United Nations Team for
Tsunami Recovery Support

Food and Agriculture Organization
of the United Nations

# Fishing Fleet Reduction and its Livelihood Implications

## *A Case Study of Palk-Bay Resource Users in the East Coast of Tamil Nadu, India*

SIFFS
South Indian Federation of Fishermen Societies

Centre for Maritime Research (MARE)

By
**Jyothis Sathyapalan**
**Jeena T Srinivasan**
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**Final Research Project Report submitted to**
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*Photographs Courtesy: CESS and V. Vivekanandan/ SIFFS*

## Context of the study

The United Nations team for Tsunami Recovery Support (UNTRS) in Chennai is facilitating the process of Tsunami recovery support through interventions that sustains disaster mitigation and ensure long term development. The Food and Agriculture Organization of the United Nations (FAO) as part of the UNTRS focuses on Fisheries livelihoods areas. FAO/UNTRS is promoting efforts to set clear directions in addressing the un-addressed issues that are important to ensure sustainable fishery based livelihoods with a pro-poor focus.

Sustainable fisheries management in the lines of co-management is an important focus area to ensure sustainable livelihoods for marine fishers.. Apart from pilot projects on developing fisheries co management model, there was a felt need of looking at the fishing fleet strength, its viability from the socioeconomic, resource base and livelihoods point of view. This is to help evolve appropriate fleet regulation mechanisms for Fisheries management. It is in this context that FAO/UNTRS as per the suggestion of the South Indian Federation for Fishermen Societies (SIFFS), engaged Centre for Economic and Social studies (CESS), Hyderabad for a study on possibility of trawler fishing Fleet reduction in Palk bay area. Palk Bay having the largest concentration of trawlers in the Tamil Nadu Coast and being an area with comparatively more regulations in place, it was chosen as the study area.

The study findings and recommendations would be taken up for discussions with various stakeholders including the policy makers to bring in most suitable policies on fleet regulation as part of Fisheries management.. It will also be an input for the forthcoming project, Fisheries Management for Sustainable Livelihoods (FIMSUL) with the Government of Tamil Nadu and Puducherry.

The study has taken Palk bay area as a typical case and looked into the existing trawler fleet strength and spread, the fishing operations and regulations, viability of fishing, factors contributing to and affecting sustainable fishing, the livelihoods implications on the owners, workers and ancillary workers. Fleet reduction and regulation strategies with emphasis on a proposed buy back scheme is discussed. The international principles and experiences are also discussed.

The study is hoped to be an important information base for policy makers, Non Governmental Organisations, FAO, other development support agencies and Fisher organisations to advocate for and take up most appropriate fisheries management measures.

We also take this opportunity to thank the study team from CESS and SIFFS for the experienced hard work. Special thanks to the Centre for Maritime Research, Amsterdam for their pro active and voluntary participation in the study and their valuable contributions. We thank Mr. Pieter Bult, UN Coordinator, UNTRS, the whole UNTRS team, Dr Daniel Gustafson, FAO India Representative, FAO fisheries experts (especially Dr Rebecca Metzner, Dr Jeremy Turner and Dr Rolf Willmann) of Rome and Bangkok, UNDP, UNFIP and DFID for all the support and cooperation. We are grateful to all the Government officers, NGO and INGO representatives, experts and fisher representative who had directly or indirectly contributed to the study. Special thanks to all officers of the Department of Fisheries Tamil Nadu

We thank all the participants of the workshop held at Chennai on 29th and 30th October 2007 on the study and for all the valuable feed back to improve and make use of the study. We specially thank Ms. Leena Nair, IAS Secretary to the Government of Tamil Nadu, Animal Husbandry dairying and Fisheries and Mr. Shambu Kallolikar, IAS, Commissioner of Fisheries Tamil Nadu for all their support.

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**Acknowledgements**

We are happy to place on record our deep sense of gratitude towards those who have made valuable contributions towards the completion of this work. At the outset, we are thankful to the FAO/UNTRS for entrusting this important work to us and for providing the financial support. Mr. C. M. Muralidharan, Fisheries Livelihoods Coordinator, FAO/ UNTRS has been very supportive and encouraging throughout the study.

We wish to express our sincere thanks to him. Here we also wish to express our gratitude towards Mr. V Vivekanadan, Chief Executive, SIFFS for suggesting this study to the FAO/UNTRS and for his co-operation and valuable inputs throughout the study.

Thanks are due to Prof Maarten Bavinck, MARE, University of Amsterdam, the Netherlands for sparing his valuable time for the study despite his busy schedule. His thoughtful comments and suggestions have been very valuable for the study. We are also thankful to Prof. V Ratna Reddy, CESS for his comments and support.

We wish to thank numerous persons who have rendered valuable support and help at the stage of data collection. We are most thankful to the research team from SIFFS for meticulously collecting the data required for the study. Sajith Sukumaran, Thaddeus Koriya, Alphonse Lordon, Antony Benchilas, B Subramaniam, Arulandandam Iruthayasami and Raja Retnam deserves special mention. We would also like to express our gratitude to Yoga Swaminatan, who functioned as an invaluable research assistant and interpreter during the qualitative field work.

We are grateful to Prof. S Mahendra Dev, Director, CESS for all the support and encouragement given to us during the period of this study. The support of the library and administrative staff of our respective institutions are also gratefully acknowledged. We thank Dr. Padmanabha Rao for preparing the map of Palk Bay landing centres and infrastructural facilities. Thanks are due to Mr. Ahmed Khan, Memorial University of Newfoundland, Canada for providing us with some valuable literature.

The service rendered by the officers and staff of the Fisheries Department, Tamil Nadu for obtaining information and secondary data is gratefully acknowledged.

Last but not least, we feel indebted to the many fishermen in the Palk Bay - crewmembers, drivers and owners alike, boat owners associations - who so generously and patiently offered their time to answer our numerous questions while in the field. Thanks is also due to Mr.R.H.Itagi, Bangalore for copy editing the report.

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## Abbreviations and Acronyms

| | |
|---|---|
| ITQ | Individual Transferable Quota |
| TAC | Total Allowable Catch |
| TURF | Territorial Use Right |
| CDQ | Community Development Quotas |
| IEQ | Individual effort quotas |
| FAO | Food and Agriculture Organisation of the United Nations |
| UN | United Nations |
| FD | Fisheries Department |
| IF | Inspector of Fisheries |
| ADF | Assistant Director of Fisheries |
| DEA | Data Envelopment Analysis |
| NGO | Non Governmental Organisation |

# Executive Summary

**Background of the study**

There have been widespread calls for global reduction in fishing fleet sizes and fishing efforts because of instances of severe over fishing and slow or dramatic collapse of fish stocks. Overcapacity which manifests in terms of technical inefficiency has been identified as the single most important factor threatening the long-term viability of exploited fish stocks and the fisheries that depend on them. This requires significant reduction in the existing fishing capacity.

The primary reason identified for overcapitalisation and over fishing has been the absence or lack of well defined property rights. When property rights are not well defined and enforced, individuals have no incentive to restrict their action even though the combined effect of each individual's action results in reduced stock size and potential yields and profits. Therefore, addressing the underlying property rights issue is of utmost importance. Property rights are a subset of institutions which structure incentives and shape human interactions. The central challenge of fisheries management lies in creating incentives that lead to desired behaviours.

**Objectives, Data and Methodology**

The primary objective of the study has been to document the characteristic features of the trawler boat fisheries in the Palk Bay, assess their technical efficiency and comment on the need for fleet reduction. A second objective is to explore the measures available for reducing fishing capacity in general and the possibilities of trawler fleet reduction through a buyback program in particular and its likely livelihood implications.

The study has used both primary and secondary sources of data. Primary source comprises both qualitative and quantitative data. Qualitative data has been collected from 10 mechanized boat landing centres along the Palk Bay during January- February 2007. A survey has been conducted among selected boat owners during April-May 2007 for collecting quantitative data on various aspects related to trawler boat fishery. The landing centres selected for the study are: Malli patinam, Sethupava Chatiram, Kottai patinam, Jagada patinam, Lanjadi, Chozliakudi, Tondi, Mandapam, Pamban, and Rameswaram. Further, a trawler boat chain analysis has been carried out to trace the number of other livelihoods attached to the trawler sector.

**Major Findings**

***Characteristic features of the Palk Bay Fisheries***

The Palk Bay is a geographically contained area in the east coast of Tamil Nadu and is dominated by trawler boat fishery. The Palk Bay is overcrowded with more than 2000 trawler boats of 28 to 50 feet in length with inboard engine capacity ranging from 68 to 120 horsepower. The surface area available per trawler is about 2 - 2.6 $km^2$. In the non-mechanised sector, motorized vessels consist of Vallam, Vathai, Ring Seine, Fibre glass boats, and others. Fishermen report that many species have declined considerably in the Palk Bay reflecting on the over exploitation of the resource.

The Palk Bay fishery is relatively better regulated than most other fisheries in India basically owing to its proximity to Sri Lanka. The maximum duration of a fishing trip is restricted to 24 hours during which both traditional and non traditional communities are involved in fishing activities.

The Fisheries Department of the Tamil Nadu government is primarily responsible for management of the Palk Bay fisheries although the presence of Coast Guard and Indian Navy indirectly contributes to fisheries management indirectly. There are also boat owners associations for dealing with both internal and external matters which include lobbying for the collective interests at the district and state levels and settlement of internal disputes.

The Department performs a number of welfare as well as regulatory functions. It is also mandatory for the Department to provide fishermen with identity cards and daily token with which they can identify themselves as genuine fishermen at sea. It has six offices along the Palk Bay. Most of the offices are badly equipped as they are thinly staffed.

The rules existing in the Palk Bay have both temporal and spatial characteristics.

The major rule pertaining to the spatial restriction is three nautical miles rule while 3 to 4 day trip rule has a temporal dimension. While the first demarcates area within 3 nautical miles for the operation of country crafts, 3 to 4 day trip or alternative day fishing rule is aimed at solving resource use conflicts between artisanal and

trawler fishing (especially drift net and trawlers) groups targeting the same species within the same fishing territory. In addition to these, there has been an annual ban put on place on mechanised boat fishing since 2001 which is fairly followed throughout Tamil Nadu. Violations or non-compliance of various rules and regulations are widely observed. Many trawler boat fishers are operating banned gears or adopting fishing practices like pair trawling. Misuse and misappropriation of subsidised diesel was also noted. It is generally observed that trawlers fully comply with 3 to 4 days rule. Coming to labour market characteristics it is seen that considerable demand for hired labour exists in the area mostly for upplementing family labour. Both wage and share contract co-exists while there are considerable market imperfections in the product market. The advance payment system aggravates the market imperfections as the boat owners are forced to sell their produce to the lender often at distressingly low prices.

**Technical Efficiency of Trawler Boats**

An analysis of the technical efficiency of trawler boats in the Palk Bay was carried out in order to assess excess capacity. The boats are operated with average four crew members consisting of both hired and family labour though their proportion differ across landing centres. The remuneration for the labourers varies according to skills required for the job. The major inputs, other than labour for fishing activities, are diesel, oil, grease and ice for preserving the harvested fish. The boat owners avail 1500 litres of diesel per month at a subsidised rate. This constitutes a major subsidy availed by the boat owners.

The technical efficiency of the boats which is related to the difference between the actual and potential output given both fixed and variable inputs has been estimated using stochastic frontier production function. In the production function, variable inputs have been used. Output have been measured in value terms and inputs like labour, diesel, oil ice etc in quantity terms. All the variables show the expected positive signs and have been found to be statistically significant. The output elasticity with respect to labour, ice and diesel have been found to be 0.38, 0.42 and 0.21 respectively. The average level of technical efficiency is 78 per cent indicating that the output can be raised by 22 per cent by following efficient harvest practices without having to raise the level of input use. It is further observed that 87 per cent of the difference between observed and the frontier output has been mainly due to the inefficient use of resources which are under the control of the boat owners. Conversely, the present level of output can be achieved with less use of inputs. It is very important to remember that the output includes the catch by crossing over to the Sri Lankan waters and therefore overestimates technical efficiency. Pamban, Thondi and Mandapam recorded the lowest technical efficiencies. Profits could be further improved by adopting better fishing practices as well as reducing the number of boats.

**Various options for regulating fishing capacity in the Palk Bay**

The present study also tries to explore the possible ways for achieving capacity and fleet reduction. As a first step we have classified the rules and regulations in Palk Bay in terms of incentive blocking or incentive adjusting measures. Incentive blocking measures attempt to restrict the level of activity of fishers whereas incentive adjusting measures address the fundamental question of property rights. In Palk Bay three types of incentive blocking measures namely limited entry through registration, time restrictions and gear restrictions are to be in place. In the wake of widespread violations, there is a need for more stringent monitoring and enforcement of above rules and regulations. Nevertheless, the three 3 nautical miles rule act as an incentive adjusting mechanism. Altogether, the level of fishing regulation in Palk Bay is relatively high as compared to other parts of Tamil Nadu or India. In this context, ‘Buyback’s of vessels are found to be an appropriate strategy for reducing the existing fleet size.

***Buyback: Feasibility and Livelihood Implications***

Buybacks, a key management tool in fisheries for addressing over capacity, over exploitation and distributional issues are considered as a form of subsidy. The important goals of this incentive blocking measure are conservation of fish stock and improvement of economic efficiency through fleet rationalization. Buybacks generally funded by governments, NGOs or international agencies are often considered as useful subsidies in fisheries unlike modernisation subsidies which increase fishing capacity.

We have explored the feasibility of buybacks in the Palk Bay and found that there exist certain favourable factors for launching a buyback program in the context of the existence of various rules and regulations. However, certain additional or supplementary measures need to be considered for making the program a success. It can be visualised as a strategic policy tool which can be utilised more as a transitional strategy rather than as a long term one in fisheries management. The interest of boat owners (who happen to be the primary stakeholders under the buyback program) have been captured by conducting a primary survey. It is

seen that nearly 23 per cent of the boat owners are willing to participate in the buyback program by selling their boats.

The analysis also tries to help us identify the determinants of the boat owners' decision making. Certain variables representing distress conditions of the boat owners act as both push and pull factors. Some boat owners facing hardships due to labour and money market problems feel distressed and want to quit fishery; for some others it is the lack of alternative livelihoods and the perceived difficulty in coping with another livelihood activity that pulls them back into fishery.

In order to understand the potential livelihood implications, a trawler boat chain analysis was carried out in two landing centres namely Kottai patinam and Malli patinam. We have noted that although there are as many as 30 activities or services which are related to fisheries only a very few are directly and proportionately related to a trawler boat. It was estimated that for every crew member in the sea there is 1.26 shore labours in Kottai patinam and 1.43 in Malli patinam. We also observe that these may be upper bound estimates due to the potential problem of double counting as people engage in multiple tasks.

Apart from these, some of the boat owners and crew members are likely to move to the traditional sectors leading to an increase in the fishing pressure within 3 nautical miles. Nevertheless, the positive externalities arising out of fleet reduction tend to more than compensate (in terms of stock recovery and abundance) for the negative effects of reduction in the per capita fishing ground in the long term.

**The way forward**

As technical inefficiency is a manifestation of excess capacity which in the longrun lead to overcapitalisation there is a need to reduce the fishing capacity in the Palk Bay. In order to control as well as reduce fishing pressure and encourage sustainable fishing a number of incentive adjusting and incentive blocking measures can be adopted. Adoption of the following measures is of utmost importance for ensuring the capacity reduction and sustainability of fisheries in the Palk Bay.

The entry of new capital into the fishery needs to be strictly restricted. Latent capacity need to be removed as this could be a potential source of threat anytime. Permit only selective technological upgrades. Upgrades which are harmful for the sustainability of biological resources should be restricted. Strictly enforce craft and gear and area restrictions.

Opting for buyback must be with a clear vision and defined objectives so as to prevent unintended overcapitalisation and unrealistic anticipation on possible future buybacks by fishermen from different places.

Provide scientific estimates of the maximum sustainable yield, and maximum allowable catch, etc from time to time in order to make more informed decisions for controlling fishing capacity. A fleet reduction program makes little sense in the context of Government subsidies for boat construction, modernization programs, etc.

While implementing buyback program, as far as possible, other input subsidies should be avoided or rationalised as they tend to prolong the transition towards alternative employment opportunities.

In the context of Palk Bay, the fleet reduction program and provision of alternative livelihood must go hand in hand. Measures to ease the credit constraints of the fishers will, to some extent, help fishers explore other livelihood alternatives voluntarily. For example, easing credit constraints will prevent at least some non-mechanized fishers (who aspire to become a trawler boat owner) from searching for alternative livelihoods.

Any loss of livelihood opportunities in the wake of buyback program needs to be compensated through creation of alternative livelihood opportunities. Insecure livelihoods can lead to social tensions and unintended outcomes of fleet reduction program. For better management of fisheries, the institutional capacity must be strengthened and better coordination of the activities of various institutions in the Palk Bay promoted.

Towards this end, it is necessary to encourage other institutions (e.g. NGOs) in mediating between government and fishermen. On the whole, it can be said that there is a need to guide the behaviour of fishermen and fishing fleets towards socially desirable goals by providing appropriate incentives and institutional environment. There is also a need to undertake more research on trawl sector, its intra sectoral and inter-sectoral linkages with other traditional fishing sectors so as to understand the employment and livelihood implications of fishing capacity reduction. Similarly there is a need to have more studies on the resource stock at different levels of fleet or fishing capacity so as to help design appropriate resource management strategies.

# Chapter 1: Introduction

### *1.1 Understanding fishing capacity*

Fishing capacity regulation is a highly debated topic in fisheries management in the wake of signals of depletion and over exploitation of fish stock in several fisheries worldwide. Due to instances of intensive fishing and slow or dramatic collapse of fish stocks, there have been widespread calls for global reduction in fishing fleet sizes and fishing efforts. (Mullon, et al 2005). Garcia and Newton (1997) has estimated that the world fishing capacity would need to be reduced by 25 per cent for revenues to cover operating costs and by 53 per cent for revenues to cover total costs. In other words many world fisheries are biologically as well as economically unsustainable.

Defining and measuring capacity in fisheries, which is a renewable resource poses additional challenges. In a simpler way, fishing capacity is defined as the ability of a vessel or fleet of vessels to catch fish. The ability is based on a number of factors including the number of fishing vessels in the fleet, the size of each vessel, the technical efficiency and the time spent in fishing. The overall catching power of the fleet is decided by the above factors although the level of utilization is a significant factor. However, fishing capacity is also a concept which has been used in various other ways that are either from the perspectives of input, output or both by different groups of people related to fisheries[1] . In order to capture the alternative views of fishing capacity FAO (2000) developed a definition based on both input and output. According to this definition, fishing capacity is the amount of fish (or fishing effort) that can be produced over a period of time (e.g. a year or a fishing season) by a vessel or a fleet if fully utilized and for a given resource condition. In this context, full utilization means normal but unrestricted use, rather than some physical or engineering maximum.

In literature, the need to distinguish between short run and long run measures of capacity has resulted in different terminology being adopted. In the case of fisheries, these have been defined as excess capacity and over capacity respectively. The concept of excess capacity relates to the difference between the potential catch if all vessels are fully utilised and current catch (FAO 2003). It is a short term measure only because it is related to current stock conditions. Under different stock conditions, a different number of vessels may be required to take the optimal catch level. A concept unique to fisheries analysis-overcapacity-is a long term concept of excess capacity. Over capacity relates to the difference between current capacity and target level of capacity (Mace 1996).

Mace (1996) identifies [over]capacity as the single most important factor threatening the long-term viability of exploited fish stocks and the fisheries that depend on them, and thus requiring a significant reduction of the existing global fishing capacity for levels to become commensurate with sustainable resource productivity. Even though, theoretically excess capacity and over capacity are clearly different, in practice it is difficult to estimate the extent of over capacity. To estimate over capacity requires a good amount of data which are either non existent or not available in developing countries. Therefore most studies has to be satisfied with estimating excess capacity alone. This limitation is true in the case of present study as well. Therefore while keeping the distinction between excess and over capacity in mind we on and often revert to the use of excess capacity even if the use of the term over capacity appears to be more appropriate and justifiable. Capacity utilization is the ratio of the current level of outputs to the potential level of outputs and ranges from zero to one. Capacity utilization measures less than one imply the existence of excess capacity, as the potential catch exceeds the current catch level. Conversely, the same catch could be taken with a smaller fleet. The existence of excess capacity is seen as a short-term phenomenon because of various reasons in which overcapitalization being the major one. Overcapacity is considered as a longer-term problem in fisheries where the existing fleet size is greater than that required to harvest a particular yield. Technical efficiency is related to the difference between the actual and potential output given both fixed and variable input use. In this study, however, we take technical

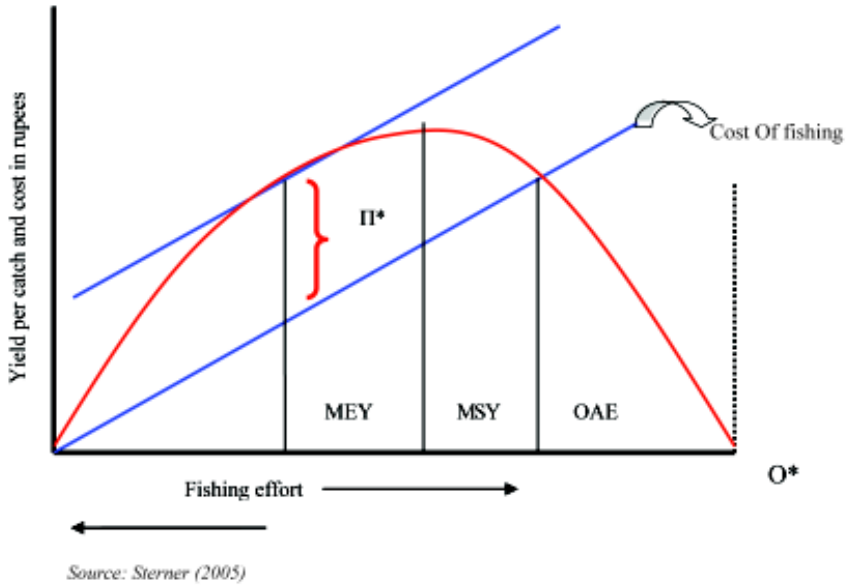
[1] *Different groups of people like fisheries technologists, managers and economists have different intuitive understanding of capacity based on either input or output perspectives.*

inefficiency as a proxi measure of excess capacity. It is well known that some of the important consequences of excess fleet capacity relate to poor economic performance, inefficiency and biological over-fishing. Excess fleet capacity not only wastes investment capital but also leads to high fishing costs. Similarly, overexploitation of stocks wastes fish resources (FAO, 1998). It can even lead to political strife in the management process. However, the primary reason identified for this kind of situation is the absence or lack of well defined property rights.

### *1.1.1 Existence of excess or overcapacity: Theoretical underpinnings*

The concept of excess capacity is commonly illustrated best using the surplus productive framework of Schaeffer (1954). The root cause of the existence of excess capacity is often attributed to open access equilibrium, which can be illustrated with reference to figure 1 where the inverted growth curve indicates that harvest first increases and then decreases in stock size. The figure shows that increased effort gives higher harvest and reduces stocks and long run harvest. With no fishing effort, in the natural equilibrium (o) yield is zero; and stock measured from right is a maximum but no benefit since no fish are caught (there may be aesthetic or other values) (Sterner and Svedang 2005). At O*, too large an effort led to an extinction equilibrium where yield is again zero. In between is the maximum sustainable yield, but this is not economic optimum since cost of fishing typically increase with scarcity.

Thus, a stock larger than at MSY could give almost the same yield but at a lower cost that gives a higher profit. This optimum policy is called maximum economic yield (MEY) which shows that hardnosed profit maximisation can led to conclusions that are more or less, conservationist (Sterner and Svedang 2005). MEY is also the way a single profit maximizing owner would manage the ecosystem. However, the waters generally have no ownership and since there is no scarcity rent each fisherman fishes up to point were marginal costs equal average harvest which is the open access equilibrium (OAE). At this point there is no rent at all; total revenue just covers total cost. The potential profit at MEY is entirely dissipated since a smaller catch is caught at much higher cost at OAE. Open access equilibrium results in biological over fishing. If the total cost curve had interesected the total revenue curve to the left of MSY, biological overfishing would not occur, but there would still be considerable economic waste in the form of technical and economic inefficiency. Here, fisher certain behaviour such as maximum investment in increased fishing capacity may be perfectly rational from an individual point of view while still being folly from collective view point. Therefore, addressing the problem of excess fishing capacity requires that the underlying problem of property rights is resolved first.




*Source: Sterner (2005)*

**Figure 1.1. Presenting fishing overcapacity**

It needs to be recognized that property rights are a subset of the institutions. Institutions are organizational constraints that structure incentives and shape human interactions (North, 1992). Property rights or regime which is a subset of institutions are bundles of entitlements that define owner's rights and duties, and the rules under which those rights and duties are exercised (Bromley, 1991). A key attribute of an institutional environment is the set of economic incentives that it embodies. These incentives, in turn, shape the behaviour of both individuals and groups. Thus, the central challenge of fisheries management lies in creating incentives that lead to desired behaviours (Hanna, 1998). That means, when property rights are not well defined and enforced, individuals have no incentive to restrict their actions even though the combined effect of each individual's actions (increased fishing effort) result in reduced stock size along with future potential yields and profits.

Nevertheless, solution to the property rights problem is not a simple one due to a variety of reasons including technical, political and social. This means that there is a need to create an enabling institutional environment for fisheries management where not only the property rights are well defined and enforced but also appropriate incentives are created which will guide individual behaviours in the desirable direction. In short, it is necessary to recognize that reducing the capacity of fishing falls under the broader question of fisheries management and, therefore, cannot be addressed in isolation. This has to be addressed in relation to other aspects of fisheries management which include besides institutional arrangements, the way in which access to fish stock is regulated, how participants in fishery react to different types of regulations and how subsidies affect participation in fisheries. Against this background, the present study addresses the need for and ways by which fishing capacity reduction can be achieved in the Palk Bay fisheries in India and also the possibilities and constraints in respect of fleet reduction through a buy back program.

### *1.2.Regulating Fishing Capacity: Importance of Incentive Based Instruments*[2]

As noted earlier, excesscapacity is a major problem faced by many developing economies where fisheries is not very well regulated and property rights are not properly defined. Need for regulating fishing capacity essentially emerges from both biological and economic considerations. Capacity regulation in terms of restrictions on harvests takes into account the biological considerations of size of stock and its regeneration; however, the information related to it is by and large limited and incomplete. Moreover, most fisheries, especially in developing countries are considered either as open access as the property rights are not very well defined; in such situations, individual fishers unable to control the activities of other fishers, have little incentive to moderate their own use. On the other hand, the fishers who want to either improve or at least maintain their fair share in the harvest, have incentives to add more and more labour and capital. The outcome of this excessive addition of labour and capital is biological overfishing and a decline in sustainable yields which manifests as overcapacity and a reduction in net benefits. Technological improvements and availability of subsidies help the fishers maintain their profits in the short run even when the stocks are declining and also provide further incentives for new entry into fishery. This calls for a change in the incentives confronting fishers.

'Incentive blocking' and 'incentive adjusting' are pointed out as two instruments fisheries management authorities can adopt for changing the incentives facing fishers and thereby reduce excess capacity. 'Incentive blocking' measures attempt to restrict the level of fishers' activities in some way, whereas incentive adjusting measures attempt to address the property rights issue where an environment can be created in which fishers benefit within harvesting constraints, and allow the market to assist in reducing overcapacity (Ward et al, 2004). Among the important incentive blocking instruments relate to limited entry, buyback programmes, gear and vessel restrictions, aggregate quotas, non transferable vessel catch limits, individual effort quota (IEQs), etc. Group/community fishing rights, Territorial use rights, individual transferable quotas and taxes and royalties constitute important incentive adjusting instruments.

[2] *This section draws heavily on Ward et al, (2004).*

**Incentive blocking instruments**

***a. Limited entry***

Regulating entry to fishing assumes utmost importance where fisheries are either open access or not regulated properly. Limited entry is generally aimed to prevent further increases in effort, increasing economic efficiency, or protecting local fishermen from outside competition and risk. However, a major problem with limited entry is capital stuffing. When the total catch of the fleet is limited, each individual tends to increase his/her share of the catch by fishing harder either byincreasing the size of the vessels or by upgrading engines (Branch, et al, 2006). Therefore, for limited entry program to be successful it needs to be supplemented with other restrictions such as gear and vessel restrictions, area restrictions etc.

***b. Gear and vessel restrictions***

Often fisheries managers attempt to reduce fishing effort by putting restrictions on vessel and gear characteristics. This is an input control measure which directly reduces economic efficiency of the fishing fleet and lower profitability so that fishermen do not have further incentives to increase fishing capacity. However, a major problem is that fishermen tend to invest in unregulated input dimensions, for example, if there is a restriction on the engine power to be used, fishermen tend to increase vessel length.

***c. Buyback schemes***

Vessel or licence buy back programs are aimed at decreasing the capacity of the fishing fleet or rationalizing the size of fishing fleets. Buyback programs are implemented in response to over fishing or a drastic reduction in the stock of fish available for harvest. One common assumption is that removing vessels with the highest catch history at the lowest cost will be optimal (Holland, et al, 1999); but the effectiveness of this approach may be undermined if vessel characteristics are not the most important determinant factor of catching power (Branch et al, 2006). A major drawback of this system, like most of the other incentive blocking mechanisms, is that it fails to address the underlying problems that create overcapitalization.

***d. Aggregate quotas***

Aggregate quotas are mainly used to maintain the fish stocks by establishing a total allowable catch (TAC) which will be allocated between different fishing gears or user groups and internationally to allocate between nations.

***e. Non-transferable vessel catch limits.***

This is also an incentive blocking mechanism where limits are defined for individual vessels without transferability between fishers. By restricting the amount of fish each individual fisher may land, the race for fish is slowed down, but the problem of overcapacity is not solved explicitly, though its growth may be reduced.

***f. Individual effort quotas***

Individual effort quotas limit the fishing effort that a fishing craft can apply to a fishery mostly by placing a restriction on trawl time, time away from port, or fishing days that the vessel can employ. The IEQs create incentives for self adjustment and where they are transferable, fishers can purchase them from existing fishers or sell to new entrants. It is pointed out that these can allow the consolidation of fishing activity and reduce the level of excess capacity and possibly the level of overcapacity.

A major criticism or drawback of incentive blocking measures in general has been that there is no guarantee that in the long term they reduce excess capacity. In fact many of the above mentioned measures tend to create incentives for increasing fishing capacity in the long run. Therefore, incentive adjusting measures are more preferable as a long term strategy.

***Incentive adjusting measures***

Incentive adjusting measures attempts to control fishing capacity by changing the regulatory environment through a market incentive that helps fishers adjust their fishing capacity. They address the underlying property rights issue more explicitly. The important incentive adjusting measures are discussed briefly here.

***a. Individual transferable quotas***

Individual transferable quotas explicitly limit the fish catch that a fleet can harvest from a fishery and assign tradable shares of the total catch to the participants in the fishery. Each ITQ holder is allowed to harvest a portion of the TAC in a given year and can transfer this right to other entities by leasing or selling it. It has been noted that the key aspect of ITQs is the transferability which encourages less efficient owners sell their quota to more efficient owners and leave the fishery, reducing overcapacity (Wertheimer and Swanson, 2000).

***b. Taxes and royalties***

Taxes on landings are also useful in reducing capacity although little empirical evidence is available in support of this. A major challenge is in determining the optimal tax rate. Moreover, as various other factors such as costs, prices, and abundance fluctuate, capacity levels need to be adjusted by an appropriate tax on a timely basis. Royalties are also used in many countries for recovering rents from natural resource extraction activities.

***c. Group fishing rights: Community development quotas***

In group fishing rights, access privileges or rights are granted to particular groups or communities; and when granted to communities, these are known as community development quotas (CDQs). These embody the interest of fishing communities that go beyond just harvesters and processors involved in the fishery.

***d. Territorial use rights***

Territorial use rights (TURFs) are a formal mechanism of assigning exclusive rights to fishery area to an individual or group. TURFs allow for the rational exploitation of resources and through ownership rights provide incentives to maintain a sustainable fishery and prevent poaching. This type of territorial rights provide long-term incentives for the resource owners to sustainably manage their resources and that they can be more effective if the owners have the ability to prevent outsiders from harvesting their resources (Branch, et al, 2006).

On the whole, incentive blocking measures are more of a command and control approach while the latter is more of a rights-based approach. Incentive adjusting measures (which create incentives for voluntary reduction of excess capacity) have limited applicability in small scale fisheries across developing countries mostly because of livelihood and equity considerations; for incentive adjusting mechanisms make an explicit reallocation of wealth in the fishery negatively affecting those who are left out in the initial allocation in contrast to incentive blocking measures which implicitly allocate wealth (Ward et al, 2004). The choice available in the initial period or short term, narrows down to incentive adjusting mechanisms, amongst which entry restrictions, gear and vessel restrictions and buy back programs are all relevant. It can be seen that in several of the small scale fisheries in developing countries like India, some form of entry and gear and vessel restrictions, in fact, do exist though the effectiveness of such measures leaves much to be desired.

In fisheries management, the problem often faced is that if only a single aspect of the fishery is regulated, fishermen may increase effort using unregulated dimensions of the fishery which may result in unintended consequences (Branch, et al, 2006). Therefore, it is to be noted that for fisheries management to be successful and also for delivering the intended outcomes, a host of measures have to be crafted together in a judicious manner rather than relying on just one measure. From the previous paragraphs, it can be observed that incentive based regulatory instruments can be very powerful in fisheries management and capacity regulation; and the choice whether to use incentive blocking or adjusting measures or both, depends upon the problem for which we are seeking a solution.

### *1.3.Capacity Regulation: Fleet reduction in the Indian context*

The marine fishing sector in India comprises four major sectors namely (a) nonmotorised artisanal sector, (b) motorized sector, (c) mechanized sector using inboard engines of 50 to 120 horse power and (d) deep sea fishing with bigger boats (25m and above) having engines of 120 horse power and above. Small trawlers, purse seines, doll-netters, gill-netters, pair trawlers are the major types of mechanised units operating in the inshore waters (up to 50 m depth). In the past traditional crafts dominated the Indian marine fisheries sector. Mechanisation of vessels brought about drastic changes in the sector. More and more indigenous crafts were motorised and the use of different types of gears was taken up to meet growing demand. Since 1960, trawling gained importance as a method for exploiting demersal fisheries (especially prawns and shrimps) (Vivekanandan, 2003) and soon trawlers became the main stay of the fishing sector with almost 50 per cent of the total Indian catch coming from it (Devaraj, et al., 1997; 1999). Moreover, the Indian government encouraged mechanization via through various subsidy programmes (e.g., for diesel engines, use of innovative gears and vessels etc.) and loans to fishers and their co-operative organizations (Srivastava, et al.,1991). As per the Government of India (2004) estimates, there are 1896 traditional fish landing centres, 33 minor fish harbours and 6 major fishing harbours serving as a base for 208000 traditional non-motorized, 55000 small scale beach landing crafts with out-board motors; 51250 mechanized crafts (mainly bottom trawler and purse seine) and 180 deep sea vessels of which 80 are in operation. Indian marine fisheries now face a number of challenges and problems threatening its long term sustainability and very survival. As a result of the introduction of many new vessels over the last few decades, current catching capacity of the fishing fleets in Indian waters far exceeds required for biologically sustainable catches from most commercial stocks at a depth down to 100 m (Devaraj and Vivekanandan, 1999)[3] . This has resulted in the reduction in the area per fisherman (Vivekananadan, et al., 2003). Presently, there are too many fishing vessels, generating an excess fishing effort in various areas, especially where valuable species occur (Somvanshi, 2001). In the context of the guidelines issued by the government of India to all the maritime states for formulating rules and regulations, most of them passed respective Marine Fisheries Regulation Acts. These Acts inter alia provide for registration of all fishing vessels, including non-mechanized crafts at their respective base ports, licensing fishing vessels for fishing in specified areas, regulation, restriction or prohibition of fishing using any specific gear etc. However, the enactments have not been carried out with conservation motive, but only with a view of avoiding confrontation between the mechanized and artisanal sectors rather than as suitable regulatory measures for ensuring sustainability of the resources. Above all there have been enforcement problems in terms of widespread violations of rules and regulations threatening the sustainability of fisheries. It can be assumed that the existing high number of vessels or boats in the fisheries is a major obstacle to even effectively implement the entry as well as gear and vessel restrictions. The outcome of such a state of affairs is clear from the annual catch reaching the optimum level and a decrease in the per capita fishing ground and the per boat area, that warrant effective management of the exploited stocks in the coastal waters up to 50m (Immanuel, et al 2003). However, no steps have been taken by the government to reduce the existing excess capacity. Given this situation, this study attempts to explore whether capacity reduction, especially fleet reduction, (basically trawler boats) is feasible. The present study has addressed this issue in the case of the Palk Bay trawler fisheries. The reasons for choosing the Palk Bay fisheries have been explained in the following section.

### *1.4. Scope of the study: The Palk Bay Fisheries*

The scope of the study is limited to the Palk Bay fisheries in the east coast of Tamil Nadu, India. Officially, five districts of Tamil Nadu have their coastal areas located along the Palk Bay. There has been more than one reason to select the Palk Bay region for carrying out this explorative study. It has been widely understood that Palk Bay has been dominated by trawler fleet and that there is overcrowding. As per our estimation[4] , the coast line of Palk Bay is about 210 kms. The surface area within the international border line is about 5000-6000 $km^2$ and the area reserved for small scale fishermen as per the 3 nautical mile rule is 800-1000 $km^2$. The eligible fishing area for trawlers is between 4000- 5200 $km^2$. The average

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[3] *Here it is important to note that only the state of Orissa has determined the optimum number of mechanized vessels of various categories for different fishing ports (James, 1992).*

[4] *Estimations are based on Google Earth and hence, subject to some degree of uncertainty.*

number of trawlers operated has been found to be 2000 and, therefore, the surface available per trawler in the Palk Bay is about 2 to 2.6 $km^2$. The length of the trawlers varies between 28 and 50 feet. They use an inboard engine with a capacity ranging from 68 to 120 horse power each. In the non-mechanised sector, motorized vessels consist of Dugout, Catamarans, Plank-built, Ring Seine, Fibre glass, Ferro cement, and others. The non-motorized crafts are mainly Dugout, Catamarans, Plank built.

The Palk Bay fishery is relatively well regulated as compared to other fisheries in India basically because of its proximity to Sri Lanka besides providing an ideal setting to explore the possibilities of a fleet reduction and the factors determining or constraining its long term sustainability. Within, the Palk Bay, the two most northern districts - Tiruvarur and Naga patinam - have been left out for some reasons. The coastal area of these districts is swampy, making it extremely unsuitable for landing trawlers. Only at the corner of the Palk Bay, Kodiakarai berths a substantial mechanized boat fleet. However, we thought it was reasonable to exclude this place, as the fishing grounds of these boats lies beyond Palk Bay and because of that the present study confine itself to the trawler landing centres located along the coastal districts of Ramanadhapuram, Puthukkottai and Tanjore.

A detailed location map of the Palk Bay is presented in in Figure 2.1 of chapter 2. It can be observed that the study area consists of ten landing centres concentrated in four distinct clusters berthing a maximum of 2260 mechanized boats(MB)[5] . Two of these clusters can be found in Ramanadhapuram district, and one in each of the other districts. By and large, the major clusters of mechanized boats are near Pamban Island, where Rameswaram, Pamban and Mandapam berth a little fewer than two thirds of the trawlers operating in the Palk Bay (1190 MB). About fifty kilometres up north, three villages - Tondi, Lanjadi and Chozliakudi - constitute the second cluster of Ramanadhapuram district (110 MB). Again thirty km up north, the distinct villages of Jagada patinam and Kottai patinam harbour the substantial Puthukkottai mechanized fleet (600 MB). In Tanjore district, the two tiny villages of Malli patinam and Sethupava Chatiram form the final cluster with a relatively smaller fleet (220 MB). Within Tamil Nadu, Ramanadhapuram - as the coastal district is officially called - is marginal in almost every sense except for the length of its coastline and fishing industry. It is characterized by its aridity, isolation and limited level of economic development. The agricultural sector is hampered by a lack of major river systems and low levels of precipitation. Also industrial development is very limited, with the district's poor infrastructure and associated isolation (Bavinck and Karunaharan, 2006). This economic marginality and associated low levels of employment opportunities (for its almost 1.2 million inhabitants) have induced many people to migrate, to the coastal areas (Scholtens, 2006). In the Puthukkottai and Tanjore districts, a much smaller portion of the population is involved in fisheries. Puthukkottai faces the same agricultural problems as Ramanadhapuram, with the mining and handloom sectors forming a major source of income6. Tanjore, on the contrary, is known for a well organised agricultural industry.

### *1.5 Research questions and objectives of the study*

From the above discussion, we can note that fleet reduction occupies an important place in the overall capacity regulation of fisheries in the Indian context. A number of research questions emerge in the specific context of the Palk Bay fisheries. These questions relate to the present situation and the way forward for trawler fisheries. For example: What are the characteristic features of the Palk Bay fishery that warrant fishing capacity regulation? What regulations already exist and how effective are they? What are the socioeconomic characteristic features of the boat owners and the boats operated? To what extent does excesscapacity exists? What is the technical efficiency of the trawler fleet? Are there any indications of the existence of overcapacity? What are the capacity regulatory measures that can be adopted? Is it possible to reduce the number of fleets as part of capacity regulation? If so, what are the possible methods that can be adopted for reducing the number of trawler fleet? Would it be possible to launch a buy back program for reducing the number of trawler boats? If so, what would be the reaction of the users? Would they be willing to participate in the buy back program by agreeing to sell off their boats? What are the likely implications of reduction in the number of trawler boats on fisheries and especially non-trawler fisheries?

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[5] *This is the maximum figure as some boats migrate to other areas outside the Palk Bay throughout the year. The minimum number of boats berthed in the Palk Bay are about 1750, mainly a result of migration of Mandapam and Jagada patinam boats.*

Keeping the above questions in mind, the study attempts to review the characteristic features of the trawler boat fisheries in the Palk Bay and to assess the technical efficiency of trawler boats and comment on the need for fleet reduction. A second objective is to explore the measures available for reducing fishing capacity in general, and the possibilities of trawler fleet reduction in particular. The specific objectives are as follows:

- To examine the characteristic features of Palk Bay fishery and the need for fleet reduction
- To explore the various ways and effectiveness of capacity regulation and fleet reduction
- To examine the facilitating and constraining factors of fleet reduction and buy back program
- To assess the livelihood implications of fleet reduction
- Finally, to identify the measures to be adopted for ensuring the long-term sustainability of capacity regulation and fleet reduction

**Table1.1. Distribution of sample households across Palk-Bay fishing harbours**

| Fishing harbours in the Palk-Bay area | Sample size | Total number of boats (approximately) |
|---|---|---|
| Malli patinam | 17 | 170 |
| Sethupava Chatiram | 10 | 100 |
| Kottai patinam | 28 | 280 |
| Jagada patinam | 33 | 330 |
| Lanchiyadi | 5 | 50 |
| Chozliakudi | 5 | 50 |
| Tondi | 4 | 40 |
| Mandapam | 48 | 480 |
| Pamban | 10 | 100 |
| Rameswaram | 66 | 660 |
| Total | 226 | 2260 |

*Based on Primary survey*

### *1.6. Data and Methodology*

To begin with, we have reviewed relevant literature on capacity regulation and fleet reduction implemented in other countries with a view to identifying the key concerns in the Palk Bay fisheries followed by collection of primary and secondary data required for the study. Various government publications constitute important sources of secondary data. Primary data collected consists of both qualitative and quantitative data. We have provided below a brief description of the manner in which primary data has been collected and the methods adopted.

#### *Qualitative data*

Qualitative data for this study has been collected from 10 mechanized boat landing centres of the three main districts along the Palk Bay area during January 4th to February 26th of 2007. With view to getting insights into the diversity and dynamics between the fish landing centres and within the landing centres themselves. More importantly, the study aims to understand the specific problems and conflicts, the role of different (local or national) institutions involved in fisheries management, the way regulations are implemented and the perceived viability of the trawler sector from the eyes of boat owners. This explorative research focuses mainly on selected boat owners in such a way as to cover that as much diversity as possible. Apart from boat owners, we have had conversations with crewmembers, traders, association leaders, the Fisheries Department. The qualitative data collection has been followed by a trawler boat chain analysis in two fish landing centres.

#### *Trawler Boat Chain Analysis*

An analysis of the trawler boat chain is nothing but tracing the number of other occupations attached to trawler boat sector, e.g. shops, ice factories, carrying boats, transportation etc in a landing centre. We have done qualitative appraisal and manual count of such occupations in two landing centres of Palk-Bay namely Kottai patinam and Malli patinam. This data has been used to examine the type of other occupations associated with fishing activities.

#### *Quantitative data collection*

The quantitative data for this study has been collected through a sample survey among boat owners during the period April-May 2007 for all the 10 landing centres of Palk-Bay area. In the absence of reliable sample frames, we adopted what we have labelled as the 'random walk method' to collect data for the study.

Using this method enumerators selected boat owners by moving in different directions in the fish landing centres in a systematic manner (until they reached predetermined size of each sub-sample). In order to select a representative sample size from the boat owners, we used approximate estimates done during the time of qualitative data collection on the total number of boats, as a benchmark, after crosschecking with key informants from fishing communities and fishery departments. The sample size was decided at 10 percent of the total number of boats. The distribution of sample households across different fish landing centres has been presented in Table 1.1. A structured interview schedule was used to collect data from the boat owners selected for the survey.

### *1.7. Chapter organization*

The present study consists of five chapters. Following this introductory chapter, the characteristic features of the Palk Bay fisheries are discussed in Chapter 2. Chapter 3 analyses the technical efficiency of the trawler boats and the need for fleet reduction. It also discusses various options for regulating fishing capacity. Chapter 4 discusses the feasibilities of a buy back program and also briefly examines its livelihood implications. Major findings and conclusion are presented in chapter 5.

# Chapter 2 The Palk-Bay fishery

## 2.1 Introduction

The Tamil Nadu marine fishery spreads over a coastal line of about 1000 kilometers with the Palk Bay being located in the east coast of Tamil Nadu. It spreads across four revenue districts of Tamil Nadu namely the *Ramanadhapuram, Puthukkottai, Tanjore* and *Naga patinam*. This chapter presents an overview of the fishing activities in the first three districts of the Palk Bay. More specifically, the chapter deals with physical characteristics such as topography, marine ecology and fishing ground. The chapter also gives a detailed account of different fishing practices that exist in Palk bay. Other factors presented in this chapter relative to the landing centre characteristics and institutional capacity for the management of fisheries.

## 2.2 Physical Geography and Marine ecology

Palk Bay is a geographically contained area situated between northwest Sri Lanka and southeast India, having total coastal area of 270 kilometres. It connects the Bay of Bengal to the northeast with the Gulf of Mannar to the south. The name Palk bay is linked with Palk Strait, named after the Dutch Robert Palk, who was the governor of Madras Presidency (1755-1763) during the British period. The Palk Bay area ends at its southern end with a chain of low islands and reef shoals that are collectively called Adam's Bridge. This chain extends from Dhanushkodi on *Rameswaram* Island in Tamil Nadu to Talaimannar in Mannar in Sri Lanka. The *Pamban* Bridge links the island of *Rameswaram* to the Indian mainland. It has been reported that the area is a troubled location since 1983 due to Sri Lankan civil war (Vivekanandan, 2004). Studies report that the Palk Bay is a very shallow flat basin with the depth never exceeds 15 meters. The average depth is 9 meters. The coast is covered by thick mangroves in *Muthupet* area and also patches of mangroves in the northern part of *Ramanadhapuram* coast. The area is also known for coral reefs. The coral reef in Palk Bay starts from *Munakad* as a wall-like formation 1-2 m broad and runs east up to *Tonithurai,* a distance of nearly 5.5 km. Here the reef width is more than 300 meters. East of *Pamban* pass, the reef again starts near *Thangachimadam* and ends near *Agnitheertham* at *Rameswaram* (Mahadevan and Nair, 1969). It has also been reported that the area is known for seaweeds and sea grasses. Maximum number of marine algae (302 species) have been recorded in Tamil Nadu, and mostly from the Palk Bay. There are 11 sea grass species also reported from the coral reef area of Palk bay (Venkataraman, 2004 p 61). The study also reports that the Gulf of Mannar and Palk Bay region has the highest diversity of sponges, mollusca, crustaceans and fishes. Today varied anthropogenic activities like destructive fishing practices, dredging, pollution *etc* are a cause for concern (Venkataraman, 2004).

## 2.3. Troubled location

It is documented that Palk Bay is a troubled location since the start of civil war in Sri Lanka in 1983. The civil war has had a deep impact on the fishing operations of this area. Till 1983, the fishers of both sides, who share a common language, and a long history of contact, carried on fishing activities harmoniously in Palk Bay with only occasional problems (Vivekanandan, 2004 p 3). On the Sri Lankan side, they had introduced severe restrictions on fishing due to security reasons. On the Indian side, fishers faced hardship as the Sri Lankan navy shot at and imprisoned a large number of fishers who crossed over to Sri Lankan waters during the two decades of the civil war. Although fishing operations were restored in Sri Lankan waters in 2002 altering the situation in Palk Bay, the operations of Indian fleets in Sri Lankan waters pose a grave threat to the livelihood of Sri Lankan Fishers. In some instances, there have been clashes reported at sea between fishers of two sides (Vivekanandan 2004 p 4). Nevertheless, there have been organised effort from both the sides to engage fishers from Tamil Nadu and Sri Lanka in a dialogue on the issue of coexistence in and also to work out a solutions for the conflict between the two groups in terms of sharing of peace and resources. Keeping this in view, the idea of a good will mission came in to force since 2003 (Vivekanandan, 2004 p 5).

## 2.4. Fishing ground

The physically contained geography of Palk Bay has some implications for the fishing ground used by fishers. First of all, as a result of the maximum duration of a fishing trip of 24 hours, virtually no fisherman

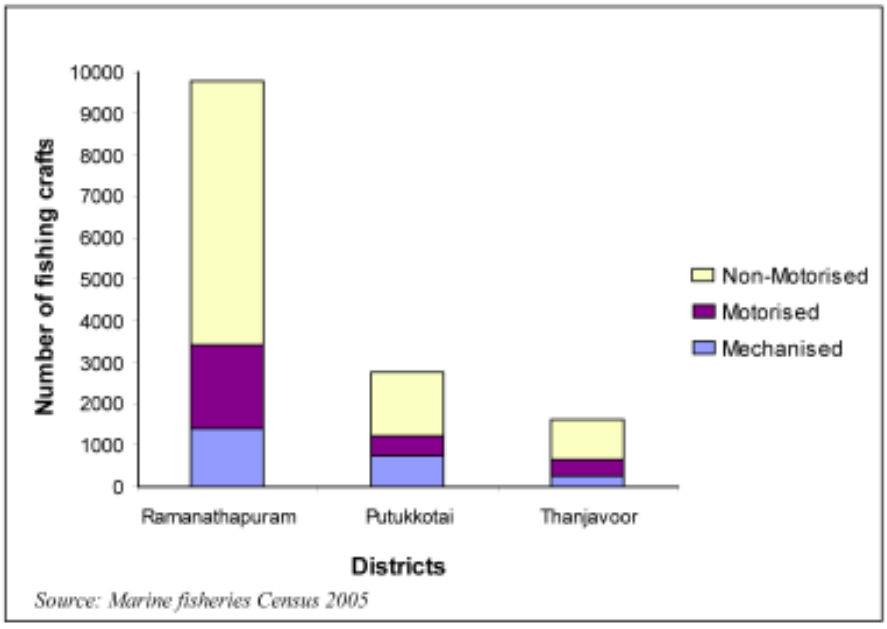
is able to visit any area outside the Palk Bay. Secondly, it has become clear that the large number of trawlers in the area competing for limited resources have 'forced' many fishermen head to Sri Lankan waters to for a sufficient catch; and this is done despite being aware of the fact that crossing the international boundary line can result in confrontations with the Indian or Sri Lankan navies, or with local fishermen (Bavinck *et. al*. 2007). Besides Sri Lankan waters, *Tondi* and the northern part of Palk Bay are also considered as fishing grounds. These considerations explain the difference of fishing grounds between the different landing centres. Especially the *Rameswaram* trawlers head enormous in eastern direction where fishing grounds are rich in marine resource (behind the Sri Lankan boarder which is just one hour away from their berthing place). In terms of excess capacity, it is more telling that the average fishing ground available per trawler is a mere 2 to 3 square km.

### 2.5. Fishing Practices

The fishing practices of Palk Bay can be broadly categorised into mechanised and non-mechanised. Figure 2.1 reveals the composition of mechanised and non-mechanised fishing crafts in all the three districts that cover Palk Bay coast. The mechanised crafts consist entirely of trawlers and are locally usually known as *Launches* or simply boats. The length of the trawlers varies between 28 and 50 feet. All boats have a portable ice box with a capacity of 200 to 500 kgs. In the mechanised sector, both single and pair trawlers operate and they both use bottom and surface nets. They use an inboard engine with a capacity ranging from 68 to 120 horse power.

The non-mechanised boats can be broadly divided into two types, namely, motorised and non-motorised boats. The motorised boats are either equipped with an Outboard Motors (OBM), that include the wooden Vathais and the fiberglass crafts, or Inboard Motors (IBM) called vallam. The marine fisheries census (2005) categorised motorised vessels into Dugout, Catamarans, Plank-built, Ring Seiner, Fiber glass, Ferro cement, and others. The non-motorised crafts are mainly Dugout, Catamarans, Plank built. The gear used by the non-mechanised fishers varies across seasons. Some of the important gears used in this sector include Sudai-valai, Eral-valai, paaru valai, tallu valai and nandu valai. An important destructive fishing practices prevailed in the non-mechanised sector is the use of Surukku madi (purse seining) and dynamite, though both are legally banned. Generally, the use of purse seining is quite common during the month of March as the chances of being caught for this illegal use are virtually nil. The study observed that shore seine fishing is also common in Palk Bay area.

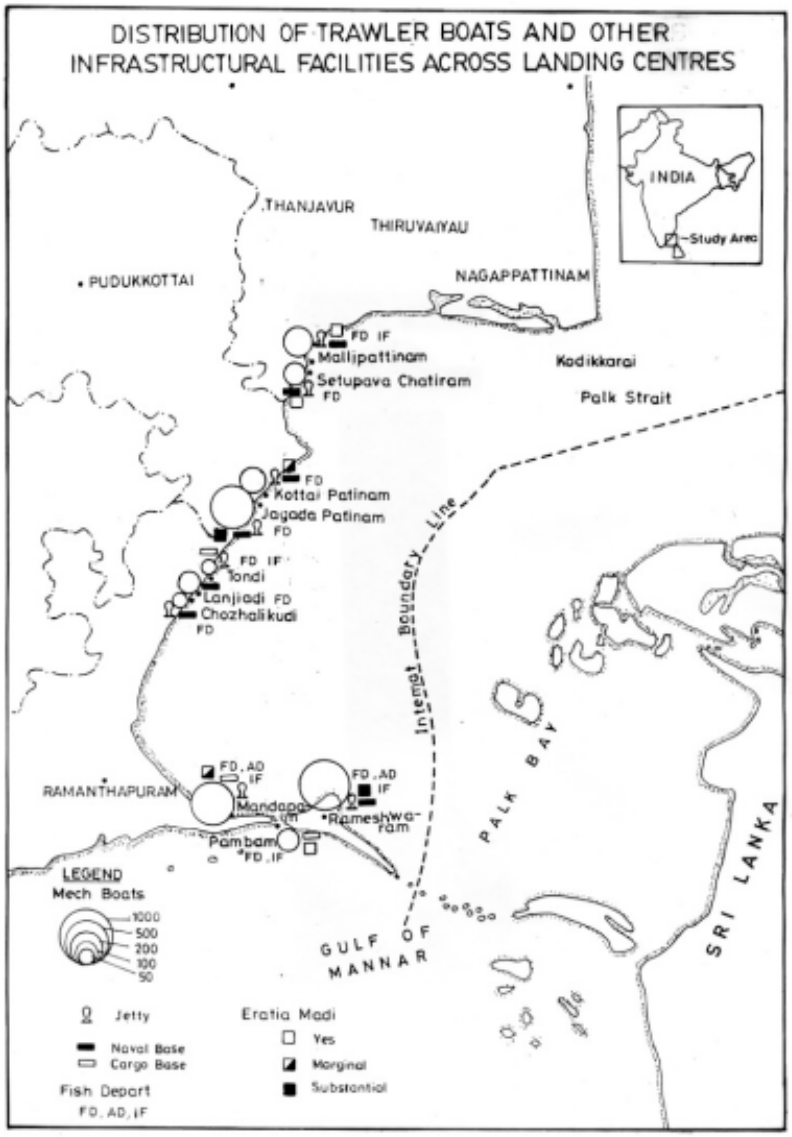
**Figure 2.1. Distribution of fishing craft by Districts**



## 2.6. Landing Centres

The Palk Bay covers four revenue districts of Tamil Nadu State namely *Ramanadhapuram, Puthukkottai, Tanjore* and *Naga patinam* having a coastal length of 130, 42 and 35 and 63 kilometres respectively[6] (Government of Tamil Nadu 1995). Total coastal area of Palk Bay is 270 kilometres, that is, approximately 27 per cent of the total coastal area of Tamil Nadu. But the present study covers only 107 kilometres of *Ramanadhapuram, Puthukkottai,* and *Tanjore* districts. The important landing centres of trawler boats in the study area are *Rameswaram, Pamban, Mandapam north, Chozliakudi, Lanjadi, Tondi, Jagada patinam, Kottai patinam, Sethupava Chatiram and Malli patinam*. The first 6 landing centres come under the *Ramanadhapuram* revenue district while *Jagada patinam* and *Kottai Patinam* are in *Puthukkottai* district. The last two landing centres, *Sethupava Chatiram* and *Malli patinam* are located in *Tanjore* district. These landing centres are provided with jetties for berthing of boats except *Mandapam* and *Pamban*. The location of the major landing centres (with the distribution of trawlers and other infrastructure) is given in Figure 2.2.

**Figure 2.2. Location and other infrastructure of Palk Bay Landing Centres**




[6] *Total coastal area of Ramanadhapuram district is 271 kilometers of which 141 kilometers belong to the gulf of Mannar area*

**Rameswaram**

The dominant fishing grounds of the fishermen are located behind the international boarder in the Sri Lankan waters. *Rameswaram* town is located very close to the international boarder line of Sri Lanka, approximately 26 Km and berths about 680 mechanised boats or trawlers. The number of country crafts operating from this landing centre is significantly less. Most of the trawler boats in *Rameswaram* have got winches and wheel house run by six cylinder engines, an indication of better quality boats. Almost all boats do not use global positioning system for identifying their location in the sea. The important gears used in *Rameswaram* are *Eral madi, Mixer madi, Meen madi, Erattai madi* and *Roller madi*. The *Eral madi* is used for shrimp fishing, while *mixer madi* target Gastropod shells, sea cucumbers, squids, crabs and fishes. *Meen madi* is a fish net targeting fishes. There are two types of *Erattai madi* (pair trawler nets) called *Chethu madi* and *Paaru madi*. The *Chethu madi* targets pomfrets, seer fish, ribbon fish, barracuda and ray fish while *Paaru madi* is used for catching rocky fishes. It is observed that every boat has 2 numbers of *Eral* and *Mixer madi*. Approximately 30 per cent of the owners use the prohibited *Erattai madi* for pair trawling. *Eral madis* are used regularly and other nets like *Meen, mixer* and *roller madis* are used during *Karavadu* season. *Rameswaram* has got an Assistant Fisheries Director's office and a navel base with 5 boats. There are 13 boat owners associations operating in *Rameswaram* centre whose interactions are better characterized by competition than co-ordination. These organisations are mainly divided along caste and political lines. Important fishing castes are *Paravar, Devar Nadar and Servai*.

**Pamban**

Fifteen kilometre west off *Rameswaram, Pamban* is located approximately 41 Km away from the international boarder line at the Southern side of *Rameswaram* Island. Although the prime fishing grounds are located in the Gulf of Mannar, during the high season of June and July around 30 out of the 90 trawlers venture into the Palk Bay. This landing centre does not have a jetty. There are 2 boat owners associations in the *Pamban* centre. Next to trawlers, a substantial number of traditional fishing crafts called *vallam* operate from *Pamban*. It has been observed that, sometimes, fishers from *Pamban* also cross international boarder for fishing activities. The major fishing communities operating from this landing centre are *Paravar* and *Ambalar*. It is a small landing centre as compared to *Rameswaram*. In *Pamban*, fishing with prohibited gears like pair trawling and purse seining, is a highly regular affair. In *naala number Vallams*, a big drift gillnet called *naala number valai* or *paaru valai*, is used without foot rope at the lower portion of the net. This net is used for fishing big sized fishes like seer fish, sharks, carangids, cat fish *etc*. In *renda number Vallams* various types of nets are used like *renda* number *valai, singi valai, nandu valai, meen valai, thirukkai valai, kola valai, mural valai* and *Eral valai*. In *Vathais,* three types of nets are used namely *kola valai, nandu valai* and *Eral valai*. *Tallu madis* are used in *Tallu Vathais*.

**Mandapam**

The second biggest landing centre of Palk Bay in the *Ramanadhapuram* district is Mandapam located nearly 47 Km away from international boarder. This village consists of 5 different landing sites berthing a total 490 trawler boats. About 200 of them are located at the Northern Palk Bay side and another 290 in the Southern Gulf of Mannar side. There are hardly any active country crafts operating from Mandapam north. All Muslim, Hindu and Christian fishermen operate from this place, mostly segregated from each other by the different landing sites. Apart from the Fisheries Department office, a large coast guard base with two hovercrafts is also located in Mandapam. There are 7 boat owners associations in Mandapam which are highly divided across in caste and political lines. The mechanised trawlers have *Eral madi, Meen madi, Erattai madi and Surukku valai* (purse seine) etc.

**Chozliakudi, Lanjadi and Tondi**

*Chozliakudi*, Lanjadi and *Tondi* are the other three small landing centres, forming a cluster north of *Ramanadhapuram* district. These locations are approximately 53 km away from the international borderline. Along with the approximately 110 trawlers, a large number of country crafts like *Vathais* and FRP (Fibre Reinforced Plastics) operate from these landing centres. We have observed that different

types of *vathais* namely *periya vathais, chiriya vathais, nandu vathais, kanava vathais, pai vathais, and Catamarans* operate in this area. The trawlers in this cluster are of poor quality as compared to other centres in the district and tend to fish near the shore rather then in the Sri Lankan waters. The common gears used in this area are *tallu madi, nandu valai, kelaka valai, kanava thoondil, meen valai, and salangai valai.* The important caste groups are *Kadaien, Pattinavar* and *Padiachy*. There is one Fisheries Director's office with Fisheries Inspector as chief for all the three landing centres located at *Tondi*. There is an Indian navel base also located in *Tondi* with 2 navy boats. From now onwards this area denoted denoted as the *Tondi* cluster.

**Table 2.1 Crafts and Gears used in Tondi Cluster (Landing Centre)**

| Craft | Gear | Targeted Species |
|---|---|---|
| Periya Vathai | Thirukkai valai<br>Tallu madi | Ray and Guitar fish<br>Shrimps and fish |
| Chiriya Vathai | Nandu valai<br>Tallu madi<br>Salangai valai (recently introduced) | Crabs<br>Shrimps and fish<br>Shrimps |
| Nandu Vathai<br>Kelaka Vathai<br>Kanava Vathai<br>Plastic boat | Nandu valai<br>Kelakka valai<br>Kanava thoondil<br>Nandu valai<br>Kelakka valai<br>Meen valai | Crabs<br>Silver whiting<br>Squid<br>Crabs<br>Silver whiting<br>Oodagam, Keluthi, Sorrah<br>Crabs |

*Based on Primary survey*

## Jagada Patinam

The *Jagada Patinam* landing centre comes under Manamelkudi fisheries inspector office. There is a navel base located in *Jagada Patinam* with two boats. In *Jagada Patinam*, common gears used are Chain madi, Meen madi, Chunk madi, Attai madi and Mixer madi. *Jagada Patinam* is a Pattinavar dominated landing centre, which comes under the jurisdiction of *Puthukkottai* revenue district. Most of the fishermen – crewmen and owners alike – originate from Naga patinam district, which explain the different characteristics of the trawlers. They are generally much larger in size than in other areas and most of them are also equipped with a wide range of technological devices. Uniqueness of this landing centre is the harmony among the owners reflected in the fact that they are all united in one strong owner organisation with substantial lobbying power.

**Table 2.2 Crafts and Gears used in Jagada Patinam Landing Centre**

| Craft | Gear | Targeted Species |
|---|---|---|
| Mechanised boats | Eral madi<br>Meen madi<br>Chunk madi<br>Othai madi<br>Erattai madi (Meen)<br>Erattai madi (Eral) | Shrimps<br>Demersal fishes<br>Gastropod shells and sea cucumbers<br>Fish<br>Pelagic and demersal fishes<br>Shrimps |
| FRP (mostly immigrants) | Piece valai<br>Vaala valai<br>Nandu valai<br>Salangai valai<br>Kavala valai<br>Kola valai<br>Kanava thoondil | Pomfrets<br>Seer, Mackerel, Sardine sps,<br>Crabs<br>Shrimps<br>sardine sp.<br>Flying fish, Full beaks and Half beaks etc<br>Cuttle fish |

*Based on Primary survey*

Compared to other landing centres, internal conflicts are virtually absent. It is noted that fishers of *Jagada Patinam* mostly cross the international boarder for fishing activities although it is located approximately 44 km away from international boarder line. During the first month of the year, pair trawling is a common affair.

### Kottai Patinam

*Kottai Patinam* is the second fish landing centre of *Puthukkottai* area. The *Kottai Patinam* landing centre also falls under the jurisdiction of Manamelkudi fisheries office, having nearly 250 trawler boats.. There are no country crafts operating from this port. Also Pair trawling is not very common although a few people practise it. Common gears used are *Chain madi, Meen madi, Chunk madi, Attai madi, Erattai madi Othai madi etc.*This village is characterized by its religious diversity and the internal rivalry has resulted in the absence of any active boat owner organisation. Fishing grounds are not primarily located in Sri Lanka as people fear arrest by the Coast Guard.

**Table 2.3 Crafts and Gears used in Kottai Patinam Landing Centre**

| Craft | Gear | Targeted Species |
|---|---|---|
| Mechanised boats | Eral madi | Shrimps |
| | Meen madi | Demersal fishes |
| | Chunk madi | Gastropod shells and sea cucumbers |
| | Othai madi | Fish |
| | Erattai madi (Meen) | Pelagic and demersal fishes |
| | Erattai madi (Eral) | Shrimps |
| FRP (mostly immigrants) | Piece valai | Pomfrets |
| | Vaala valai | Seer, Mackerel, Sardine sps, |
| | Nandu valai | Crabs |
| | Salangai valai | Shrimps |
| | Kavala valai | sardine sp. |
| | Kola valai | Flying fish, Full beaks and Half beaks etc |
| | Kanava thoondil | Cuttle fish |

*Based on Primary survey*

### Sethupava Chatiram and Malli patinam

*Sethupava Chatiram* and *Malli patinam* are the two landing centres of *Thanjore* district. At *Malli patinam*, the Muslim community dominates the fishery. Nearly 30 percent of the population is from *Ambalar* community. There is a Fisheries Department office located right on the *Malli patinam* beach. Although the boat owners association is divided on religious grounds in *Malli patinam*, they work together for their common interests. In *Sethupava Chatiram* Hinduism is the dominant religion of the owners. Both places berth a substantial number of country crafts; in *Malli patinam* there are mainly FRP boats (mainly 'imported' from tsunami affected areas) whereas *Sethupava Chatiram* has a long tradition of fishing with *vathais*. The trawlers in this area are the most marginal in the Palk Bay, both in terms of size, value and equipment. Nevertheless, pair trawling is widely practised by most owners and seen as the only way of making some profits. The trawlers also generally violate the 3-nautical mile rule as the fishing grounds are mainly located right next to the shore. The traditional fishermen in the area are as poorly organised lot to combat these violations which substantially affect their interests. The Sri Lankan fishing grounds are located too far away (56km) to be beneficial given the high diesel price.

The above discussion reveals substantial variations among the landing centres in terms of trawler characteristics, fishing activity, population, organisation, use of gears etc. Most of the diversity can be explained in terms of geographical and population characteristics. Fishermen from places like Tondi and Tanjore clusters that located far from Sri Lanka do not cross the border. In villages, where mechanised boat owners are relatively better organised than the traditional fishermen, tend to violate regulations more easily (like using of prohibited of pair trawlers). Country crafts do not operate from big landing centres as they are located at small landing centres. In big landing centres like Rameswaram, boat owners associations are fragmented on the basis of religion or politics.

**Table 2.4 Crafts and Gears used in Sethupava Chatiram and Malli Patinam**

| Craft | Gear | Targeted Species |
|---|---|---|
| Tallu Vathai and FRP | Tallu madi | Shrimps |
| | Thirukkai valai | Ray fish |
| | Salangai valai | Shrimps |
| Kanava vathai | Kanava thoondil | Cuttle fish |
| Trawlers | Eral madi | Shrimps |
| | Kuni madi | Senakuni |
| | Erattai madi (shrimps) | Shrimps |
| | Erattai madi (Fish) | Pelagic and demersal fish |

*Based on Primary survey*

## 2.7. Disappearing species: An indicator of resource depletion

The Palk bay regions harbours various marine resources such as Sharks (Suraa meen), Skates & Rays (Uluvai meen and Thirukkai meen), Eels, Cat fishes (Keluthi meen), Saurids and Saurus, Perches, Mullets (Madavai), Sciganids (Ooraa), Leiognathus (Kaarai or Kaaral), Lactarius (Kuthippu), Pomfrets, Soles, Cod (Kalavaai), Mackeral (Paarai), Seer fish (Seelaa), Penaeid prawns (Eral), Non-Penaeid prawns, Lobsters (Singi), crabs (Nandu), Cephalopods, etc. Sea cucumber and chunk are also to be found. .In our discussion with fishermen, we have found that many species are on the decline. The declining trend indicates that the health of the Palk Bay ecosystem is under stress. Table 2.5 shows the Tamil names of these species.

**Table 2.5 Fish species became not common in the Palk Bay ecosystem as reported by fishers**

| Local name of the fish | Common Name | Scientific Name |
|---|---|---|
| • Kalandan *Eral* | • Jinga Prawn | • Metapenaeus affinis |
| • Komban Sorrah | • Round headed shark | • Sphyma blochii |
| • Poovali | • Elongata illisha | • Illisha elongata |
| • Ullam | • Chinese Herring | • H. toli |
| • Vella vaval | • Silver pomfret | • Pampus argenteus |
| • Seela choorai | • Sarda orientails | • Oriental bonito |
| • Perum Parai | • Thread-fin trevally | • Alectis ciliaris |
| • Ayilis | • Common dolphin fish | • Coryphaena hippurus |
| • Thirukkai meen | • Rays | • *Dasyatis microps* |
| • Kuthippu or Suthumbu | • White fish | • Lactarius lactarius |
| • Uluvai | • Skates | • ---------- |
| • Karal | • Pony fish | • Silver bellies |
| • Vilaimeen | • Long-face emperor-bream | • Lethrinus miniatus |

*Based on Primary survey*

## 2.8. Fishing Communities

The total number of fishing villages in Palk Bay stand at 169 with a total population of 140202 (Fisheries Census, 2000). Both traditional and non traditional communities are involved in fishing. The traditional communities include *Ambalakarar, Paravar, Pattinavar, Kadaien, Paruvatha Rajakulam* and *Padiachy*, while non-traditional communities include *Muslims, Theevar, Nadar Konar etc*. It has been reported that 54.15 per cent of the total fishers are literate. The Palk Bay fisheries are known for the heterogeneity and fragmentation among their fisher folk. The reason for this can be traced to the topography of the Palk Bay. The Palk Bay a relatively shallow region (often referred to as a lake) with calm surroundings makes mechanised fishing a relatively easily accessible occupation. During the heydays of the mechanised fisheries in the 80s and 90s, many inland people found themselves attracted to exchange their troubled

inland sectors for the employment in the marine fisheries sector. As a result, many fishing villages in the Palk Bay ended up with a remarkable jumble of people from different religious, residential and occupational backgrounds. Thus both fishermen who are traditionally engaged in fishing and a large number of so-called non traditional fishermen vent to the waters to get their portion of the seas' wealth. It goes without saying that the co-existence of these different groupings has led to a number of ongoing conflicts. A detailed discussion on different religious and caste group are presented in chapter 3.

## 2.9. Institutional Capacity for Fisheries Management

### Fisheries Department

The primary responsibility of fishery management rests with Tamil Nadu Fisheries Department. The institutional duty of the Fisheries Department is both enormous and complicated. First of all, it has to implement a number of welfare schemes meant for the fishermen community. The main scheme under concern here is the provision of 1500 litre of sale tax free diesel per month per mechanised boat. Secondly, they are to maintain the records of the fishing operations. Thirdly, they have to implement a wide range of fisheries regulations, including those falling under the Tamil Nadu Marine Fisheries Regulation Act of 1983. Add to this, if conflicts arise, fishermen can appeal to the Inspector of Fisheries to solve. Finally, the Fisheries Department has to provide fishermen with identity cards and daily fishing tokens with which they can identify themselves as genuine fishermen. This extensive and complex procedure implies that the officials must simultaneously act as welfare providers, registration officers and policemen. Along the concerned districts, the Fisheries Department has six offices, three of them located in the southern cluster and the other three in the remaining clusters. These offices are headed by an Inspector of Fisheries with staff strength of about 2 to 8. while the big landing places of *Rameswaram* and Mandapam are headed by an Assistant Director. The offices are generally, poorly equipped and often face the problem of open vacancies.

### *a. Regulation in Palk Bay fisheries*

In this section, we have tried to set out the important rules and regulations of Palk Bay fishery. These rules can be classified based on its temporal and spatial characteristics. While the rules pertaining to the spatial restriction is three nautical miles, 3 to 4 day trip has a temporal dimension. In addition to these rules, they observe a fishing 'holiday' generally known as 45 days ban (and also locally referred to as Government Strike). Important fisheries regulations are provided in table 2.6. A detailed discussion of these regulations is provided in the next section.

**Table 2.6 Fishery regulations and its rationale in Palk bay**

| Regulations | Rationale |
|---|---|
| • Three nautical mile rule:<br>• Three to four day rule<br>• Banned nets | • Regulations stemming from the conflict with the artisanal fishermen (mainly the conflict between drift net and trawlers) |
| • 45 days Ban | • Regulations stemming from the resource degradation |
| • Fishermen are not allowed to cross the International Boundary Line<br>• Fishermen have to possess an identity card, issued by the FD<br>• If a trawler heads to the sea it requires a fishing token, issued and signed by the FD<br>• A maximum of five crewmembers are allowed to man each trawler<br>• One can only receive sale tax free diesel provided one possesses a fishing token | • These are regulations exclusively for Palk bay area arising out of the proximity to Sri Lanka. |

*Source: Discussion with fishery officials*

***b. Three nautical mile rule***

One of the important clauses of the Tamil Nadu Marine Fisheries Regulation Act of 1983 relates to the three nautical mile rule that aims to demarcate fishing ground for the operation of country crafts (*vallam, Vathai, FRP crafts*) from trawlers. The rule restricts the operation of mechanised vessels only beyond 3 nautical miles which is to be used exclusively by the country crafts. Violation of this rule has been observed in many places throughout the area (Bavinck 2003, Scholtens 2006).

***c. Three to four day rule***

In order to solve the resource use conflicts between artisanal (non-mechanised) and trawler fishery in targeting same species within the same fishing territory, alternative night schedules were introduced for both the groups in 1993 (Bavinck 2003). This regulation aims to guarantee exclusive right to trawlers on alternative days. Generally, all trawler fishermen obey this rule. Based on the tokens issued by the Fisheries Department in 2006, it is calculated that the on an average a mechanised trawler goes to the sea for 100 days a year (out of the 135 legally allowed nautical days). The limited number of days that fishermen venture into the sea (on average about 1/3 of the allowed nautical days are not used throughout the area) is an indicator of over capitalization as well. Table 2.7 provides the details of the fishing activity in *Rameswaram* for a one-year period.

Many artisanal fishers however, head to the sea for 6 days per week although on trawler days they will keep near the shore. Even many artisanal fishers believe that the rule is actually meant to restrict trawlers and not to limit their operational scope.

***d. The 45 days ban***

In 2001 the Government of Tamil Nadu introduced an annual ban on mechanised boat fishing, lasting from April 15th till May 29th, which became generally known as the 45-day ban. During this period, the mechanised boats are strictly forbidden to enter the sea. This restrictive measure was aimed at the conservation and regeneration of fish stocks and is well obeyed all throughout Tamil Nadu.

**Table 2.7 Details regarding trawler fishing in a year period (April 15 2005 – April 14 2006) from *Rameswaram* town**

| | | | |
|---|---|---|---|
| - | Total number of issued tokens during given one year period | - | 61393 |
| - | Total number of nautical days (356 * 3/7) | - | 154 |
| - | Banned nautical days (45 days ban) | - | 19 |
| - | Total number of legal nautical days | - | 135 |
| - | Idle nautical days due to self imposed strikes | - | 15 |
| - | Idle nautical days due to too heavy weather | - | 5 |
| - | Total number of active nautical days | - | 115 |
| - | Total number of trawlers (estimated average throughout the year ) | - | 700 |
| - | Number of trawlers going out on an average active nautical days | - | 539 |
| - | Average number of fishing days per trawler | - | 88 |

*Source: Scholtens 2006 p 20*

**Rule violation**

We found many trawler boat fishers practice pair trawling in Palk Bay region although the net (*Erattai madi*) is banned since 2000 by a government order (GO). The qualitative data collected during the first phase of this study shows that fishers have reasons in favour and against the use of *pair trawl net* (Table 2.8). We have already mentioned the different locations where this net is practiced at a larger scale. This study also observed use of other destructive gears in trawler boats which include *Chunk madi and Attai madi etc*. It is already mentioned that other destructive fishing practices like use of *Surukku madi* (purse seining) and occasional use of dynamite also exist in Palk Bay. Both are legally banned techniques. The use of purse seining is quite common during March.

***a. Soft disobedience or misuse***

First, there is the possibility of getting subsidised diesel without really going to the sea As the diesel can either be sold to outsiders or fellow boat owners or – in the case an owner having more than one boat – can be used for one of his boats that ventures into the sea.

***b. Hard misuse***

Secondly, if one sells ones boat (for example to a boat breaker) but keep his RC book, there is a possibility of fishing tokens and subsidised diesel being issued on continues basis. This diesel can be sold for a little margin to either fellow boat owners or outsiders. However, according to the Fisheries

**Table 2.8 Reasons provided by fishers for opposing and favouring Pair trawling in the Palk bay fishery**

| Opposing pair trawling | Favouring pair trawling |
|---|---|
| - is an ecologically destructive fishing method,<br>- reduces the catch available for other trawlers and small scale fishermen<br>- reduces the fish prices thereby affecting other fishermen<br>- It does a great appeal on the limited labour available.<br>- Pair trawling used to be operated from January to March, but now it is operated throughout the year. | The net is not destructive as it is used for catching migratory pelagic fishes.<br>- It targets only fish and not prawns which are targeted by the 'ordinary fishermen. Hence it has no impact on the catch of others or on the price<br>- All the protest is just a matter of jealously of smaller owners, as we have strong boats and big amounts of money are involved.<br>- In *Pamban*, pair trawling is also allowed for three months per year. In *Rameswaram*, we need the same. If this is allowed, we can promise not to go anywhere throughout the rest of the year.<br>- Small scale fishermen are no longer opposing pair trawling<br>- With regard to the criminal act: how can you punish innocent crewmembers. This is ridiculous.<br>- "If pair trawling is become banned (in practice) we shall fight against it. Otherwise, possible to increase the horsepower of the motor and operate the net with one boat. That is already being done by boats in Tuticorin". |

*Based on Primary Interviews and focus group discussions*

Department, this problem got solved in September 2006 when an extensive physical identification of boats was carried out. All RC books that were not connected to an existing boat were cancelled. In Rameswaram for example, 40 RC books were cancelled. Evidently large sums of money were reportedly offered to the FD by some powerful owners to continue their illegal activities, but accepting this allegation appears difficult as inspectors from different districts carried out the physical identification. However, these misuses appears to occur especially in the larger landing centres like Rameswaram, Mandapam, *Kottai Patinam* and *Jagada Patinam* where it is almost impossible for the Fisheries Department to monitor whether boats with fishing token really venture into the sea. Evidently, these activities have to be carried out in secrecy because without substantial influence or facing local 'enemies', it is very difficult for boat owners to abuse this scheme, as their local 'enemies' would be eager to lodge a complaint to the FD.

### Coast Guard and Navy

Given the sensitivity of the area, the Coast Guard as well as the Indian Navy have a substantial presence in the Palk Bay. Across the districts under concern, there are four naval bases, one in each cluster. The navy personnel make use of nine hired blue painted fishing boats (40 ft) on which they patrol daily or twice-daily along the coastal areas. The Coast Guard is located on the southern shore of Mandapam and has thus – strictly taken – no base in the Palk Bay. However, the modern hovercrafts operate from Mandapam, make regular checks in the southern areas of the Palk Bay. Additionally, the Coast Guard patrols with several ships permanently along the international boarder line.

As far as the fisheries in the Palk Bay are concerned, the responsibilities of the Coast Guard and the Navy do not differ significantly. More importantly, their principal duty is to safeguard the sovereignty of the national waters, and prevent smuggling activities, and this falls under the authority of the Central Government. This implies that they are not legally committed to the enforcement concerns of the fishing regulations designed by the Tamil Nadu government and makes their cooperation with the fisheries department principally limited to issues dealing with security, such as checking the fishing tokens and preventing fishermen from crossing over the Sri Lankan border.

Although fishermen have nothing to fear from these security forces as long as they possess appropriate documents and stay within the Indian side of the border, they are generally afraid of them. Reasons include a general dislike of 'uniformed North Indians' and the fact that the Navy sometimes takes possession

of some high value prawns. For landing centres where fishermen often 'have to' head to the Sri Lankan waters – like Rameswaram and *Jagada Patinam* – their fear is obvious as they need to circumvent their boats and ships in order to succeed. Recently, the Coast Guard has launched a 'community interaction program', with a view to improving relations with the fishermen. At local meetings they express their ability and willingness to speak Tamil and also assist fishermen in emergency situations. By doing so, they hope to establish a mutually beneficial relationship with these prime actors on the sea.

**Boat owner associations**

The final unofficial but important players in the institutional field are the boat owner associations. In each landing centre, one or more of these associations are present depending on the heterogeneity of the owners' backgrounds. For example, in *Jagada Patinam*, where virtually all owners belong to the Pattinavar caste, there is one association with all owners as members. We have already seen that Rameswaram, on the contrary, has thirteen associations, divided along the lines of religion, caste and political affiliation. In total, there are about thirty associations spread across ten landing centres.

The operational scope of the boat owners associations has basically two dimensions: dealing with internal and external matters. To start with the latter one, lobbying for the collective interest of the boat owners at the district and state level is of vital importance. In the young history of the mechanised boat sector, this kind of lobbying has proved successful in many instances, with the allotment of sale tax free diesel as the most recent example. Their second commitment relates to internal affairs, with a focus on the settlement of disputes between the trawler owners and the traditional boat owners.. Boat associations are generally acknowledged by the Fisheries Department as vital bodies in representing the interests of the fishermen; and the interaction between them is substantial. In those landing centres where boat owners are well organised (like *Jagada Patinam, Malli patinam* and *Rameswaram*), they even have the power to negotiate the scope of regulations with the Fisheries Department. Boat owner associations usually have a board headed by a president and a secretary and tend to raise a small tax on sea going boats (in the form of prawns or money) in order to secure their financial needs.

The capacity of these associations tends to be a function of their fragmentation. In this respect, in landing centres with a high number of associations, competition for prestige tends to impede effective cooperation in collective lobbies against outside world. As a result, their institutional strength differs significantly from one landing place to another.

## 2.10. Labour Market

The labour market in the Palk Bay consists of both hired and family labour. Among hired labour, there are many migrants. Some of these migrants have become settlers as they have been living in the respective villages for a considerable amount of time. Wage, and share contract both exist although they differ across landing centres. Some boat owners even opine that labourers (crew) are much better off as compared to owners. This is because most labourers working in the boats get a guaranteed minimum income as wages. They get credit for their consumption and other productive needs. Today labour shortage is a micro level problem in many landing locations in the Palk Bay. Fishers say that it is difficult to get people to work on boats, especially in *Thanjore* district during the agricultural harvest season. Table 2.9 shows the character of labour market that exists in different locations of the Palk Bay.

## 2.11. Product Market

The fish market at many locations in Palk Bay is highly imperfect in that it functions like a monospony; for example, in the southern part of Palk bay, there are two main buyers called NILA and DSM who are brothers as well. So there is no competition between buyers. The fish price is always kept artificially low. Middlemen also play an important role on keeping the price at a lower level. There are two levels of middlemen before reaching the fish from fishers to processor. So the present market condition affects the profitability of fishers. They do not have any right over deciding fish price. The market is characterised by low landing prices. The trends show that declining profitability of fishers has been getting worsened due to increasing diesel prices and to a lesser extent declining catches.

## 2.12. Conclusion

The above discussion on the characteristic features of Palk Bay fishery reveals various issues related to fishery management. These issues can be classified in to three broad categories. (a) Location specific

**Table 2.9 Characteristic features of labour market across different landing locations of Palk bay**

| Landing centre | Migration origin | Cash or Share contracting | Incentive mechanism |
|---|---|---|---|
| *Rameswaram* | In migrants from uchipuli, Nagachi, Muthalathoor, Kolachal, Muttom, Kaiapattinam, Madurai, Thoothukudi, Ramanad, *Tondi*, Arpukottai, Perumkulam, Mandapam, Thirunelveli, *Pamban*, Kanyakumari, Akramesi, Veerasthalam, Ottankalam, Vembar Manamadhurai | Wage system and incentive based on revenue | Salary system one day<br>Boat worker: 120 Rs + 3% of the revenue, with a minimum of 300 to 350Rs.<br>Driver: 150 Rs + 5% of the revenue, with a minimum of 500Rs. |
| *Pamban* | Immigrants from Marthandam, Kappakkad, *Ramanadhapuram*, Thankachimadam, Akkamadam, | Wage system and incentive based on revenue | Depends on net used |
| Mandapam | In migrants from Uchipuli, Perumkulam, Nagachi, KK Rannathpuram, Pullaimadam, Puthupetti, Methalodai, Valanthara | Wage system and incentive based on revenue | Salary driver:-250 + 50Rs per 1000Rs catch revenue<br>Salary lesker 150 + 40Rs per 1000Rs catch revenue Salary worker=300 |
| *Tondi* | Immigrants from Thalamancode, Aprai, Thinayathoor, uppera, Pallom Kottai | | There is no fixed salary/sharing system, it depends upon the catch. If the owner incurs loss the salary is between Rs 200 and 250, and for every 1000 Rs profit the workers can expect to get Rs 50 extra. |
| *Jagada Patinam* | Labour in migration from Palakudi, Nagai, Thihar pattinam, Puthu petti, Akkara Petti, Tharagampadi, Nagapattinam, Nagoor, Thirupattinam, Vamagiri, Thalam petti *Rameswaram* | Weekly wage system ranges between 400 to 600. | Incentives are paid in cash that vary from 30 to 50 rupees per 1000 rupees worthing catch |
| *Kottai Patinam* | Labour in migration from *Rameswaram*, Aranthangi, Uchipuli, Thankachimadam, Manapad, Thuthukudi, Meemisal, Karakudi, Muthupetti, KK Nellai, Chettikulam, Naripoor, Ramanad, Puthukottai, Embel, Oriyoor, Mandapam, Nagari, Thirunelveli | Sharing system | The crewmembers receive 20% of the catch value as salary, which is equally shared among them, although the driver will receive 20 to 30 percent more. Because of this sharing system, workers prefer to go to the sea with three rather than four crewmembers. |
| Sethupava Chatiram | In mingration from Avadiamai Kottai, Pillayar thadai, Puthukottai, Sambai pattinam | Share contracting. 15 to 20 percent of the catch is paid to laboures including incentive | Share contracting as explained in the case of *Kottai Patinam* |
| *Malli patinam* | Immigration from puthukottai, kadaloor, melakkot Andigar, chinnamada, peruvooram | Share contracting. 20 percent of the catch is paid to laboures including incentive | Share contracting as explained in the case of *Kottai Patinam* |

*Based on field notes*
*Note: It is observed that those owners' whose crew consist of relatives tend to pay a fixed salary, whereas owners with less close links to their crew prefer to pay wages based on incentives.*

issues, (b) Issues related to fishing practice (c) institutional and market related issues. As far as the location is concerned, it is a troubled place due to Sri Lankan civil war and conflict over sharing fishery resources with Sri Lankan fishers. Secondly, issues like the use of destructive gears, and depletion of fishery stock come under the category of fishing practice. Other important issues that need most urgent attention are related to market condition and institutional set up. Finally, declining profitability, imperfect market condition in product and factor markets, and low landing price of fish do work against the interest of fishers. In the third chapter, we deal with the issue of technical efficiency of trawlers for more in-depth analysis using primary data.

**Table 2.10 A summary of the characteristic features of Palk bay fishery**

| Geography and Marine Ecology | Biodiversity | Landing centres | Fishing Practice, Crafts and gears | Institutional Characteristics and functions | Fishing regulations | Core Issues |
|---|---|---|---|---|---|---|
| • Low island<br>• Reef shoals<br>• Shallow flat basin<br>• Depth never exceeds 15 meters (Venkataraman Wafar 2005) | • Rich in seagrasses, seaweeds, crustaceans and fishes (Venkataraman Wafar 2005) | • Total 10 landing centres for Trawler boats<br>• Landing centres distributed in three revenue districts<br>• Landing centres are *Rameswaram, Pamban*,Mandapam-north, Soloaikudi, Lanjadi*Tondi, Jagada Patinam,Kottai Patinam, Sethupava Chatiram* and *Malli patinam* | • Mechanised and Non mechanised fishing<br>• Shore seine fishing and gathering<br>• Crafts (Trawlers, Vallam, *Vathai*, Fiber boats)<br>• Gears (Gill nets, trawl nets etc)<br>• Pair trawling, Substantial number of pair trawlers are located in *Rameswaram* and *Jagada Patinam*.<br>• Vallam, *Vathai* and FRP are mostly located in small landing centres | • Department of fishery<br>• Coast guard and Indian Navy play an indirect role in monitoring fishing activities<br>• Recently, the Coast Guard has launched a 'community interaction program', with the aim of improving relations with fishers.<br>• Alliance for Release of Innocent Fishermen (ARIF). Works for the co existence of fishermen in both India and Sri Lanka (Vivekanandan 2004)<br>• South Indian Federation of Fishermen Societies (SIFFS)<br>• Boat owners association<br>• Both cash and share contracting practice | • Licensing of fishing boats<br>• Token system<br>• Monsoon ban<br>• Limited movement of boats between landing centres (boats need Anchor permit)<br>• 3 to 4 days agreement between country craft owners and trawler fishers through a government order<br>• 3 nautical mile rule of the Tamilnadu marine fisheries regulation Act 1983 (Violation are observed in many landing centres of Palk Bay) | • Troubled location due to civil war in Sri Lanka since 1983.<br>• The civil war has had a deep impact on Palk Bay fishery (Vivekanandan 2004)<br>• Existing Capacity of the number of boats exceeds planned capacity in Landing centres.<br>• Practice of destructive fishing gears e.g rathmadi, *Chank madi*, attaimadi, suruku valai *etc*<br>• Over fishing and resource degradation<br>• Stock of many marine species are under stress<br>• Less co-ordination between different institutions<br>• Poor human resource of fisheries department<br>• Boat owners associations are fragmented on caste and political lines<br>• Declining profitability of fishing<br>• Imperfect product and factor market<br>• Aspiration to become a trawler owner is common among artisanal fishers<br>• Labours are in migrats<br>• Low landing price for fish |

*Based on primary data*

# Chapter 3: Trawler Boat Fishery in the Palk Bay

## 3.1. Introduction

In the previous chapter, we have observed that the Palk Bay Fisheries is not a pure open access resource as there are various types of regulations (stemming from different reasons) even though the degree of their effectiveness differs considerably. These restrictions and regulations on fishing were designed with a view to resolve social conflicts arising out of competition for fishing space due to its strategic location and the proximity to Sri Lankan waters. In continuation of our earlier observation that the availability of fishing ground per trawler boat is limited, in this chapter, we present a more detailed analysis of the trawler boat fishery. This is basically to understand their operative practices in terms of various inputs use, harvested output and efficiency in fishing. Analysis of technical efficiency helps us understand the necessity, if any, for fishing capacity or fleet reduction and the options available for reducing it. The analysis of trawler fishery presented in this chapter is based on the primary data gathered from sample boat owners.

## 3.2. Profile of the boat owners

### Religion and Caste particulars about boat owners

To begin with, we present a socioeconomic profile of the sample boat owners selected for this study. The boat owners selected are heterogeneous in terms of their religion and social groups. As noted in the previous chapter, the major religious groups are Hindu, Muslim, and Christians. We have observed that Christians constitute about 51.8 per cent of the total population while the Hindus and Muslims account for 40.2 and 8 per cent respectively. The distribution of population in terms of religion across fish landing centres shows that Christian population is concentrated in Rameswaram, Pamban, Mandapam and Kottai patinam. Hindus are relatively more concentrated in Tondi, Jagada patinam, and Sethupava Chatiram landing centres, whereas Muslims dominate in the Malli patinam landing centre; a small proportion of Muslims is also found in Mandapam, Kottai patinam, and Sethupava Chatiram landing centres.

Important social groups are Chettiyar (8.0%), Pattinavar (6%), Kadayar or Pattankutti (6), Nadar (3.5% of Hindu), Ambalar (4.4%). Besides other caste groups like Vellaleva, Kallar, Asari, Pulluvar, Thevar, Yadav, Pillaimar, Ahamudiar, Valayar, and Chenkuthav' Among Muslims, there is no caste diversification; however, a small group of Muslims identify themselves as Lebbari (1% Muslims). The only caste groups that cut across two religions are Paruvatha Rajakulam (Hindu (4.4%) and Muslims (6.6%) respectively) and Paravar, the biggest group (50.4), however, fishermen ,in general are known as Meenavar irrespective of whichever religion or caste they belong to.

### Ownership of boats

Ownership of trawler boats is the most important thing as far as fishing is concerned. While 79 per cent of the boat owners reportedly own only one boat, sixteen percent reported having at least two boats and another 3 and 2 per cent having 3 and 4 boats respectively. Paravar community is seen to own more number of boats. Nobody reported to have own more than four boats, although from the qualitative survey we have come to observe that a few owners possess a virtual fleet. From the distribution of the size of boats that they own, it has been observed that those having more number of boats also have bigger sized boats. The percentage of smaller boats is more with single boat owners. Majority of the boats are between 32 to 42 feet in size (Table 3.2). It is also obvious that those who wish to have more than one boat also prefer bigger sized boats, that is, at least above 32 feet in length. We have also observed that there are no boats beyond 50 feet in length. The major reason for this could be attributed to the restrictions in terms of alternate days for fishing and the stipulated time for their return. Because of this time restriction[7] there might not be a need for bigger boats. Therefore, boats less than 50 feet in length seem to be optimal for them considering the time constraint imposed on fishing.

[7] *We have discussed these rules in the previous chapter.*

**Table 3.1 Distribution of fishers by caste in the Palk Bay Coastal area**

| | Number of boats | | | | | |
|---|---|---|---|---|---|---|
| Caste | 1 | 2 | 3 | 4 | Total | % |
| Meenavar/Chettiyar | 19 | 3 | | | 22 | 9.73 |
| Kadayar/pattankutti | 10 | 3 | | | 13 | 5.75 |
| Nadar | 6 | 1 | 1 | | 8 | 3.54 |
| Lebbari | 1 | 1 | | | 2 | 0.88 |
| Vellaleva | 1 | | | | 1 | 0.44 |
| Kallar | 1 | | | | 1 | 0.44 |
| Asari | 1 | | | | 1 | 0.44 |
| Parvar | 89 | 21 | 2 | 2 | 114 | 50.44 |
| Muslim | 13 | 1 | | 1 | 15 | 6.64 |
| Ambalkar | 6 | 1 | 2 | 1 | 10 | 4.42 |
| Parvatharajakuram | 6 | 3 | 1 | | 10 | 4.42 |
| Pulluvar | | 1 | | | 1 | 0.44 |
| Thevar | 1 | 1 | | | 2 | 0.88 |
| Yadav | 5 | | | | 5 | 2.21 |
| Pillaimar | | 1 | | | 1 | 0.44 |
| Ahamudiar | 3 | 1 | | | 4 | 1.77 |
| Valayar | 2 | | | | 2 | 0.88 |
| Chenkuthav | 1 | | | | 1 | 0.44 |
| Pattinavar | 13 | | | | 13 | 5.75 |
| | 178 | | | | | |
| **Total** | **(78.76)** | **38(16.81)** | **6(2.65)** | **4(1.77)** | **226** | **100.00** |

*Based on Primary data*

**Table 3.2 Size wise distribution of boats across different category of boat owners**

| **Owners with** | **Less than 32 fee** | | **between 32 to 42** | | **42 and above** | | **Total boats** |
|---|---|---|---|---|---|---|---|
| | **No** | **Percent** | **No** | **Per cent** | **No** | **Percent** | **Number** |
| Single boat | 8 | 4.49 | 154 | 86.52 | 16 | 8.99 | 178 |
| Two boats | 2 | 2.63 | 59 | 77.63 | 15 | 19.74 | 76 |
| Three boats | 0 | 0.00 | 17 | 94.44 | 1 | 5.56 | 18 |
| Four boats | 0 | 0.00 | 11 | 68.75 | 5 | 31.25 | 16 |

*Based on Primary survey*

It is also difficult even to guess whether the boat owners induct newer boats, nor it is possible, in most cases, to get a fair idea of the age and life of the boats as they undergo continuous repairs. Most boat owners buy second hand boats and get them thoroughly repaired. These repairs are carried out so intensely that it is almost impossible to get fair idea on age related efficiency, and life of the boats. When the repair costs become too high the boats are dismantled in the break yard. Despite these limitations we have tried to gather information on the age of boats as reported by the boat owners and also whether newer and most modern or sophisticated boats are being inducted into the Palk Bay fishery. The average age of

**Table 3.3 Distribution of boats by size and average age across landing centres**

| Landing centres | Length less than 32 | | 32-42 | | 42-above | | For all | |
|---|---|---|---|---|---|---|---|---|
| | Av. Age | Number | Av. Age | Number | Av. Age | Number | Av. Age | Number |
| Rameswaram | 19.33 | 3 | 22.31 | 65 | 19.76 | 24 | 21.83 | 92 |
| Pamban | 0 | 0 | 28.5 | 4 | 16.33 | 7 | 17.5 | 11 |
| Mandapam | 15 | 3 | 16.14 | 53 | 25 | 1 | 16.06 | 57 |
| Tondi | 0 | 0 | 16.46 | 18 | 11 | 1 | 16.32 | 19 |
| Jagada patinam | 0 | 0 | 14.26 | 34 | 12 | 2 | 14.14 | 36 |
| Kottai patinam | 0 | 0 | 17.85 | 33 | 25 | 1 | 17.89 | 34 |
| Sethupava Chatiram | 0 | 0 | 18.05 | 12 | 10 | 1 | 17.05 | 13 |
| Malli patinam | 5 | 3 | 17.27 | 21 | 0 | 0 | 16.49 | 24 |
| **Total** | **13.11** | **9** | **18.95** | **240** | **0** | **37** | **18.98** | **286** |

*Based on Primary data*

boats is over 20 years in Rameswaram and above 16 for most other landing centres with the exception of Jagada patinam (Table 3.3). However, we do not have a fair idea about how often they replace boats.

## 3.3. Economic aspects of trawler boat fishery

### Labour and wages

In the Palk Bay, trawler boat owners employ both family and hired labourers as crewmembers. It has been found that 78 per cent of the boat owners happen to be crewmembers as well. This percentage is very high in Pamban and Sethupava Chatiram where 90 per cent of the boat owners also function as crewmembers. In the case of owners with single boats 4 labourers are employed on an average, of which 2.7 are hired and the rest constitute family labour. The involvement of family labour decreases from 2 to 3 boats beyond which it increases marginally. Labour absorption per boat, among owners with single boats, is more in Pamban and Rameswaram when compared to other landing centres. However, the scenario changes slightly in the case of owners with two boats. In this case also, labour absorption is more in Pamban followed by Jagada patinam and Mandapam. Involvement of family labour for the second boat decreases considerably in Rameswaram which could be due to the shortage of family labour. In contrast to this, in Pamban, while the involvement of family labour for the second unit of boat remains more or less the same, the involvement of hired labour increases considerably in the third boat as compared to other landing centres. Jagada patinam and Rameswaram are the other landing centres which show higher involvement of hired labour for the second boat. It is also interesting to note that in the landing centres like Sethupava Chatiram and Malli patinam, the proportion of hired labour decreased for the second boat increases for the third boat. Therefore, it is important to recognise that labour absorption per boat differs not only according to landing centres but also according to the number of additional boats owned by the owner. Both share and wage contracts prevail in the Palk Bay regarding remuneration for hired labourers. In most landing centres except Sethupava Chatiram and Malli patinam, however, it is predominantly wage contract that exist. In these two landing centres Captain and Assistant Capitan are on share contract. These are also jobs which require good skills. Although there are both types of contracts existing in the labour market, in the estimation of labour cost, we have excluded share contract owing to the paucity of data. Wage bill for family labour has been calculated by imputing prevailing wage rate for hired labour. The estimated labour cost is given in Table 3.5. The labour cost per trip per boat has been to be found to the highest for single boat owners as it is more labour intensive. We can observe that the wage cost for hired labour as a proportion of total wage cost, enhances as the number of boats increase with the exception of Sethupava Chatiram and Malli patinam. In these two landing centres, the cost of family labour is more for boat owners with two boats.

**Table 3.4 Distribution of Family labour and hired labour across different categories of boat owners and landing centres**

| Landing centres | Owners with one boat | | | Owners with two boats | | | Owners with three boats | | | Owners with four boats | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hired labour | Family labour | Total labour | Hired labour | Family labour | Total labour | Hired labour | Family labour | Total labour | Hired labour | Family labour | Total labour |
| Rameswaram | 2.8 | 1.3 | 4.1 | 3.4 | 0.5 | 3.9 | 3.5 | 0.3 | 3.8 | 2.6 | 1.3 | 3.8 |
| Pamban | 4.6 | · 1.1 | 5.7 | 5.5 | 1.0 | 6.5 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mandapam | 2.9 | 1.4 | 4.3 | 2.9 | 1.4 | 4.2 | 2.7 | 0.3 | 3.0 | 0 | 0 | 0 |
| Tondi | 2.2 | 1.1 | 3.3 | 2.3 | 1.0 | 3.3 | 2.3 | 0.7 | 3.0 | 0 | 0 | 0 |
| Jagada patinam | 2.3 | 1.4 | 3.6 | 3.3 | 1.0 | 4.3 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kottai patinam | 2.5 | 1.1 | 3.6 | 2.7 | 0.7 | 3.3 | 0 | 0 | 0 | 2.5 | 0.5 | 3 |
| Sethupava Chatiram | 2.9 | 1.0 | 3.9 | 1.5 | 1.5 | 3.0 | 0 | 0 | 0 | 0 | 0 | 0 |
| Malli patinam | 2.0 | 1.7 | 3.7 | 1.0 | 2.0 | 3.0 | 2.7 | 0.3 | 3.0 | 3.8 | 0.3 | 4 |
| Total | 2.7 | 1.3 | 4.0 | 2.9 | 0.9 | 3.9 | 2.9 | 0.4 | 3.3 | 2.9 | 0.8 | 3.6 |

*Based on Primary data*

**Table 3.5 Distribution of total wage bill across hired and family labour for one boat trip across category of owners and landing centres**

| Landing centres | Boat owners with one boat | | | Boat owners with two boats | | | Boat owners with three boats | | | Boat owners with four boats | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Hired labour | Family labour | Total | Hired labour | Family labour | Total | Hired labour | Family labour | Total | Hired labour | Family labour | Total |
| Rameswaram | 1373 (68) | 644 (32) | 2017 | 1681 (87) | 247 (13) | 1928 | 1728 (91) | 165 (9) | 1892 | 1283 (68) | 642 (32) | 1876 |
| Pamban | 3271 (80) | · 798 (20) | 4069 | 3949 (85) | 718 (15) | 4667 | 0 | 0 | 0 | 0 | 0 | 0 |
| Mandapam | 1544 (67) | 752 (33) | 2297 | 1535 (68) | 729 (32) | 2264 | 1433(89) | 179 (11) | 1612 | 0 | 0 | 0 |
| Tondi | 929 (67) | 464 (33) | 1393 | 985 (70) | 422 (30) | 1408 | 985(78) | 282(22) | 1267 | 0 | 0 | 0 |
| Jagada patinam | 1061 (63) | 630 (38) | 1675 | 1537 (77) | 461 (23) | 1998 | 0 | 0 | 0 | 0 | 0 | 0 |
| Kottai patinam | 1153 (70) | 500 (30) | 1653 | 1230 (80) | 308 (20) | 1538 | 0 | 0 | 0 | 1153 (83) | 231 (17) | 1384 |
| Sethupava Chatiram | 1160 (74) | 406 (26) | 1566 | 609 (50) | 609 (50) | 1218 | 0 | 0 | 0 | 0 | 0 | 0 |
| Malli patinam | 874 (55) | 728 (45) | 1602 | 437 (33) | 874 (67) | 1311 | 1165 (89) | 146 (11) | 1311 | 1661 (95) | 131 (5) | 1748 |
| Total | 1387 (68) | 669 (33) | 2053 | 1512 (76) | 475(24) | 1987 | 1489(88) | 200 (12) | 1689 | 1495 (81) | 412 (19) | 1855 |

*Notes: Wage bill for family labour was calculated by imputing prevailing wage rate for hired labours; Figures in parentheses are percentage share; For Sethupava Chatiram Malli patinam, wage rate exist only for crew members (captain and assistant captain will get wages on the basis of share contracting. Based on Primary data.*

**Migrant labour**

Hired labourers available in the Palk Bay comprise migrant labourers as well. From the table given below, it is seen that almost 53 per cent of the boat owners employ migrant labourers. In-migration to these landing centres could be due to the prevailing high demand for labour. The proportion of migrant labourers is more in Lanjadi (100 per cent)[8], Chozliakudi (80 per cent), Tondi (75 per cent) Kottai patinam (68 per cent), and Rameswaram (62 per cent) as compared to other landing centres (Table 3.6). From the field discussions, for example in Lanjadi, we have observed that most of these migrants have been living there for a fairly long time and do not even identify themselves as migrants. The fact that migrants are able to settle down in these villages itself shows that there is a demand for labour from the trawler sector. It is in Pamban that the proportion of boat owners employing migrant labour is lowest and also that they incidentally employ less number of hired labours.

**Other major inputs: Diesel, Oil and Ice**

Diesel is yet another major input in fishing. Quantity of diesel used per trip is more in Pamban (288 litres) and Rameswaram (263 litres) islands which is well above the overall average of 223 litres. Use of diesel is lowest in Malli patinam (169 litres), Jagada patinam (206 litres) and Mandapam (210 litres). It should be noted that the boat owners can avail diesel at a subsidized rate of Rs 28 per liter for 1500 litres per month. In this context, it is important to mention that there is an ever increasing demand for subsidised diesel. However, considerable malpractices have been observed with respect to the use of subsidised diesel. In some cases we have noted that some boat owners keep the registration of their boats (which have been already broken down) for availing their quota of subsidised diesel and then sell it to others at a margin. We will discuss the issue of diesel subsidy at length in another chapter.

With regard to inputs like oil, grease and ice, we have managed to get information only on the cost incurred and not the quantity used. Over Rs 300 is incurred on oil and ice together per trip. Boat owners from Pamban have reported maximum expenditure on ice among all the landing centres baring Jagada patinam where the cost incurred is the least.

**Advance system**

It is important to note that the Palk Bay fishers face credit constraints. As they do not have access to formal money lending institutions, they rely on a number of other sources to meet their credit requirements. These include money lenders, fish and prawn traders, family, friends, etc. More than half of the sample boat owners reported that they have borrowed money or have taken advances from multiple sources. However, we do not have data on the amount of cash advances taken and outstanding dues however. Fish and Prawn traders constitute the single largest source of credit. Venturing into the sea each time requires huge investments money, which the boat owners cannot afford especially in the context of variability in catch. Most of the times the borrowings are made in the form of cash advances to meet the input costs for each trip to the sea with a promise to pay back after the harvests are made. However, these borrowings are not repaid or the advances not fully settled after the harvests. If the actual output is less than the expected for few consecutive trips, then the boat owners fall into a debt trap. As many as 80 per cent of the boat owners admit that they have incurred outstanding dues or that they have not settled the advances they had availed of in the past. Nevertheless, it is noteworthy that almost all the boat owners have borrowed money for fishing purposes rather than for any other unproductive consumption purpose.

A major negative outcome of availing advance money is that it curtails the freedom of boat owners to sell their produce at competitive prices thereby push them into debt trap. Further, they are bound to sell the produce to the lender often at distressingly low prices as compared to the market price. As many as 58 per cent of the boat owners confide that they are not allowed to sell fish to any one other than to the lender. They also express their inability to settle the advance they had taken in the same season for the same reason. Only 8 per cent of the boat owners have reported that they have been able to pay off or settle their advances.

[8] *But many migrants have been living in Lanjadi for many years.*

**Table 3.6 Distribution of boat owners employing migrant labourers as crew**

| Landing centre | Boat owners employing migrant labours | | Boat owners not employing migrant labours | | Total boat |
|---|---|---|---|---|---|
| | Number | Per cent | Number | Per cent | |
| Rameswaram | 41 | 62.12 | 25 | 37.88 | 66 |
| Chozliakudi | 4 | 80.00 | 1 | 20.00 | 5 |
| Tondi | 3 | 75.00 | 1 | 25.00 | 4 |
| Mandapam | 19 | 39.58 | 29 | 60.42 | 48 |
| Kottai patinam | 19 | 67.86 | 9 | 32.14 | 28 |
| Lanjadi | 5 | 100.00 | 0 | 0.00 | 5 |
| Pamban | 2 | 18.18 | 9 | 81.82 | 11 |
| Malli patinam | 9 | 52.94 | 8 | 47.06 | 17 |
| Sethupava Chatiram | 4 | 40.00 | 6 | 60.00 | 10 |
| Jagada patinam | 14 | 42.42 | 19 | 57.58 | 33 |
| **Total** | **120** | **53.10** | **106** | **46.90** | **226** |

*Based on Primary data*

**Table 3.7. Use of Various Other Inputs Across Landing Centres**

| Landing centres | Diesel (in litres) | Oil (in Rs) | Grease (in Rs) | Ice (in Rs) |
|---|---|---|---|---|
| Rameswaram | 263 | 185 | 74 | 157 |
| Pamban | 288 | 165 | 59 | 247 |
| Mandapam | 210 | 184 | 57 | 137 |
| Tondi | 175 | 198 | 61 | 156 |
| Jagada patinam | 206 | 150 | 51 | 133 |
| Kottai patinam | 199 | 172 | 55 | 138 |
| Sethupava Chatiram | 233 | 159 | 52 | 148 |
| Malli patinam | 168 | 156 | 63 | 201 |
| **Total** | **223** | **174** | **61** | **154** |

*Based on Primary data*

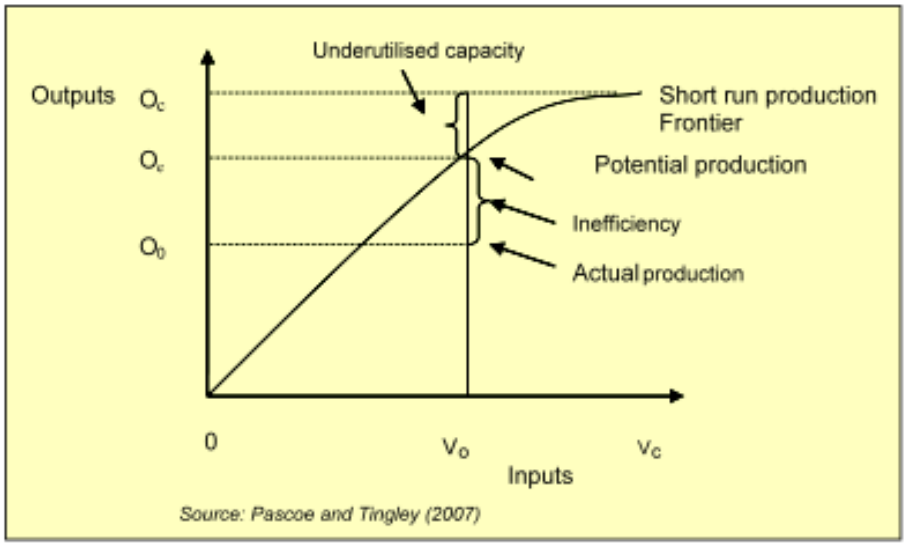
## 3.4. Technical Efficiency of Trawler Boats in the Palk Bay

In order to assess the current status of fishing capacity in the Palk Bay we undertook a more detailed analysis of technical efficiency of trawler. In continuation to chapter 1 which introduced various concepts related to fishing capacity and utilisation, in this chapter we undertake a more detailed analysis of technical efficiency of trawler boats and see whether the results corresponds to what we have obtained in the qualitative as well as subjective assessments of trawler fishery in the Palk Bay. As pointed out earlier, capacity utilisation and efficiency are similar concepts each representing the degree to which vessels perform relative to other vessels using similar level of inputs. Capacity utilization is the degree to which the vessel achieves its potential (capacity) output given its physical characteristics (i.e. fixed inputs such as size, engine power etc.) (Pascoe and Tingley, 2007). Efficiency in economics can be explained in terms of the optimal combination of inputs to achieve a given level of output (an input orientation) or the optimal output that could be produced given a set of inputs (an output orientation). In this study, we have considered the second one and, therefore, technical efficiency means the relationship between vessels inputs into the fishing production and its outputs with full efficiency being achieved when outputs are the maximum from a given set of inputs. In other words, technical efficiency is related to the difference between the actual and potential output given both fixed and variable input use. Inputs used can be either

fixed (eg. vessel length, gear etc) or variable (eg time spent, crew employed etc). Some of the fixed inputs can also be intangible like skills of the skipper or captain. In the present study, however, we do not take into account intangible inputs like skills of the skipper.

Pascoe and Tingley (2007) illustrates the concept as follows (Figure 3.1.) A vessel of a given size is observed to be producing $O_0$ level of output as a result of using $V_o$ levels of inputs. If all the inputs were fully utilized (i.e. using $V_c$ rather than $V_o$ potential (capacity) output would be $O_c$. Even at lower level of input usage, if the vessel is operating efficiently it would be expected to produce $O_e$ level of output. Hence the difference $O_e$-$O_o$ is due to inefficiency.

**Figure 3.1 Capacity Utilisation and Inefficiency**




In general terms, the measurement of firm specific technical efficiency is based upon deviations of the observed output from the best production or efficient production frontier. If a firms' actual production point lies on the frontier, it is perfectly efficient, but if it lies below the frontier then it is technically inefficient, with the ratio of the actual to potential production defining the level of efficiency of the individual firm (Pascoe and Mardle, 2003), (trawler boats in this case).

A common feature of the methods that were developed to measure technical efficiency following Farrell's (1957) definition is that information is extracted from extreme observations from a body of data to determine the best practice production frontier (Lewin and Lovell, 1990). From this the relative measure of technical efficiency for the individual firm is derived. The important techniques for estimating technical efficiency are stochastic frontier production function and data envelopment analysis (DEA)[9].

An important feature of the DEA is that it incorporates multiple outputs directly into the analysis. This is a multi-output measure and, is, therefore, an alternative to single output measure. However, as it is non-parametric, it is sensitive to random error and also does not provide estimates of the impact of individual inputs on the level of outputs or the relationship between the outputs themselves (Pascoe and Mardle, 2003).

Stochastic frontier production function is another method widely used for measuring technical efficiency which we have used in this study as well. This analysis was developed independently by Aigner *et al* (1977) and Meeusen and van de Broeck (1977) and is based on an econometric specification of a production frontier. In this study using a Cobb-Douglas specification, the production frontier of a boat for N boat owners has been specified as

$$\ln y_i^{\max} = \beta_0 + \sum_k \beta_k \ln X_{ki} + v_i, \qquad (1)$$
$$i = 1,.....N$$

[9] *Details of these measures have been given in Kirkley and Squires (1999).*

Where $y_i$ is output of the ith boat, $X_{ki}$ are k factors determining the production frontier, and $v_i$ is a random variable reflecting noise and other stochastic shocks entering into the definition of the frontier – factors such as bad weather, variability in stock and so on. This random variable is specified as independently distributed with zero mean and constant unknown variance $\sigma_v^2$ , and independent of the $X_{ki}$.

$$v_i \sim iidN(O,\sigma_v^2), \qquad i=1,\ldots\ldots N \qquad (2)$$

The difference between $\ln y_i^{\max}$ and observed $\ln y_i$ is a measure of the technical efficiency of the boat i and is modeled as an unobserved non-negative random variable $u_i$ , which is assumed to be distributed independently of $v_i$ and the $X_{ki}$

$$u_i = \ln y_i^{\max} - \ln y_i \geq 0 \text{ , i=1,}\ldots\ldots..N \qquad (3)$$

Substituting (3) into (1) gives the estimable regression equation which can be estimated by maximum likelihood after specifying the density function for $u_i$ . Following Kumbhakar, Ghosh and McGuckin (1991) the estimation has been done in one step to overcome the inconsistency problems as in two stage[10] . The inefficiency effects were defined as a function of boat specific factors but were directly incorporated into the maximum likelihood estimation. Thus

$$\ln y_i = \beta_0 + \sum_k \beta_k X_{ki} + v_i - u_i \text{ , i=1,}\ldots\ldots\ldots N \qquad (4)$$

The maximum likelihood estimation yields consistent estimators for $\beta, \gamma, \sigma^2$where $\beta$ is a vector of unknown parameters,$\lambda = \sigma_u / \sigma_v$ and$\sigma^2 = \sigma_u^2 + \sigma_v^2$ . Based on the assumptions $v_i \sim iidN(O,\sigma_v^2)$, and, *E(v)=0*, Jondrow *et al* (1982) computed the conditional mean of $u_i$ given$\varepsilon_i = v_i - u_i$ as a measure of technical efficiency as

$$E(u_j/\varepsilon_j) = \sigma^*\left[f^*(\varepsilon_j\lambda/\sigma)/1-F^*(\varepsilon_j\lambda/\sigma)) - \varepsilon_j\lambda/\sigma\right] \qquad (5)$$

Where $f^*, F^*$ respectively are standard normal density and cumulative distributions evaluated at, $\varepsilon_j\lambda/\sigma, \sigma^2 = \sigma_v^2 + \sigma_u^2$ , $\lambda = \sigma_u/\sigma_v$ and $\sigma^* = \sigma_u^2\sigma_v^2/\sigma^2$

The estimates of $\sigma^2, \lambda,$ and parameter vector $\beta$ are obtained by maximum likelihood estimation. Replacing $\varepsilon, \sigma^*$ and $\lambda$ by their estimates in equation 4 and 5, we derive estimates for $v$ and $u$.

The mean inefficiency is a function of boat specific factors such that

$$m_i = Z\delta + W_i \qquad (5)$$

Where $Z$ is the vector of boat specific variables which may influence the firm's efficiency and $\delta$ is the associated matrix of coefficients and $W_i$is identically and independently distributed random error term (Battese and Coelli 1995).

### 3.5. Specification of the variables in stochastic frontier production function

As explained earlier, technical efficiency has been estimated by fitting a Stochastic Frontier Production function. The estimation has been done in one step using Frontier 4.1 which uses the ideas of Kumbhakar, Ghosh and McGuckin (1991) and Reifschneider and Stevenson (1991) to overcome the inconsistency problems present in two stage procedure. As pointed out above the inefficiency effects are designed as a function of the boat specific factors which are directly incorporated directly in to the Maximum Likelihood Estimates. Since the data used for the purpose is a cross section of 226 boats in essence the estimates provides us to what extent technical efficiency exist in the Palk Bay fisheries. Due to data limitations of not having a panel or time series data these measures are no way estimates of overcapacity which reflects the long term problems in fisheries but can be interpreted as a measure of excess capacity. We have used variables mainly representing variable inputs in the analysis. The explanation of the variables included in the model (see next page).

Here special mention has to be made regarding measurement of output. Remember that this is multi-specie fishery which poses measurement problems if we use the quantity of catch as a measure of output. In stochastic frontier production function models the use of a single measure of output under such circumstances imposes a number of restrictive assumptions. Summing up the weight of each output

[10] *It has been pointed out that there is the inconsistency problem in the assumptions about the distribution of the inefficiencies. In the first stage, the inefficiencies are assumed to be independently and identically distributed (iid) in order*

**Table 3.8. Definition of variables included in the stochastic frontier production function and Inefficiency models**

| Variable | Description |
|---|---|
| Ln_output | Log of value of output |
| Ln_lab | Log of total number of labourers employed in the boat per trip |
| Ln_diesel | Log of diesel used per trip in litres |
| Ln_ice | Log of quantity of Ice used per trip in blocks |
| Qty_diesl | Log of quantity of diesel purchased from the open market |
| Cabin | Dummy variable representing whether boat has cabin or kendri 1=Yes, 0 otherwise |
| Len_boat | Log of length of the boat in feet |
| Pair_traw | Dummy variable whether the boat uses pair trawling 1= Yes; 0 otherwise |
| Mkt_lab | Log of number of laboures hired from market |

assumes that all species are equally important in the catch. But in fisheries it might so happen that a substantial portion of the catch is of low value. The suggested way to over come this is to incorporate price into the measure as is done in this study. This requires the assumption that output prices do not differ between firms, and changes in 'output' due to changes in price need to be compensated for (Pascoe and Mardle, 2003). Measurement of output poses additional challenges because of geo-political reasons in our study context. Although considerable proportion of harvests comes from the Sri Lankan waters as well we are unable to divide the output coming from Indian waters and illegally coming from Sri Lankan waters separately[11]. Therefore, we must keep in mind that technical efficiency estimates may be on the higher side and to that extent an overestimate. We will discuss the limitations of incorporating price into the measurement of output in a later section.

The stochastic production function and inefficiency models estimated in one step are given in the table below[12]. Although all the three variables included in the stochastic production function model have *a priori* expected signs and are statistically significant. Almost 80 per cent of the output is contributed by the use of labour and ice. The output elasticity with respect to labour, diesel and ice are respectively 0.38, 0.21 and 0.42. $\beta_0$

**Table 3.9. Maximum likelihood estimates of a stochastic production frontier**

| Variables | | | | | |
|---|---|---|---|---|---|
| | | 0 | 6.978429* | 0.443313 | 15.741540 |
| Ln_diesel | $\beta_0$ | 1 | 0.210386** | 0.090857 | 2.315574 |
| Ln_ice | $\beta_1$ | 2 | 0.425569* | 0.092118 | 4.619837 |
| Ln_lab | $\beta_2$ | 3 | 0.381704* | 0.102015 | 3.741663 |
| Constant | $\beta_3$ | 0 | -0.321861 | 3.293672 | -0.977210 |
| Qty_diesl | $\delta_1$ | 1 | 1.005890*** | 0.516092 | 1.949052 |
| Cabin | $\delta_2$ | 2 | 2.382514*** | 1.348054 | 1.767373 |
| Len_boat | $\delta_3$ | 3 | -1.31719** | 0.528086 | -2.494277 |
| Pair_traw | $\delta_4$ | 4 | -0.844354 | 0.524711 | -1.609178 |
| Mkt_lab | $\delta_5$ | 5 | -0.701108*** | 0.356736 | -1.965341 |
| | sigma-squared | | 0.994020** | 0.432182 | 2.300002 |
| | gamma | | 0.869924* | 0.060935 | 14.276144 |
| Log likelihood function=-136.80322 | | LR test=18.234 | Mean technical efficiency =.78 | | |

**,**,***, 1,5, and 10 per cent level of significance respectively* *Based on primary data*

[11] *While some boat owners were willing to give information of fishing across the borders others were reluctant. Therefore, we could not exclude the output from fishing in the Sri Lankan waters in the analysis.*

[12] *We used FRONTIER4.1 software for estimation*

The estimated $\gamma$ being 0.87 indicates the presence of significant inefficiencies in the production or harvest. In other words, about 87 per cent of the difference between the observed and the frontier output has been mainly due to the inefficient use of resources under the control of the sample boat owners. The null hypothesis that ($H_0$ $\gamma$ = 0) inefficiency did not exist was rejected. We also investigated the validity of the model used for the analysis. These tests are performed using generalised likelihood-ratio statistics, *LR*, which is defined as: $LR = -2 \ln[L(H0) / L(H1)]$, where $L(H0)$ and $L(H1)$ are the values of the log likelihood function under the specifications of the null and alternate hypotheses, respectively. The *LR* test statistic has an asymptotic chi-square distribution with degrees of freedom equal to the difference between the number of parameters in the unrestricted and restricted models. The LR statistic of 18.234 is significant at close to one per cent significance level. Further the boat level inefficiencies are affected by most of the variables included in the model. The coefficients of the variables for the quantity of diesel purchased from the market and availability of cabin-kendri in the boats are positive and statistically significant whereas it is seen that employing more number of hired labour adversely affects the technical efficiency. Contrary to what may be expected pair trawling does not significantly improve the technical efficiency of the boats and is an undesirable biologically destructive practice.

The average level of technical efficiency is estimated at 78 per cent indicating that the output can be raised by following better harvest practices without having to raise the level of application of inputs. Conversely, the present output can be produced by much lower use of inputs. Across landing centres, we find that technical efficiency is lowest in Pamban followed by Thondi and Mandapam (Table 3.10). As noted earlier the measured output includes those harvested from crossing the international boarder line as well. If we were able to deduct the output harvested by crossing the international boarder line, the technical efficiency will be much lower than what we have estimated here. The proportion of harvest coming from the Sri Lankan side is more in Rameswaram and somewhat less in other landing centres. This means that there is no reason to remain complacent with the fact that over 22 per cent inefficiency exists in the study area. On the other hand, in spite of including output from Sri Lankan waters, the trawlers in the Palk Pay are operating at an average level of technical efficiency of 78 per cent only. This is a pointer of the severity of problem.

When we group the number of boats in the different landing centres on the basis of their technical efficiency levels, we can see that only 27 per cent of the boats operate with technical efficiency of about 80 per cent. Maximum numbers of boats (68 per cent) operate at moderate levels of technical efficiency that is between 60 to 80 per cent as defined here. There are also about 5 per cent of the boats with technical efficiency less than even 60 per cent.

**Table 3.10. Technical efficiency of trawler boats across landing centres**

| Landing centres | Mean | Minimum | Maximum | Std. Deviation |
|---|---|---|---|---|
| Rameswaram | 0.7791 | 0.2697 | 0.9007 | 0.1105 |
| Solakudi | 0.8324 | 0.6945 | 0.8949 | 0.0854 |
| Thondi | 0.7357 | 0.6590 | 0.9063 | 0.1161 |
| Mandapam | 0.7415 | 0.2171 | 0.8759 | 0.1379 |
| Kottaipattanam | 0.7887 | 0.5928 | 0.8916 | 0.0747 |
| Lanchiyadi | 0.8317 | 0.7685 | 0.8711 | 0.0427 |
| Pampan | 0.6628 | 0.3163 | 0.9213 | 0.2142 |
| Mallipattanam | 0.8153 | 0.5866 | 0.8927 | 0.0824 |
| Sethupavachatram | 0.8472 | 0.7280 | 0.9078 | 0.0522 |
| Jagathapattanam | 0.8061 | 0.4869 | 0.9390 | 0.0939 |
| **Total** | **0.7784** | **0.2171** | **0.9390** | **0.1169** |

*Based on Primary data*

The percentage of inefficient trawler boats has been found to be more in Pamban while Rameswaram and Malli patinam have over 46 per cent of the boats operating with technical efficiency of above 80 per cent (Table 3.11).

**Table 3.11 Distribution of boats according to technical efficiency across landing centres**

| | Less than 50 percent | Between 50 to 60 | Between 60 to 70 | Between 70 to 80 | Between 80 to 90 | Above 90 | Total |
|---|---|---|---|---|---|---|---|
| Rameswaram | 0.414 (3) | 0.582 (1) | 0.668 (4) | 0.758 (31 | 0.867(26) | 0.901(1) | 0.779(66) |
| Solakudi | | | 0.695 (1) | | 0.867(4) | | 0.832(5) |
| Thondi | | | 0.662(2) | 0.712(1) | | 0.906(1) | 0.736(4) |
| Mandapam | 0.318(3) | 0.573(2) | 0.666(8) | 0.761(16) | 0.842(19) | | 0.741(48) |
| Kottaipattanam | | 0.593(1) | 0.678(4) | 0.768(8) | 0.843(15) | | 0.789(28) |
| Lanchiyadi | | | | 0.769(1) | 0.847(4) | | 0.832(5) |
| Pampan | 0.319(2) | 0.593(1) | 0.652(3) | 0.795(1) | 0.806(1) | 0.920(2) | 0.663(10) |
| Mallipattanam | | 0.587(1) | | 0.746(4) | 0.858(12) | | 0.815(17) |
| Sethupavachatram | | | | 0.728(1) | 0.847(7) | 0.908(2) | 0.847(10) |
| Jagathapattanam | 0.487(1) | | 0.653(3) | 0.763(8) | 0.848(18) | 0.926(3) | 0.806(33) |
| Total | 0.369(9) | 0.584(6) | 0.666(25) | 0.759(71) | 0.852 (106) | 0.916(9) | 0.778(226) |

*Based on Primary data*

On the whole, it has been observed that the boat owners have failed to achieve the potential level of output for the given level of inputs and, therefore, are unable to maximise their profit. The profits could be increased either through increasing their output (Ward *et al*, 2004) by adopting better fishing practices, or by better management of fisheries or both. One of the ways is to improve their harvest practice which can ensure stock recovery as well. Another important way to reduce inefficiency would be to reduce the number of boats. It is based on the argument that reducing the number of vessels in the fishery would result in the effort level also being reduced (preferred by scientists) and directly reduce capacity (important from managers' point of view). When effort is reduced as a result of reduction in fleet size there will be a better recovery of stocks and better management due to the smaller size of the fleet. The outcome of both will be that the remaining boats are able to operate more effectively and efficiently so as to maximise their profits. Also the problem of inefficiency gets reduced from the economists' point of view. This in itself lays the solid ground for reduction of the existing number of fleets in the Palk Bay.

### 3.6. Important limitations of the analysis of technical efficiency

Some of the major limitations for carrying out this analysis relate to the lack of reliable data on several variables or inputs, though we have managed to overcome them to some extent. However, a major limitation has been in terms of measuring output as in most studies of efficiency, output is a physical measure of volume. Like most other fisheries, the Palk Bay is also characterised by joint production or is multi-specie. Therefore, as widely used, we have taken the aggregate value of output as output measure having implications for the analysis. As the value is dependent on both quantity and price the measurement of technical efficiency may get affected by price changes as well. Further, assuming that fishers are profit maximisers, a change in the relative prices may result in a change in their fishing strategy. As a result, the function is not truly a production function and as such the efficiency scores may represent a combination of allocative as well as technical efficiency (Pascoe and Mardle, 2003). The alternative method suggested in literature is to estimate the cost frontier (dual function) as a system of equations which allows for the multi-outputs to be incorporated separately (Rao and Battese, 1998; quoted in Pascoe and Mardle, 2003), but this would require more detailed information on input and output prices which is not available to us. Since this is related to cross section data, had the prices been available, it would have been unlikely to have sufficient variations across different boats or fleet.

Further, we have been unable to include the stock effect or its variability in the production function as well. According to Pascoe and Greboval (2003), when capacity is defined without the resource stock, it provides a measure of the potential output in the absence of resource constraints. Whether or not to include resource abundance in measurement of technical efficiency depends upon the information desired by resource managers and the time frame concern. They further point out that when the information about the capacity is sought for the purpose of knowing whether to reduce overall harvesting capacity, capacity should be assessed without the inclusion of the resource levels. Therefore, exclusion of stock effect in our analysis does not considerably change the inferences drawn as the estimates are within a common time frame and area. However, if it had been for inter-period comparison, then these are certainly serious limitations.

### 3.7. Regulating fishing capacity in Palk Bay: Various Options

The above analysis of technical efficiency is a pointer towards the need for reducing fishing capacity in general, and the number of trawler boats in particular. The need for regulating fishing capacity is also evident from other subjective and qualitative assessments of the Palk Bay fisheries. Qualitative measures are based on the observations made during the course of field work and also on the perceptions of the boat owners; in terms of their overall experience in fishery. It is important to note that majority of the boat owners are of the opinion that the overall catch per trip is considerably less; as also the catch of certain species that we had pointed out in the previous chapter. Some of the boat owners attribute this to the destructive harvest practices and the uncontrolled increase in the number of trawler boats (and the resultant decrease in the fishing ground per boat). Moreover, as noted earlier in chapter 2 the fishing area per boat is considerably low indicating increased competition for fishing space. All these point towards the long term problems in the fisheries such as overcapacity and overcapitalisation.

Having realised the need to reduce the capacity, it is now worthwhile to examine the existing measures to regulate fishing capacity and what additional measures need to be adopted for capacity reduction. Here, by capacity reduction, we mean the trawler boat capacity. Since we have already discussed fishing regulation on the basis of incentive blocking and incentive adjusting measures, it would be appropriate to classify the rules and regulations in the Palk Bay from this perspective.

**Incentive adjusting measures**

Under this measure, the access to fishery is limited to those fishery participants who hold the rights over a share of a total allowable catch. It is premised on the ground that this system tends create incentives for voluntary reduction of excess capacity by fishers as attention is taken away from increasing catches to focusing more on reducing the cost of catching fish (Ward *et al* , 2004).

This right-based management of fisheries is not yet well developed in the case of the Palk Bay fisheries although it is desirable to move in this direction, and is also not an altogether unachievable task for there exists some sort of demarcation of rights based on an altogether different logic or criteria. An example of this is the three nautical miles rule which indicates that trawler boats are not allowed to fish within the first 3 nautical miles from the shore; this is to resolve the conflicts between trawler boats and other traditional crafts (Bavinck, 2006) Similarly, along the Palk Bay, there are many landing centres, and boats are allowed to berth in a particular landing centre after obtaining a berthing permission from the Fisheries Department.

Boats from each landing centre have particular destinations, as fishing grounds along the Bay although no formal mechanisms for such demarcation exist. In fact, the boats are legally free to move on the sea as long as they stay within the Sri Lankan border and outside the 3 nm line and return to their allocated harbour within 24 hours. In practice however this freedom is more limited, because of the high diesel cost and the potential of conflicts when one enters fishing ground that are close to another landing centre. At this stage it is important to point out the role of Coast Guard and Navy who operate in this area. They keep a check on this though it is more for security reasons. However, to some extent they deter the free movements of trawler boats at least across the international borders although it is a widely known fact that border violations frequently occurs. This can be further strengthened.

The community development rights (CDRs), Individual Fishing rights and individual transferable quotas known to exist in more developed fisheries, are absent here. Throughout the world there is an emerging consensus about the successes of using rights based fisheries management (Ward *et al* , 2004). Moreover, adopting incentive adjusting measures to address excess capacity might not be a right choice in the Palk Bay fisheries with an existing large fleet size. Therefore, the first step would be to create an enabling environment by removing at least some of the boats from an oversized fishery. This in fact is the real challenge.

It is to be remembered that there is an underlying equity issue involved in the adoption of incentive blocking and incentive adjusting measures. As noted in chapter 1, this is especially true for incentive adjusting regulations because they make an explicit reallocation of wealth in contrast to incentive blocking measures which implicitly allocate wealth (Ward *et al* , 2004). In the Palk Bay, or developing countries at large, issues of employment and livelihood, social justice, resource allocation between mechanized and traditional sectors are very important. Therefore, measures which allocate fishery wealth more explicitly are likely to lead or aggravate social tensions and conflicts and need to be employed carefully. The option then boils down to incentive blocking mechanism more as a transitory measure, while moving towards incentive adjusting measures.

**Incentive blocking measures**

Three types of incentive blocking measures are known to exist in the Palk Bay: a) limited entry through registration, b) time restrictions and c) gear restrictions. First let us take measures to limit entry. In Palk Bay, both registration of boats and a separate licence are required to access fishery. In addition to these certain other methods are also there to limit entry, which virtually support licence system. First is obtaining permission for the vessel. Here a registration for the boat is a must. However, now no new registrations of boats are permitted thereby closing entry of new boats to the fishery. This has led to the creation of a second hand market for registration numbers as several boat owners simply transfer the registration number of a boat that has been broken down to a newly acquired one. Once a boat owner obtains a register number and licence he can set out for fishing after obtaining a token from the Fisheries Department. Tokens for trawler boats as noted in an earlier chapter are issued only 3 times a week on alternative days mainly because of the competition for fishing space. This token is subsequently necessary for obtaining diesel subsidy[13] . Fishermen are also required to have identity cards before going to the sea; these cards are still being issued to newcomers.

This type of registration system limiting entry to fishing is flawed. While it can be argued that stoppage of new registrations have stopped entry of new boats, it is not useful in reducing the already existing ones. The major reason is that even if the boats are not usable or broken down replacement is made with the already existing registration numbers. Additionally this has generated a clandestine market for registration numbers, which obviously is not a healthy sign. This calls for revamping of registration or entry limiting measures.

Gear and vessel restrictions attempt to control capacity by controlling the use of inputs in the production of fishing effort. This includes prescribing the minimum mesh size, restrictions on the length of certain gears or total ban of certain destructive gears etc. In the Palk Bay in fact some of these restrictions do exist. However they are seldom strictly enforced. As such, it is crucial to ensure that existing gear and vessel restrictions are strictly enforced. Our field observations reveals that fishers are not following mesh size regulations and are still widely adopting destructive fishing practices like pair trawling. These regulations have to be strictly monitored and enforced. Unless actions are taken to prevent destructive fishing practices, even fleet reduction may not result in desirable outcomes. However, one must be very careful in designing the monitoring and enforcement programs, otherwise, there cause chances of encouraging corruption in the sector. In some fisheries in India, penalties or fines for violations is very low as compared to the income they can generate by illegal operations or violation of rules. In many instances the probability of being caught is also low because of weak monitoring. In case of being caught for violations, fishermen tend to bribe the officials who are generally from the lower cadre and get rid of

[13] *We will discuss this point in a later section in detail.*

the problem; otherwise, fishermen have to spend time and money to get confiscated gears and vessels back resulting in high subjective costs, which can be over and above the fine that they have to pay (Srinivasan, 2005).

Other important incentive blocking instruments such as aggregate quotas, non-transferable vessel catch limits, and individual quota limits have not been experimented in the case of the Palk Bay fisheries or in India. This is a very difficult task because of the existing high fleet size and various other reasons including incomplete or unscientific information regarding the resource stock, regeneration, allowable catch *etc*. More detailed scientific studies need to be carried out in this direction before adopting such measures.

To sum up, incentive adjusting measures which is a rights based system is desirable and there is a need for the fisheries regulation to move towards that direction. However, the current scenario is not conducive to rely only on that. Incentive blocking is already partly in place, but it is insufficiently/unsuccessfully enforced. In order to complement the enforcement issues, and at the same time to provide a better ground for enforcement, there is a need for capacity reduction.

While the incentive blocking mechanisms if properly enforced can prevent the growth of fishing capacity, its usefulness in reducing the already existing capacity is very limited. Here comes the importance of a buyback program; in the current context of the Palk Bay, this arguably is the most important one, as it has never been experimented in India and most other developing countries with a few exceptions like China or Malaysia. International experiences with buyback programme yields mixed results. In the following chapter we discuss buyback programmes in detail and attempt to draw lessons from international experiences and also explore their suitability in the case of Palk Bay fisheries.

### 3.8. Conclusion

In this chapter we have tried to discuss various aspects of the trawler boat fishery in the Palk Bay which includes the profile of boat owners, and various economic aspects. The details of variable input costs are also discussed at length including labour and non labour costs. Further, we attempted to measure the technical efficiency of the trawler boats and have found that the boats are realising only up to 78 per cent of their potential. Although this estimate seems to be on the higher side a word of caution is in order. The output measures here include those harvested from the Sri Lankan waters as well since the fishers often trespass into their boundary. There is no way to separate the portion harvested from Sri Lankan side though the fact remains that considerable portion is from there. Had we been able segregate that output into two portions, the technical efficiency would be much lower than what we have estimated here. Over 87 per cent of the difference between potential harvest and actual harvest is due to factors which are within the control of the boat owners. The analysis emphasises the need to downsize the existing trawler fishery. This is important not only for the technical efficiency point of view but also for solving the conflict between the Indian and Sri Lankan fishers for sharing of resources in the Palk Bay. An analysis of the existing regulations points out that although there are various rules and regulations which, when strictly enforced, can prevent further overcrowding of boats, there is hardly any regulation to reduce the number of boats presently existing. Here comes the relevance of a buy back program. Although theoretically it is very useful to reduce the fishing capacity, international experience with buyback yield mixed results. Therefore, there is a need to know whether buyback is feasible in the context of Palk Bay and if so, what its implications are. We address this issue in the following chapter.

**Table A1 Average Value of catch realized by Palk Bay boat owners by landing centre and boat size**

| Landing centres | Boat length less than 32 | | | | Boat length between 32 and 41 | | | | Boat length above 41 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Average value of catch realized in one trip | Maximum valueof catch realized in one trip | Minimum value of catch realized in one trip | Estimated value of catch realized for one fishing season (135 days in a year) | Average value of catch realized in one trip | Maximum value of catch realizedin one trip | Minimum value of catch realized in one trip | Estimated value of catch realized for one fishing season (135 days in a year) | Average value of catch realized in one trip | Maximum valueof catch realized in one trip | Minimum value of catch realized in one trip | Estimated value of catch realized for one fishing season (135 days in a year) |
| **Rameswaram** | **6615** | **22633** | **6000** | **1586175** | **8649** | **31556** | **637** | **1837880** | **13071** | **39095** | **5538** | **2596681** |
| **Pamban** | | | | | **6833** | **24950** | **700** | **1461713** | **10242** | **50092** | **4958** | **2938125** |
| **Mandapam** | **3568** | **19870** | **3000** | **1189725** | **6172** | **21980** | **2643** | **1385787** | **7775** | **22400** | **5000** | **1582875** |
| **Tondi** | | | | | **6586** | **18023** | **1077** | **1155856** | **9950** | **26400** | **4589** | **1842255** |
| **Jagada patinam** | | | | | **7200** | **10932** | **203** | **825089.5** | **4960** | **18250** | **3456** | **1199970** |
| **Kottai patinam** | | | | | **6569** | **18922** | **625** | **1175245** | **4800** | **24500** | **4567** | **1524015** |
| **Sethupava Chatiram** | | | | | **7713** | **12260** | **1145** | **950287.5** | | | | |
| **Malli patinam** | **6910** | **15300** | **4000** | **1179450** | **7057** | **12595** | **525** | **907968.8** | | | | |
| **For all landing centres** | **5698** | **19193** | **3167** | **1262563** | **7214** | **20921** | **1068** | **1314134** | **11075** | **38307** | **4240** | **2412995** |

*Source Primary survey*
*Estimated 135 effective fishing days in a year on the basis of 3 to 4 day rule*

# Chapter 4: Feasibility of Buybacks in Palk Bay Fisheries

## 4.1. Introduction

In the previous chapter we have pointed out that there exist various possibilities to control fishing capacity in the Palk Bay. Several of the existing rules and regulations, if enforced strictly, can to a certain extent help prevent the future growth of trawler fishing capacity. It has also been found that among the various policy measures already in place, there are no measures which can be helpful in the reduction of capacity mainly the total number of trawler boats that already exists. Here comes the relevance of buybacks for the reduction of fleet size. In general, buybacks of fishing vessels, licenses, other access rights, and gears are considered as a key management tool to address the problems of overcapacity, overexploitation of fish stocks and distributional issues. Reducing fishing capacity through removing vessels and licenses, and relieving pressures on resource stocks allow vessel profits and resource rents to rebound, fish stocks to recover, and income and wealth distribution to change through redistribution of access and compensation and transfer payments. The objects of most buyback programs often include a mixture of all three goals (Holland et al, 1999). A fourth and fifth objectives have been added to this. The fourth objective is the conservation of ecological public goods and their services whereas the fifth objective is strengthening a period of transition from a fishery with overfishing, overcapacity, and incomplete property or use rights to a more rationalized fishery and in some instances under rights-based management (Curtis and Dales, 2007). Buybacks which often focus on inputs and access rather than property or use rights for the catch or area rights represent a second-best rather than first best approach to managing fishing capacity.

## 4.2. Buyback: Lessons for Palk Bay from International Experience

Vessel buyback programs have been applied in several parts of the world though it is more found in developed countries. Many governments in North America and Europe[14] initiated such programs that involved millions of dollars (Holland *et.al*. 1999; Weninger *et.al*. 2000). In economically less developed countries buyback programs are not common yet, excepting perhaps China and Malaysia. In spite of their popularity, international experience with buyback programs has a mixed record of success due to several potential complications (Holland *et.al*. 1999, Clark *et.al* 2005). Groves and Squires (2007) summarize the lessons from fisheries buybacks. They identify at least eight reasons for buyback which they emphasised are not mutually exclusive. They are:

1. directly increasing economic efficiency
2. modernizing fleet and adjusting their structure and composition
3. facilitating the transition from fisheries with overexploited stocks and overcapacity to private or community based conservation and management.
4. providing alternatives when individual transferable quotas or common use or property rights with effective management are infeasible.
5. providing disaster or crisis relief
6. addressing compensation and distributional issues
7. conserving common resources or fish stocks underlying a fishery
8. conserving biodiversity and ecological public goods such as ecological services etc.

Whatever may be the reasons for a buyback program, they are considered as a form of subsidy in fishery. It is known that a range of subsidies are present in fishery which can have a direct or indirect impact on the level of fishing capacity/effort of the fishing fleet. Lindebo, 2005, categorises them into the following

- income support and unemployment insurance (tax relief)
- price subsidies and subsidies to processing and marketing (minimum price)
- subsidies to capital costs (e.g. vessel modernisation and construction)

[14] *Countries in which buyback programs have been carried out: Canada, United States, Netherlands, Norway, Denmark, the United Kingdom and Australia (Holland D. et. al. 1999). Argentina, Belgium, Estonia, Finland, France, Greece, Japan, Russia, Spain, South Korea, Sweden, Taiwan (Pauly & Sumaila 2006). China and Malaysia also have recently introduced buyback schemes.*

- subsidies of variable cost (tax exemption for fuel)
- subsidies for vessel decommissioning

The use of subsidies in the extraction of natural resources in general, and fisheries in particular, has been subjected to debate worldwide on the premise that it can be harmful to the sustainability of the resource. Therefore, FAO (2001) calls for the progressive reduction of subsidies and economic incentives that contribute directly or indirectly to the build up of excessive capacity. Lindebo (2005) points out that this type of subsidies alters the cost/revenue structure of fishing operations and profitability of fisheries and impacts their investment decisions. Subsidies can lead to higher capacity or effort levels. This means that subsidies tend to alter the incentives facing the fishermen and therefore, influence their investment decisions. In fact a major apprehension found with the buyback programs is the likely changes of the fishers behaviour that generates both intended and unintended results. A buyback program can be self-defeating by creating incentives to invest in more capital, increase capacity utilisation and improved technology. The increased profits due to stock improvement may act as an incentive to increased investments which is detrimental in the long run thus defeating the basic objective of a buyback program.

Further, an expensive buyback program may remove only a marginal portion of the fishing fleet, as less efficient vessels tend to be willing to depart while 'hard-liners' tend to remain in the fishery. Consequently, actual fishing capacity may not decline to a significant degree (Clark et. al. 2005). Other complications arise if buyback programs are not co-implemented with a strict access regulation regime. In such cases, capacity may easily re-enter the fleet, both horizontally and vertically. Vertical seepage refers to additional capacity entering the fishery through upgrading (input stuffing) of the remaining fleet, necessitating a further round of buybacks. For example, Canada's Pacific salmon fisheries recently experienced their third buyback program. These repeated rounds of buyback in themselves can generate incentives for overinvestment in fisheries. Horizontal seepage refers to the danger that new boats simply re-enter the fleet resulting from the increased attractiveness of the reduced fleet. The latter complications indicate that a buyback program can be successful if only there is a properly functioning institutional regime capable of controlling potential influx in the sector.

The experience of Danish fishery emphasizes the importance of taking measures to address the externalities that create overcapitalisation. Lindebo and Vestergaard (2004) analyses the Danish national capacity regulations and adjustment policies including vessel decommissioning, construction and modernisation during the period 1992-2002. It is pointed out that with continuing decline in fish stocks in the European region, it remains unclear whether capacity reductions have led to improved rents from the fishery, as the developments in physical catch rates observed during 1992-2003 have been found to be very poor. Further evidence from analysing capacity utilisation of trawlers indicates that no substantial improvements in fleet efficiency have materialised. Furthermore, despite physical capacity being capped, the capital invested in vessels through modernisation can be expected to continue increasing, as it has been doing since 1996. The increase in capitalisation is, in essence, a sign that vessels in the future may continue to increase their catching potential.

Based on the above arguments it must however not be misunderstood that buybacks are not at all effective. A number of arguments have been put forth in favour of buybacks. It is argued that buybacks, by reducing numbers, increase profitability, strengthen positive incentives, improve attitudes, and lower exploitation pressures on fish stocks, and also facilitate self-enforcing voluntary agreements among the industry participants (Squires et al, 2006). Another advantage is that a smaller fleet tends to be easily manageable. Generally it is found that governments, NGOs or some international agencies fund buybacks. The payments used to buy out excess fishing capacity are often represented as useful subsidies on the ground that overcapacity encourages over fishing apart from causing economic waste. An important aspect of buyback programs is that, unlike many regulatory programs, the compensation to fishermen who leave their sector makes buyback schemes politically acceptable to the fishermen (Weninger *et.al*. 2000).

In fact, there are number of cases where buybacks have been effective. For example, Spagnolo (2004) reports a successful decommissioning scheme for the Italian Clam fishery. After trying out several experiments with central management of fisheries, a co-management approach called clam Programme was started in 1996 where voluntary buyback was an important element. However, in this case a scientific

assessment of the clam stock in each fishing area was made prior to launching buyback in order to decide the number of vessels to be withdrawn and the areas to be prioritised. After spending a considerable amount of money for setting up the platform, the buyback was launched and the results showed that owners were willing to take an active part in the implementation of the program. Here the withdrawal amount was calculated on the basis of the market value of the licence. In fact this buyback was carried out in different rounds. In the first round, more expenditure was incurred on stock assessments whereas in the second round, it was for actual buyback.

Spagnolo and Sabatella (2004) analyses the impact of the European Union buyback scheme in the case of northern and central Adriatic sea bottom trawlers. Here fisheries are highly multi-specific. It is argued that in Italy during 1997/2002 the whole buyback program brought about a 14 per cent reduction of the fleet. The Northern and Central Adriatic Sea recorded some positive outcomes and significant impact on the resources; and the estimates of biomass indices and the catch per unit of effort showed the inversion of the negative trends for some important stocks. It is said that the positive outcome was achieved by monitoring both the fishing capacity and level of activity as per the relevant Italian regulation.

In another study, Fox *et al* (2004) present an interesting case of Australian fisheries where buyback program is deemed to be a success. In this study, the authors used a unique data set from the South East Trawl Fishery and a model which decomposes profits into contributions (due to productivity, output prices, input prices and (quasi) fixed inputs) for assessing individual vessel economic performance following a 1997 license buyback and the establishment of a brokerage service for stimulating quota trading. It is interesting to note that all vessel classes experienced substantial productivity gains in the year immediately following the license buyback and the establishment of a quota brokerage service. Further, they also high light that smaller vessels, which generally have a low flexibility to substitute for inputs, benefited the most from the changes, with their mean contribution of productivity to profits rising by 60 percent over the sample period. The beneficial effects of the buyback and increased quota trading are in stark contrast to the generally un-favourable long-term outcomes commonly associated with vessel buybacks in input-controlled fisheries.

On the whole, it can be said that buyback schemes were inadequately structured to ensure the actual removal of fishing capacity along with the removal of the vessels whenever they failed to realise the expected benefits. Although in a buyback, a reduction in the number of vessels means the rent is shared among a few vessels, the long run gains from the buyback depends actually on the ability to restrict new entry (Hannesson, 2004; Squires *et al,* 2006). In other words, the participants of buyback are required to leave the industry altogether. Allowing them to remain in the industry may negate the effects of a buyback like in the case of Washington salmon fishery (cited in Branch *et al,* 2006). In the Washington salmon fishery in 1975 buyback nearly 40 per cent of the participants in the program sold unwanted license or vessel, upgraded vessel and gear, and remained in the industry. The history of the BC salmon fisheries also suggests that the benefits associated with buybacks, without a change in the economic incentives faced by fishers, tend short lived as capacity and fishing effort creep back up over time.

Squires et al (2006) points out that there are certain critical preconditions for a buyback program, amongst which the most important is the proper registration of licences and vessels for creating a well defined eligible owners. A second precondition relates the measures to prevent *in situ* measures for preventing new boats from entering the fishery in place of the ones that have been removed. The third issue is regarding the funds received from the buyback that can be used for financing further investment in fishery. To sum up, it can be said that buybacks are a form of subsidies and the success of these programmes relies heavily on whether fishermen can be drawn out of the fishery for future financial gain as opposed to what they would otherwise gain, if they remained in the fishery (Frost et al 1995).

The lessons from international experiences are clear. A buyback program is potentially a sound tool to address overcapitalisation, provided it simultaneously addresses its underlying causes; these underlying causes concern mainly the modernisation subsidies and the open access nature of the sector. However, the paradox of buyback programs is that Governments use subsidies to counter overcapitalisation, while this status is often a result of Governmental modernisation subsidies themselves (for example for diesel, gear improvement, motorization, and mechanization). In this context, buyback programs can be ambiguous

if they do not address the underlying externalities that create overcapitalisation. However, this does not mean that buyback program and any other kind of subsidy cannot co-exist.

For the Palk Bay region, or developing countries at large, the principle goals of a fishery management tools cannot be restricted to economic efficiency (that is optimization of capacity use) and ecosystem health. Considering the nature of the fishing sectors in these countries, issues of employment, social justice and recourse allocation between the mechanized and traditional sectors deserve substantial attention. The more fundamental underlying cause of overcapitalisation needs to be addressed. From the above experiences, one can observe that while implementing buyback program, equal importance has to be given to the fundamental causes leading to overcapitalisation and additionally, equity and livelihood issues in the Indian context. This implies that fisheries institutions need to have the capacity to restrict capital entry in order to sustain the positive effect of a fleet reduction program, and also have measures put in place to ensure the livelihoods of people affected by the reduction in fleet size.

Clark *et al* (2005) points out that if vessel buyback programs can overcome the seepage problem, they have a beneficial impact on fisheries conservation and can reduce economic waste- provided vessel owners' expectations pertaining to resource manager's policy are myopic. Further, it is noted that, if fishermen anticipate buyback even if seepage problem is eliminated, buyback might not deliver the expected results. Therefore, no signals should be given to the participants of potential future buybacks which can negate the effects of a successful buyback.

On the whole, buybacks can be considered as a powerful tool for reducing capacity provided it is properly structured taking into account the specific characteristics of fisheries. In the case of Palk Bay fisheries, it is seen that the launching of buyback is, in principle, possible as different forms of regulations exist and as such there is sufficient ground for introducing a buyback program provided the rules and regulations are strictly enforced. In this case, buybacks can be seen as a strategic policy tool utilised as a transitional strategy to restructure relations among participants and create positive incentives that reinforce conservation and management objectives. From the literature, we have identified some preconditions for buybacks to be effective, addressing them can be very useful in the case of Palk Bay.

**Some preconditions for buyback programs to be effective**

From the review of literature, it is possible to say that there are certain preconditions to be met for the buybacks to be effective in Palk Bay and similar fisheries.

- Scientific estimation of stocks and the allowable number of vessels and catch
- Proper registration of licences and vessels creates a well- defined group of eligible owners and provides well-defined boundaries to the fishery and program.
- Limiting access to fisheries.
- Establishing broad participation and co-operation of users.
- Objectives and scope have to be defined clearly

It can be summed up that there are several facilitating factors for introducing buyback program in the Palk Bay. It also needs to be emphasised that while introducing buyback program, a number of supplementary measures along the lines mentioned have to be adopted as well; that include a rethink on other input subsidies existing presently apart from diesel which help reduce costs of exploitation, and ensure profits besides providing incentives for further investment. However, in the present situation, subsidies for buybacks can prove to be beneficial if carefully defined and targeted. As buyback requires co-operation from participants, it is not yet clear, as to how the boat owners will react to the program. In this study, we have tried to capture the feasibility of buyback mainly in terms of the response or interest of the boat owners and evaluate the institutional capacity for introducing buyback program. We discuss them in detail as follows.

### 4.3. Feasibility of Buyback in the Palk Bay

In this section, we explore the response of the boat owners for a hypothetically proposed buyback program in the Palk Bay. A hypothetical scenario of buyback in the context of trawler fleet reduction was explained to the boat owners and their response in terms of their willingness to sell off their boats in such a scenario

was captured. In the scenario no reference was given to the likely compensation package for buyback as it can lead to several biases in the boat owners' response. Prior to explaining the buyback program we asked the opinion of the boat owners on the profitability of trawler boats during the recent times. We also sought their opinion regarding the measures to be taken to make trawler fishing more profitable.

Consequently, elicited 'Yes' or 'No' responses in terms of their willingness to exit fishery through this program were coded to generate a dummy dependent variable. The dummy variable represents '0' if the boat owners said 'No'; it is coded '1' if the boat owner said 'Yes' or agreed to sell their boat. It is important to point out that 52 (23 per cent) of the 226 boat owners said 'Yes', that is they were willing to sell their boats, and 150 (66.4 per cent) categorically said 'No' or that they were not willing to do so). About 24 boat owners did not respond to the question or were indifferent. Since it was difficult to separate no response people from responses of the indifferent people, we omitted them for further analysis[15].

Since the response of the boat owners is a discrete variable, we have used a logit model to analyze the data to find out the socio economic characteristics of the boat owners who said 'Yes'. Following Gujarati (2003), the logit model has been specified as:

$$P_i = E(Y = 1 | X_i) = \frac{1}{1 + e^{-(\beta_1 + \beta_2 X_i)}} \quad \text{.....1}$$

where $Y = 1$ means the boat owner decides to sell the boat in buyback program given $X_i$; $X_i$ is a vector of explanatory variables and is the base of natural logarithm. Equation 1 can be written as

$$P_i = \frac{1}{1 + e^{-z_i}} \quad \text{.....2}$$

where $Z_i = \beta_1 + \beta_2 X_i$ Equation 2 represents a cumulative logistic distribution function. Since, given in equation 2 gives the probability that the boat owners decides to sell their boats under buyback program, then, the probability that the boat owner decides not to sell is

$$1 - P_i = \frac{1}{1 + e^{z_i}} \quad \text{.....3}$$

Therefore, we can write

$$\frac{p_i}{1 - P_i} = \frac{1 + e^{z_i}}{1 + e^{-z_i}} = e^{z_i} \quad \text{.....4}$$

$\frac{P_i}{1 - P_i}$ is the odds ratio that the boat owner decides in favour of selling boat. The natural log of equation 4 is given as follows:

$$L_i = \ln\left[\frac{P_i}{1 - P_i}\right] = Z_i = \beta_1 + \beta_2 X_i \quad \text{.....5}$$

Here *L*, the log of the odds ratio is linear in *X* as well as in parameters. The estimable logit equation can be specified as follows:

$$Li = \left(\frac{p_i}{1 - P_i}\right) = \alpha + \beta_1 \text{Caste} + \beta_2 \text{p\_exe} + \beta_3 \text{ n\_boat} + \beta_4 \text{cab\_kendri} + \beta_5 \text{mig\_ban} + \beta_6 \text{destruct}$$
$$+ \beta_7 \text{own\_crew} + \beta_8 \text{invo\_years} + \beta_9 \text{jag\_kot} + \beta_{10} \text{mal\_sed} + \beta_{11} \text{Skill} + \beta_{12} \text{pro\_act} + \beta_{13} \text{child}$$
$$+ \beta_{14} \text{hired\_lab} + \beta_{15} \text{L\_short} + \beta_{16} \text{advance} + \varepsilon$$

Where $\alpha$ is a constant, $\beta$s are co-efficient of each variable and $\varepsilon$ is the error term. (refer Table 4.1. for the definition of each variable)

**Choice of variables included in the logit model**

The variables were selected in such a way that it captures various aspects of the boat owners' individual or household characteristics as well as various aspects related to trawler fishing. First, we will explain, reasons for the selection of variables and the expected signs of their coefficients in the regression. Caste of the boat owner and per capita consumption expenditure of household represent the socioeconomic status of the household. In this case 'caste' is defined as a dummy variable which takes value 1, if the

[15] *We still have sufficient sample size, as the omitted sample account for only about 10 percent of the total sample.*

boat owner belongs to Paravar community and zero other wise[16] . It is assumed that the Paravar community which is the largest homogenous group engaged in fishing will be more willing to participate in buyback by agreeing to sell off their boats. During informal discussions with the boat owners, owners from Paravar community expressed their despair at the declining profitability of trawler boats and seemed to be more interested in the introduction of such a program. Based on this observation, we expect the coefficient of the variable to have a positive sign.

The per capita consumption expenditure of the households represents their economic status. The expected sign of the coefficient for the variable is, however, ambiguous. On the one hand, it could be argued that higher the per capita consumption expenditure, the better off the boat owners are. Therefore, participating in the buyback would not have significant implications for their livelihood, and as a result, the coefficient can have a positive sign. On the other hand, if trawler boat fishing is their major source of income, then parting with their boats may impoverish them. In that case they may not be willing to sell their boats.

The number of boats and quality or capacity of the boats could be an important factor deciding the returns from fishery. Although it can be argued that those boat owners owning more than one boat would not mind parting with at least one of their boats, here we argue vice versa. Expansion of fleet by way of adding more and more boats reflects the boat owners' deeper interest in continuing and intensifying their fishing activities not just as a subsistence activity (perhaps more for industrial purposes). In such a situation they may be interested in reaping economies of scale and interested in selling their boats. Therefore, we expect a negative sign for the coefficient of the variable 'N-boat' representing number of boats owned by the owner. Similar arguments can be made for the variable "*cabin-kendri"* (winches and wheel house)' which reflects better capacity or quality of boats. The variable has been coded as 1 if the boat has cabin (wheel house) or *kendri* (winches), otherwise 0.

Apart from the socioeconomic and boat related characteristics, the extent of their dependence on fishery and its history which reflects the boat owners stake may be crucial deciding factors participating in buyback or not. In order to capture this, we included two variables such as 'own_crew' and 'invo_year' which reflects the extent of the family's involvement in fishing activities and their coefficients are expected to be negative. Those boat owners, who use destructive fishing practices or banned gears in their attempt to maximize profits, might not be interested in buyback program. Therefore, the coefficient of the variable 'destruc' which represents whether the boat owner adopts destructive fishing practices is expected to be negative. Those boat owners who migrate to other landing centres during the 45 day ban period, 'mig-ban' are also expected to be unwilling to sell. This is mainly because they migrate to other landing centres to offer their labour. In the absence of own boats these boat owners would have to either engage in distress migration or end up as labourers which of course is not a preferable situation for them. Therefore, 'mig-ban' is expected to have a negative coefficient. Similarly the response of the boat owner is expected to differ by landing centres belonging to different districts. This is basically to capture the expectations of the boat owners on the opportunities for alternative livelihoods taking into account the district characteristics and level of development. We expected a positive sign for the coefficients of the landing centre variable representing *Puthukkottai* and *Tanjore* district since both are relatively better off as compared to Ramanadhapuram. It is assumed that more employment opportunities are available in these areas as compared to Ramanadhapuram. Therefore, the sign for variables "Ja_kot" (Puthukkottai area) and "Mal_Sed" (Tanjare) are hypothesised to be positive. Both are dummy variables coded 1 for the respective landing centre otherwise 0[17] .

Boat owners' decision to participate in the buyback program also depends upon present availability of alternative livelihood. Those owners who do not have alternative livelihoods presently or perceive to have one in the near future, will not be willing to participate. One of the ways of capturing their possibility for an alternative livelihood is to know whether they have skills in using traditional crafts (skill). Another

[16] *Although we wanted to group the boat owners into traditional and non-traditional communities, we found that the number of years of their engagement in fishing activities would make their stake more explicit. Since the average number of years of fishing did not significantly differ across various communities, we preferred to define Caste as a dummy variable as given above and keep number of years in fishing as separate variables.*

[17] *Two dummy variables are selected to represent location since we have three districts in the study area. For 'n' categories, n-1 dummy are always selected to avoid dummy variable trap (Gujarati 2003).*

**Table 4.1: Variables specified in the logit model**

| Variable | Definition | Measurement of variable | Expected sign | Characteristics represented |
|---|---|---|---|---|
| Caste | Caste of the boat owner | Paravar =1 (50.25%)<br>Otherwise=0 | Positive | Socio-economic |
| P-exe | Percapita expenditure of the household | Mean 1710 (Rs) | Ambiguous +/- | |
| N_boat | Number of boats | Owners having more than 1 boat = 1 (21.18%), otherwise =0 | Negative | Quantity and quality of boat |
| Cab_kendri | Whether boat is having cabin or kendri | Boat with cabin and kendri 1= (12.32%)<br>otherwise = 0 | Negative | |
| Mig_ban | Migration to other places during 45 day ban period | 1= migrant (7.3%)<br>0 = otherwise | Negative | Intensiveness of involvement in fisheries (extent of dependence) |
| Destruc | Adoption of destructive fishing practices | Using banned gears = 1 (24.63) %<br>otherwise =0 | Negative | |
| Own_crew | Owner crew member | Owner goes as crew in boat =1 (20.69%)<br>otherwise =0 | Negative | |
| Invo_year | Years of experience in fishing | Average involvement =24.67 years | Negative | |
| Ja_kot | Jagadapattnam and kottapattnam landing centres | 1= location<br>0 = otherwise | Positive | Landing centre locational characteristics |
| Mal_sed | Mallipattnam Sedubhachatiram | 1= location<br>0 otherwise | Positive | |
| Skill | Skill of the boat owner to use traditional fishing methods | With skill =1 (72.41 percent)<br>otherwise =0 | Positive | Livelihood alternatives |
| Prod_acti | Whether boat owner has any other productive activity | With productive activity =1 (5.91)<br>otherwise = 0 | Positive | |
| Child | Whether boat owner would like his children in fishery | Liked= 1 (54.68%)<br>Otherwise =0 | Negative | Future prospects in fishery |
| Hired_lab | Whether boat owner experiences labour shortage | | Positive | Labour market |
| Lab_short | Whether boat owner experiences labour shortage | Experience =1 (53.20%) otherwise =0 | Positive | |
| Advance | Whether boat owner had outstanding advance | Debt trap in years = 4.23 years | Positive | Money market |

*Based on Primary data*

way is to know whether they have any other productive activity (Prod_acti) and their education levels. Education was included in the regression and was found not to exercise any influence on their decision to sell their boats. Therefore, it is finally omitted from the regression. Those boat owners who are skilled in traditional fishing and those who have other productive assets are assumed to be more willing to sell their boats. Similarly, those boat owners who foresee the livelihood of their next generation also in fishing, would be less willing to participate in buyback.

Other than the above factors, problems faced by the boat owners in continuing with fishing activities due to the input market problems may be an important factor in deciding whether to sell the boats or not. One such in the labour market problem is skilled labour shortage (lab_short). Those boat owners who presently face more labour shortage especially for skilled labour, may be more interested to participate. Likewise for those boat owners whose proportion of hired labour (hired_lab) is higher also might be more willing to participate. Another factor is the indebtedness of the boat owner due to outstanding advances taken by them. If the boat owners have long outstanding advances (out_adva) to be settled, it can be assumed that they in a desperate situation to clear off their debts even if that means they have to part with whatever little fishing assets they have.

**Results of logit analysis and discussion**

Table 4.1 presents the maximum likelihood estimates of the logit regression[18]. The coefficients of the variables that found to be statistically significant are 'skill, migra, destruct, own_crew, invo_year, L_short, hired_lab and advance'. These variables also have the expected signs. For example, it has been found that those boat owners who have skills in the use of traditional crafts may be more willing to sell their boats than those who are unskilled. This means that they might be having the confidence that there is something for them to fall back on in the fisheries sector itself in the event of being unable to operate trawler boats. Other boat owners who are more likely to participate in the buyback program are those who presently face labour shortage, employ more number of hired labour and those who have long outstanding dues for settlement.

Among the other variables found to be significant are, migra, destruct, own_crew and invo_year and all have expected negative coefficients and also found to be statistically significant. This means that when compared to non-migrants, boat owners migrate to other landing centres as labourers during the 45 day ban period are more unlikely to participate in the buyback program. Similar is the case with those who adopt destructive fishing practices, boat owners who work as crew member as well, and who are engaged in fishing activities for a longer period of time. These variables, in a way, represent the extent of the boat owners' dependence on trawler boat fishery.

Other variables representing caste, per capita consumption expenditure, availability of other productive or alternative activities are found to be not significant. Interestingly the variables representing the quality and quantity of boats have also been found to be a non- significant factor in influencing the decision of the boat owner. There is an assumption that boat owners with marginal quality boats tend to be more willing to participate; however, the results of the logit regression do not validate this hypothesis. The logit model has a good explanatory power as is evident from the pseudo $R^2$ of 0.13.

On the whole, we observe that it is the factors representing distress of the boat owners that are acting as both push and pull factors. While certain sections of the boat owners being distressed due to labour and money market problems would be more willing to leave the sector (push factors), for others it is the distress of a different form which holds them back in fisheries. For some boat owners their dependence on trawler boat fishery is so much that even during the 45 day ban period they migrate to other places in search of fishing activity as labourers. Some of them also adopt destructive fishing practices in their dire attempt to maximize their returns from fishing. These groups of boat owners have been engaged in fishing for many years and also act as crew members. Because of all these it is reasonable to assume that there are a group of boat owners who do have considerable alternative livelihood opportunities or might even find it difficult to cope with an alternative source of livelihood in the event of leaving the sector.

[18] *Data have been analyzed using the software STATA.*

**Table 4.2. Maximum likelihood estimates of the logit model**

| Variables | Coefficient | Std. Error | z | P>\|z\| |
|---|---|---|---|---|
| Caste | 0.06069 | 0.40339 | 0.15 | 0.88 |
| p_exe | -0.00009 | 0.00016 | -0.59 | 0.555 |
| n_boat | 0.05188 | 0.66133 | 0.08 | 0.937 |
| cab_kendri | 0.39355 | 0.56960 | 0.69 | 0.49 |
| mig_ban | -2.11073 | 1.16184 | -1.82 | 0.069 |
| destruc | -1.20758 | 0.53377 | -2.26 | 0.024 |
| own_crew | -0.94390 | 0.49613 | -1.9 | 0.057 |
| invo_years | -0.03217 | 0.01680 | -1.91 | 0.056 |
| jag_kot | 0.19091 | 0.47938 | 0.4 | 0.69 |
| mal_sed | -0.40453 | 0.71552 | -0.57 | 0.572 |
| Skill | 0.81232 | 0.43206 | 1.88 | 0.06 |
| pro_act | 0.08707 | 0.70883 | 0.12 | 0.902 |
| child | -0.01106 | 0.43882 | -0.03 | 0.98 |
| hired_lab | 0.21164 | 0.12260 | 1.73 | 0.084 |
| L_short | 0.70256 | 0.37724 | 1.86 | 0.063 |
| advance | 0.07398 | 0.04623 | 1.6 | 0.11 |
| _cons | -1.81624 | 0.82880 | -2.19 | 0.028 |
| Number of observations =202<br>LR chi2(16) = 31.67<br>Prob > chi2 = 0.011<br>Log likelihood = -100.42<br>Pseudo R2 = 0.1362 | | | | |

*Based on Primary data*

More importantly, we have not come across any significant pull factors including availability of alternative sources of livelihood influencing the decision making of boat owners in terms of participating in the buyback program. These are very important factors when it comes to identify boat owners who are more likely to participate in the buyback program.

### 4.4. Employment and Livelihood Implications of Fleet Reduction

Although it is evident from the analyses presented earlier that there is a need as well as possibility of fleet reduction in the Palk Bay, a question of utmost importance emerges here in terms of likely implications it might have on employment and livelihoods of fishery dependents. Since in countries like India fishing is a major livelihood activity for many people, it can be assumed that any reduction in the fleet size can have serious implications on the livelihood of the people. We know that fishing activities have both backward and forward linkages as well as primary and secondary beneficiaries; and any change in the scale of the activity due to reduction in fleet size can have a multiplier effect on the livelihoods of various sections of the society. Therefore, it is important to understand the magnitude of such effects. In this chapter, we try to analyse some of these linkages associated with trawler fishery and try to quantitatively as well as qualitatively assess the effects on livelihoods. For this, first of all, it is important to understand the trawler boat chain itself. In the following sections, we analyse the trawler boat chain and identify the major stakeholders and assess the types of stake they have over the fisheries.

**The trawler boat chain**

In an effort to trace the trawler boat chain we collected data from Kottai patinam and Malli patinam landing centres. The number of services or activities that are directly or indirectly related to the operation of trawler boats have been traced and listed. The people who are most directly related to trawler boats are none other than the crew members. From the collected data, it is estimated that there are about 1120 crew members in Kottai patinam and 680 members in Malli patinam. Apart from the crew members, there are over 30 different types of services or activities coming directly or indirectly in the trawl chain. The services range from carrier boats to tea shops and *idly* shops or sellers. There are a number of units providing various services and employing many. In terms of the number of units existing, in Kottai patinam, we find that there are over 100 units of carrier boats, 65 units of merchants and over 50 sheds of dry fish whereas in Malli patinam it is 24, 37, and 18 respectively. The employment provided by these various units differs according to the type of business or service that they provide. For example, a unit of carrier boat employs only one person whereas a single boat repair yard may employ up to 50 persons.

In the first instance it appears that the fleet reduction can have serious repercussions on the livelihood of so many people; but a closer look shows that there are only very few activities and livelihoods that are directly as well as proportionately related to a single trawler boat.

For instance, carrier boats are directly related to the trawler boat activity and they even cater their services to multiple trawler boats. Therefore, removal of one boat or few boats is unlikely to affect the service or livelihood of people working in the carrier boats proportionately. The magnitude of effect depends upon how many trawler boats are removed from the Palk Bay. Including all the people working in the supporting activities in the shore we find that there is about 1.26 shore labour available for every crew labour in Kottai patinam and 1.43 in Malli patinam. We observe that these estimates may be an upper bound as there could be double counting with respect to shore labour as people might engage in multiple tasks.

On the whole, it is seen that fleet reduction can have direct livelihood effects mostly on the crew members. Here again, it is unlikely that they are totally displaced from employment in the fishing sector. We observe at least two options before them. Those who are skilled in the use of traditional gears might be absorbed in that sector to some extent and the surplus labour supply, owing to fleet reduction can be absorbed in other trawler boats as most of these landing centres face labour shortage especially skilled worker. As some of the boat owners as well as crew members, in the wake of fleet reduction might be moving to the traditional sector, it can lead to crowding in effect in that sector[19] which in turn can lead to a marginal decline in the per capita availability of fishing ground. With the fleet reduction lead to better stock recovery, the profitability of both modern and (trawler sector) and traditional sectors tends to improve. These temporary happenings in the short run can be effectively tackled with proper planning and designing of the buyback program. We will discuss this aspect in the following chapter.

Let us examine what roles the existing institutional arrangements and governance can play in ensuring the sustainability and what additional management reforms are required a successful fleet reduction program. From the previous chapters it is obvious that important institutions operating in this context happen to be Fisheries Department, Boat Owners Associations, Cost Guard, and Navy *etc*, each with its own objectives. We can identify these institutions in terms of their role in fishery governance, that is; (a) the way in which individuals are allowed to access fish resources, (b) the decision making structure of the institutions (c) the special scale of management. Based on these criteria, a major role is perceived for the Fisheries Department since it is the ultimate decision making authority in fishery management and also as a custodian of the entire fishery resources. We have identified that the access regulation in Palk Bay is at a higher level as compared to other parts of Tamil Nadu due to certain exclusive access rules that exist, e.g. 3 to 4 day rule. The trawler boat fishery fully complies with the 3 to 4 day rule although there are violations among traditional crafts in a few landing centres. In addition to the 3 to 4 days rule, the 3 nautical mile rule of the Tamil Nadu Marine Fisheries Regulation Act also plays a supplementary role in regulating access. Although, the rationale of 3 nautical miles was to resolve resource use conflicts

[19] *Since analysis of the traditional sector was beyond the scope of the present study we do have sufficient data and therefore is unable to make quantitative projections of the magnitude of effects.*

**Table 4.3 Distribution of various livelihood activities linked to trawler boat sector in Malli patinam**

| Type of Livelihood Activity | No of days in a week | Total number of unit | Number of people employed | Total employment |
|---|---|---|---|---|
| Carrier Boats | Full time | 111 | 1 | 111 |
| Bullock Cart | part time | 9 | 1 | 9 |
| Oil shops | full time | 4 | 2 | 8 |
| Work shops | full time | 6 | 3 | 18 |
| Lathe | full time | 6 | 3 | 18 |
| Net shops | full time | 8 | 2 | 16 |
| Rash Material shop | full time | 2 | 1 | 2 |
| Ice Plant | full time | 4 | 3 | 12 |
| Diesel pump | full time | 4 | 3 | 12 |
| Hotels | full time | 6 | 2 | 12 |
| Tea shops | part time | 6 | 2 | 12 |
| Bakery | Full time | 3 | 2 | 6 |
| Pan shop | Full time | 7 | 1 | 7 |
| Boat Repair | Full time | 1 | 50 | 50 |
| Net Repair | part time | 6 | 3 | 18 |
| Sweet shops | Full time | 5 | 2 | 10 |
| Saw mills | Full time | 1 | 4 | 4 |
| Welding shop | Full time | 2 | 2 | 4 |
| Merchants | Full time | 65 | 6 | 390 |
| Saulting /Fish | Full time | 33 | 6 | 198 |
| Sheds of dry fish | Full time | 51 | 6 | 306 |
| Lorry service | pary time | 17 | 3 | 51 |
| Cycle Rikshaw | Full time | 75 | 1 | 75 |
| Matadoor, Petti auto | Full time | 20 | 1 | 20 |
| Water Tank | part time | 5 | 1 | 5 |
| Boat Breaking | Full time | 7 | 3 | 21 |
| Boat movers | part time | 1 | 8 | 8 |
| Own Business | part time | 3 | 1 | 3 |
| Idli sellers | part time | 1 | 1 | 1 |
| Waste merchants | part time | 7 | 1 | 7 |
| Total shore labour (a) | | | | 1414 |
| Total boats (b) | | | | 280 |
| Total crew © | | | | 1120 |
| Total labour (a+c=d) | | | | 2534 |
| Ratio of shore labour to crew | | | | 1.26 |

*Note: Figures are estimated based on trawl chain analysis carried out in Kottaipattinam and Mallipatinam*
*Based on Primary trawl chain data*

**Table 4.4 Distribution of various livelihood activities linked to trawl sector in Malli patinam**

| Type of Livelihood Activity | No of days in a week | Total number of unit | Number of people employed | Total employment |
|---|---|---|---|---|
| Carrier Boats | 3 days in a week | 24 | 1 | 24 |
| Oil shops | Daily | 4 | 2 | 8 |
| work shops | Daily | 5 | 4 | 20 |
| Boat movers | | 1 | 8 | 8 |
| Boat breaking | Daily | 1 | 3 | 3 |
| Boat repairs | Daily | 1 | 50 | 50 |
| Lathe | Daily | 5 | 3 | 15 |
| Net shops | Daily | 6 | 2 | 12 |
| Ice plant | Daily | 2 | 3 | 6 |
| Diesel pump | Daily | 2 | 3 | 6 |
| Hotels | Daily | 6 | 2 | 12 |
| Tea shops | 3 days | 7 | 2 | 14 |
| Petty/panshop | Daily | 8 | 1 | 8 |
| Bakery/cool drinks | Daily | 6 | 2 | 12 |
| Net repair | Daily | 16 | 3 | 48 |
| Sweet shops | Daily | 2 | 1 | 2 |
| Wood shops | Daily | 2 | 1 | 2 |
| Welding shops | Daily | 2 | 2 | 4 |
| Merchants | 3 days/daily | 37 | 6 | 222 |
| Salting | 3 days/daily | 16 | 6 | 96 |
| Dry fish | 3 days/daily | 18 | 6 | 108 |
| Lorry service | 3 days | 15 | 3 | 45 |
| Cycle Rickshaw | 3 days | 20 | 1 | 20 |
| Matadoor /Petty Auto | 3 days | 8 | 1 | 8 |
| Water tank | 3 days | 3 | 1 | 3 |
| Head loaders | 3 days | 90 | 1 | 90 |
| Spare parts | Daily | 5 | 1 | 5 |
| Idli sellers | 3 days | 3 | 1 | 3 |
| Own Business | 3 days | 125 | 1 | 125 |
| Total shore labour (a) | | | | 979 |
| Total boats (b) | | | | 170 |
| Total crew © | | | | 680 |
| Total labour (a+c=d) | | | | 1659 |
| Ratio of shore labour to crew labour to crew | | | | 1.43 |

*Based on Primary Survey*

between traditional drift net users and trawlers, today it act as a territorial use right of non-mechanised traditional crafts. We have observed that such exclusive privileges to non-mechanised traditional crafts works in favour of access regulation. Altogether, a higher level of access regulation in Palk Bay, as compared to other parts of Tamil Nadu, gives a suitable institutional environment to launch a buy back programme. In order to have such a suitable institutional environment, it is also important to enforce gear restriction more effectively, which can be achieved by taking fishermen organisations in confidence e.g. boat owners associations. The existence of a large number of boat owners associations is seen as a powerful institution for enforcing various access and resource use regulations that exist in Palk Bay. The presence of coast guard and navy whose mandate is the protection of national sovereignty can also be utilized in fisheries management because of strategic importance of the Palk Bay fisheries. Efforts can be made for better coordination of the activities of various institutions existing in the Palk Bay. It can also be thought in terms of formalising the relationship between Fisheries Department and other national security agencies for effective management of fisheries without overburdening the forces with an additional mandate of natural resources protection. In the event of launching a buyback, co-ordination of these institutions can evolve a suitable environment to implement fleet reduction programme. Finally, the third dimension of management is the special scale at which regulations are set. The default pattern in commercial fisheries around the world is for large scale spatial management; this often being the product of the definition of the "unit stock" of fish resources. Since, Palk Bay is a geographically contained ecosystem; many rules are created exclusively for this area. So it is possible to set the entire quota of Palk Bay fishery for the resource users who belong to this area. In this context it is important to note that there are very limited migrant fishers accessing the Palk Bay resources. Therefore, the present institutional environment and small resource use groups within Palk Bay area, give an appropriate setting to launch buyback programme as a transitional strategy towards a more rights based management of the Palk Bay fisheries. Ostrom (1999) has shown that small groups can, and will, organise for self interest when the setting is appropriate.

### 4.5. Conclusion

This chapter has tried to present the feasibility of a buyback programme in the Palk Bay. We observed various favourable factors for launching a buyback program. Some of the rules and regulations already in place like 3 nautical miles, 3-4 day fishing demarcates certain rights over fishing and limit entry in the Palk Bay, However, as non-compliance are also observed, there is a need for evolving supplementary measures. In Palk bay, the buyback programme can be visualised as a short term strategy in fisher management. The analysis of boat owners' interests in the buyback program shows that nearly 23 per cent of the boat owners are willing to participate in the buyback by selling their boats. We have also tried to find out the major reasons for their participation and they found to be distress factors acting as both push others pull. Some boat owners facing hardships due to labour and money market problems feel distressed and want to pull out from fishery; for some others, it is the lack of alternative livelihoods and the perceived difficulty in coping with alternative livelihood activity that pull them back into fishery. In order to assess the likely implications on livelihood, we have estimated the proportion shore labour to crew member which turns to be out 1.26 and 1.43.

# Chapter 5: Major Findings and Conclusions

## 5.1. The Research Problem

Various fisheries across the world have been witnessing overcapitalisation, over harvesting and depletion of stock thus giving signals for immediate action to control fishing capacity. A manifestation of overcapitalisation or excess capacity is to be found in technical inefficiency. Different countries have responded to it by adopting various measures for controlling fishing capacity, though their effectiveness differs considerably. A primary reason for overcapitalisation and overharvesting has been the absence or lack of well defined property rights as a result of which individuals have no incentive to restrict their action even if the combined effects leads to the reduction in stock size and future yields. It is emphasised that addressing the problem of overcapitalisation, or inefficiency requires that the underlying problem of property rights are resolved first which is incidentally not an easy task.

Property rights are understood as a subset of institutions that structure incentives and shape human interactions. In fisheries, the central challenge has been to create incentives that lead to desired behaviours. It emphasises the need to create conducive institutional environment where not only the property rights are well defined and enforced, but also incentives for influencing individual behaviours in the desirable direction; this includes the ways in which access to fish stock is regulated, the way in which fishery participants react to different types of regulations and the ways in which subsidies affect participation in fisheries and above all the overall institutional arrangement for managing fisheries. 'Incentive blocking' and 'incentive adjusting' measures are widely adopted for altering the incentives facing the fishers and also for reducing excess capacity or overcapitalisation. Incentive blocking measures which include limited entry, gear and vessel restrictions, buyback programs, aggregate quotas etc attempt to restrict level of activity of fishers, whereas incentive adjusting measures that include group/territorial use rights, individual transferable quotas, taxes etc address the fundamental question of property rights. While incentive adjusting measures are preferable for long term sustainability, incentive blocking is more useful as a strategy during transition to rights based fisheries management. Keeping these in view, the present study explores the need and the ways for capacity regulation. Special attention has been paid to exploring the possibilities and constraints of fleet reduction through a buyback program and its likely livelihood implications.

## 5.2. Major Findings

### Characteristic features of the Palk Bay Fisheries:

The Palk Bay is a geographically contained area in the east coast of Tamil Nadu and is dominated by trawler boat fishery with a number of traditional fishing units operating as well. As per the estimates available, the Palk Bay is overcrowded with more than 2000 trawler boats of 28 to 50 feet in length with inboard engine capacity ranging from 68 to 120 horsepower. The surface area available per trawler is about 2 - 2.6 $km^2$. In the non-mechanised sector, motorized vessels consist of Vallams, vathais, *Fibre glass*, and others. The non-motorized crafts are mainly Vathai and Vallams. Apart from the low per trawler availability of surface area for fishing, fishermen report that many specie have declined considerably reflecting the pressure on the resource. The Palk Bay fishery is relatively better regulated than most other fisheries in India basically because of its its proximity to Sri Lanka. Because of all these the Palk Bay fishery provides an ideal setting for exploring the possibilities of fleet reduction and the factors determining or constraining its long term sustainability.

Within Palk Bay, the present study confines to the trawler landing centres located along the coastal districts of Ramanadhapuram, Puthukkottai and Tanjore. The important landing centres for trawler boats in the study area are *Rameswaram, Pamban, Mandapam north, Chozliakudi, Lanjadi, Tondi, Jagada patinam, Kottai patinam, Sethupava Chatiram and Malli patinam*. The maximum duration of a fishing trip is 24 hours and boat owners cannot fish outside the Palk Bay area although it is known that many of them cross the international boundary line implying confrontation with Indian or Sri Lankan Navy. The total number of fishing villages in Palk Bay stands at 169 with a total population of 1,40,202. Both traditional and non traditional communities are involved in fishing.

The Fisheries Department of the Tamil Nadu government is primarily responsible for management of the Palk Bay fisheries although there are a number of other institutions indirectly involved. The Coast Guard as well as the Indian Navy whose duty is to secure the sovereignty of the national waters, general security, prevent smuggling activities has substantial presence in the Palk Bay. Apart from these institutions there are also boat owners associations for dealing with both internal and external matters which include lobbying for the collective interest at the district and state levels and settlement of internal disputes.

The Fisheries Departments performs a number of welfare as well as regulatory functions. The Department maintains the records of fishing operations as well as implements the scheme of sale tax free diesel of 1500 per month per mechanised boat. It is also the mandate of the Department to provide fishermen with identity cards and daily token by which they can identify themselves as genuine fishermen at sea. The Fisheries Department has six offices along the Palk Bay. Most of the offices are badly equipped as they are thinly staffed with 2 to 8 staff members and headed by an Inspector of Fisheries, while the big landing places of *Rameswaram* and Mandapam are headed by an Assistant Director.

The rules existing in the Palk Bay can be classified on the basis of temporal and spatial scales. The major rules pertaining to the spatial restriction is three nautical mile rule while 3 to 4 day trip has a temporal dimension. While the first demarcates area within 3 nautical miles for the operation of country crafts, 3 to 4 day trip or alternative day fishing rule is aimed at solving resource use conflicts between artisanal and trawler fishing targeting same species within the same fishing territory. In addition to these, there is an annual ban on mechanised boat fishing since 2001 which is fairly obeyed throughout Tamil Nadu.

Despite some strict rules and regulations, violations or non-compliance of various rules and regulations are widely observed. Many trawler boat fishers are operating banned gears or fishing practices like pair trawling. Misuse and misappropriation of subsidised diesel was also noted. Some of the boat owners procure diesel without actually going to the sea and later sell them to a fellow fishermen or outside at a higher price. In some other cases the boat owner keeps the registration book of the boat even after selling the boat in the break yard and continue to avail the diesel at subsidised price using the registration book.

Now coming to the labour market there is considerable demand for hired labour in the area. Many of the boat owners also work as crew members. Wage and share contracts exist for different categories of crew members although differences across landing centres. There exist considerable market imperfections in the product market. The advance payment system aggravates the market imperfections as the boat owners are bound to sell their produce to the lender often at distressingly low prices. The above mentioned aspects highlight that the Palk Bay fisheries is under considerable stress and needs immediate attention.

**Technical Efficiency of Trawler Boats**

An analysis of the technical efficiency of trawler boats in the Palk Bay has been carried out in order to assess the need for fleet reduction. We have conducted a sample survey among 226 randomly selected boat owners for a more detailed analysis of the trawler boat fishery in the Palk Bay. The selected boat owners are a heterogeneous group as they belong to various traditional as well as non traditional fishing communities. The number of boats owned by them range from one to four with a size of less than 50 feet. The sample survey helps us in understanding the economic aspects of trawler boat fishing. The boats are operated with average four crew members consisting of both hired and family labour though their proportion differ across landing centres. Different modes of labour contracts including, wage, share and both prevailed in the Palk Bay area. The remuneration of the labourers differs according to their skill. For example, the Captains are paid wages as well as a percentage share of the produce. In general, labour shortage, especially for jobs which require more skills is reported. This might be the reason for a large number of migrant labourers settling down in the area. For example, in centres like Lanjadi, although the proportion of migrant labourers is reported to be cent percent, they have been living there for so many years and have become virtual settlers. The major inputs other than labour for fishing are diesel, oil, grease and ice for preserving the harvested fish. The boat owners avail 1500 litres of diesel per month at a subsidised rate. This is a major subsidy availed by the boat owners.

The technical efficiency of the boats which is related to the difference between the actual and potential output given both fixed and variable input use has been estimated. We have used stochastic frontier

production function for estimating technical efficiency using a Cobb-Douglas Specification. The inefficiency model was estimated in one stage using FRONTIER4.1 The dependent variable output has been measured in value terms as the fishery is multi-specie. The explanatory variables were log of total labour employed, log of the quantity of diesel as well as ice used per trip per boat. All the variables have had the expected positive signs have been found to be statistically significant. The output elasticity with respect to these has been 0.42, 0.38 and 0.21 respectively for ice, total labour and diesel. The average level of technical efficiency is 78 per cent (even after including output from across borders) indicating that the output can be raised by 22 per cent by following efficient harvest practices without having to raise the level of input use. It is further observed that 87 per cent of the difference between observed and the frontier output has been mainly due to the inefficient use of resources which are under the control of the boat owners. Conversely, the present level of output can be produced by much lower use of inputs. Pamban, Thondi and Mandapam have the lowest technical efficiencies. It is pertinent to observe that only about 4 per cent of the boats operate with more than 90 per cent technical efficiency. Profits could be improved by adopting better fishing practices as well as by reducing the number of boats. When the number of boats is reduced, it results in reduced levels of effort leading to better stock recovery, better management with the outcome that remaining boats will be able to operate more effectively and efficiently. Thus the boats will be able to maximise their profits and at the same time smaller fleet can be better managed allowing for the recovery of stock. This implies that there is a need for reduction trawler boats in the Palk Bay area and improve the fishing practices adopted by the boat owners.

Here it is worthwhile to point out that in the analysis of technical efficiency the measure of output includes those obtained from fishing beyond the international border line with Sri Lanka. Had it been possible to exclude the output harvested from Sri Lankan waters, the technical efficiency of trawler boats is likely to be much lower than what is obtained now. Fleet reduction apart from technical efficiency ground also assumes utmost importance when we consider the conflict situation with Sri Lanka. As the presence of Indian fleets in Sri Lankan waters are a threat to restoring the livelihood of Sri Lankan fishers, there are several instances of clashes at sea between both sides. Therefore, fleet reduction certainly might prove to be beneficial for working out solutions to this conflict and for security reasons.

A major limitation of the analysis has been the use of value of output as dependent variable instead of quantity which is often preferable in the analysis of technical efficiency. As a result, the efficiency scores may represent a combination of allocative as well as technical efficiency. Data limitations have prevented us from estimating cost frontier function which is a suggested alternative in such cases. Although stock effect has been not explicitly included in the analysis, the obtained measure is based on the assumption of absence of resource constraints. Nevertheless, when information is sought for the purpose of knowing whether to reduce overall harvesting capacity, it is pointed out that capacity should be assessed without the inclusion of the resource levels.

**Various options for regulating fishing capacity in the Palk Bay**

As the analysis of technical efficiency points towards the need for capacity or fleet reduction we have explored the possible ways for achieving that. This necessitates an analysis of the rules and regulations already existing in the Palk Bay as well as the new measures required in this direction. Needless to mention that capacity here means trawler boat capacity. We have tried to classify the regulations in terms or incentive blocking of incentive adjusting measures.

Incentive adjusting measures which is premised on the ground that the system of rights create incentives for voluntary reduction of excess capacity is not yet well developed in the Palk Bay like elsewhere in India. However, certain demarcation of rights exists in the Palk Bay. For example, although community development rights (CDRs) and individual fishing rights or transferable quotas are non existent, the territorial rights for fishing within three nautical miles lie with the non-mechanised craft users.

Whether we adopt incentive adjusting or incentive blocking measures there is an underlying question of equity involved. In the latter case, it is more implicit whereas in the former, it is more explicit. Adopting incentive adjusting measures before creating enabling institutional environment tends to create social tensions as it allocate fishing wealth more explicitly. Therefore, in the short term, incentive blocking

measures have to be adopted more as a strategy to create an enabling environment for incentive adjusting measures for ensuring sustainability in the long run.

In the case of Palk Bay, three types of incentive blocking measures that already exist can be strengthened further. They are, limiting entry through registration, time restrictions and gear restrictions. Considerable lapses are prevalent in the system; for example, since the issue of new registrations is stopped there is a second hand market for registration numbers even if the boat to which it is attached does not physically exist. The registration number is further used for obtaining tokens for fishing and diesel at a subsidised price. This malpractice needs to be stopped. There are enforcement problems in gear restrictions. It is learnt that there are wide spread violations of mesh size regulations and adoption of destructive and banned fishing practices like pair trawling. As trawler fishing is allowed on 3 days with time restrictions, it is in fact a form of restriction on individual efforts. There is a need for more stringent monitoring and enforcement of rules and regulations. Care must be given while designing various measures otherwise corruption may creep in which can negate the effects of regulation. Large fleet size and lack of scientific data on fish stocks are major hindrances for using measures like quotas and catch limits in the present situation. All of the above measures, if properly designed and enforced can be very useful in preventing future growth of the capacity though its utility in reducing of existing capacity is limited. Buybacks are found to be the most appropriate one for reducing the existing capacity. Since international experience with buybacks offers, mixed results, it is of utmost importance to know about its feasibility in the context of Palk Bay before hand.

**Buyback: Feasibility and Livelihood Implications**

Buybacks which as a key management tool in fisheries for addressing over capacity, over exploitation and distributional issues are considered as a form of subsidy. Subsidies alter the cost/revenue structure of fishing operations, profitability and thereby impact their investment decisions. The important goals of this incentive blocking measures are conservation of fish stock and improvement of economic efficiency through fleet rationalization. Buybacks, generally funded by governments, NGOs or international agencies are often considered as useful subsidies in fisheries unlike modernisation subsidies which increase fishing capacity. The important argument in favour of buybacks is that by reducing number of vessels or licences, increasing profitability, strengthening positive incentives, improving attitudes, and lowering exploitation pressures on fish stocks, buybacks, helps in the establishment of self-enforcing voluntary agreements among the industry participants. The major criticism of buybacks is that it is expensive and often results in the removal of only marginal portion of the fleet while leaving hard-liners in tact. Complications also arise if buyback programs are not co-implemented with a strict access regulation regime resulting in both horizontal and vertical seepages. Vertical seepage refers to additional capacity entering the fishery through upgrading (input stuffing) of the remaining fleet, necessitating a further round of buybacks. Horizontal seepage refers to the danger that arising out of new boats simply re-entering the fleet because of the increased attractiveness from the reduced fleet. From the literature, it appears that the major reason for the failure of buybacks is the failure to address the underlying externalities that cause excess capacity. Wherever these are addressed, buybacks have met with success.

We have further explored the feasibility of buybacks in the Palk Bay. In fact we have found that there exist certain favourable factors in the context of various rules and regulations existing in the Palk Bay for launching a buyback program. However, certain additional or supplementary measures need to be taken up in order for the program to be successful. More specifically, buybacks in the case of Palk Bay are visualised as a strategic policy tool which can be utilised as a transitional strategy rather than as a long term strategy to help create incentives that reinforce conservation and management objectives. There are also institutional capacities already in to place in the Palk Bay for effectively launching the buyback. However, the various institutions involved directly as well as indirectly in the fisheries management need to be strengthened further and properly coordinated to ensure co-operation of the various participants. This includes the Fisheries Department, Boat Owners Association and others like the Coast guard and Navy who are indirectly helping fisheries.

The boat owners' interests (who are the primary stakeholders of buyback program) have been captured by conducting a primary survey. Their response towards a hypothetical buyback has been analysed using

a logit model as explained in chapter 4. It is seen that nearly 23 per cent of the boat owners are found to be willing to participate in the buyback by selling their boats. The analysis also helps us identify the determinants of the boat owners' decision making. It has been found that aspects representing distress of the boat owners as both push and pull factors. Some boat owners facing hardships due to labour and money market problems feel distressed and want to quit fishery; for some others it is the lack of alternative livelihoods and the perceived difficulty in coping with alternative livelihood activity that pulls them back into fishery.

In a developing country like India where a large proportion of the population are dependent upon fisheries for their livelihood, it is important to understand how a fleet reduction can affect them. For this we have carried out a trawler boat chain analysis in Kottai patinam and Malli patinam. Fishery has both backward and forward linkages as well as primary and secondary beneficiaries. In the present analysis, we have confined ourselves to primary beneficiaries. From the trawler boat chain analysis we have found that there are as many as 30 activities or services which are related to fisheries. However, only a few activities are directly and proportionately related to a trawler boat. It has been estimated that for every crew member in the sea there are 1.26 shore labours in Kottai patinam and 1.43 in Malli patinam. We have also observed that these may be upper bound estimates due to the potential problem of double counting as people engage in multiple tasks. Apart from the labour, some of the boat owners and crew members are likely to move to the traditional sectors leading to an increase in the fishing pressure within 3 nautical miles. Since fishing capacity in the traditional sector is beyond the scope of the present study, we do not have estimates of the livelihood impact. It goes without saying that the positive externalities from fleet reduction (in terms of stock recovery and abundance) tend to more than for compensate the negative effects of reduction in the per capita fishing ground in the long term. As a short term measure, it would be better to explore the possibility of expanding the area demarcated for traditional crafts marginally.

### 5.3. Sustainability of fleet reduction: Some concluding remarks

The study on the Palk Bay fisheries points out the need for capacity reduction in general and fleet reduction in particular. When compared to most other fisheries in India, the Palk Bay fisheries is better regulated and provide an appropriate stage for experimenting with various capacity reduction programs aimed at improving the technical efficiency of boats. There must be more awareness among boat owners regarding better harvest practices without having to add more inputs, as a large part of the inefficiency is due to factors that are within the control of the boat owners. As technical inefficiency is also a manifestation of excess capacity, there is a need to reduce the fishing capacity. In order to control as well as reduce fishing pressure and encourage sustainable fishing, a number of incentive adjusting and incentive blocking measures can be adopted. While as a long term strategy, more emphasis can be laid on incentive adjusting measures, the institutional environment is not ripe enough to rely only on that now. Therefore, it is important that incentive blocking is adopted as a transitional strategy in terms of creating an enabling environment for incentive adjusting measures in the long run.

In summary, it is observed that adoption of the following measures is of utmost importance for ensuring the capacity reduction and sustainability in the Palk Bay.

- The entry of new capital into the fishery needs to be strictly restricted.
- Latent capacity need to be removed as this could be a potential source of threat anytime.
- Permit only selective technological upgrades. Upgrades which are harmful for the sustainability of biological resources should be restricted.
- Strictly enforce gear and area restrictions.
- Opting for buyback must be with a clear vision and defined objectives so as to prevent unintended overcapitalisation and unrealistic anticipation on potential future buybacks by fishermen from different places.
- Provide scientific estimates of the maximum sustainable yield, and maximum allowable catch, etc from time to time in order to make more informed decisions for controlling fishing capacity.
- A fleet reduction program makes little sense when it co-exists with Government subsidies for boat construction, modernization programs, etc.

- While implementing buyback program as far as possible other input subsidies should be avoided as they prolong the transition towards alternative employment (Branch et al, 2006)
- In the context of Palk Bay, the fleet reduction program and provision of alternative livelihood must go hand in hand.
- More concerted efforts need to be made to solve the conflict between Indian and Sri Lankan fishers and to restrict activity within their respective boundaries.
- Measures to ease credit constraints of the fishers will to some extent help fishers explore other livelihood alternatives voluntarily. For example, easing credit constrain will prevent at least some non-mechanized fishers (who aspire to become a trawler boat owner) to search for alternative livelihoods.
- Any loss of livelihood opportunities in the wake of buyback program needs to be compensated for through creation of alternative livelihood opportunities. Insecure livelihoods can lead to social tensions and unintended outcomes arising from fleet reduction program.
- For better management of fisheries, the institutional capacity must be strengthened and better coordination of the activities of various institutions in the Palk Bay promoted.
- Towards this end, it is necessary to promote mediating institutions (e.g. NGOs) between government and fishermen.

On the whole, it is observed that there is a need to guide the behaviour of fishermen and fishing fleets towards socially desirable goals by providing appropriate incentives and institutional environment. After all fisheries management is about managing fishermen. The management schemes that minimize the incentive for non-compliance and facilitate effective enforcement are ultimately the successful ones. Enforcement of rules and regulations will be easier and better when it is in the interest of the fishermen to comply with, either because the penalties are high or because of a long-term interest in the fishery. Moreover, simple regulations that are easy to enforce, are most likely to avoid the development of a norm of non-compliance in a given fishery (Branch *et al*, 2006).

### 5.4. Limitations of the study

A major limitation of the study is that it focuses largely on capacity regulation in the trawler sector alone. However, it needs to be acknowledged that trawler is only one important sector in the fisheries and any change in this sector can have impact not only within this sector but also on other sectors. Therefore, there is a need to undertake more research on the inter-sectoral as well as intra-sectoral linkages which can give a clearer picture of the employment and livelihood implications which we have not addressed at length in this study. More scientific studies on the resource stock at different levels of fleet reduction or fishing capacity are also very important in terms of designing appropriate resource management strategies. There is also a need to examine the impact of diesel subsidy on trawler fisheries in the Palk Bay. Moreover, there is a need to monitor the technical efficiency of trawler boats by generating a time series or panel data base so that more insights can be gained on the extent or excess or overcapacity in the Palk Bay and its determinants which the present exploratory could not accomplish due to time and resource limitations. Since there appears possibility of a buyback in the study area more in-depth studies incorporating the cost of buyback are needed.

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