those rights with other fishers. This means that least efficient fishing units can opt out of the fishery by selling their rights to more efficient fishers. This brings down the operational cost of fishing, thus increasing the profitability.

2. Effort control/Input control

These measures are to limit the number of boats or fishers who work in a fishery, the amount, size and type of gear they use and the time the gear can be left in the water. It can also limit

the size or power of vessels and the periods when they fish. *Licenses* or permits restrict the number of boats where as *effort quotas* limit the amount of time spent working by a given unit of gear, a vessel or a fisher. In reality, limited licenses do not control fishing mortality as license holders can compete among themselves, which increase overcapitalization and harvesting costs. More over, as mentioned earlier, fishers are smart enough to make good for the loss of catch incurred due to effort restrictions by modifying their gear or craft through a process known as *technological creep*. This is true with restrictions in vessels or gears also. In fact the *mother* of most of the indigenous innovations made by fishermen in their craft and gear is this *necessity* (see the Box 18).

3. Technical measures

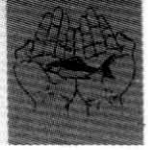
These include restrictions on a) fishing season or time, b) area where fishing is allowed, c) mesh size of gears used d) size and sex of fished species that are caught or landed. In most of the multi –species tropical fishery, like ours, these are the most favoured management measures.

a) Time or fishing season restrictions

The most common method used in India is restricting the number of fishing days during critical phases in the life history of the fished species. This is now being implemented as monsoon season (south west) closure of fisheries for mechanized fishing vessels. This is based on the general belief that most of the fishes, shrimps/prawns and cephalopods undergo peak spawning during the monsoon seasons (Vivekanandan,2004). The maritime states of the country take year-to –year decision on the period and duration of closure. There is a variation in the duration and time of the seasonal closure along west coast and east coast of the country (table 7).

Table 7. Seasonal closure of fishing in India

No	State	Months	Duration (days)
1	Gujarath	May-September	145
2	Maharashtra	July-August	65
3	Goa	July-August	60
3	Karnataka	July-August	60
4	Kerala	June-July	45
5	Tamil Nadu	April-May	45
6	Andhra Pradesh	April-May	45
7	Orissa	April-May	45
8	West Bengal	April-May	45



b) Area restrictions

Most of the maritime states have incorporated provisions for demarcating fishing areas for mechanized and artisanal vessels in the respective Marine Fisheries Regulation Acts (Table 8). This was necessitated by the persistent conflicts between these two sectors in the inshore waters, which are comparatively more productive. However, implementation of these provisions is tardy.

Table 8. Demarcation of fishing areas for artisanal and mechanized vessels

No	State	Artisanal	Mechanized
1	Gujarath	Nil	Nil
2	Maharashtra	10-20 m depth	Beyond 20 m depth
3	Goa	Up to 5 km	Beyond 5 km
3	Karnataka	Up to 6 km	Less than 15mOAL:6-20 km More than 15mOAL: beyond 20 km
4	Kerala	Up to 10 km	Less than 25 GRT:10-22 kmMore than 25GRT: beyond 23 km
5	Tamil Nadu	Up to 5 km	Beyond 5km
6	Andhra pradesh	Up to 10 km	Less than 20mOAL:10-23 kmMore than 20mOAL: beyond 23 km
7	Orissa	Up to 6 km	Less than 15mOAL:5-10 kmMore than 15mOAL: beyond 10 km
8	West Bengal	Nil	Nil

In the case of highly vulnerable or depleted fish stocks a total closure of the fishery for a prescribed, but longer, period is advocated. Marine Protected Areas (MPA) and No Fishing Zones (NFZ) allow the rapid build up of spawning stock biomass and enable the fishery to recover.

b) Mesh Size regulations

The intention of mesh size regulations is to allow the escape of juveniles so that they compensate for the loss of the biomass once they achieve biological maturity and marketable size later. The loss of juveniles and other fish discarded by the shrimp trawlers, which uses a Cod End Mesh size of 10 mm against the recommended size of 35 mm (Kalawar *et al* ,1985) is estimated to cause economic loss to the tune of about Rs 600 million in Indian waters every year (Devaraj and Vivekanadan,1999). Though regulation of mesh size,, especially the Cod End Mesh size of trawlers, is biologically very effective its implementation is very difficult in a multi-species context. Banning or restricting the mesh size of one gear

is quite likely to deprive certain fishers of their very livelihood options.

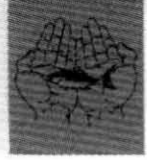
d) *Size and sex restrictions*

This is achieved by assigning minimum landing sizes (MLS) for fish species. But this will be effective only if it is possible to measure the MLS *in situ* or returned to the sea alive. It is essential to ensure that fishermen are not targeting fishes below the prescribed MLS. In reality it is difficult to meet both these conditions.

Management measures and their implications in respect of marine capture fisheries of India have been summarized in table 9.

Table 9. Management measures and their implications

Sl. no	Management measure	Information base	Implications
1	**Biological** MSY	Knowledge of population characteristics by species, catch and effort data	Ideal scientific management method -Difficult to implement -Difficult to convince fishermen -Effective extension needed
2	Closed areas and seasons	Spawning ground/ seasons: nursery areas	Protracted spawning in the population and variations in peak spawning periods make it difficult: information on spawning grounds scanty
3	Regulation of fish length (legal size)	Length at first maturity, growth and life span	Multi spp and multi gear problems: mesh size regulation most suitable and perhaps a recommendable measure
B	**Technological** 1.Control of fishing effort	Gear wise effort and catch: MSY / MEY	Regulation of number of fishing fleet : effective monitoring necessary
2	Fishing zone demarcation	Zone wise information on availability and abundance: zone wise total allowable catch	Difficult to implement due to open access nature-leads to conflicts among resource users-effective legislation and execution required
3	Regulation of gears	Gear survey; effect of the gear on the stocks	Strict licensing necessary, leads to social and rehabilitation issues
4	Deep sea fishing	Availability and abundance of resources in space	Capital intensive, licensing and control of fleet, regulation of



		and time, techno-economic viability, quality of resource, post harvest technology	operation beyond specified depth zones to avoid conflicts with the coastal fishing activities.
C	**Others** 1. Artificial recruitment/ ranching	Spp, seed production, site selection, monitoring of released stocks	Recommendable measure.. essentially to be implemented by the Government.. Private sector may not be interested
2	Environmental protection	Pollution of coastal waters by agro-industrial pollutants, effect of pollution on organisms	Monitoring of pollution, regulation on effluent discharges in coastal waters
3	Ecological improvement	Interactions of different activities in the coastal zone: effects of trawling and such other gear on the sea bed and the fauna, environmental factors responsible for toxic blooms	Coastal zone management, monitoring the impact of fishing activities on the sea bottom ecology.
4	Conservation of critical ecosystems and biodiversity	Coral reef ecosystem, sea grass ecosystem, mangroves	Prohibition of dredging and quarrying of corals , destruction of sea grass beds and removal of mangrove forests.
5	Mariculture	Development of viable technology of Mariculture	A promising and definite means of augmenting fish production and of improving the coastal rural economy, can be advantageously blended with capture fisheries. Conflicts among fishers and fish farmers

Source : *Murthy,1997 (modified)*

4 Social measures

a) Co-management

These are different management approaches, which, in general occupy a middle of the road space between the absolute public and private spheres along the management continuum. They focus on devolved /decentralized management especially the concept of

co-management. Co-management is the mechanism by which the state and user groups share responsibility for the formulation and implementation of management strategies. The idea is built on the assumption that when fishermen or their organizations are given a pro-active role in fisheries management i.e., when they get involved directly and formally in the management decision-making process, they develop more responsible attitudes towards resource use, and rule compliance. Resource users, as an informed community, are expected to take collective authority in this approach. But the trouble with this approach is that it is easier said than done. The success of this approach depends on a number of factors that function at different levels like supra-community, community and individual/ household level (Pomeroy *et al.*, 2001). The missing link often is community itself – a community in its fullest sociological sense (Jentoft, 2000).

c) Traditional Institutions for Self-regulations

There are many traditional institutions which directly or indirectly influence/address the resource management questions within the fisher folk community. The strength of these institutions are its embeddedness. They can be called as *sui generis* forms of co-management and can be used as very effective platforms for co-management interventions. (Ramchandran,2004). For a detailed consideration see the case study on *Kadakkody* (sea court) which is still functional along the Malabar coast of Kerala (see Annexure 1).

A brief theoretical background on various issues in Extension as well as the logic of constructivism is explored in the next chapter.

4
CHAPTER

Issues in Extension, Constructivism - A brief Theoretical background

Though the term **extension** is popular mostly as a synonym for agricultural extension in our country its usage in the marine fisheries sector is less conspicuous. Fisheries extension is, sometimes, believed to encompass marine capture fisheries also. But, as we can find, this conceptualization is inadequate due to many reasons. In this chapter an attempt is made first to examine the necessity of having a separate extension system for marine capture fisheries, one with a different *logic and logistics* compared to the dominant paradigm in agricultural extension. Then a *conceptual model* for the same is suggested drawing mostly on the epistemological traditions of constructivism in contrast to that of positivism prevalent in the sociology of science.

What is extension?

Extension is generally considered as the link between the research system and the client system. This conceptualization is given in figure 4. In the case of agriculture (including farming, animal husbandry and aquaculture) the institutionalisation of such an extension system, as one of the policy instrument used by the government to stimulate agricultural development ,under the public sector has played a tremendous role in ushering the much-acclaimed Green Revolution in the country.

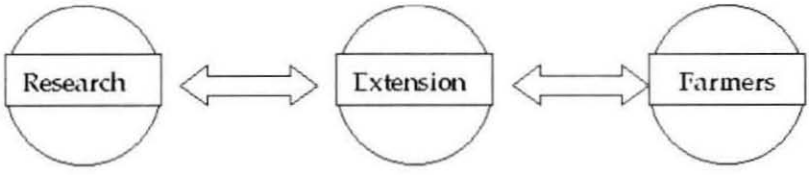


Fig. 4 Extension as a link between research system and client system (farmers)

It is very difficult to come to a universally acceptable definition for extension. Misra (1993) has compiled not less than 50 definitions for extension (see Box 13 for the development of

the concept of extension). However, the definition given by van den Ban (1985), an internationally recognized extension scientist has been widely followed. He defined extension as the *conscious use of communication of information to help people form sound opinions and make good decisions.*

Box - 13

Extension-the genesis

The actual use of the term "extension " originated in England in 1866 when *James Stuart*, Fellow of Trinity college Cambridge gave lectures to women's associations and working men's clubs in England. In 1871 he proposed to organize centres for extension lectures under the Cambridge University, which formally adopted the proposal in 1873. Later it was adopted by other universities like Oxford, London etc and came to be known as the "extension movement".

Agricultural extension became popular first in USA after *Seaman A Knapp* started demonstrating to farmers the pest control measures developed by the agricultural experiment stations in 1902. These extension activities later developed into a Cooperative Extension Service in each state in association with Land Grant Colleges, which were agricultural colleges (and later Agricultural Universities) built on lands granted by the Federal government. (This is the model adopted while creating Agricultural Universities in India)

(Source: *Swanson,1984, and van den Ban & Hawkins,1985*)

The Transfer of Technology (TOT) Model of extension

The transfer of technology model has been the most dominant extension model of the public sector extension system in our country.

In this model (Fig. 5) the extension system has been (mis)conceived as a "delivery mechanism" for the technologies developed by the research system. The technology has been considered as an end-of- the-pipeline product of research. The research system or the technology generation system (in our case comprised of the ICAR Research institutes and State Agricultural Universities) is assumed to carry out research in three modes viz., basic research, applied research and adaptive research. The *prototype technology* developed by the basic and applied research system will be field tested in different locations in the adaptive research phase, where social scientists mainly extension scientists play a big role in what is known as Front Line Extension programmes. In such pre-evaluation trials conducted in the farmers' fields the technology is supposed to be evaluated on a number of attributes like *relative advantage* (profitability), *compatibility, complexity, divisibility, and communicability*. The technology, thus found to be "proven" will be handed over to the Extension system (i.e.,

State Departments of Agriculture/Animal Husbandry/Fisheries) for wider dissemination.

The job of the extension agency, which is composed of individuals trained in the *science behind the technology*-for e.g., agriculture science in the case of farming technologies, aquaculture /fisheries science in the case of aquaculture technologies- as well as the *extension process* (i.e., the use of extension methods with a theoretical background in behavioural sciences like communication science, psychology, rural sociology etc –which are outputs of *extension research* and being imparted through what is known as *extension education*), is to make the farmer take a decision to continuously use the technology (a process known as *Adoption*). Once other farmers follow suit it leads to *diffusion* of the technology, which takes place over a period of time. This is also known as the Diffusion of innovations model proposed by Everett M Rogers in 1962.

Box - 14

Technology and Innovation

The word **Technology** is derived from the Greek word *techno -logia* which is derived from the root *techne* , meant discourse on the arts. Thus initially it refereed to applied arts or crafts, then to tools or machines. Now technology is used in the sense of "set of tools, rules, and procedures through which scientific knowledge is applied to a given task in a reproducible manner." (Manuel Castells, quoted in Capra, 2002).

Anything perceived as new by the end user is **Innovation**. For e.g., a technology released long back may be an innovation for a farmer who is coming to know about it now.

The model assumes that a) the farmer lacks adequate knowledge and insight to recognize his problem or to think a solution b) the farmer lacks motivation to behave in a desired way, and c) the farmer lacks resources (technological inputs). These barriers are to be removed by the extension system.

Agricultural Policy (Higher production)

The whole system works under a policy climate that equates agricultural development with efforts to increase the agricultural production. The national target in total production is always set to surpass the rate of population expansion on the linear assumption that higher production leads to higher employment, which leads to higher demand and thus more production (This is known as the Keynesian economic model). So the technology is narrowed down to mean yield-increasing technology. The aim of the research system, in this perspective is to come out with newer technologies, which promises a maximum potential yield (for e.g., high yielding varieties).

Since the conditions in the research stations are always superior there bound to be a difference in the potential yield and what actually is obtained in the farmer's field. This *yield gap* was more or less considered as an *extension gap*, which justifies the intensification of the extension effort to attain the goal of higher production. The technologies have a " hardware" component (the high yielding seeds, chemical fertilizers, pesticides, etc) and a "software" component (the knowledge base for the scientific use of these inputs known as the package of practices). The easier option to promote adoption was to subsidize the technological inputs (the hardware component), which ultimately led to the denigration of agricultural extension as mere transfer of technology in a physical sense. This resulted in the bureaucratization of the extension process. The job of the extension agent was to take care of the distribution of subsidized inputs to eligible farmers and s/he got little time to engage in providing extension advice (that is mostly on the "software" aspect).

The logic of higher yield becomes a convenient one to justify higher public investment for the whole system. The advantage is that the performance of the research and extension system can be assessed in terms of technology adoption. Higher the adoption, higher is the per capita production, which needs more investment in research and extension. It also gives a false immunity to the research or technology generation system as it could easily pass any reason for failure of the technology (e.g., poor performance in the real conditions of the farmers field) partly to an inefficient extension system and partly to the incompetence of the farmer. ("Technology is infallible and you blame the extension or the farmer"). The extension system also gets the benefit of some excuses. The compartmentalization of research and extension enables the extension system to defend its lapses on a bad technology. But what is being lost is the true significance of extension, which is more than mere technology transfer.

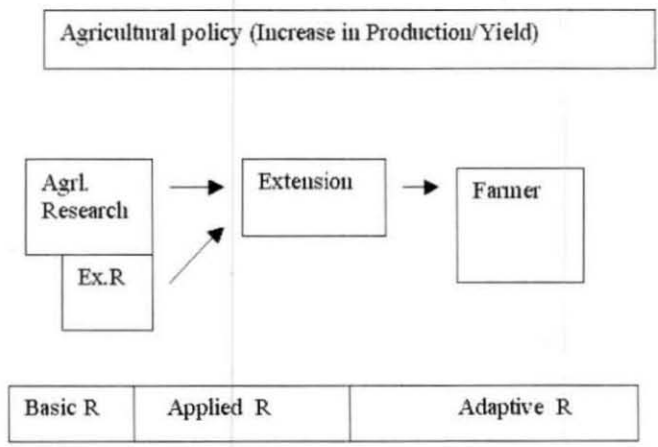
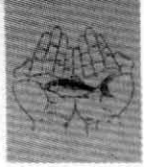


Fig. 5 TOT model as applied in India



Beyond technology transfer

The most invidious fall out of the TOT model has been the narrow and distorted focus in which the public as well as policy makers have construed the extension system (For clarification of some of such false notions see Box 15). Though TOT model has been subjected to much criticism in recent times especially in the context of sustainable development, the simple fact is that it cannot be dislodged, even if it is discredited (Ruttan, 1996). The increasing realization that it is the institutional context in which the technology generation system as well as the extension system has been organized that decides the direction and dynamics of the whole enterprise led to alternative models that try to view the issues in a holistic perspective. The advent of the bandwagon of *sustainability* has given an impetus to this process. Some of these models are Farming System Research (FSR), Participatory Technology Development (PTD), Agricultural Knowledge and Information System (AKIS) etc.

Box - 15

What extension is NOT

1. Extension *per se* is **not** a panacea for all our problems in the farming sector. It is just one of the many factors (market forces, credit system, policy climate, resource base) that facilitates development.

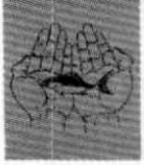
2. Extension is **not** TOT alone. It includes Human Resource Development (HRD) also. This necessitates the need for the extension agent to acquire more social science skills (community mobilization, conflict management, problem solving, etc), than mere knowledge about the technology being transferred.

3. Extension does **not** take place in a political vacuum. Nor does the technology generation system too.

4. Extension is **not** an alibi for an ill-validated technology. The rejection of technology by the farmer is not an irrational decision. It simply means that there is incongruence between his/her needs or the resource endowment and the technological promise.

Logic of alternative extension models

The point of departure these models make is the radical shift in the way we approach the whole question of social change. The assumption behind TOT model, implemented in a top –down fashion, has been that social change can be induced through an agency. It has been conceived as a process driven by *technological optimism* –the belief that we have technological solutions or magical bullets for all our problems. Economic growth is postulated to depend on technological growth whose engine has been science or scientific research.



The failure of technology is attributed to two reasons. One is the mismatch between the actual need of the end user and the recommended technological solution. And the other is probable weakness in the technology generation process itself. The solution for the former cause , according to one school of thought led by Schumacher, E.F, author of the famous book 'Small is Beautiful", has been to develop *Appropriate Technologies*. The latter, more radical in its pursuit, demanded a re-look into the philosophical foundations of science.

Cartesian Paradigm

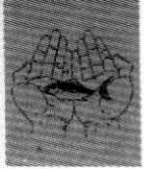
The philosophical basis of Science (more correctly called western science) for the last 300 years has been what is known as the *Cartesian Paradigm* proposed by Rene Descartes, a brilliant mathematician cum philosopher, in the seventeenth century (Capra,2002). It views nature or reality on the fundamental division between mind, " the thinking thing (*res cogitans*)" and that of matter, "the extended thing (*res extensa*)". It is this "mind-matter divide" which acts as the conceptual basis for what we understand as conventional science. The essential characteristic of science is the method of reasoning suggested by Descartes namely analysis or reductionism. It is this logic that enabled NASA to send men to the moon. But this logic of reductionism is insufficient to solve the problems now confront humanity.

Santiago theory of Cognition

Two developments that brought out a radical shift in this paradigm have been the system view of life and the Santiago theory of Cognition. The system view looks at the world in terms of relationships and integration. A system is an integrated whole whose properties cannot be reduced to those of smaller units. Life is being understood now as a property of the system as a whole. In the perspective of systems thinking, systems are not real structures. They are intellectual constructs that help us understand the complexity of human experience. According to two biologists Humberto Maturana and Francisco Varela, the leading proponents of this view, living systems are defined as an *auotopoietic network*. In simple terms it means that the most defining character of a living system is self-generation (called as autopoiesis-literally meaning self-making).

Cognition, i.e., the process of knowing, they argue, is a phenomenon of living, self-reproducing (auotopoeitic) beings. Mind according to them, is not a thing but a process-a process of cognition. And the process of cognition, i.e., the process of knowing is identified with the process of life itself. This is known as the Santiago theory of Cognition put forth by Maturana and Varela.

According to this theory a living system is a *structurally coupled system*. Structural coupling establishes clear differences between the way a living system and a non-living system interact with the environment. For e.g., when you kick a stone it will react to the kick in a linear chain of cause and effect. And its behaviour is amenable to prediction using the basic laws of Newtonian mechanics. But when you kick a dog the situation is different. The dog will react with structural changes according to its nature and non-linear pattern of organization. The resulting behaviour is almost unpredictable.



Thus it can be seen that a *structurally coupled system is a learning system*. Continual structural changes in response to the environment - and consequently continuing adaptation, (Co-evolution) , learning and development are key characteristics of behaviour of all living things. This leads Maturana and Varela to their startling and powerful definition of *knowledge as "effective action in the domain of existence."* The notion, that mind and matter no longer appear to belong to separate categories, but as two complementing aspects of the phenomenon of life-the process and structure, has far reaching implications. The most important is the setback it causes on the Cartesian paradigm.

Positivism

This understanding about the biology of cognition makes us to think about the way we try to know about reality or nature (i.e., what we accept as science) in a radically different way. Maturana and Varela (1987) argue...."at the core of all our problems we face today is our very ignorance of knowing." The dualism of mind and matter or in other words subject and object gives rise to the *representational model of knowing*. In this model the individual, the subject gets knowledge about an external world of objects as they are represented in the mind through sensory perception. This *reality is taken for granted*. When reality is conceived as something that exists *out there* and driven by immutable laws of nature, the job of science is to unravel them through rigorous observation and experimentation. This unshakable foundation of knowledge built on the certainty of scientific knowledge is known as Positivism. Positivism is said to follow a realist ontology-i.e., what is believed to exist. And its *epistemology* (i.e., the ways by which we acquire knowledge), as already said, is based on objective, experimental and empirical techniques. (See Box 16 for a few typical statements under Positivism)

Box - 16

Elements of Positivism

1. Reality exists independent of human observer
2. Scientific research allows us to acquire true knowledge about nature of that reality
3. Scientists discover the truth; they lift the veil and unravel nature's secrets
4. The aim of research is to contribute to the stock of knowledge
5. Scientific research is the only source of innovation
6. Technology is applied science.

Positivism in social sciences.

Positivism has been the dominant paradigm in social science (though it could not send men to the moon!). **Auguste Comte** who introduced the term "sociology" first called the scientific

study of society as "social physics". Emile **Durkheim** and Max **Weber**, considered as the principal founders of modern sociology identified social facts as the causes of social phenomena. Though social facts like beliefs and values are clearly nonmaterial they were conceived mostly as social forces, analogous to the concepts in physics. But there was opposition to this mode of reasoning and this led to two schools of thought namely structuralism and functionalism. But the basic concepts of social structure and human agency were treated as linear cause-effect relationships. The theoretical basis of extension science also has been positivism. This is evident in the TOT model, which, as we have seen, was a planned behavioural change on the basis of rational action, mediated by technology. It works on a communication model, which assumes a linear and mechanical relationship between the sender of a message and a passive receiver.

Positivism to Constructivism

The negation of the mind-matter duality helps us to find the pitfalls in the positivist assumptions. Some of them are given below:

1. Human mind is not blank (*tabula rasa*) when an observation is made.

   What is observed and how it is observed is influenced by our existing theoretical framework. So it is difficult to have an objective observation or experimentation.

2. Positivist science has failed to provide explanations for social life unlike what it could offer for natural phenomena.

3. It is doubtful whether emerging human problems like ecological sustainability, which is complex and chaotic, can be resolved by a science built on the logic of positivism.

4. The labels like 'truthful' or 'objective' reality or "scientific truth" are often used to provide a false mask of validity for the arguments of sectoral interests.

It is being increasingly realized that a new paradigm other than that of positivism is essential to engender a sustainable society. The alternative to positivism is *constructivism*. It posits that knowledge about reality is not a projection, but a *social construct*- the result of a collective learning process. Originally proposed by two sociologists called P.L.Berger and T.Luckmann in 1966, (Chermack and van der Merwe,2003), this is an epistemology which assumes that reality is socially constructed.

They proposed this idea while analyzing the sociology of knowledge. Constructivism is a philosophy of learning founded on the premise that, by reflecting on our experiences, we construct our own understanding of the world we live in. Each of us generates our own "rules" and "mental models," which we use to make sense of our experiences. Learning, therefore, is simply the process of adjusting our mental models to accommodate new experiences. This can be depicted as Learning loops (Kolb and Rubin(1991) (see Fig. 6).

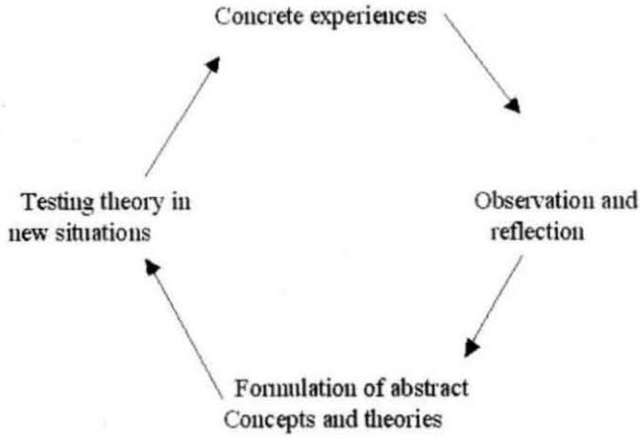
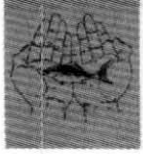


Fig. 6 Kolb and Rubin's learning loop

Over time groups of people, through discourse and dialogue develop an inter-subjective system of concepts, beliefs, theory and practices that they consider to be reality. Based on their intentions and experience, people construct reality creatively with their language, labour and technology. Constructivism recognizes the primacy of language. Humans are reflexive knowledgeable beings because of language. Language is the medium through which objective reality is negotiated and constructed by individuals in a society.

Consciousness and reality arise from language and not vice versa. Learning takes place in a historical and cultural context. People attribute meaning to their surroundings and act accordingly. But while attributing meaning (interpreting) they rely on a number of implicit assumptions, which are embedded in their history and culture. The trouble is that all their assumptions may not be equally valid. But our future depends on the right choices we make in order to avoid the tragedy that visited the Norsemen (Box 3). People need to be facilitated in transcending the conditions that prevent making such wrong decisions. The question is *what science can do here?* This question is all the more important given that our predicament is increasingly anthropogenic, and technology or market increasingly fail to solve our problems.

The constructivist angle for answering this question is to go for a paradigm shift in the sociology of science. In this perspective the objective of science is not the accumulation of knowledge but the creation of fresh modes of perception (Bohm,1993). This demands radical reforms in the way in which science is currently being conceptualized, institutionalized and practised. It is often said that the paradigm of conventional science is similar to that of the famous Indian parable of Blind men seeing the Elephant. When people belonging to different disciplines (theoretical frameworks that causes selective perception) approach the reality with a reductionist logic they not only fail to see the "elephant" (reality) but also insist that what they see is "the elephant". So the remedy being suggested is to break the disciplinary barriers and work in an integrated and interactive way. Still there is one more hurdle. The expert's knowledge, even if produced in a multi-disciplinary way may not be agreeable to



the perception of the wider society, which is composed of multiple actors (They are called the stakeholders). So it is obvious that they should be made active partners in the process of reality construction or knowledge generation. But the prevailing paradigm of science will not take it easy to view that reality is man-made. This may be wished away as socio-psychological distortions.

Implications for Extension

A sustainable society cannot be built on the aggregation of individual preferences. As Roling (2002) succinctly puts it

> *"when you and your enemy belongs to the same system*
> *solutions must be found in managing relationships"*

Instrumental use of technologies to control nature for assumed human purposes is going to be futile. The way out is "to look for interactive ways of getting things done in theatres with actors who are interdependent with respect to some contested natural resource or ecological service". This process is otherwise known as **Social Learning**. It reflects the idea that the shared learning of interdependent stakeholders is a key mechanism for building more desirable futures. It is based on conflict resolution, negotiated agreement, convergence of goals, theories and systems monitoring and concerted action. In characterizing Social Learning, Roling has used a beautiful Dutch metaphor (See box 17).

Box - 17

"Wheelbarrow full of Frogs"

"The image of frogs (multiple actors) grouped together in wheel barrow (an elevated platform) offers much room for creative elaboration. From the wheelbarrow, as it is elevated, actors can observe their problem situation from a different perspective. Life in the wheelbarrow with the many other frogs involves different kinds of relating and negotiations than life in the pond/puddle (their own communities, organization etc). The frogs may struggle with one another to find their most ideal position within the wheelbarrow or may be happily inter- relate in their new social environment, or perhaps both. The barrow has the potential to move, with outside support. It can easily lose balance if the terrain is muddy /rough. If moved, at any given moment, frogs are likely to jump out. If the driver of wheelbarrow moves suddenly to avoid losing one frog, others might fall off or jump out on the other side. The balancing act of keeping all frogs inside the wheel barrow while manoeuvring across potentially difficult terrain is a challenge demanding engagement, presence of mind, flexibility and stability. If the wheel barrow stays still, however, over time the frogs will likely jump out and find a nice pond to sit in somewhere else or go back to their old pond and life is as usual."

(Source: *Leeuwis and Pyborn, 2002*)

According to Jurgen Habermas (1987), one of the leading sociologists in the world, humans take action based on three types rationality namely Instrumental , Strategic and Communicative. A comparison of these rationalities, as given in table 10, will help us to clarify the contours of the paradigm shift we have been discussing so far.

It can be seen that though each of these rationalities are not mutually exclusive a communicative rationality is more relevant in the case of natural resource management as exists in marine fisheries. A combination of these rationalities, interpreted in a constructivist way will be the basis for formulating our strategies. This is attempted in chapter 6 after trying to locate, by way of a brief review, the dominant logic of extension efforts so far undertaken in marine fisheries sector.

Table 10. A comparison of Habermas' rationalities

	Modes of thinking (rationality)		
	Instrumental	**Strategic**	**Communicative**
Predicament	Lack of control over causal factors	Competition, scarcity	Humans are a major force of nature, anthropogenic destruction of habitat. Lack of control over ourselves.
Objective	Control nature for human purposes	Win, gain advantage, optimize utility	Negotiated agreement, concerted action
Dynamics	Causation	Rational choice, struggle for survival, market forces	Interdependence, learning, reciprocity, trust
Knowledge base	Scientific Research	Economics	Social learning, Cognitive theory
Effect based on	Technology	Strategy	Conflict resolution, agreement, learning, ability to reason in view of contextual change, (critical reflection)
Policy form	Engineering, Hard system design, Regulations	Fiscal policy, Market stimulation	Negotiated Participatory Knowledge (NPK) Interactive Policy Making (IPM), Social process design, Facilitation,

(Roling, 2002. modified)

5
CHAPTER

Extension Research and Technology Transfer in Marine Fisheries - a review

Extension is generally understood, though its rhetoric has undergone a sea change both in terms of its epistemology and methodology (Chambers *et al*, 1989, Roling, 1990., Haug,1999, Sulaiman & Hall, 2002, etc), as the link between the Technology Generation System and the Client or Stakeholder system. It is the interface mechanism which is either formal as in the case of public funded Research and Development System (also called as the Ministerial approach) or informal as in the case of the NGO sector. It is the former one that is being considered here. Extension research, coming under the broader purview of Extension Education, deals with strategic questions associated with the extension process (van den Ban and Hawkins, 1988).

In fisheries sector, Extension is often portrayed as the weakest link. Unlike agriculture (crop farming) or animal husbandry the extension system in marine fisheries in India is yet to mature as an institutionalized mechanism with adequate policy support, despite pioneering research contributions from various fisheries research institutes.

In this chapter an attempt is made to find out the reasons for this malady. It analyses the extension research works conducted in marine fisheries sector, notably those done in the pioneering marine fisheries research institutes in the country especially Central Marine Fisheries Research Institute. An overview of the past efforts will help to understand the priorities, problems and prospects of fisheries extension, with special emphasis on marine capture fisheries sector, in a historical perspective. The extension research efforts undertaken so far have been collected and reviewed. A historical perspective is then contemplated and major findings under different areas are discussed before delineating the issues as well as future challenges. The results quoted are typical ones and hence no thematic bias is indented.

Marine Fisheries Extension –An overview

The various research studies spanning about three decades have been collected, classified and presented in Table 11. The research studies conducted so far has been found to cover about 10 major research areas.

Table 11. Extension Research-an overview

Sl. No	Areas of Research	Authors	Remarks on major findings
1	Measurement Techniques	1. Srinath (1988)	Attitude Scale for aquaculture
2	Adoption of Technologies	1. Balasubramanian *et al* (1998) Gupta (1992)	Adoption behaviour of Fisherfolk on crafts and gears, Quality control in prawn peeling units
3	Behavioural variables	1. Srinath (1988) 2. Srinath &Gupta (1988) 3.Gupta (1989 & 1991) 4.Rajeev & Krishna (1995) 4. Ramchandran(2002)	Psycho-social aspects of motorisation, Behaviour of fisherwomen & Development. Programs, Aspirations of fishermen; Decision making by women, Perception on prawn group farming Behaviour on technological change & regulations
4	Communication strategies	1Gupta (1990) 2Gupta (1991) 3Ramchandran (2002)	Communication strategy for fisheries TOT, Use of media by fishermen, Designing communication tools for Responsible Fisheries
5	Extension Education/ Methods/ approaches	1Jancy (1986) 2. Srinath (1986) 3.Gupta& Srinath (1992) 4Krishna *et al* (1994) 5.Devaraj *et al* (1997) 6.Sathiadhas *et al* (2002)	Role of extension in marine fisheries, HRDTOT Model for prawn culture, First line extension programme in a village, Action research in Chellanam Demonstration of ornamental fish farming, Extension issues in conservation of sea turtles.
6	Training Evaluation	1 Srinath (1987) 2.Sheela (1995)	KVK training for women-Knowledge gain Training on sea weed foods for women

7	Socio-economics	Sehara *et al* (1988), Sathiadhas &Panikkar (1988), Sathiadhas (1997)	Socioeconomic characteristics of marine fishermen in different states
8	Women empowerment, gender issues	1. Srinath (1987) 2. Arpita (2000) 3.Vipinkumar (2001) 4.Ashalatha *et al* (2002)	Role of women in small scale fisheries Ergonomic problems of women workers, Mussel farming by SHGs, Role of women in fisheries sector
9	Responsible Fisheries	Ramchandran (2003)	FAO code of conduct and communication tools.
10	Home science extension	Srinath (1988)	Nutritional status of marine fishermen

After doing a content analysis of these typical studies the history of extension research has been captured under three phases of development which can be called "conceptualization", "extension in action" and "pre- institutionalization" (Table12). The characteristics and major thrust areas with notable findings are elaborated further under each phase to understand the over all direction and span of the research areas.

Table12. The phases of development of fisheries extension in CMFRI

Sl. No.	Phase	Period	Thrust areas
1	Conceptualisation	1980-90	TOT models in mariculture
2	Extension in action	1990-2000	Extension methodology for mariculture, micro level studies, behavioural studies in marine fisheries
3	Pre-institutionalization	2000-	Addressing issues in marine fisheries, macro level studies

Phase 1. "**Conceptualisation**"

Compared to agriculture (crop farming) the emergence of a research –extension system is a recent phenomenon in fisheries. It was natural that the initial attempts in developing extension strategies/approaches in fisheries were modelled more on the ones already implemented by the agricultural extension system in the country. As far as extension research in CMFRI is concerned, the 80's can be considered as a phase of conceptualization as initial attempts in this regard were made during this period. (However it doesn't mean that this phase has answered all the conceptual questions that plague fisheries extension nor is a once-for-all process). Thus, the nascent years during the 80's, with the appointment of extension scientists in the then Fisheries Economics and Extension Division (FEED) saw the

struggles to translate the principles of agricultural extension into fisheries sector, especially shrimp farming. The major studies and efforts in this phase are discussed below.

a) Development of TOT/HRD models.

The early eighties saw the emergence of many path breaking technologies in mariculture, scientific culture of prawn being the pride among them. It was imperative to develop effective methods for its transfer to the field. A model was developed for the transfer of prawn culture based on the logic of Roger's linear model on "diffusion of innovations"(Srinath,1987) and was later put into practice in selected coastal villages in Kerala in association with the Krishi Vigyan Kendra (KVK) of the institute. On similar lines an attempt was made to apply the Human Resource Development model in the case of marine fisheries sector (Gupta,1990).

b) Measurement techniques

The TOT model laid emphasis on the role of extension as an external agency in bringing desirable changes in the farmer so as to make him/her adopt the technology developed by the technology generation system. The effectiveness of the extension intervention depended on the willingness of the client to accept and adopt the technology. Thus it was essential to know in advance the psychosocial factors that decide the adoption-diffusion process by way of administering tools that measure psychosocial variables. A few attempts were made to develop and use scales to measure the attitude and awareness of aqua farmers regarding the new technology in scientific prawn farming (Srinath,1988). The micro-level studies in some of the coastal villages revealed that a majority of potential adopters had favourable attitude towards the technology. The measurement techniques were later extended to probe the behavioural domain of marine fisher folk like psycho-social aspects of motorisation (Srinath, 1988) aspirations of fishermen and decision making by fisherwomen (Jancy,1990) etc.

c) Impact assessment

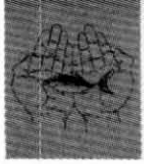
The training programmes offered by the KVK (which was established in 1976) were subjected to evaluation studies (Srinath,1987). It was found that diffusion of the innovations depended not only on need-based training programmes but also on favourable market factors.

d) Nutritional status of fisher community

Attention was given on other aspects like home science extension and a few micro level studies were made to understand the nutritional status of fisher community by analyzing the daily food consumption pattern (Srinath, 1988). The fishers were found to consume less calories (1,827) than the recommended allowance of 2800 calories /day though intake of the protein and calcium was above the recommendation. The lack of purchasing power and working in odd hours made most of the fishermen depend on low calorie foods.

e) Socio-economic studies on marine fishermen

A number of socio-economic studies conducted during these period in different maritime



states of the country (Sathiadhas and Panikkar,1988) have highlighted the importance of extension intervention to ameliorate many of the social problems afflicting the fisherfolk communities like illiteracy, irrational credit behaviour, alcoholism, lack of conservation orientation etc.

II. **Extension in action**

The period 1990 to 2000 brought fisheries extension in much policy and media limelight due to the successful implementation of many action- oriented extension research experiments. They are discussed below.

a) Action research experiments

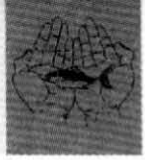
The action research conducted for rural empowerment in Chellanam village, later known as *"Chellanam model"* (Srinath *et al*,1994) stole the limelight. The project proved the role of extension science in helping to work out a methodological framework for rural women's empowerment. The empowerment model underlined the importance of extension education playing the pivotal role in bringing out positive changes in self-perception of women, decision making /entrepreneurial skills, innovativeness and group mobilization as a prerequisite for empowerment to take place. The hallmark of the project was the "technological & institutional pluralism" it offered to the women target groups while maintaining a balanced view on the gender issues. Based on the felt needs of the community, sufficient interventions – technological (scientific prawn farming, low cost prawn feed making unit, net braiding unit, installation of smokeless *chulas* etc) social (day care center, nutrition education)& economic (tea shop run by women)- were introduced after motivating them through entrepreneurial training programmes as well as financial empowerment realized through credit offered by banks and Central Social Welfare Board. The activities were spearheaded through an organization for women, called *"Matsya Mahila Vedi" (Fisher* women's forum) which was registered as a charitable society with 200 members.

b) First line extension model

The Chellanam attempt could be considered as a successful culmination of earlier initiatives like First line extension conducted in the same village (Gupta & Srinath,1992). The First-line extension being a purely extension research intervention did not provide financial incentives to the target group. This lacuna was taken care in the *Chellanam model.*

c) Group farming approach in aquaculture

The model also proved for the first time that the success of the "Group farming approach", which was well proved among the paddy cultivators of Kerala, could be replicated in the case of prawn farming too. A study (Rajeev & Srinath,1995) showed that the perception of prawn farmers on group action was quiet encouraging. The project was appreciated by the State Planning Board as a triable model for women empowerment in the state.



c) Innovative methods for TOT

A number of innovative extension programmes were launched to disseminate scientific prawn culture, prawn seed collection, fish processing etc. Notable among them has been the creation of a regular platform for interaction between the research system and the client system on a monthly basis known as "Fishermen-Farmers-Industry –Institute Meets". More than 40 such meets have been conducted so far in different coastal villages. The immediate problems raised by the stakeholders were taken care of by suggesting appropriate technological solutions developed by the institute during these meets. They have acted as a mechanism for feed back on researchable issues also. Nevertheless, the extent to which this feedback was given adequate research attention needs to be ascertained.

d) Dissemination of mariculture technologies

A number of programmes were undertaken to demonstrate various technologies developed by the institute like prawn farming, integrated finfish culture, crab culture and fattening, mussel culture, sea weed culture etc. some of the programs were implemented in collaboration with the Fisheries Department of Kerala through the Special Component Plans. The viability of ornamental fish culture as a low investment , self employment homestead opportunity for the coastal community was demonstrated (Devaraj *et al*,1997). A series of pamphlets in Malayalam, Hindi and English were released on different technologies explaining methods of farming, economic aspects etc.

e) Extension research studies

The other areas which got research attention were use of media by fishermen (Gupta,1991) adoption of quality control measures in prawn peeling units (Gupta,1992) and training on foods from sea weeds (Sheela,1995). A study on the evaluation of a group discussion by experts and farmers from two districts on developing oyster farming in Kerala helped to identify not only the potential areas but also the possible constraints like complexity of technology, interference with traditional fishing and navigation which may lead to social conflicts, pollution etc in a participatory way (Srinath,1994).

A case study on the innovative method of feed preparation using locally available ingredients by a farmer suggested the possibility of a Problem Solving Model of Extension in aquaculture (Gupta,1992) and this has been successfully developed into a low cost shrimp feed technology namely "*mahima*"- by a nutrition scientist of the Institute (Manpal and Srinath, 1994).

III. Pre-institutionalization.

This phase has been called as Pre-institutionalisation as the need of the hour is not only to consolidate the theoretical and practical knowledge base obtained out of the past two decades of extension research but also by conducting macro- level policy analyses on factors that so far prevented the formulation of a cogent fisheries extension strategy , with special emphasis to marine capture fisheries in the country. Some of the studies undertaken in this phase (Ramchandran,2001., Ramchandran,2002., Ashaletha, 2003., Sheela,2003) try to fill this gap.

The major points of departure in the research design and philosophy being followed in this phase are:-

1) Emphasis on a national perspective: All the research projects being carried out in this phase are located in more than three maritime states in order to get a national perspective on the extension issues. The projects now run in Kerala, Tamil Nadu, Karnataka, Maharashtra and Orissa.

2) Beyond Technology Transfer and Policy focus: The extension research needs to focus its attention on wider socio-legal issues prevalent in the marine fisheries sector to suggest strategic development interventions. Thus new issues like Responsible Fisheries, Gender issues, perception on Technology change &regulatory mechanisms, Indigenous Knowledge System etc. are being taken up for diagnostic and futuristic studies.

2) New Methodologies: The breakthroughs in extension research methodologies like PRA/ PLA, Co-learning, Grounded theory, Meta analysis etc are being utilized along with Survey and case study methods.

4) Inter-Disciplinary approaches: In tune with the realization that disciplinary boundaries are meaningless in the farmers' fields, technologies are being refined and developed through on-farm trials run by inter disciplinary group of scientists. The activities in the IVLP-TAR programme and the establishment of a single-window delivery system called Agricultural Technology Information Center (ATIC) have been undertaken with this point in mind.

Concluding observations

The short review on the research works of the past three decades provides valuable lessons, which should be used as guiding lights while charting out the future direction in marine fisheries research and extension. Below are given a few suggestions in this regard.

1. More attention needed in marine capture fisheries extension.

The past extension efforts have riveted around building extension strategies for the transfer of a few mariculture technologies (like shrimp farming) with the result of very meagre attention being paid to marine capture fisheries. In fact very little efforts have been made to address the peculiar problems in the marine capture fisheries sector in an extension perspective. Many studies on socioeconomic aspects of marine fisherfolk conducted in different maritime sates of the country have called for extension interventions, especially in the context of CRZ regulations (Sathiadhas, 1997). Average level of innovative behaviour scores in a study conducted among three different categories of fishermen in two states indicated that there was serious time-lag in adoption scores (Balasubramaniam *et al.*,1998).

2. More emphasis needed on adoption and impact studies on mariculture technologies.

Though the technology generation system has performed well over the past many decades the information on technology adoption on a larger scale remains a gray area. Adoption of

a technology is the major yardstick by which the performance (and even the political sustenance) of a Public funded R&D system is assessed.

The feed back information on many mariculture technologies, but for shrimp farming, remain so enigmatic that the technology generation system has been forced to take a "baby sitting role" than taking a proactive role of coming out with new technologies and more refined options to the stakeholders. A probable reason for slow diffusion of mariculture innovations could be the absence of systematic efforts in following the mandatory steps and procedures (like Constraint Analysis, Method and Result Demonstrations, Multi -Locational On -farm Trials etc) before popularizing a technology.

Another related issue is the lack of clarity in resolving the issue of conflict in the use of water bodies, mostly common properties, by way of clear legislations. In fact this has been identified as the major constraint in slow spread of mariculture technologies.

3 Increasing understanding on research –extension linkage & institutionalization required

The extension system in Marine Fisheries in India is conspicuous by the absence of its formal institutionalization. In the case of agriculture the dominant mode of its institutionalization is what is known as the Transfer of Technology (TOT) approach (based on the Classical Diffusion model (Rogers, 1983.) which is represented as a three tier system comprising of technology generation , frontline extension and grassroots level extension. While the technology generation as well as the frontline extension activities come under the mandate of the ICAR research institutes as well as the State Agricultural Universities (SAUs) ,the grassroots level is clearly assigned to the respective State departments. This well-established three-tier system of research extension linkage has been hailed to play a yeoman role in ushering the green revolution in the country. However in the case of Fisheries we have a very weak and rudimentary two tier set up in spite of a Blue revolution which in the normal sense covers the rapid strides made in aquaculture, the marine fisheries sector being given only a complimentary role.

The mandate and organizational structure of the institutions that constitute the current research-extension system in fisheries need not be the most appropriate one to take up the new role. A related issue is the absence of extension professionals who have strong background in both the fisheries and extension sciences. The question of how these institutional weaknesses can be corrected awaits serious attention.

6
CHAPTER

Reinventing Marine Fisheries Extension System

"Until now man has fought *Nature,*
From now on He will fight *his own nature."*

– A Dutch poem

In comparison to the situation prevailing in agriculture/aquaculture, the Research- Extension –Client system in the case of marine fisheries is characterized (or often riddled) with a number of peculiarities. This is being explained below using the figure 7.

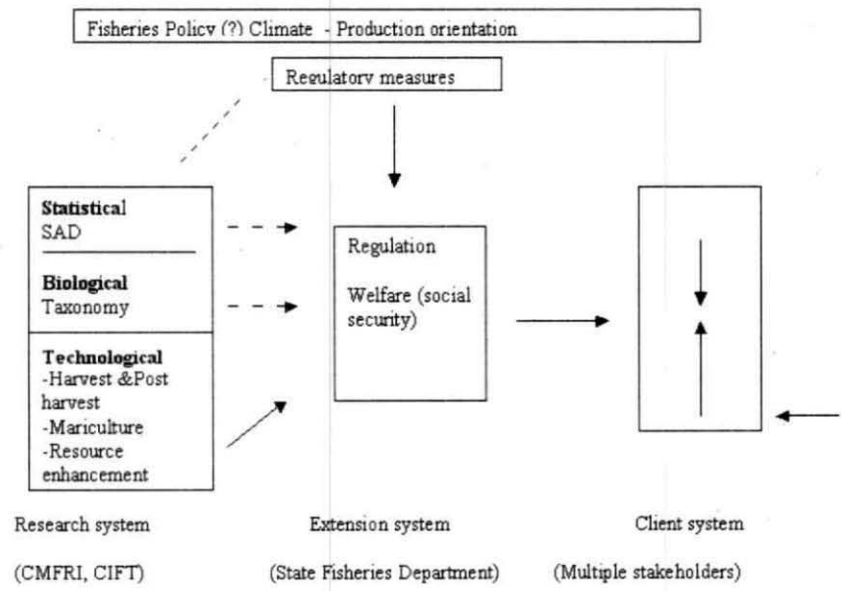


Fig. 7 Flow of information in Fisheries Research –Extension System at present

Research system - anachronism or ahead of times?

The research system in marine capture fisheries mainly[1] consists of Central Marine Fisheries Research Institute (CMFRI) and Central Institute For Fisheries Technologies (CIFT) both headquartered at Kochi. Both the institutions have regional research stations located in almost all the maritime states of the country. The research trajectories and hence the information output of the research system can be captured under four major categories

a) **Statistical**

This consists of the huge stock assessment database like annual total catch (species wise, &region wise), annual MSY for different species, production potential etc developed by CMFRI.

b) **Biological**

This is made up of biological and taxonomical information regarding the different species of marine organisms mainly fish. This is also done by CMFRI.

c) Technological

CIFT is concerned with harvest and post-harvest technologies where as development of Mari culture technologies as well as resource enhancement techniques like Sea ranching, Fish Aggregating Devices etc is under the purview of CMFRI.

d) **Socio-economical**

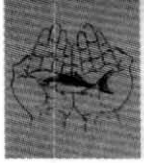
This deals with the socio-economic profile of the fisher folk in different maritime states of the country, data on economics of fishing operations, technological change, policy –related issues etc.

Strategic gaps

Both the statistical and biological information, which obviously form the crux of marine fisheries science, belong to a "software" type of technology. We can better call it as Marine Fisheries Scientific Knowledge System (MFScKS) rather than Technology. There are three grave difficulties, what I call as *"strategic gaps"* with this knowledge system in the extension point of view.

1. This information is supposed to help policy makers in formulating fisheries harvest plans or regulatory measures. But unfortunately *"research directed fisheries management"*, as it is manifested in temperate countries is conspicuous by its absence in our country.
2. The practical utility of this huge information base for fishermen is yet to be demonstrated.
3. An effective transfer of knowledge is an epistemologically difficult proposition.

[1] There are other institutes like Fisheries Survey of India, Central Institute for Fisheries Education and Fisheries Colleges under State Agricultural Universities.



The classical reaction to this malady could be to decry the whole enterprise of marine fisheries research as obsolete or as an anachronism. But I prefer to call it as one, which is "ahead of times". This is mainly because of the fact that the demand and hence the value of such information becomes apparent only if there is a crisis in the robustness of the marine resource. It is only recently that the marine fisheries sector in our country has opened their eyes to the writings- scribbled long back by marine fisheries scientists- on the wall. As we have seen in Chapter 2 the birth of fisheries science itself has been a band-aid response to a resource crisis. Now a time has come for us to be pro-active instead of thinking about firefighting strategies. It is clear that the epistemological component of this database, if not the information *per se*, is going to be relevant in the days to come.

The technological component consisting mostly of a "hardware" nature (for eg. harvest and post harvest technologies, mariculture technologies etc.) is amenable to a TOT logic. And there have been some attempts (See Chapter 5) to transfer this technology through the extension system. But this is also fought with institutional and contextual hurdles. For e.g., a crucial factor deciding the spread of open-sea Mari culture technologies is the timely resolution of the issue of property rights. It can be resolved only if government comes out with well-thought out sea-use policies. Bereft of an explicit demand for technologies, most of which were originally developed two to three decades back, the job of the research system has been to keep them on the heart-lung machine and pray for good times to come! This has one way resulted in the dampening of efforts to direct the research process towards either refinement or more creative efforts to come out with new technologies.

In the case of harvest technologies the major hurdle is the *leiseze faire* environment existing in the technology generation scenario. Unlike the farm sector, the technology generation system in harvest sector and to a large extent the post- harvest sector is dominated by a vibrant private sector which enjoys absolute freedom, without any checks and controls, in developing and promoting innovations. At present there is no mechanism to scrutinize the ecological soundness of these innovations being generated by fishermen themselves. The situation is something like the farmer himself making and spreading Bt cotton technologies! This is disastrous enough not to belie correction.

Another related problem being faced by the research system is what is known as *technological creep* (see Chapter 2). Though this phenomenon can be interpreted as the power and glory of an indigenous technical knowledge system, unbridled expansion of such innovations can bring collective ruin. For an illustrative case see Box 18.

Extension research –a court jester?

Extension research, in the way it is understood in the case of agricultural extension is hard to find in marine fisheries sector. In the case of agricultural extension the supposed role of extension research has been to play a significant role in the Front Line Extension while validating the prototype technologies in the farmers' fields and find solutions to the strategic questions put forth by the extension system. Extension *per se* is not the mandatory role of an extension scientist as it is the mandated function of the State Departments of Agriculture.

Box - 18

"Yamaha Empowerment" to "Inboard Invasion"

In Kerala motorization by way of fitting Out-Board Motors (OBM)on traditional crafts started in the early 1980s has brought out revolutionary changes in the economic condition of the traditional fishermen. With the government declaring it as the development strategy the technology got a wonderful record of diffusion, that too without an obvious extension effort. Their number now is estimated to be over 30,000 in the State against a handful few in the1980s. What got the traditional fishermen attracted to this costly but small gadget, a Japanese innovation, was the empowerment it offered in their struggle against the invasion of mechanized trawlers in the inshore waters. It also gave a new respectability to the traditional fisher folk –hitherto derogated as a primitive hunter- gatherer.

But the spiraling cost of kerosene fuel and spare parts for OBMs forced the fishermen to innovate cost cutting harvest technologies. This resulted in many innovations. The recent case is the introduction of huge traditional boats fitted with In-Board Engines. Equipped with mechanized winches and a huge storage space, the greatest advantage of these crafts is that they can outsmart the mechanized trawlers and still claim the benefits of the traditional label! The mechanized fishermen allege that it is a clever technological ploy to circumvent the monsoon trawl ban. This has fomented new conflicts. Though the investment is to the tune of Rs22-25 lakh per unit the profit margin is to the tune of Rs30,000-70,000/day/unit compared to Rs 4000-6000 /day/ unit in motorized boats. It can employ about 40-50 fishermen also. Within a span of four years their number has crossed 600 against a recommended number of 1300. Doubts have been cast on the ecological soundness of the gears they use and their very legality under the existing regulatory rules. Its uncontrolled expansion in the inshore waters may put the motorized fishermen also in jeopardy.

(Source : *Kurup,2003*)

Since the research –extension linkage is practically non-existent; the feedback mechanism that supplies strategic questions to the extension researchers is obviously missing in the case of marine fisheries sector. This is mainly due to the absence of an institutionalized methodology in the technology generation system. The concept of Multi- Locational Field Trials, a vital step in the technology generation system in agriculture, is still nascent in the fisheries research system. A major reason for this is the lack of control the scientists can confidently (in the statistical sense) exercise on their experiments. In a situation where the link between the research system and the extension system is weak, if not non-existent, it is hardly surprising to see that extension research is unable to assert its identity as one distinct from extension work.

Extension system- a benevolent dictator?

Extension being a State subject, the State Department of Fisheries is supposed to do the extension work. But they are mainly entrusted with the job of implementing regulatory measures as well as taking care of the welfare programmes indented for the development of the fishermen. Extension is given very low priority. This duality in functions is more or less like the role of a benevolent dictator, which results in role conflict among the functionaries. It is apparently difficult to play the role of a policeman and an evangelist simultaneously.

As we have already seen developments in the marine fisheries sector, to a large extent, has taken place without the active support of a public sector extension system. This is not an exception but almost a rule in many parts of the world. This is precisely why, unlike agricultural extension, the literature is very scanty for marine fisheries extension.

(Notable exceptions are Cole,1977,Thomson,1979,Teitze ,1984,Jungeling 1992., Ananth, 2000. But it is to be noted that the TOT logic dominates all these discourses).

In the case of Technology Transfer the Department has played an indirect role for promoting motorization among the artisanal /small-scale of fishermen by way of providing subsidies to the OutBoardMotors(OBMs) which are imported from Japan. The programme started in the1980s and resulted in what can be called as "Yamaha Empowerment". Now it is being implemented as a central sector scheme through the departments in all the maritime states.

An ideal Research Extension system

An ideal research- extension system is portrayed in figure 8. The important features envisaged in an ideal scenario in contrast to the prevailing situation are:

1. The three subsystems (research, extension and client) are well connected through two-way communication linkages. Information flows not in a unidirectional linear fashion.

2. The inflow of technologies from the private sector or indigenous knowledge system, which is at present located outside the Research –Extension-Client system, is directed first to the Research system (The arrow at the left corner indicates this). The ecological soundness of these technologies will have to be validated by the research system before transferring to the client system through the Extension system.

3. The conspicuous presence of a Cognitive or behavioral research component in the research system.

4. A distinct, but corollary extension machinery under the State Department of Fisheries. This will avoid the role –conflict prevalent now. The extension functionaries can make use of the incentive component of welfare measures they dole out, geared towards sustainability.

5. The role of NGOs is given an explicit recognition.

6. The goal of the over all policy climate cannot be higher production, but an explicit thrust on sustainable production. This will demand alternative indicators of performance unlike the revenue –oriented ones used at present for both the research system as well as extension system, and

7. The logic of research is a combination of positivism and constructivism. Thus equal importance is given to TOT and HRD aspects of Extension. The principles of Co-management will guide the entire process.

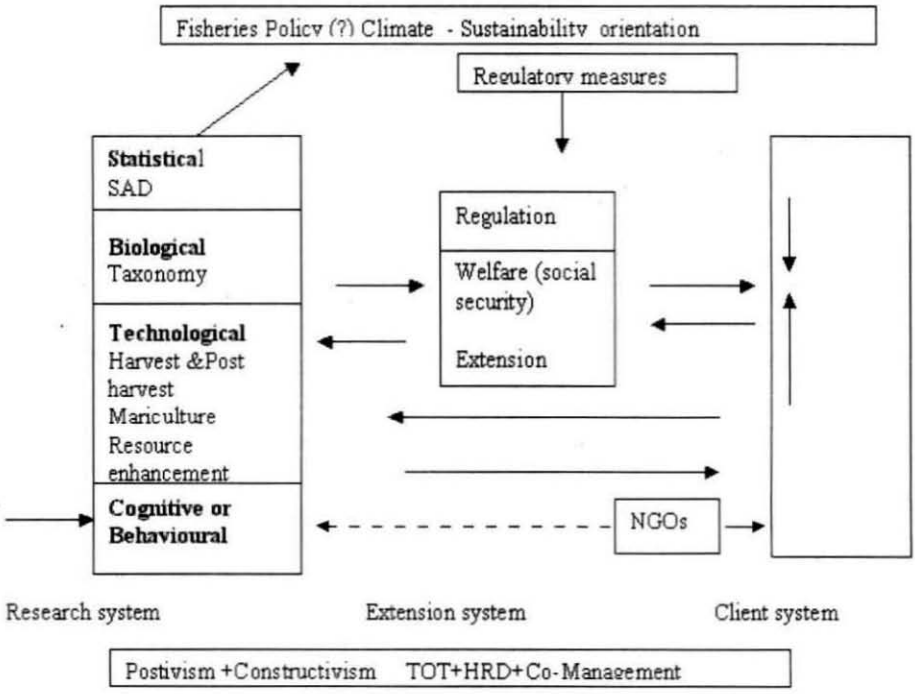


Fig. 8 Information flow in Research -Extension system-an ideal scenario

Is there a Need for Marine Fisheries Extension system at all?

At this stage it is quiet likely that the question on the significance of a Marine Fisheries Extension system is likely to crop up. The answer is both Yes and No.

If the extension system is conceptualized as a delivery mechanism working with TOT logic as well as a false sense of technological infallibility, a public funded extension system is almost impractical in the case of marine capture fisheries. But it is immensely relevant if the entire system is redefined in a constructivist perspective. The reasons for this are

1. The fact that marine fish production has started to enter a plateauing phase necessitates us to forge proactive resource conservation strategies based on the precautionary principle enshrined in the concept of Responsible Fisheries.

2. The philosophy of *absentee management*, which denies the active involvement of the state, will bring disastrous results in the future.

3. There is a nascent but significant awareness among the fishermen on the need for responsible fisheries management.

4. The technology generation system must take a proactive and precautionary role to exercise control over the direction of technological change taking place in the harvesting sector in order to avoid the pitfalls of technological creep.

But what is needed is a new logic and logistics for a marine fisheries extension system. Armed with the theoretical background in fisheries science, extension science and constructivism we can attempt a new model. It is to be noted that the model proposed is a transition vehicle to attain the goal of a Sustainable/Responsible Fisheries System as depicted below.

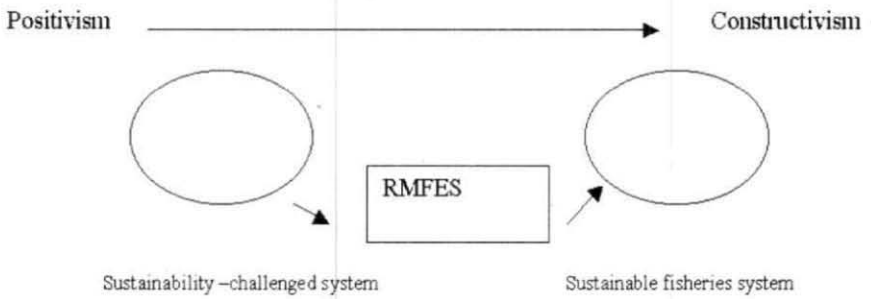


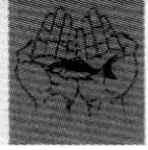
Fig. 9 The logic of the model

Premises

Before going to the model let us recapitulate some of the premises /insights, many of which have been discussed in the previous chapters, which we have to keep in mind.

1. Marine fisheries sector, being a Common /Open Access Resource the *de facto* ownership of which is vested with the State, is characterized by absentee management. The extension system, or even the research system, has played very little role in the technology transfer that has taken place in the sector by way of motorization /mechanization .

2. As long as the resource remained robust there has been no concern for sustainability. But the recent realization that the current level of exploitation, if unbridled, can invite the perils of a 'tragedy of the commons' that has already taken its toll in most of the fisheries



in the temperate seas call for concerted extension approaches to implement conservation measures so that optimum utilization of the resource can be sustained.

3. The management measures being practiced in temperate countries may not be practical in our situation.

4. Marine Fisheries Science is fought with inherently debilitating challenges, which are ominously more blatant in the context of a multi-species system existing in our waters. But the applicability of its epistemology as a pedagogical tool deserves more attention.

5. Indigenous institutions like *kadakkody* (see annexure 1) can be used as effective sensitization platforms while designing communication /extension strategies for responsible fisheries management. It is possible to make use of these platforms as social laboratories to instill positive behavioural changes among the fisherfolk.

6. It is essential to make our fishery sector competent in the emerging world economic order in the wake of WTO regulations like stringent adherence to Sanitary & Phyto-sanitory measures, HACCP etc. The competency in International seafood trade is decided not only on the ability of ensuring supply of safe and healthy produce but also taking sufficient precautions in not falling in the trap of non-trade barriers which is further compounded by the "reversal of burden proof' clauses.

7. The responsibility for making the entire chain of harvesting, processing, and distribution in marine fisheries "clean and correct", technologically, socially and ecologically, is vested with all the different stakeholders of the sector. The need for educational programmes in this regard is never felt so important and immanent.

8. The credo of Responsible fisheries as enshrined in the FAO Code of Conduct for Responsible Fisheries could form the *raison deitre* of a New Extension Approach, which probably can not invoke the conventional TOT logic as being practiced now. What is required is a shift in paradigms to inculcate an ethos of conservation among the stakeholders.

9. The main reason for the inability of the State to respond to this challenge may be the economic logic of social choices that dominate the policy discussions. The individual, in a CPR context, according to this thinking lacks the incentive to adopt conservation measures. But recent experiences indicate the existence of conservation orientation as a subliminal behavioral component in the cognitive domain of fishers.

10. Efforts are needed to translate the rich and huge data base on stock assessment and taxonomy in marine capture fisheries to practical information relevant to the needs of the fisher folk. This demands conceptual and methodological reforms in the way marine fisheries research is being undertaken now.

11. The social sciences should play an active role in redefining a Research –Extension system oriented towards Responsible/Sustainable Fisheries in the country.

The model

The conceptual model proposed is discussed below by way of two figures 10 & 11.

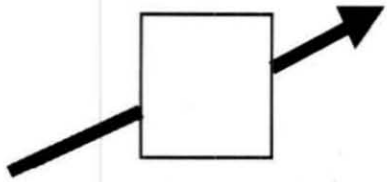


Fig. 10 The model showing the temporal dynamics

In the first figure the temporal dynamics or the iterative nature of the system is shown. The whole system is conceived to take place as Co-Learning Cycles. The second figure elaborates the model (what is shown as the Box in the first figure) in detail.

There are three levels in the model. Each level conceived as a Learning cycle, is temporally and spatially interconnected. These levels are discussed below.

Level I Constructivist Learning Loop for Marine Fisheries Research

This is shown in the left hand side corner. The level I is the driving force or engine of the model. The most significant feature at this level is the constructivist reform envisaged in the research system or the Knowledge Generation System. The cardinal point of the reform process is the convergence of two knowledge systems namely the Marine Fisheries Scientific Knowledge System and the Marine Fisher's Indigenous Knowledge System. The next important step in this loop is building up of scenarios by making use of the new knowledge base constructed. These steps are discussed below.

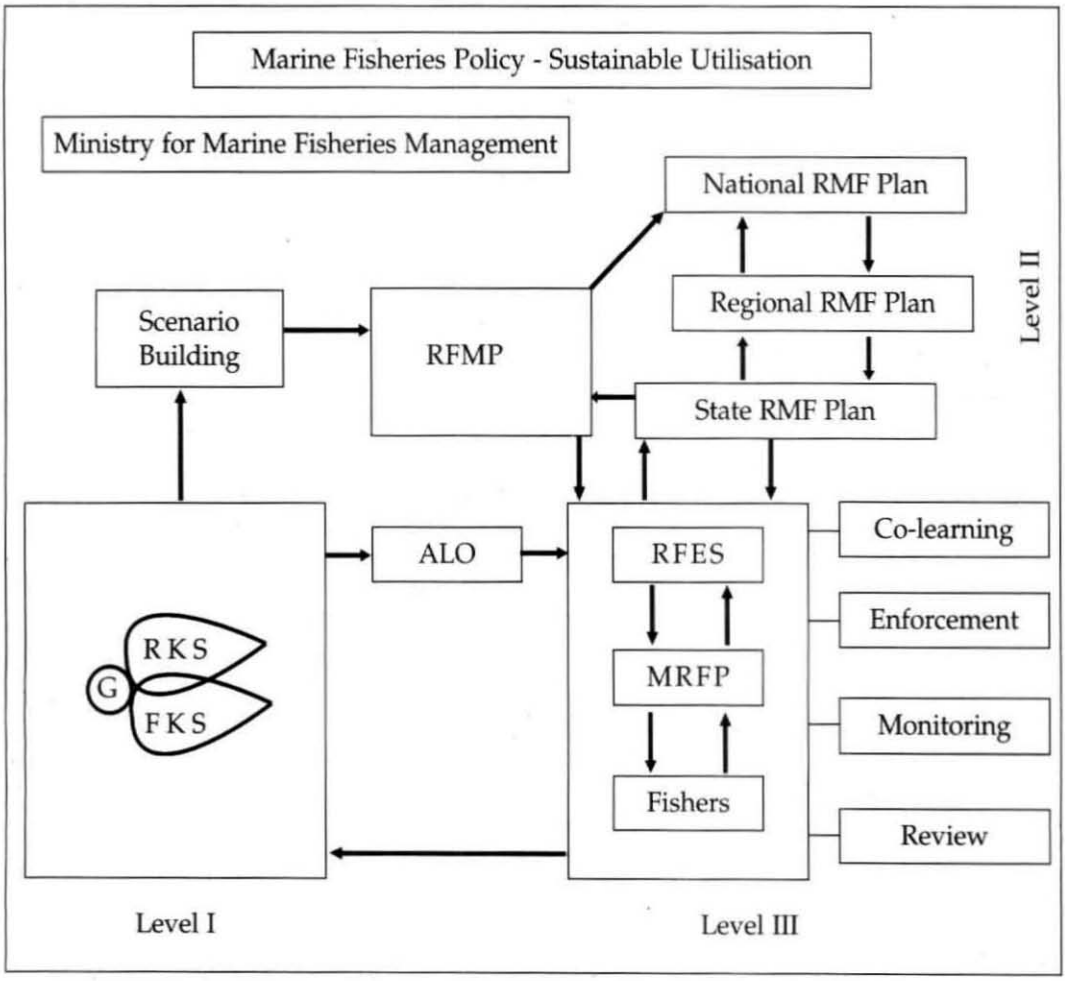
Step i) ***Convergence of two knowledge systems***

This is achieved by blending the Scientific Knowledge System with the Fisheries Indigenous /ecological Knowledge system. The extension research system has to play a very important role here. The function of the extension research system is to facilitate the convergence of the two knowledge systems in practical terms. For eg. the extension research system can design suitable methodologies and praxis for endeavors like Participatory Stock Assessment Or Participatory Assessment of Biodiversity.

Tasks of the extension research system

The extension system has **three major tasks** here:

1. To *facilitate* the creation and maintenance of a multi-disciplinary Responsible Fisheries research platform at the research system level
2. To *facilitate* the creation and maintenance of a multi-stakeholder Responsible Fisheries Platform at the client system level
3. To *facilitate* the convergence of the two systems



RFMP - Responsible Fisheries Management Plan; RFES - Responsible Fisheries Extension System; MRFP - Multi-stakeholder Responsible Fisheries Platform; ALO - Alternative Livelihood Options; RKS - Research generated Knowledge System; FKS - Fishers' Knowledge System; G - Government

Fig. 11 Responsible Marine Fisheries Extension System - Constructivist perspective.

The whole exercise has to take place on a **co-learning mode** where the Multi-Stakeholder Responsible Fisheries Platform (MSRFP-shown on the right side as a subsystem) should be facilitated to participate actively. The stakeholders have to be more than mere suppliers of data. They have to be empowered with the logic, methodology and tools used by the research system. In short the stakeholders work hand in hand with scientists on mutually acceptable reference points that define the new epistemology.

Challenges

a) Bridging the communication gap

The biggest challenge of the extension researchers is to bridge the communication gap between the scientists and the fisher folk. This challenge is a Herculean one as the mistrust between fishery scientists and fishermen has been legendary due to reasons, which lie scattered in the dichotomy between scientific validity and livelihood necessity.

The peculiarities of the two knowledge systems explain the reasons. For the fisher folk the ontological objective of their epistemology is their day-to-day survival. It is a socially constructed knowledge system. The incongruence between the two knowledge claims results in serious problems in the way they perceive fisheries science. A classical eg.is the way scientists refuted the *sheep –dog theory* of the whale fishermen in the 1900s(see Box 19).

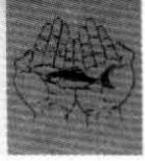
To a large extent the marine fisheries research system and the client system has so far enjoyed a parallel existence. Since the emphasis was on regulations, the fisheries bureaucracy and consequently the research system were often treated with mistrust and hostility. There is an extreme degree of polarization among the different sectors like small-scale traditional fishers, motorized fishers and the capital intensive mechanized fishers. The open –access nature of the resource combined with unbridled capital penetration often lead to conflicts over resource use. And no wonder marine Fisheries Science or Research was perceived to be an enterprise fuelling the (capitalistic) agenda of some sectors. For eg., a slogan chanted by agitating artisanal fishermen in front of CMFRI during the 1980s exemplifies this animosity and mistrust. "You white-elephant scientists and researchers /you servants of capitalism /The research you conduct /Is it to save the workers /or to serve the capitalists?" (quoted By Kurien,1990).

This chasm is confounded by the scientific challenge of internalizing the element of uncertainty, which, to a large extent, is still insurmountable. This is precisely why the fisheries science is unable to give unambiguous Yes/No answers on various issues. Though it is agreed that resources need to be conserved it is difficult to come out with technological measures, which are agreeable to all.

Extension in such a defensive communication climate is apparently a challenging task. But every challenge brings forth new opportunities. Making the vital link between the research system and the stakeholder system offers immense opportunities for the marine fisheries research system in general and the extension research system in particular.

b) *Opportunistic use of knowledge claims*

Another problem is the way in which the knowledge claims are utilized opportunistically. The scientific validity is often unpalatable to a section of the fisher folk. For eg. Trawl operators refute the basic logic of trawl ban that it is the time when most of the fishes breed, by citing the example of *karikkkady* (*P. stylifera* – a type of shrimp which is available only during monsoon months). Interestingly this view could not be falsified by fishery science. The result is that the



traditional stakeholders who constitute the majority do not view fishery scientists favorably. They always question the validity of the findings of the science, which go against their interests.

c) Scale gap

This gap is not just a question of lack of understanding on the side of the fisher folk but is rather associated with the basic scales at which the resource basis for fisheries is observed and understood (Degnbol,2001). For e.g., take the case of the concept of average stock, the fundamental unit of observation in fisheries science. Fisheries scientists and fishers view the local abundance of fish with its associated hydrographic or benthic conditions differently. For the scientist it is a problem because it does not represent the stock mean and hence to be overcome by appropriate sampling design. Where as for the fishers it is an opportunity for a profitable harvest.

Box - 19

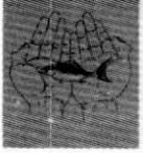
"Sheep-Dog theory"

Modern whaling technology invented by Svend Foyn, a Norwegian, in the early 1900s led to the development of a thriving industry centered around commercial exploitation of fin whales along the coast of Northern Norway. Towards the end of 19th century a conflict arose between the local fisher population, which depended on the cod fishery, and the whaling companies, which came form southern Norway. In the center of the conflict was the knowledge claim from the local fishers. They believed (what is known as the sheep-dog theory) that the cod fishery was dependent on healthy whale stocks. In their view the whales would chase the cod's bait, herring and capelin, towards the coast and the cod would follow. Without whales, the capelin and herring would stay out at sea. So would cod, which then would be out of reach for the fishers' small coastal vessels. The fisher believed that the whaling operations threatened the whale stocks and thus their fishery. The conflict soon attained political dimensions. In fact the political mobilization behind the issue helped the Labour Party to win a seat in the Norwegian Parliament for the first time. On the other side was the enormous prestige of the whaling industry. The Government was forced to intervene in the issue and a natural scientist was appointed to resolve it scientifically. The findings of the famous scientist Johan Hjort disproved the sheep –dog theory of the fishermen. He concluded that the whale could be important in order for the fishers to locate the fish, but it was not important in order to bring the fish to shore.

(Source : *Eythorsson,E.1998*)

The New Knowledge Base

The convergence of the two knowledge systems facilitated by the extension research system, results in the construction of new knowledge (It is to be noted that what is aimed at is neither a database nor an information base. The term knowledge base is used in full recognition of the difference in the connotative meanings of the terms). This is composed of



four Knowledge bases namely

1) **Knowledge base on stock assessment**

2) **Technological Knowledge base on alternative livelihood options**.

This includes well validated, location specific technology packages (hardware and software) on various alternative options like Mari culture, coastal aquaculture, coastal agriculture etc.

3) **Technological knowledge base on harvest /post- harvest technologies**

This consists of Innovations in crafts and gears made by active and enlightened cooperation of the fishermen, private entrepreneurs and scientists. No such innovation should be promoted without analyzing their ecological soundness in a participatory manner.

4) **Cognitive Knowledge base**

This implies the knowledge generated by behavioral scientists not only on contextual variables like socio-economic dynamics, policy /legal issues, gender-sensitive and cognitive variables (psychological domain of individual fisher folk) but also on the strategies required for the facilitation process.

The research activities under 2& 3 must recognize the logic of Multi-Locational Trials.

At level 4 it is essential to maintain a healthy liaison with NGOs and activists working among the fisherfolk. Though it may not be possible for the researcher to always support the normative positions being taken by the different interest groups the issue of sustainable utilization of the resource need to be used as a common rallying point wherever possible.

Step II) Building and evaluating scenarios

The new knowledge is utilized to build responsible fisheries scenarios. A consensus on the most acceptable scenario, taking care of the concerns for sustainability can be arrived through contested negotiations. What is aimed at here is an informed consensus which is arrived through a participatory decision making structure that makes Responsible Fisheries Management Plans by incorporating inputs from the four knowledge /technology base after demonstrating the relative attributes of various management choices. The basic challenge here is to translate the negotiated positions into management actions like effort reduction. It is extremely difficult to reach complete agreement among competing interests. But a participatory evaluation of the alternative scenarios, if done more on an analytical basis keeping the previously –agreed management objectives in focus than on the basis of political concerns, would help to reduce divergence among the stakeholders. The advantages of occupational pluralism existing among the fisher folk, availability of alternative livelihood options etc can be effectively utilized here.

These Responsible Fisheries Management Plans can be suitably aggregated into regional and national fisheries plans.

Level II Constructivist Learning Loop for Marine Fisheries Extension

This is the second learning cycle initiated by the Responsible Fisheries Extension System with the active participation of the Multi-Stakeholder Responsible Fisheries Platforms. The extension system is conceived as distinct but not independent machinery under the Department of Fisheries.

Functions

The main function of this system is to facilitate the formation of these platforms. The functionaries have to be equipped with social science skills like group dynamics, conflict resolution, motivation, and social learning etc. The main task of the facilitators is to develop responsible fisheries ambassadors among the stakeholders. The extension research system has to take a crucial role here by providing necessary Human Resource Development skills.

Creating *Responsible Fisheries Co-learning Centers* in each coastal village could be thought of as one way to institutionalize these activities. These Platforms must be entrusted with the job of implementing the fisheries plans they themselves have constructed in the level I learning cycle.

The duty of enforcement and monitoring of the plans is also vested with them. Conflicts if any should be resolved at this level. The services of the enforcement wing can be resorted only if these efforts fail. The other functions of the platform are reviewing the whole process periodically, identification of beneficiaries for the welfare schemes, and formation of cooperatives.

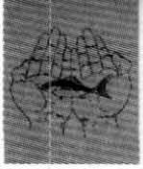
Establishing *Community Radio Stations* is another activity which can be attempted. This will provide unique opportunities for strengthening community feeling by way of acting as decentralized platforms of message generation apart from serving the usual communication functions like keeping the members of the Multiple Stakeholder Platforms and others informed.

Logic and strategies

Though the dominant logic is that of **Co-management** the point of departure is the shift in the focus from community to individuals and then to institutions. An institutional approach focuses on the ability of groups of people to create and enforce rules-rules that are products of social negotiation, economic and political forces (Allison,E.H and Ellis,F. 2001).

These institutions may or may not tally with notions of community, and may in fact be more likely to be the product of compromise between different actors or stakeholders.

Individuals who are convinced that they are part of the problem and hence part of the solution only can build a sustainable community. The change has to take place in the cognitive domain of the individual. Since each individual is a structurally coupled learning system (in the constructivist perspective) *you can never direct change; you can only disturb him or her.*



The role of the extension system is to "disturb" them positively. Along with social learning, the principles of " conscientisation" proposed by Paulo Freire can be effectively utilized here (See Box 20).

Box - 20

Conscientisation

As formulated by Paulo Freire this means the stimulation of *self-reflected critical awareness* in people of their social reality and of their ability to transform that reality by their conscious collective action. It is a problem –solving education.

A self self-reflected critical awareness is achieved by "looking into oneself" and using what one hears, sees and experiences to understand what is happening in ones own life. From this understanding arises an inner conviction that you yourself, together with like –minded others, can do something to change your lives to transform reality.

It is a process in which the people try to understand their present situation in terms of the prevailing social, economic and political relationships in which they find themselves. This analysis of reality must be undertaken by the people who can decide what their important needs and experiences are , and not by experts. From this analysis the people themselves may take action against the oppressive elements of their reality. This involves the breakdown of the relationship between subject and object and constitutes the essence of true participation.

(Source : *Burkey, 1993*)

It is not impossible to find certain individuals who have developed such self-reflected critical awareness and they can be set as role models in the community. Wherever there are enlightened individuals who advocate the credo of responsible fisheries the RFES should identify and recognize them to act as ambassadors. Such stakeholder- induced change is more durable and more likely to be emulated by the fisherfolk. So, identifying and making use of responsible stakeholders in the community is a promising strategy.

Stakeholders-induced Responsible Fisheries

It is not difficult to find certain fishermen, who by virtue of an inherent *self-critical awareness* take the initiative to engender responsible fishing practices in the community. It is of utmost importance for the extension system to take cognizance of such individual initiatives and lend all support to them. They are natural ambassadors of responsible fisheries who can be taken as role models. They can be converted into opinion leaders too. They can play a key role in the formation of the Multi-Stakeholder Platforms. Two such illustrative cases have been given in Boxes 21 & 22.

Box - 21

Stakeholder-induced responsible fisheries - Case of Jean Guy d'Entremont, Canada

Jean Guy d'Entremont is a Canadian fisherman steeped in the fishing business.

He skippered an 18 meter inshore trawler for 7 years , and in 1992 took over his parent's fish –processing company in West Pubnico, Nova Scotia. In his spare time , he taught himself the basics of fisheries science. Seeing all sides of the problem, he became convinced that fishermen must become more involved in the scientific assessment of stocks. "Fishermen are the first to touch the fish", he says. "They are the ones who can tell managers and regulators straight from the horse's mouth what 's out there in terms of stocks, gear and technology."

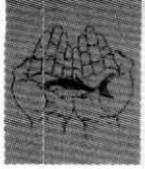
To initiate a more productive dialogue, he organized two North Atlantic Responsible Fishing Conferences, held in March 2000 in Fraseburgh, Scotland, and in November of the same year in St Johns , New Foundland, These meetings- a third will be held next June in Yarmouth, Nova Scotia-bring fishermen from across the North Atlantic to meet with fisheries scientist and government representatives. Fishermen can swap practical knowledge and expertise-for example , on techniques for reducing incidental catches of non-target species-while sharing their perspectives on fisheries management with policy makers and those who advise them. He is the Co-founder of Canadian Responsible Fishermen, and vice chair of the Fisheries Resource Conservation Council.

(Source : *Schiermeier,Q.2002*)

Level III Constructivist Learning Loop for Marine Fisheries Policy Making

This learning cycle is envisaged to take place at the higher-level decision that engenders an enabling policy climate for the effective realization of the responsible fisheries plans.

The country is yet to come out with a cogent policy statement for marine fisheries. At present the fisheries policy climate is dominated by the logic of higher production so as to justify the investment being made by the government. Export promotion is clearly the priority and the State has not fully recognized the importance of taking proactive measures for ensuring the sustainability of the resource. The most important job for members of the bodies empowered to provide legitimacy for the plans is to take part in the level I and level II Learning loops.



Box - 22

Stakeholder-induced responsible fisheries - Case of Jossy Palliparambil,India

Jossy Palliparambil is a mechanized boat owner cum fisherman in Munambam, one of the advanced fishing harbours in Kerala. He is now known more through his organization *Green seas* . After the death of his father he was asked to take charge of the fishing business of the family. Soon he got concerned about the depletion in marine fishery resources brought out by the un-scientific practices like night trawling followed by mechanized fishermen.

Realizing that ultimately it is the future of the fisherman, including himself, is going to be in peril he organized a campaign for sea friendly fishing practices. Being a staunch advocate of Gandhian principles he conducted this in a very unique way. He and his crewmembers took a public pledge that they would never do night fishing and put a banner "Good Bye to Night Trawling" on their boat called 'Sincere' in 2000 May. He prepared and distributed pamphlets in Malayalam and Tamil on the need for banning night trawling among the fisher folk.

Though the fishermen community harangued him initially, the self-campaign slowly gathered momentum and by 2001 he could make his fellow boatmen take a collective decision to totally ban night trawling. This culminated in the whole community, under the aegis of the Local Panchayat, declaring Munambam village as the fist Sea Friendly Village in Kerala. He has opened a study center equipped with a library where fishermen come to discuss the issues of cost effective fishing and conservation.

(Source: *Ramchandran,2003*)

The grave difficulties being faced by the policy makers cannot be ignored in this context. Though there are marine fisheries regulation acts in all the maritime states serious interventions are required to get them reoriented towards the goal of sustainability. The FAO Code of Conduct for Responsible Fisheries needs to be contextualised to suit the peculiarities of each State. A first step in this direction could be to get the code translated in to all maritime vernaculars (See box 23). Voluntary codes of conduct can then be attempted as coastal village declarations or even village ordinances wherever coherent community institutions exist. The idea is that the community should 'own' the code. They should not feel it as prescriptions.

The vexed problem of property rights may be touted as the biggest stumbling block in taking up extension activities. The conflict between the traditional fishermen and the motorized / mechanized fishermen still remains unresolved. But it is to be noted that those who subscribe to the myth of superabundance has come down across the fisher folk categories. This is a positive sign for kindling the conservation ethos, which exists as a subliminal force among fishermen. There is a school of thought, which argues that restricting the entitlement for fishing activities only to the real fishermen is the best solution. "Sea back to the fishermen"

like "Land back to the tiller" is their slogan. The merits and demerits of this argument need to be studied as the boundaries between traditional and non-traditional fishermen is getting blurred in the wake of increasing pace of motorization taking place in the country.

Concluding remarks

The basic argument in this chapter has been that an extension system built on the logic of constructivism can play a better role (than the conventional one built on the TOT logic alone) in the much –needed transition to a sustainable marine fisheries sector in our country. Creation of an ethos of responsible fisheries among the stakeholders of the marine fisheries sector is a challenge, which can be addressed only through a multi-pronged approach that replaces single line bureaucratic methods with participatory approaches facilitated by multiple stakeholder constituencies. This depends on various factors like

a) An enabling policy context

The basic reason for the complacency being noticed in the matters of fisheries management in the country is the political vacillation over whether conservation agenda should be given a clearer policy focus or not. The dilemma is understandable given the complexity of various socio-economic issues that still plague the sector. But the fact that sustainability of the resource base, as indicated by available research findings, is under serious threat cannot be brushed aside. Conservation should mean preserving the resource to ensure a sustainable economic and social activity.

b) Enabling institutions

For realizing New ideas new institutions are absolutely necessary. Change is the key word now. Making precautionary decisions in the face of uncertainty demands organizations, which are endowed with reflexive flexibility. Current institutional structure is too petrified with an array of mandated functions and associated bureaucratic procedures that prevent them from becoming learning organizations. But the initiative towards this change has to come first from within the research system. Some of the silver lines at the edge of the cloud are:

i) Scientific manpower and research network

We have the unique advantage of having the largest network of marine research institutions functioning along the vast coastline of the country. The excellent scientific manpower available with these centers has the potential to bring radical transformations in each of the coastal village. What is required is to have an institutionalised research paradigm that takes a balanced view on both fish and fisher folk.

ii) Change in attitude of fisherfolk

Another promising factor is the change in attitude of fisher folk towards conservation orientation. It may now be available only as a subliminal force in their cognitive domain. But it can be kindled using imaginative communicative interventions. Effective extension is effective

communication. But the very process of development of communication tools itself can be converted into opportunities of co-learning and stakeholder participation(See Box 22). It is equally important to encourage initiatives for responsible fisheries by providing suitable incentives. As already indicated welfare measures can be intelligently redesigned here.

Box - 23

Communication interventions for Responsible fisheries-Initiatives at CMFRI

A number of communication tools and strategies have been developed under the research project "Designing and Validation of communication strategies for responsible fisheries-A Co-learning approach" implemented at CMFRI with financial assistance from the National Agricultural Technology Programme. The hallmark of the project has been the active participation of stakeholders at every step of designing and validation. The message and medium of communication were selected based on the findings of the Assessment for Responsible fisheries Information Needs.

The notable outcomes of the project are:

a) Communication tools

1. The Malayalam translation of the FAO Code of Conduct for Responsible Fisheries(CCRF)
2. Fisher friendly versions (books and brochures with cartoons and illustrations) of the code in Malayalam and Hindi.
3. Animation films in all maritime languages of India. (Incidentally, the English version of the film titled "Little fish Tiny Nets "was short listed in the Earth Vision film festival held at Tokyo,2003)
4. Campaign materials wall-hangers, T-shirts etc. with the message of responsible fisheries.
5. Videofilm 'Colourful voices for Responsible Fisheries'

b) Communication strategies

1. Designing and validation of communication tools through active participation of stakeholders .(For eg. an All Kerala painting competition for the students of fisheries –related educational institutions on the theme of responsible fisheries and a Participatory painting on the same theme were conducted . The prototype of the animation film was pre-tested in different coastal villages and changes as suggested by fisherfolk were incorporated).
2. Co-learning workshops for fisher folk where scientists and fisher folk shared

their knowledge and experiences.

3. Radio talks, articles in newspapers, fisheries-related magazines on Responsible Fisheries.
4. Telecasting the animation film through the "Doordarshan" channel at periodical intervals and conducting feedback studies in selected coastal villages.
5. Public functions for the release of the tools developed.
6. Making the tools available at Internet under www.aticcmfri.org.
7. Distribution of copies of FAO CCRF to NGOs, individual fishers, and fishery-related officials

(Source : *Ramchandran,2004*)

iii) Alternative technological options

The research system has already produced a basket of alternative livelihood choices. The potential areas for the uptake of these choices can be first identified using GIS platforms and then their location specificity can be ascertained using PRA techniques. But it should be ensured that these options do not create new forms of ecological degradation as well as resource use conflicts that further impoverish people who are dependent on the resource.

iv) Rich tradition of Local Ecological Knowledge

The Traditional knowledge base has evolved around the astonishing level of biodiversity available along the coasts of the country. Along with documentation enough attention need to be given on how to mobilize social power behind this knowledge base. "Professionalising" artisanal fishers (who happen to be the custodians of this knowledge) through modernization of crafts and gears is likely to be counterproductive. One way to keep these traditions alive is to reward indigenous innovations after scientific scrutiny by the research system. Competitions can be held to identify and promote innovative ideas like new gears (for instance, those that reduce by-catches/juveniles).

The transition process to a responsible marine fisheries scenario is not a technological fix. It is a socio-political one built fundamentally on cognitive changes in the stakeholders. Mere supply of information will not result in voluntary changes in behaviour. As Olsen (2003) remarks, a connection has to be made between values and beliefs of an individual or a society. The best way to engender this empowering connection is to make the stakeholder, hitherto considered as a social outlier, an active epistemological partner in the creation of the very knowledge system upon which a praxis of responsible fisheries is constructed.

In short our aim must be, to paraphrase Mahatma Gandhi, to make "every coastal village a

research laboratory; And every fisherman a scientist". The inherent weaknesses in the policy domain or institutions should not be treated as excuses for inaction. The charm of *No-management* is deceptively disastrous. It is hoped that any attempt to redefine the whole research-extension system in the lines suggested here would be rewarded in the future.

In the struggle against *uncertainty*, which is the defining statement of marine fisheries, the only silver line is Hope-the kind of hope as conceived by Vaclave Havel (1990), the great Czech playwright and statesman,

...hope is not the conviction that something will turn out well

but the certainty that something makes sense, regardless of how it turns out...

1
ANNEXURE

Conflict resolution or *sui generis* co-management?

- Case Study on Kadakkody (Sea court) in Kerala, India

Introduction

While building scenarios for a brave new world in fisheries by 2020, Delgado *et al.* (2003) says "sustainability- motivated environmental regulations and institutions will rapidly become more prominent, starting in the developed countries and then spreading to developing countries." Locating the source of future innovations in fisheries management as a geographical exclusivity may smack of either cultural appropriation or a lack of appreciation on the ecological motivation that can be supplied by certain institutional forms of natural resource management that still exist in some of the developing countries. Though the focus/rationale of modern fisheries management informed by fisheries science over a period of hardly two centuries, mostly a phenomenon of the developed countries, has vacillated from "Prisoners' Dilemma" of the 1950s to "Precautionary principle" of the 2000s the challenge has remained the same. In this context it would be of interest to find that a traditional community based marine fisheries management institution namely *Kadakkody* has stood the test of many centuries in India.

The baffling persistence of this unique institution as well as the institutional reinvention it has undergone offers a unique opportunity to probe an interesting array of questions. Prominent among them are 1) How and why this institution has survived? 2) Should or can the State support it? and 3) Does it offer any design principles /insights in reinventing sustainability –oriented institutional forms appropriate to the peculiarities in tropical marine capture fisheries?

The analysis is attempted in the pattern of a grounded theory approach and hence no *a priori* theoretical framework is followed. The paper is divided into I) description of the structure

and functions of *kadakkody* along with an eye- witness account of the litigation process II) an examination of its legitimacy as well as role as a CBMFMI III) interplay of factors that define its evolution and IV) Role of the state and policy implications.

I) The Structure and functions of *Kadakkody*

The *"Kadakkody"*, which is considered as a linguistic aberration of the Malayalam word *kadal-kodathy,* literally means "sea- court" (*kadal* =sea and *kodathy* =court). But it functions more than as a court as it has legislative, executive and judiciary roles to play in the Araya and Dheevara communities of Hindu fishermen belonging to Kasargodu district of Kerala[1]. *Kadakkodies* make their presence felt strongly in four regions viz., Kasaragod, Kizhoor, Kodikkulam, Bakkalam in Kasaragod district.

What makes this traditional community institution, working mainly as a conflict resolution mechanism unique is the supposed role it plays as a Community Based Fisheries Management Institution. No such institution has been reported from any other maritime states of India. Though functional only in a few pockets of North Malabar coast of Kerala, these age old institutions are similar to many of the *Caste Panchayats* which were prevalent in rural India.

I.a) **Constitution of the *kadakkody***

The *kadakkody* enjoys judiciary as well as executive powers by virtue of certain peculiarities in its constitution. Each *kadakkody* is an adjunct to the temple of the fishermen community in each village. The ruling deity in all these temples, and hence the village, is *Kurumba Bhagavathy* who is considered as the most-worshipped "mother goddess" (Devi) among Hindu fisherfolk in Kerala.[2]

Each *kadakkody* consists of three distinct bodies, the members of which sit separately in three groups when the court is in action. They are *Sthanikans, Kadavanmar/Sahayiees and the Temple committee. Sthanikans* (meaning "the permanently authorized") who are 11-13 in number are directly involved in the conduct of the temple rituals. They constitute the jury. *Kadavanmar* are assistant priests acting mainly as temple messengers. They represent the "police". The temple committee is a democratically elected body. Each of the three bodies are discussed below:

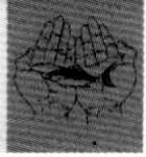
I) Sthanikans/" the Jury"

The *Sthanikans* are composed of four separate constitutional groups, namely *Karanavanmar, (4* members*) Achanmar/Kshethresanmar (6* members*), Kodakaran (1* member*) and Anthithiriyan (2* members*).*

The composition of the jury (Table 13) is further elaborated below

a) Karanavanmar

They are revered as the high priests of the temple and they act as "magistrates" in the



kadakkody. (*Karanavar* means "the doer" / "the causer"(Jeffrey,1992)). They are family heads with high prestige and ceremonial powers and belong to four *"Illams"* which are ancestral families of temple priests called *"Karmikal"* –the one who is hereditarily authorized to perform rituals. The names of the four *Illams* are *Chempillam, Kachillam, Karillam, and Ponnillam. Illam* is believed to represent the root family of the kinship group from which other families got branched off.[3]

Each *karanavar* is addressed by an ancestrally bestowed and permanent designation which indicates the name of the first (primordial) head in that particular family's genealogy. These designations are *Kandankaranvar, Karya karanavar, Panan karanavar and Kuppa karanavar.*

The appointment of *karanavar* is by virtue of a combination of factors like birth order and destiny. The eldest male member of each *Illam* is usually designated as *karanavar* in consultation with the astrologer.[4] Once designated as *karanavar* he is no longer called by his real name[5] .

The *karanavar* can be easily distinguished by the sartorial pattern they display in public which gives them a feminine look[6]. They always wear white *dhothi* and white *"veshti"*(a lose dress that covers the torso) ,clean shaven, but grow hair on their heads which will be kept folded on the back of the head as women do, and they wear golden ornaments like ear rings, necklace etc.

b) Achanmar

They are six in number and are basically oracles (*velichapadan*) at the temple. *Kurumba,* the main deity is in fact a composite deity consisting of four manifestations namely *Kurumba moothaval*(the elder Kurumba) *Ilayaval (the* younger one), *Dandan* and *Khandakarnan*. The oracle of each of these four manifestations is known as *Ayathan.*[7] There are two additional deities in each temple called *Vishnumurthy* and *Gulikan* whose oracles are not given any special name.

Table 13. The composition of the jury

Sl.No	Name/Title	members	Function in sea court.
1	**Karanavanmar / Kshethresanmar**	4	Act as "magistrates"
2	**Achanmar** *a) Ayathanmar (4)* *a) Vishnumurthy* b) *Gulikan*	6	Assist the magistrates
3	*Kodakaran*	1	-do-
4	*Anthithiriyan*2	2	-do-

c&d) Kodakkaran and Anthithiriyan

Kodakkaran *is the one who holds the ceremonial umbrella over the deity during temple festival and it is the duty of the* Anthithiriyan *to light the evening lamp daily at the temple.*

II) Kadavanmar (the messengers / "police")

They are assistants to the major priests, and are hence called *upa- karmikal*. They act as messengers in the *Kadakkody*. Occasionally they take the role of "police" in accosting the complainant to the court at the command of the jury apart from providing services like passing errands and making announcement of holding of the court by hoisting red flags[8] along the beach (known as *kodivalikkal) or* hanging fresh coconut leaves on the boats (known as *tholuvekkal*). No boats will go for fishing once the signal for holding of the court is given.

III) The Temple committee

This is a democratically elected body, which looks after the administration of the temple. The committee has a president, a secretary and a treasurer. This is a comparatively recent addition to the court and can be interpreted as an attempt to strengthen the legitimacy of the court in tune with democratic aspirations of the community.

!.b) The working of the court- A brief eye witness account

In order to understand the working of the court, a brief account of proceedings of a court, which we attended (and video documented) at Kasaba Beach at Kasaragod on 14th January , 2004, is given. We witnessed the arbitration of three different issues and an accidental case of instant punishment meted out to two fishermen for violating the decorum of the court. The proceedings are narrated under six events in chronological order.

Event 1. Signalling the summoning of the court

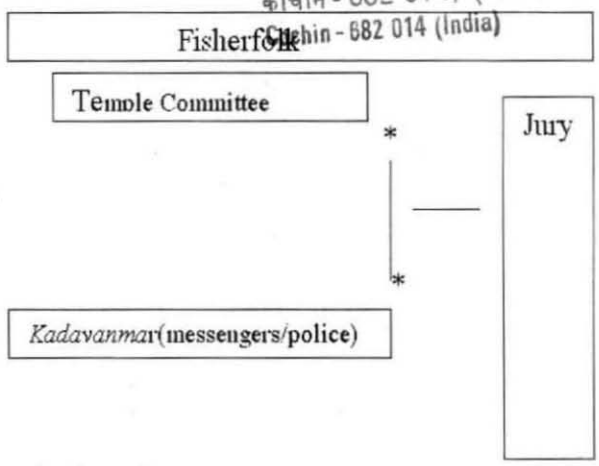
The red flag indicating the holding of the court was hoisted by 3pm in front of the temple yard on the beach.

Event 2. Holding of the court

The court was held at the open beach and lasted for about two hours from 5.30pm. to 7.20pm. The sitting arrangement of the court is graphically shown below.

The *Sthanikans* /jury (13 members) sat on the beach facing east with the Arabian Sea at their back (west). The *Kadavnmar* sat on their left and the temple committee on the right side. People sat behind the temple committee leaving an open space in front of the jury. About 200 people , interestingly all men, had gathered to participate in the proceedings.

Fig. 12 Sitting arrangement of the court



Event 3. Reading out the Agenda

The proceedings started with the Joint secretary of the *Sree Kurumba Bhagavathy* Temple Trust reading out the agenda. On top of the agenda was the issue of recent hike in kerosene price announced by the Central Government. Other issues consisted of a clemency petition "filed" by the sea court of *Kodikkulam* on the issue of transgression of "boundary" as well as use of banned gear by fishermen from the adjacent village and a complaint on inequity in taking up of catch share to the temple.

Event 4. Adjudication process

The items in the agenda were taken one by one by the jury. The jury subjected each item in the agenda to meticulous examination. There was serious deliberation, which was marked by the full-throated participation of many of the fishermen assembled. No one was barred from expressing one's own opinion.

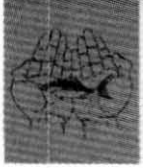
A brief discussion on the agenda items, which were considered by the court, is given below:

Agenda 1. Kerosine permits

The hike in kerosene price announced by the central government (from Rs 10 to Rs 26 per litre) and consequent reduction in granting of kerosene permits was the hot topic. The court , after taking note of the opinions expressed by the fisher folk assembled, ruled that, since the issue was a common one affecting all fisherfolk of the State it has to be confronted in coordination with other *kadakkodies* and so it was adjourned for further discussion.

Agenda2. Transgression of "boundary" and use of banned gear by fishermen from the adjacent village

A boat which went for fishing from the adjacent village called *Kodikkulam* was alleged to have done fishing near Kasargod coast in violation of the regulations of the Court. The fishermen of the boat when tried to sell (by auction) their fish to the fisherwomen at Kasargod



beach they were forbidden by members of the *Sree Kurumba Bhagavathy* Temple Trust as it was found that the kind of net used by the *Kodikkulam* boat was not in vogue in Kasaragod. Later on, the boat crew gave a petition to the Sea Court at Kasargod through their sea court. It was argued (in the petition) that the boat was not landed deliberately but was forced to land at Kasargod beach due to drifting in the sea. They denied to have done any fishing in the Kasargod coast as the catch on that particular day was exceptionally heavy. Since the complainants failed to turn up on the day and the court could not decide whether the petition should be considered at all, it was adjourned for 17th January[9].

Agenda 3. Inequity in Catch share to temple

Another complaint brought to the attention of the court was regarding the refusal of some of the members of the *18 koottams* (a conglomeration of fishermen who go for fishing in groups of 4 boats with 40- 50 crew members in each boat) in the customary practice of giving a share of the catch to the *"Madham"*-(part of the temple where the monks stay and considered to be more ancient than the temple itself). It was alleged that the representative of the *Madham*, when approached the fishermen to collect the share, was humiliated recently. When the plaintiff argued that the boats which were not going for fishing also should be asked to provide the share there were noisy interventions by the fishermen assembled and obviously the opinion was divided. Hence the case was adjourned for another day.

Event 5. A case of Instant punishment

While the petition was being discussed under agenda 2, two young fishermen got engaged in verbal fight. It was against the decorum of the court and the fishermen were asked to face the jury. When they did not turn up voluntarily the jury ordered the *"kadavanmar*/police" to "arrest" them and bring to the court. The two fishermen were asked to stand at a distance of about 5-6 feet from the jury and about 10 feet from each other. Before entering the open space in front of the jury ("prosecution chamber") they were asked to remove their shirts and rubber shoes. They were grilled by the jury and their arguments were listened to . The arguments lasted for about 20 minutes. It was a tough time for the jury to prevail over them. At one point of time one of the *karanavan* had to warn the more belligerent of the two that the fate of his father who was drowned in the sea would visit him also, if he did not pay respect to the dictates of the court which is nothing but the will of *Bhagavathy*. Finally they were declared as guilty of violating the decorum of the court and were sentenced to undergo punishments. They were asked to perform 50 *"ethams"* (public genuflexion) right away and offer 1kg of castor oil[10] to the temple by each of them. At the request of few of the fishermen members the jury reduced the number of *"ethams"* to 25. The court admonished them not to repeat this kind of mis- demeanour after they performed the *ethams* in public.

Event 6. Closing of the court

The court ended by 7.20 pm unceremoniously. We were approached by some of the fishermen asking to delete the episode of instant punishment from our video recording, as it would offend their prestige. When asked to comment on their perception on the punishment no

one, especially the younger members with whom we interacted, seemed to question the authority of the jury.

II a) Legitimacy of Kadakkody

Legitimacy is defined as a reservoir of loyalty on which leaders can draw; giving them the discretionary authority of loyalty they require to govern effectively (Tyler, 1990). It is important in explaining the rule-compliance behaviour of actors. Legitimacy in fisheries is the acceptance of the applied regulations (Nielsen,2003). The legitimacy of *kadakkody* mainly owes to the fact that the entire adjudication process takes place in the context of a temple-centric value system. The factors defining the legitimacy of *kadakkody* are discussed below:

1) Divine Authority

Being staunch devotees of *Kurumba Bhagavathy* the Araya fishermen are very religious. Since the high priests of the local temple as well as the oracles of the "worshipped manifestations" of the deity constitute the jury, they hold immense normative and eclectic power over the community. They are revered as the visible faces of their Mother Goddess. Thus the decisions of the court are considered as "godly" or divinely ordained and so, inviolable. They believe firmly that violation of the decisions of the court would fetch them the wrath of the goddess. (Look at the way this belief is being cleverly manipulated by the *karanavan* as mentioned earlier). It is this authority, the source of which is internal,[11] that makes even the most severe punishment namely social ostracism acceptable among the members despite the availability of services of the State owned judicial system to the community[12].

2) Social embeddedness

According to Wilson and Jentoft (1999), the embeddedness perspective as developed by Polanyi (1957) and Granovetter (1992) , provides a bridge between structural and agency accounts of fisheries management. It maintains the basic dialectic perspective that man is both the producer and the product of society , and that social institutions ,despite their natural appearance ,are the construct of social action and choice.

The sea court is an institution, which is very well embedded (structurally, functionally and normatively) within the social fabric of the fisher community. This feature enables the court to ensure that the guilty does not escape using any loopholes in the law as it is deemed to be possible in the case of State legal system. The apparent homogeneity of the community (mutual familiarity, reciprocity, similarity in livelihood activities and values) makes it easy to enforce sanctions and to manage conflicts. In other words the ability of the community to transcend its narrow definition of "aggregation of utility maximizing individuals " to a "well-connected system rooted in kinship, culture and history" (Jentoft,2000) goes a long way in the success of the fisheries management system. It is interesting to note that most of the jury is active fishermen too.

3) Systematic procedures and behavioural norms

The court proceedings are systematically coordinated and executed despite the absence of any codified /written norms. The democratically elected temple committee sets the agenda for the court, as all the complaints have to be first brought to the attention of the committee. In the case of criminal offences like property disputes or physical assaults, an amount of Rs.50 (little more than $1) has to be deposited with the Jury through the committee. Inter regional disputes involving fishermen from other villages will be resolved by a joint sitting where the jury or its representatives of both the *kadakkodies* in question will participate. There is a set pattern for sitting arrangement for the different entities in the court (Fig.12).

4) Participatory and Transparent process

The entire adjudication procedure is conducted in a democratic and participatory manner. The decisions are arrived through detailed and meticulous examination/deliberation where everyone of the community has a right to express one's opinion. The social pressure thus accrued is so tremendous for the members that they cannot reject the decisions of the court.

5) Quick and fair judgments

The transaction cost in *kadakkody* is comparatively less as the court can be summoned at very short notice. The verdict is quick and punishments are instantaneous. One important feature that makes the system acceptable by the community in general is the flexibility allowed in punishments. The jury often reduces the severity of punishments if an open appeal is made in the court. Since their justice is rooted in a world view that is based upon relationship the threat of banishment is far more serious than life imprisonment or the death penalty, for it removes the very context that gives a person's life meaning and identity. The emphasis in adjudication is on dialogue, harmony and renewal rather than adversarial dispute and punishment in the modern legal system.

6) Functional diversity (Counselling and Catharsis)

Apart from playing the executive role the court also acts as an avenue for public catharsis as well as personal counselling. The jury gives a patient hearing to the arguments tolerating even vitriolic accusations and counter accusations to a large extent, which allows public release of pent up emotions of hatred or animosity. When cases like divorce, inter-caste marriages etc come to the consideration of the court it deliberately delays taking any quick decisions so as to provide sufficient time to the litigants for rapprochement leading to mutual settlement.

7) Shared sense of pride

Any kind of litigation except that of murder comes under the purview of the sea court. The community takes pride in the fact that the institutionalized judicial system comprised of the district court and the local police station gives preference to the sea court in resolution of any case emanating from the community. It is with an omnipresent sense of pride that the

respondents recalled that there was not even a single instance of a case having failed at *kadakkody* and hence brought to the Government judiciary system for adjudication.

II b) Role in Fisheries Resource Management

Kadakkody has been hailed as a viable institution for Community Based Marine Fisheries Management (Kurien 2003). But the question "whether *kadakkody* can be considered as a Community Based Fisheries Management Institution?" is seldom considered. An attempt was made to collect the unwritten or non-codified rules / norms evolved by the *kadakkody* over the years for the management of the fisheries resources across the four study areas. It was found that in general there were only four such measures now being practised[13]. They are given below:

1) Night fishing is banned during the months of June, July and August.

2) Gillnets are not allowed during monsoon. It is allowed after 5 of *Kanni* month[14] (ie around 20-21 September).

3) Fishing is prohibited during the following occasions

   a) days when the temple celebrates annual festival(ie 20-24 March)

   b) when there is a death in the community

   c) when sea court is summoned

   d) auspicious days or any day as decided by the temple committee

4) Fishery related disputes or conflicts should be first brought to the sea court

Status and Validity of regulations endorsed by the kadakkody

Night fishing during the months of June, July, and August has been banned and is strictly being followed as an age-old practice. However, there is a brewing discontent among the fishermen over the inability of the *kadakkody* in controlling mechanized boats coming from Mangalore located in the adjacent state of Karnataka doing night-fishing in their waters. This they alleged, defeats the restraint they have been imposing themselves. Such resentment among fishermen makes it difficult for the *kadakkody* to impose strict fines and punishments to the defectors within the community as it used to do in the past. Though the fishers are convinced about the harmful effects of night fishing there are reasons to believe that the persistence of the norm could be more due to the sea becoming inaccessible for their motorized crafts during these monsoon months. Two reasons could be attributed to this conclusion : 1) that night fishing is harmful to the fishery is scientifically contested; and 2) that the period of prohibition for the use of gillnets has been reduced since 1980s after the advent of motorization.

In order to understand the validity of night fishing as a conservation measure the type of gears used by the fishermen as well as the nature of their fisheries need to be looked into (Table 14).

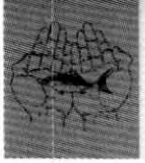


Table 14. Description of the fishery and gears

Sl No	Description of the gear Name	Length (m)	Mesh size (mm)	Cost (Rs million)	Major fishes caught	Time of use
1	Ranivala (*queen net*)	375-400	18-20	0.25	Sardines, Mackerel, Prawns	Any time
2	Ayilavala (*mackerel net*)	450-475	58-60	0.05	Mackerel	monsoon
3	Driftnet	900-1000	100-110	0.1	Seerfishes	Night fishing
4	Manchivala (*pomfret net*)	700-900	100-110	0.015	Manchi* (pomfrets)	Early morning evening
5	Kanathavala (*dense net*)	900	52-54	0.018	Whitefish, mackerel, small sharks, prawns	Any time

(Sardine=*Sardinella Spp;* mackerel=*Rastrelliger kanagurtha*; Seer fishes=*Scomberomorus Spp*; Pomfrets=*Formio niger (Parastromateus niger), Pampus argenteus,P.chinensis*; Whitefish=*Lactarius lactarius)*

**Manchi in Kannada refers to pomfrets*

But for one gear called *Ranivala,* which is a smaller type of ring seine, all others are indigenous variations of gillnets and most of the fishes caught are pelagic. The opinions[15] of fisheries scientists at CMFRI were, as shown below, divided over whether banning night fishing acts as a conservation measure.

a) "Not an effective conservation measure"

1) In fact night fishing was found to be beneficial (i.e. more catch) in the case of certain types of shellfishes like prawn (eg *P.monoceros*).

2) Though the period (June to August) coincides with the breeding season of most of the fishes caught there is no evidence that night fishing alone has a detrimental impact on their breeding behaviour. Daytime fishing also must be harmful. The only exception could be mackerel and sardine, which spawns during night. (Bal and Rao,1984). The spawning season of these fishes is given below. The studies indicate variation in the spawning season depending on the locality where the study was conducted. Since no study is available exclusively for Kasargodu region the results of studies conducted at Mangalore and Calicut[16] , between which Kasargod falls are shown. Mangalore is closer to Kasargod.

Table 15. Spawning season of fishes

No.	Species	Locality	Spawning season	Source
1	*Sardinella longiceps*	West –coast Mangalore Calicut	June-November May-Oct May-Oct	James ,1992
2	*Rastrelliger kanagurta*	West coast	June-Aug; Oct-Dec;Mar-July	James,1992
3	*Scomberomorus Spp*	SW Coast Mangalore Calicut	May-August Jan-Sep Apr-May	Bal & Rao,1984 Luther *et al*, 1997
4	*Formio/Parastromateus niger, Pampus argenteus, P.chinensis*	SW Coast Mangalore	July-October Oct-Dec	James,1992 Luther *et al* 1997
5	Prawns	SW coast	Through out the year	James, 1992
6	*Lactarius lactarius*	SW coast	November-March (peak Feb-Aprl)	CMFRI (2002)

5) Since it is difficult to prevent fishermen from other places doing night fishing in their waters the feasibility of the measure is doubtful.

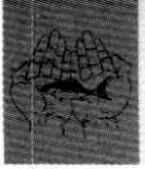
6) The state government has so far not declared night fishing as a destructive practice.

b) "Yes, *a conservation measure*"

1) Most of these fishes exhibit vertical movement in the water column during night. Higher catch also means higher percentage of gravid fish, esp. during the breeding season, which may lead to recruitment over fishing.

2) Gill nets are usually operated during night and the beneficial effects of its prohibition during the period is complemented by the fact that monsoon trawling by mechanized boats, which is otherwise done during day time, is banned by the State government during June-July.

3) It is interesting to note that night fishing using purse seines during September-December has been prohibited by the Karnataka Purse Seine Fishermen's Association in Mangalore coast (Kemparaju *et al* 1992).



III) **Interplay of factors**

The dichotomy in the fisher's as well as the scientists' rationale raises certain pertinent issues which boarder on two kinds of crises we are confronted with, that of fisheries science on the one hand and that of fisheries management institutions on the other.

a) Challenges in Fisheries science?

Since it is difficult to out rightly reject these measures imposed by the *kadakkody* as "unscientific", the typical positivist reaction would be to highlight the need for conducting more location specific studies on the behaviour of fishes as well as a study to assess the impact of indigenous regulatory measures. But the bigger question is whether it is necessary for the (public funded) fisheries science to crack its brains to provide a definite answer given the fact that there is allegedly a crisis in fisheries science itself (Symes 1996; Wilen & Homans,1998) .

Nothing captures the humility of fisheries science against its fatigue to be an unambiguous guiding light to fisheries management decisions,[17] especially in the tropical waters, than the concept of Responsible fisheries, which is premised on the precautionary principle. As Jennings *et al* (2000) admits, "in the absence of good science, insurance through the precautionary use (of no-take zones) may be preferable to reactive band-aids".

As in the case of any conservation measure, surmounting the difficulties of a neo-classical economic valuation process in appreciating the intrinsic natural values (Hannon, 1997) could be the real reason behind the alleged crisis in fisheries science. The challenge is how to accommodate the shift in the burden of proof without romanticizing traditional ecological epistemologies while searching for a post –normal science paradigm (Ravetz, 1999) in marine fisheries research.

It could be argued that the absence of ambivalence, unlike the scientists, shown by the members of *kadakkody* (for that matter any Traditional Ecological Knowledge systems) on the "scientific sanctity ' of their practices helps to fill what Cannibal and Winnard (2001) calls as a "strategic gap" in an information-poor context of environmental management.[18] The wisdom in resorting to a scientific legitimacy rather than a cultural one for making such decisions, as the case here, to manage the "chaotic interface between the social and biophysical complex", is questionable. Rather it warrants " a truly precautionary approach (which) requires a broader philosophical outlook than seeing the oceans as simply providing exploitable resources" (Gerrodette, *et al.* 2002). In that sense it would not be unjustifiable in romanticizing the TEKS as it would invite attention on a much needed paradigm shift though the implications are, obviously, detrimental to the livelihood options(!) of those perched on the fisheries science bandwagon.

b) Institutional challenges

Kadakkody is such an institution[19] that "is characterized on the one hand by having firm roots in local history, practice, and space, and on the other by being unwritten and non-codified,

thus permitting continuous interaction, with constant dual reference to continuity and change, to past generations as well as to present challenges" (Ruddle ,1992). The prevalence of this institution, despite the existence of various factors that threaten its survival, is mainly due to the strength of *social capital* that is inherently available to this community.

Social capital includes the behavioural patterns of trust and cooperation that create and strengthen relations among persons and organizations (Solow,1999). The role played by *kadakkody* in resolving other resource –related conflicts in the community so as to maintain the social integrity of the village is noteworthy. The most frequent cases that come for settlement by the *kadakkody* are compensation for destruction of fishing crafts and gears, dispute over fishing certain schools of fish targeted by another boat and credit tying labour-related problems.

It could be argued that it is the resilience of this social capital that could have prevented the "tragedy of their commons" (Hardin,1968) in the past. Nevertheless, it is doubtful to what extent *kadakkody* would tide over what Ostrom *et al.* (1994) has called as the common –pool resource problems, i.e. internalization of the externalities posed by technological advancements (heterogeneity, increase in fishing power, spatial and temporal enhancement) as well as the erosion of mechanisms for social exclusion caused by the encroachment of boats from other villages violating the established norms in these waters.

It is reasonable to expect that once the infrastructural impediments like lack of a fishing harbour in the area, are overcome these fishermen would graduate to technological up-gradations like mechanized trawlers, mechanized winches, electronic equipments etc. which would force the *kadakkody* to dilute the regulations. The outcome of such developments is the disintegration of these institutions as has already happened to *kadakkodies* which were existing in other villages like Kannur, Dharmadam, Chalil, Puthiyappa etc. of Malabar Coast in the past.

Disintegration of *kadakkodies*

The social homogeneity of the Araya fisher community, which has been acting as a bulwark against the onslaughts of various structural challenges- like prevalence of the State legal system, growth in literacy, support from state sponsored social security mechanisms, impact of Gulf money[20] etc,- that could have helped to weaken the hold of the court over a "newly empowered" fisherfolk-, is now being challenged by *technological heterogeneity*.

The use of different technologies like OBM s on their traditional crafts, new gears like ring seines,[21] (which were mini purse seines introduced by fishermen from south) practices like night fishing has polarized the community technologically and later economically vitiating the solidarity they used to enjoy as long as they remained traditional fishers in the true sense.

It is not without opposition that they accepted every new technology. It is worth examining why the xenophobia exhibited by the community could not sustain the endorsement it initially received from the *kadakkody*.

The practice of night fishing during monsoon was a taboo till some of the fishermen found it irrational not to practice the same when they discovered that it was the night trawling introduced by mechanized boats that caused a dwindling in their daily catch. Since the *kadakkody* had no means for prevailing its authority over the mechanized fishers as they came from other places the fishers perceived that the institution was incapable to provide stability which is the fundamental role of any institution[22].

The *kadakkody* found it impossible to contain the internal dissension, which led to an erosion of trust in it and this was found to be the major reason for disintegration of many *kadakkodies* in the region. As Giddens(1991) has pointed out ,in times of change it is but natural that the individual actor who is subjected to the change will have to reconstruct a new reference system with a new balance between stability and turbulence. The major impact of these developments, thus leading to a new reference point, was the abrupt disruption in the shared sense of resource *boundaries* which the community has been preserving through a system of social contracts (Mariussen,1996) . But livelihood pressures got the better of a collective feeling of *boni patres familias*[23] resulting in conflicts and unhealthy competition. Then the question is how the *kadakkodies* in Kasargod could withstand the forces of disintegration unlike those in the adjacent regions.

The answer lies in the following facts

1. Unlike the *kadakkody* in other villages the Kasargod *kadakkody* tried to make a collective response to the menace by convening a joint meeting of all the four *kadakkodies* to convince the members on the ill effects of night fishing during monsoon months. Though not a unanimous decision the *kadakkody* could agree that no one, at least from their community, would go for night fishing during monsoon months and the defaulters would have to face penalties, even excommunication.

2. The people gradually came to accept the fact that it was too dangerous and risky to do night fishing, as the sea would be very rough during monsoon months. More over, night trawling by mechanized boats had brought immense damage to their gillnets.

3. The ban on monsoon trawling declared by the Government of Kerala in 1988[24] gave a shot in the arm as night trawling during the ban period came to an end.

It is seen that an interesting combination of factors like the social cohesion in the face of an external threat, collective rationalization and the serendipitous benevolence of the State regulatory regime that have defined the persistence of this institution.

The future of Kadakkody- *Institutional innovations*

A countervailing strategy being tried out by the fishermen in this region is to engender a horizontal expansion of the social capital through *institutionalised networking* of *kadakkodies*. They have realized that institutional reinvention is the way out. One such attempt is the *Kadakkodi Samrakshana Samithy* (Association for the protection of kadakkodies) located at Puthiyangadi ,in Kannore district.

The association was established in the year 2000 as a registered society under the Kerala Cooperative Society Act by a group of local fishermen, majority of them belonging to Muslim religion, in an effort to revamp a Mosque-centric *kadakkody* that was active here till three decades back. The institutional innovation they have brought out has been the formation of the association as a lose coalition of four *kadakkodies* located at Madayi, Ramanthali, Mattoor, and Payyannoor. The association has a total registered membership of 600 fishermen, mostly of the motorized group using OBMs upto 80 HP. The membership, with an annual fee of Rs 10/(1$=45) is open to any active fisherman in the region. The association has a 35 member working committee, which is elected by the general body. The governing body consists of a President, Vice-president, Secretary, Joint secretary and treasurer. The Muslim community dominates (more than 55 per cent) the working committee. The body meets once in two months regularly except in the case of emergencies.

Apart from its active role in resolving conflicts as well as engendering fishing regulations (like ban of night fishing during June to August) the association is more involved in welfare activities like providing financial assistance during bereavement, accidents, marriage, children's education etc. The legislative and executive role is comparatively limited and the punishments/ sanctions are not as severe or religiously ordained as in the case of *Kasargodu kadakkody*.

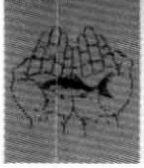
The working capital of the association is mainly raised out of contributions from each member, which is collected in kind as a share from the daily catch in addition to the annual membership fee. Though there is no upper limit the share should not be less than two per cent of the daily catch. They own an office room with a telephone connection. Interestingly the main mode of communication among the members is through telephone as there is at least one mobile phone in each boat of the members. In general, the association functions more like a fishermen cooperative society with a token role in imposing self –regulations.

Since the association has not established any formal linkage with the Kasaragod *kadakkkody*, despite their eponymous intention to protect *kadakkodies* there exists a space for vertical expansion in networking. As some of the members said the prospects got marred by the politicisation of the communal divide between Hindu Arayas and Muslims in the aftermath of massacres in Marad.[25]

IV) Role of the State and policy implications

The revival and rejuvenation of traditional customary systems in the context of the new realities with a limited but crucial government involvement has been suggested as one of the most promising political options for upgrading and managing artisanal fisheries (Panayottou,1982). The State is considered as the *de jure* owner of the marine resources and hence the responsibility of its management has been vested with the State. At the same time the State often is blamed as a graver predator by its inability to be proactive in the sustainability point of view (Bavinck, 1998).

Though the government of Kerala has so far not considered the *kadakkody* seriously as a



viable co-management mechanism, the action of the state in implementing fishery regulations like banning monsoon trawling has indirectly helped the legitimacy of the sea court. The decisions of the state needs to be based on scientific correctness and the incompetence of fisheries science, as explained above, to provide unambiguous recommendations make it a difficult proposition. Now, the question is Can or should the State take any role in this context? Or what lessons the case offers in terms of a policy framework for marine resource conservation?

It is not easy to answer these questions as we are now standing at the interface of two different metaphysical systems of world views. Before going further it is necessary to make a typological distinction for the two forms of sea courts we have discussed. The nature of social embeddedness, which the sea court enjoys, poses some problems in categorizing it as a Co-management institution *per se*. Since the role of the state has never been a historical *raison dieter* in its evolution and the fact that at present it is more of an understatement it would be better to call the former as a *sui generis* form of CBCRM institution and the other as State supported /induced CBCRM institution (A typological differentiation is given in Table 16).

Table 16. Typological differentiation of two forms of co -management

Characteristics	***Sui generis* form of CBCRM**	**State –induced/ supported CBCRM**
Level of Autonomy/Self-governance	High	Low
Basis of legitimacy	Divine	Legislative
Group Homogeneity	High	Medium
Compliance	High	Low
Social embeddedness	High	Low
Adaptability	High	Low
Ethos	Cosmic	Livelihood
Norms	Uncodified	Codified
Management agenda	Inclusive (fisheries is only a part)	Exclusive
Epistemological base	Socially Embedded Tacit Knowledge	Mostly an Officiated version
Ownership over means of production	Exclusive	Inclusive

That the State has not de-legitimised the *kadakkody* indicates that it has acted as an advocate of co-management by default. It is doubtful whether the state can ever take an overt role in co-management mainly because of the difficulty to define and monitor a boundary for the various resource users of an open access, multi- species, multi- gear fishery. However, reviving the possibilities of respecting boundary as a social contract as well as rekindling the

conservation orientation that exists, in however subliminal form it may be, in the collective cognitive domain (("social memory" (Berkes *et al.* ,2003)) of sea courts can be attempted by designing proper incentive structures for Resource Conservation Behaviour (Uphoff and Langholz,1998).

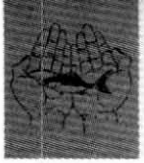
The inability to resolve the vexed question of "who actually owns it" has lead to the deplorable 'nobody owns it and nobody is responsible" state of affairs typical of common property resources. This violates a fundamental management principle: "responsibility is always vested with authority and authority is always vested with responsibility'. The most important insight from the case study is how the *sui generis* form of sea court has solved this management conundrum by invoking the philosophy of Divine ownership and authority. To own something is to feel personally responsible for its preservation. Here, the sense of individual ownership is achieved not as subversion but as sublimation of what they perceive as divine ownership.

It is not surprising why the fishermen have told almost unanimously *kadalamma" (the* goddess, mother sea), instead of ' the state", as their answer to the question "who owns the sea", though the reductionist paradigm we nurture, at least the ones who are still skeptical about the *Gaia* hypothesis (Lovelock,2003), would make us expect it otherwise. The sentiment of divine ownership (God's sovereign governance according to Bratton,1984) is a universal *leit motif* of all religions of the world. And this is more likely to breed an attitude of stewardship than the lack of it.[26]

But it is doubtful to what extent the group authority legitimized by this sentiment and built on the world view of "Community of beings" *vs* "Dominion over nature" has been used to mitigate the destructive results of unrestrained competition. To paraphrase Emerson , the power of divine ownership, as the basis of Co-management, has seldom been tried. This may sound anachronistic for the proponents of a secular democratic state. But a recognition, even if a rhetorical one, of this fact would help us to transmute the anarchy of a "data-less" management regime (Johannes, 1998) to the synergy of a "people –rich" one. In that case will it be less problematic if we address the question of ownership in a sense of ethical entitlement than that of material entitlement?

Ownership as social cognition is the outcome of an indigenous epistemology that views knowledge as a relationship (coming- to-knowing as Peat (1994) calls it) with an attendant array of obligations and responsibilities, which each member of the community has to observe as faith. Faith is the centrepiece of a connected life. It is this connectivity as a self-generating social network that creates a bond among the members of what organizational theorist Wenger (1998) calls as a "community of practice" characterized by the mutual engagement of its members in a joint enterprise resulting over time a shared repertoire of routines, rules of conduct and knowledge.

Fishing is still an all-men game. It has been pointed out that the ideological roots behind glorification of materialism lie in the universal association of manhood with individual possessions (Gilmore,1990). It seems that the feminisation of the Divine authority they



worship is an anthropological strategy to overcome the likely pitfall of "male ideologies", through the dominance of an 'object centered consciousness', violating the spirit of collective ownership. Nevertheless, there is no guarantee that resource conservation will top their livelihood agenda forever unless the State regulates the diffusion of technological innovations in harvesting, propulsion and even communication.

The usual approach in studying traditional systems of knowledge is to subject it to reductionist methodologies so as to generate a list of conditions/strategies under which commons are governed sustainably. The total number of factors that affect successful management of commons may be somewhere between 30 and 40(Agarwal,2001). But the question is "Can anyone create a sustainable institution by "shaking up" the factors deciphered?". One may point out that the only missing link is the will of the people. But the realization that it is an awfully enormous gap should augur well for the State (national and international) to be proactive in recognizing and fostering *sui generis* forms of CBCRM institutions across the world. The role of the State should be to enable political contexts that nurture the genesis and co-evolution of people's own resource management initiatives and institutions. What is required is the emergence of a new political ethos built on the foundations of ecology and ethics. A few possible such eco-political responses, which the state can initiate in this regard, are given below:

1. Like bio-diversity it is easier to protect existing forms of cultural diversity than trying to build it, howsoever grandiose may be our theoretical foundations of sustainability. (See Berkes et al 2003). So, providing International recognition and support to such institutions by declaring them as Global Marine Stewardship Heritages like the UN declaring Common heritage sites will definitely help to invite attention of other fisher communities to take motivational cues and to boost the morale of the members of these institutions.
2. The sustainability of these institutions can be ensured if special considerations are provided to them in the implementation of neo-liberal market strategies like eco-labelling, eco-tourism or making use of the WTO provisions under geographical appellations so that they can garner premium price for their catch.
3. While designing communication /extension strategies for responsible fisheries management these institutions can be used as benign models of public-private interface as well as sensitisation platforms (Schols, 2004). It is possible to make use of these platforms as social laboratories to instill positive behavioural changes among the fisherfolk by co-developing suitable modules using emerging cognitive concepts like Neuro-Linguistic Programming , Social Learning etc.
4. Necessary changes should be made in the fisheries policy of the concerned state to grant legislative sanction for legal autonomy in fisheries management related issues. It would be more effective if it is done in a holistic framework of local self governance rather than attempting fisheries management issues in isolation.
5. The state fisheries management institutions should seek the active support of the religious institutions prevalent in the region. It can call for religious institutions among the fisherfolk to go beyond the pontificating role of an external facilitator to that of an internal

mediator who acts as a bridge between ecology and faith. (Can the Pope for that matter any religious head, call for an end to the destructive practices in fishing as a condition for membership in the church?)

6. Unbridled penetration of capital in fisheries sector especially in the small-scale fisheries sector has relegated fishermen (who hitherto owned the means of production and thus the sea) into fish labourers. The state must initiate necessary legislative interventions for removing the "absentee sea-lordism" which is quite rampant now.

Conclusions

1. Coexistence of institutions of local self-governance in a "State within State" mode is not impossible. If the state is able to deliver the governance as well as stewardship functions which it is ought to do by way of effective enforcement of fishery regulations (eg as provided in the Marine Fishery Regulation Act in the case of Kerala) it will ensure the complementary survival of these institution and not vice versa.

2. The persistence of *Kadakkody* depends on a multiplicity of factors, which is so complex that it defies any bureaucratic duplication in its institutionalization as a co-management platform. Nevertheless, the process of its institutional reinvention can be made use of an opportunity to probe the possibilities of forging a convergence between public and private property regimes in the emerging context of decentralization of State power to local self-governance institutions.

   But it is to be borne in mind that the whole process is circumscribed by technological innovations-indigenous or introduced (which is aggravated by the fact that it is at present left unbridled) and the difficulties involved in achieving a real sharing of resource management power (Pomeroy and Berkes, 1997). It is not out of context to mention that the state should desist from taking a reified view on Indigenous *technical* knowledge and should take a stringent precautionary approach in preventing the spread of indigenous innovations, which are often nothing but cleverly manipulated contraptions to circumvent existing fishing regulations.

3. Since the epistemological base that defines the logic of the conservation ethic of the community is an embedded social construct, validation of its legitimacy is beyond the scope of modern marine fisheries science. Or, perhaps, the project of modern marine fisheries science has to undergo a radical *volte face* process of "normative contextualisation" which should enable its findings to get incorporated into the collective cognitive domain of the community.

4. If the conservation issues in tropical waters are too complex to invite mediation of a public-funded research system, the logic and logistics of the institutionalized marine fisheries R&D demands a serious review. It is naive to anticipate that a multi-species, multi-gear/craft, multi-ethnic open access context of marine fisheries will be able to be more sensitive to scientific realities than the political ones. As Hilborn (2002) remarks "the key to successful fisheries management is not better science, better reference points or more precautionary approaches but rather implementing systems of marine governance that provides incentives for individual fishermen, ,scientists and managers

to make decisions in their own interest that contribute to societal goals". This suggestion, however, is pernicious enough to leave the very social justifiability of the existing research configuration an open-ended dilemma.

FOOTNOTES

[1] Kasargod, which **lies between** North latitudes - 11°18' and 12°48'East longitudes - 74°52'and 75°26',is the northern-most district of Kerala State.The distance from the state capital Thiruvananthapuram is 575 km.

[2] According to one legend the *Kurumba bhagavathy* is an avatar of *Kodungallor Bhagavaty* , one of the most ancient mother god temple which is believed to have been constructed in the first century A.D. by Cheran Chenguttuvan, the famous Chera king for *Kannagi*, the legendary heroine of *Chilappadhikaram*,(a famous Tamil literary work) of the Cheras dynasty. According to the writings of Pliny, Kodungallur,- known as Musiri at that time was an ancient maritime port city and capital of the Chera kingdom-, had maintained trade relations with Rome. Another legend takes the view that the *Bhagavathy* had accompanied the forefathers of these fisherfolk when they were forced to migrate from Kollam in Southern Kerala after a young fisherman murdered the village ruler for molesting his sister. Before settling at Kasargod they came via Kodungallur.

[3] It is worth to note that *Illams* usually refer to the homes of Brahmin priests (*Namboodiris*),the highest in the caste hierarchy in Kerala.

[4] The astrologer takes into consideration the horoscope as well as the "interpretation of the formation the conch shells make when diced in a ritual called "prasnam vekkal"(resolving the puzzle)

[5] For eg. Though the real name of the *karanavar* of *Karillam* at Bekkalam is Krishnan he is now known as Panankaranavar and "Panan" is the name of the first *karanavar* of that *Illam*.

[6] When asked about the lack of representation of their womenfolk in Kadakkody one Karanavar told us that, with their feminine looks, they make good for it!

[7] 1.They are called as *Moothyothithan, Ilakothithyan,Dandothithyan, and Kandothithyan* respectively.

[8] Black flag is used to announce death in the community.

[9] We were informed later that the case was amicably settled in the sea court held on 17-01-04

[10] Castor oil is used for lighting the lamps in the temple.

[11] Absence of external authority ,if buttressed by cooperation and reciprocity among members of community will avoid tragedy of the commons(Axelord 1984)

[12] The nearest police station is hardly two km away and the district court is 5km away.

[13] But it was informed that there were more such regulations in the past and were stringently followed.

[14] In earlier days till the advent of motorization it was allowed only after 10th of *Thulam* (ie 9-10 October)

[15] In the absence of specific studies on the issue , what is given is 'scientific speculations"

[16] CMFRI has regional research stations at Mangalore and Calicut.

[17] Fisheries management is primarily a decision process (Hilborn et al .,1993)

[18] Strategic gap is a condition of imbalance between what an institution or culture is and what it would like to be, considering its ability to achieve that desired state within the constraints set by its external socio-economic natural environment.

[19] Institution is "humanly devised constraints that structure human interaction, made up of formal constraints (rules,laws,constitutions),informal constraints(norms of behavior, conventions, and self-imposed codes of conduct), and their enforcement characteristics.(North,1993 quoted in Berkes *et al* 2001))

[20] The remittance of people working in Gulf countries plays a dominant role in the economy of Kerala.

[21] Originally developed and introduced by Central Institute of Fisheries Technology, Kochi ,though later banned under the Kerala Marine Fisheries Regulation Act(1980),it is a very efficient gear for exploitation of pelagic fishes like oil sardine, mackerel ,anchovy etc.(Thomas etal.2003)

[22] The basic role of an informal institution is to give ontological security.

[23] Meaning "good heads of household" from a remarkable passage in Capital (Marx,Karl)..."They(Individuals on earth) are simply its possessors ,its beneficiaries, and have to bequeath it in an improved state to succeeding generations as *boni patres familias*.."(Quoted by Foster,2000)

[24] The ban is now effective for 45 days from 15th June to 29th July every year.

[25] Recent incident of a series of massacres in a coastal village in the adjacent district of Calicut is alleged to have widened the gulf between the two communities in the Malabar coast.

[26] *The good shepherd gives his life for the sheep . The hireling cares not for the sheep*(John 10v11-12).

2
ANNEXURE

Technological change in World Marine Fisheries - A Historical trend line

Prehistoric times

85000	First recorded use of active fishing techniques (spears, arrows, or stones)
10000	First maritime people –The Maglemosians who lived along the Baltic coast
8000	Use of hooks (wooden and bone) in Greece, Egypt,
2000	Use of nets in Egypt

Historic times

1870	Small sailing vessels (smacks) were fishing with beam trawls
1878	First steam trawlers which increased towing power.
1880	Introduction of Otter boards that enabled use of larger nets First Government Fishery Biological Research Institutions (For eg. The Danish Biological station (under one man ,CG Petersen, later absorbed in Danish Institute for Fisheries and Marine Research in 1952) and an Institute in Denmark were established in 1889)
1890	Steam powered drift netters
1899	First multilateral fisheries conference at Stockholm
1900	Reduction in smack fishing fleet, Catching small fishes for making fish meals as animal feed Formation of ICES (International Council for the exploration of the Sea) 1902 at Copenhagen
1910	Reduction in fishing pressure due to World War I
1920	Emergence of Soviet fishing fleets, Introduction of I) Trawling for herrings, I) bridles and bobbins on otter trawling gear enabling bottom trawling iii) anchor and fly seining Industrial production of fish meal-intensive fishing of small pelagics

1930	Bills passed in European parliaments prohibiting landing of plaice and haddock under a certain minimum size
	Introduction of I) Radio telephones ii) Echo sounders iii) powered line and gillnet haulers
1940	World war causing 70% reduction in catches
	Introduction of stern trawling with otter trawls
	"North sea convention" under which European fishery nations agreed for minimum landing sizes and minimum mesh sizes for some important species
1950	Ecosounder used as fish finders
	Synthetic fibres used for net and rope manufacture
	Power blocks for hauling nets
	Ship-board freezing facilities
	Icelandic code wars
1960	North east Atlantic Fisheries Commission
	Introduction of double-beam trawling
	Beginning of Single vessel mid-water trawling
	Introduction of quotas for herring catches
1970	Icelandic code wars (1975-76)
	Imposition of 200 nautical miles fishery limits (EEZ)
	Total Allowable Catch (TAC) for sole, plaice
	Total ban on North sea herring fishery
	Introduction of pout box as a conservation measure
	Establishment of ICLARM
1980	Individual Transferable Quota system in Iceland, Newzealand
	EEC Common Fisheries Policy
	Unite Nations Law of the Sea.
1990	Cancun declaration –the FAO Code of Conduct for Responsible Fisheries
	Development and application of ecosystem tools like
	ECOPATH, ECOSIM, ECOSPACE
2000	Reykjavik Declaration on Ecosystem Based Fisheries Management

(Sources : *Christensen, 1989., Jennings et a l 2002., Mc Goodwin, 1990*)

3
ANNEXURE

Technological change in Marine Fisheries in India - A Historical trend line

1780	First attempt to study Indian fish fauna (mostly inland) by Russel
1860	Francis Day's studies on fish and fisheries of India (1868) First marine fishery survey by Col.Alcock (1869) Export of fish oil (sardine) from Malabar to London
1880	Department of fisheries in Madras
1890	Indian fisheries Act (1897)
1900	-Industrial commission recommends fisheries studies by Central Government
	-Studies by Sir F.A.Nicholson and Dr.James Hornell
	-Post of Fisheries Officer (Nicholson in 1905)
	-Survey of offshore fisheries using steam powered vessels
	-Post of Director of fisheries (Nicholson ,1907)
1910	-Off shore Fishing by steam powered vessels
	-WH Lucas Report-I) trawling experiment within 30 fathom Bombay Coast was a failure ii) provision of duty- free salt to boats staying more than 24 hrs
1920	-First Cooperative society for Fishermen (Kerala, 1917) -first Indian Director fisheries –Dr Sunder Raj -Surveys using Bottom trawlers ("Lady Goschen") (1927-29) - Committee recommends the closure of Madras fisheries Department
1930	- Studies by Hora
	- Report by H.T .Sorley-recommends post of Fisheries Inspector
	-Introduction of freezing technology for fish storage
1940	-First report on Fishing industry

-Proposal for establishing a Central Fisheries Research Institute by Baini Prasad, Director Zoological survey of India (1943)

-Establishment of CMFRI at Madras (1947 3 Feb)

-Establishment of CIFRI, Barrackpore (1947)

- Deep-Sea fishing Station , Mumbai (1948)

-Introduction of steam trawlers for surveys (1948-"meena")

-First All India Fisheries conference

1950 –FAO assisted programmes on small craft mechanization

Introduction of trawling

-Technical cooperation Agreement between UN, USA and India

-Indo Norwegian Project (INP) -1952

-Export of frozen shrimp (13 tonnes) to USA from Kochi (1953)

-Advent of Nylon nets

-Introduction of gillnets

-Bull trawling with Japanese help by New India fisheries Company Mumbai

-Fishermen training center at Satpati, Gujarat (1954)

-Establishment of CIFT, Kochi (1958)

-Fish processing industry

1960 -Establishment of Central Institute for Fisheries Education , Mumbai (1948)

-Marine Product Export Council (1961)

-Central Institute of Fisheries Nautical and Engineering Training (CIFNET) , Kochi (1963)

-Manufacture of Marine diesel engines

- National Institute of Oceanography, Goa (1966)

-Introduction of 32' trawlers.

-Introduction of Bottom trawling

-International Indian Ocean expedition

-100% Indian built trawler ("Meena Khojini") 1969, Mumbai

-First Fisheries College (Mangalore –1969)

1970 -Pelagic Fisheries Project (PFP) at Kochi

- CMFRI HQ at Kochi (1971)

-Integrated Fisheries Project (IFP) 1972

-diversified products

-Marine Product Export Development Agency (1972)

-Trawling by Mexican outrigger trawlers (Union Carbide Company)

- Exploratory Fisheries Project (EFP):

- Surveys using steel trawlers for demersal sources

-Introduction of Purse seine (1975, Karnataka coast)
-Fisheries Cooperatives under NCDC (1974)
-Declaration of EEZ (1976)
Chartered and Joint venture schemes for deep-sea fishing
-State Fisheries Development Corporations
KVK of CMFRI (1977)
-Fisheries College in Tamil Nadu (1977), Kerala(1979)
-Bay Of Bengal Programme (1979)
-Establishment of Fisheries Harbours

1980 -Extensive deep sea surveys under EFP
- Maritime zones of India (Regulation of fishing by foreign vessels act) 1981
-Introduction of Tuna long liners
-Introduction of OBMs and Intensive motorization
-Agitation by fishermen in Kerala
-Central Institute for Brackish -water Aquaculture (1985)
-National Bureau of Fish Genetic Resources (1983)
-Fishery Survey of India (1983)
-MFR Acts (Kerala and Goa (1980) Maharashtra (1981) Tamil Nadu (1985), Karnataka (1986).
-Kerala Fishermen Welfare Act, MATSYAFED (1984)
-Beach Landing Crafts by BOBP in eastern coast
-Gillnets made of High Density Polyethylene
-Monsoon trawl ban in Kerala introduced
-Introduction and popularization of ring seine or mini purse seine
-Commissions to study fisheries conflicts (Babu Paul,1984., Kalawar,1985., BalaKrishnan Nair(1988))

1990 -Introduction of echo sounders
-Introduction of Mini Trawling
-Small trawlers venturing deep-sea prawn
-Multi Day fishing
-MFRA by West Bengal
-FAO Code of conduct for Responsible Fisheries in Tamil

2000 -FAO Code of conduct for Responsible Fisheries in Malayalam (2002)
-Traditional crafts modified to fit Inboard engines
-Traditional crafts made out of Fibreglass
-MFRA by Gujarat
-Use of mobile phones

(Sources : Dixitulu & Paparao, 1994., Korakandy, 1994., Bensam, 1999)

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