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Evaluation and Assessment of Economic Losses on Account of Inadequate Post Harvest Infrastructure Facilities for Fisheries Sector in Tamil Nadu

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Preface

The fisheries sector is an important player in the overall socioeconomic development of our country. The vibrancy of the sector can be visualized by more than 13 fold increase that India achieved in fish production in just six decades, i.e. from 0.75 million tonnes in 1950-51 to 10.07 million tonnes during 2014-15. This resulted in an unparalleled average annual growth rate of over 5 percent over the years which have placed the country on the forefront of global fish production, only after China. Besides meeting the domestic needs, the dependence of over 14.5 million people on fisheries activities for their livelihood and foreign exchange earnings to the tune of US$ 5.51 billion (2014–15) from fish and fisheries products, equaled about 18 percent of the export earnings from the agriculture sector, amply justifies the importance of the sector on the country's economy and in livelihood security.

For development, the sector contributes by providing food and nutritional security as well as employment opportunities to a considerable number of our population. Over the last six decades, the fishery sector has transformed itself from a purely traditional activity into a significant commercial enterprise. Thus, it is obvious that increasing fish production will certainly help to promote growth and development but fish, particularly marine resources, are fast depleting due to overexploitation of our coastal areas. Given such resource constraint, preventing the loss of fisheries, particularly during the various post-harvest stages gains more significance.

Thus, though the sector has transformed in terms of its nature and significance, there are challenges yet to be addressed but reducing or if possible, eliminating economic losses of fisheries due to inadequate post

infrastructure (PHI) facilities is one of the most important of them. Being a highly perishable commodity, fish requires proper landing facilities, processing, storage, transport and distribution facilities running through the entire supply chain from capture to consumer. Adequate provisions of such infrastructure may result in the utilization of fish in a cost-effective and efficient way and absence of such required infrastructure facilities result in considerable wastage and losses. As there is limited scope for horizontal expansion to cope with the public food demand, vertical intensification through integration of different farm based enterprises and post-harvest loss reductions could help to meet expected increase in production demand and quality.

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Abbreviations

AERC	Agro Economic Research Centre
CIFT	Central Institute of Fisheries Technology
EEZ	Exclusive Economic Zone
EIA	Export Inspection Agency of India
EU	European Union
FAO	Food Agricultural Organization
FH	Fishing Harbour
FJ	Fish Jetty
FLC	Fishing Landing Centre
GDP	Gross Domestic Product
GSDP	Gross State Domestic Product
ICAR	Indian Council for Agricultural Research
ICMRO	International Centre for Marine Resource Development
IDRC	International Development Research Centre
Kg.	Kilogram
MFV	Marine Fish Vehicles
MPEDA	Marine Product Export Development Authority
MTL	Mean Trophic Level
NRC	National Research Council
NRI	Non Residential Indian
PHI	Post-Harvest Infrastructure
PHL	Post-Harvest Food Loss

RSW	Refrigerator Sea Water
TAFCOFED	Tamil Nadu Fisheries Co-operative Federation
TNFDC	Tamil Nadu Fisheries Development Corporation Ltd
U.K	United Kingdom
USAIIO	U S Agency for International Development
USD	United States Dollar

Executive Summary

Tamil Nadu is one of the pioneering states in India which is behind the development of Fisheries sector. The development efforts dates back to pre independent era and the state set good models of development in field of fisheries science and technology. However, the planned development of the sector started from the Second Five Year Plan onwards. The contribution to the State's GDP is 0.7 percent. The importance of this sector as a source of cheap animal protein has been growing in view of change in the life styles of both the rural and semi urban population. The demand for fish and fishery products shows growing trend and the depletion of resources in near shore waters demands the use of this resource effectively and make available to common man. These make it necessary to ensure that every kilogram of harvested fish is fully utilized for human consumption. The loss in the post harvest fishery has been estimated at 15 percent owing to lack of adequate post harvest infrastructure in the State. The primary objective of this project is to evaluate and asses the postharvest infrastructure in the state and suggest policy measures and identify the specific types of infrastructure required to be established/provided to minimize/eliminate the postharvest fishery losses in the state.

There is no established/tested methodology to evaluate and asses the fishery loss assessment which among other things is Questionnaire Loss Assessment Method. For this study, a structured questionnaire was used to collect data from the stakeholders involved in the supply chain of fish marketing. The following are the Fishing harbours/Fishing Jetty which were

selected for the study, with the prior approval of the Ministry of Agriculture (Department of Agriculture and Farmers' Welfare, Dairying and Fisheries), New Delhi.

The study revealed that in spite of thrust given in the post-harvest sector there has been no sustained focus on the following:

- The design of the landing platforms in fishing harbours and fish landing centres.
- The method of staking fish in fish containers and the method and the ratio of icing.
- The maintenance of hygiene in the landing platform and the surroundings within the fishing harbours and the fish landing centres.
- The design of fish auction halls with central drainage and water supply arrangement to keep the hall in a very hygienic manner.
- The disposal mechanisms for the fish wastes.
- The location of fish curing/drying platforms with in the fishing harbor/s.
- The location of place to keep miscellaneous fish meant for reduction for fish meal with in the fishing harbor/s.
- The maintenance of wholesale /retail fish markets, especially, the fish markets in general and their unhygienic condition which is appalling.
- T he study found that in respect of Tamil Nadu, the post harvest fishery losses at the retail marketing is very high to the tune of 12 percent.
- Therefore, a lot more in terms of policy and administrative thrust has to be given in respect of retail domestic fish marketing, which would ensure more fish available to consuming public but also ensure more income to fishers.

- The institutional fish marketing, involving the existing two public organizations, viz., Tamil Nadu Fisheries Development Corporation Ltd. and The Tamil Nadu State Fishermen's' Cooperative Apex Federation Ltd. Has been suggested to overcome this issue of retail fish marketing and loss sustained both by the sellers, and the consumers and of, course the fishers who would take a higher share of the consumer rupee.

- This study also suggests invoking relevant provisions of the Food Security Act and enforcement jointly by the officials of the Local Body Authorities and the Department of Fisheries.

Chapter I
Introduction

Fisheries sector plays a significant role in the Indian economy in terms of its contribution to growth and development. For growth, the sector contributes through its share in GDP and foreign exchange earnings gained through the export of fish and fishery products. For instance, in 2012-13, contribution of fisheries sector in India's GDP was 1.07 percent and its share in the GDP of the agriculture sector was 5.307. The fish production in India has reached 8.30 million tonnes per annum during 2013-14. The export earnings per annum has reached USD 2.9 billion mark and this is about 17 percent of nation's total export earnings.

For development, the sector contributes by providing food and nutritional security as well as employment opportunities to a considerable number of our population. Over the last six decades, the fishery sector has transformed itself from a purely traditional activity into a significant commercial enterprise. Thus, it is obvious that increasing fish production will certainly help to promote growth and development but fish, particularly marine resources, are fast depleting due to overexploitation of our coastal areas. Given such resource constraint, preventing the loss of fisheries, particularly during the various post-harvest stages and gains more significance.

From nutritional standpoint, fish is one of the most important animal protein foods available in many developing and under-developed countries. Approximately, 53percent of the world's harvest is captured by developing

nations and a large portion of fish catch is consumed domestically (FAO 1985). Fish can be regarded as an indispensable food item for large segments of the world's population, where protein needs are great (Pariser,1973).

The chemical composition of sea food comes quite close to that of land animals. The principal constituents are: water 66-84 percent; protein 15-24 percent; lipids, 0.1-22 percent; and mineral substances, 0.8-2 percent. Certain mol-lusks such as mussels have an appreciable content of glycogen (1-3 percent). Fish oils, in general, consist predominantly of triglycerly esters of fatty acids and minor proportions of free fatty acids, vitamins, colouring matters, hydrocarbons, sterols, phosphatides, etc. However, fish oils differ remarkably from vegetable oils in containing a great variety of fatty acids.

1.1. Importance of the Fish Sector

Fish fats as a whole show a higher vitamin A level than those of most terrestrial animals. This particularly applies to the liver oils. Fish as food, more specifically as a protein donor, is bound to move towards focal position in view of the dwindling milk and meat resources.

Apart from quality, fish also constitutes quantitatively a good source of protein. The edible portions of fresh water and estuarine fishes investigated in India contain about 14-25 percent protein. In marine fishes also quantitatively, fish consumption might in a significant measure supplement the low-protein, high-cereal diet consumed in many countries of the world. Fish, including processed fish like fish flour, has been found to improve such

diets. Cereal proteins are rather low in lysine and methionine, in both of which fish protein is relatively rich.

A closer study of diets in various areas of the world has revealed that many diets are deficient in certain vitamins and essential amino acids. Fish, even in small quantities, may make up for these deficiencies. Moreover, in sections of our globe where severe malnutrition and even hunger are facts, even small variations in the nutritive value of all components of the diet are of interest.

It has been estimated that more than one half of the world's population suffers from varying degrees of under-nutrition and malnutrition. While a more precise estimate is not yet possible owing to lack of sufficient data from many parts of the world, there is enough evidence already to justify such a conclusion. In view of the close and direct link between the nutritional status of a population and its health and efficiency, the serious implications of this unsatisfactory situation are obvious.

It is unfortunate that, in spite of the great advances made in the knowledge of food and nutrition and in its application to raise the level of nutrition, the large majority of the human population is still living on a suboptimal nutritional level in the light of the dietary standards recommended by various bodies. This relates both to qualitative and quantitative deficiencies in the diet in large areas of the world.

Fish catch fluctuations are a severe handicap for the economic returns of the fishing fleet and the fish industry in almost every kind of fishery. The

major causes of these fluctuations included: (1) migration of the fish and changes in their accessibility at various times of the day and of the year; (2) variations in the sizes of the fish population; and (3) differences in the intensity of fishing. There is frequently an interrelationship between the availability vis-à-vis the abundance of the fish and the intensity of fishing. In view of the large protein needs of the human race, the greatest possible yield should be sought.

Most national fishery policies include the following objectives:

i. To increase income and employment within the fishery sector;
ii. To improve the levels of national nutrition, especially the availability of fish protein;
iii. To maintain maximum utilization of fishery sector;
iv. To increase foreign exchange earnings; and
v. To reduce inequities in the distribution of income and food supplies within the fishing community.

The right to harvest national resources carries with it the responsibility on the part of the government, fishermen, processors and distributors to maximize its utilization. The reduction of fish losses can help alleviate shortages of other protein foods. Implied in the increased utilization is the need for reduction of losses due to poor landing and sanitation throughout the distribution chain.

The limited supply of sustainable fishery resources dictates that increasing demands for fishery products in the future will not be satisfied by increasing the fish harvest. However, a net increase in production and availability of good quality fish and fishery products can be achieved through

an effective post-harvest fishery system that will include adequate and better infrastructure facilities that would prevent loss of the commodity.

Post-harvest is defined as the period which begins when the food item is separated from its growth medium. Fish is one of the most perishable food items, yet fish serve as an excellent animal protein source in developing countries. There is a demand/interest in fish utilization, i.e. the use of formerly discarded species of fish as waste and the opening up of markets, both domestic and foreign for fish caught in developing countries.

Demersal trawl catches often comprise many different species and sizes of fish and shell fish, which have to be divided into several categories and stored apart from each other. Among the main post-harvest losses are the large catches of small fish taken by shrimp trawlers from tropical waters (IDRC, 1982, Bello,1986).

One of the factors which for a certain lapse of time retard the post-mortem autolytic and bacterial decomposition of the flesh and its protein is the death-stiffening of the muscle tissue-rigor mortis. It starts 1-7 hr. after death. Its peak in slaughtered fish, kept in ice, lies between 5 and 22 hr. after death. The total duration of the rigor covers 30-120hr. Suffocated fishes not held in ice show a shorter period of muscle toughening (32-93 hr.). A prolongation of the rigor mortis period, consequently, is of great economic importance.

Tropical fish have a shorter shelf life than cold or temperate water species when stored under their equivalents ambient conditions since the

bacterial and chemical reactions responsible for spoilage will proceed faster at the higher temperatures. In tropical climates (25-40^{0}C), fish may spoil before they have been removed from the net (Lima dos, Santos, 1973) and almost certainly within 24 hours of capture (Disnet, 1976).

The handling of fish on board and the way of preparation exercise some influence. If the fish are handled carefully and stored in ice, a doubling of the rigor mortis period is possible to obtain. Washing can considerably reduce the load on the fish. It is clear that the flora of fish immediately after icing in the hold will almost certainly differ both qualitatively and quantitatively from that of the newly caught, ungutted, uniced fish. During the journey from the fishing grounds to the home ports, further alterations occur as spoilage proceeds, their extent depending on such factors as the time taken to reach port and the temperature history of the fish in the hold.

Handling of fresh fish, in the broad sense, covers the entire post-harvest operations in marketing, including chilling, transportation and retailing. The ultimate objective is the utilization of the commodity in the most profitable manner, giving maximum benefits to the producer and the consumer.

The final quality of the product is roughly a function of the total time temperature course of fish from the time it is caught till it reaches the consumer's kitchen. The temperature dependence varies for different products. Canned and dried products are the least sensitive to temperature induced deterioration, even though this is a significant factor.

The market share of fresh fish has not dropped in recent years. On the contrary, it is concluded from market analysis that it can be considerably increased if satisfactory quality is available.

The task of building a sensible model for the technology of post-harvest handling of fish involves the linking namely, resource, commodity, environment, infrastructure and market. Partly due to conservatism and mostly due to lack of indigenous research data, the tendency has been to adopt and superimpose the Western model (which is essentially a temperate or cold zone model) on a tropical situation.

Multiplicity of species in a pelagic geo-climatic environment and a market governed by cultural and socio-economic disparities, all conspire together to render the problems of under-development more formidable.

Being confined largely to inshore region, fish caught in tropical fisheries, harbours heavy loads of initial bacterial population (Shewan, 1978).

About two-thirds of the total landed fish in India is consumed in the fresh condition and the remaining is utilized for preservation by other methods. It is interesting to note that fishes caught from inland sources are almost entirely diverted to the fresh fish market, none of the long-term preservation techniques being employed for them.

The keeping quality and acceptability of fish depend to a large extent on their ante-mortem activity. Excess Struggling before death as in the case of fish caught in the gill nets adversely affects their quality.

Fresh fish undergoes quick spoilage if adequate cautions are not taken while fishing, storage on fishing craft, icing, transport and marketing. Any injury inflicted on the fish surface during handling gives free access to spoilage bacteria into the flesh. The skin of the fish is a natural barrier which prevents entry of micro organisms into the interior and when once that gets bruised, spoilage rate is accelerated. A hundred-fold increase in bacterial load is observed in bruised fishes compared to physically sound ones at different stages of preservation in crushed ice . Further all surfaces like boat deck, fish holds, fish baskets, tubs, trucks and shovels with which the fish come in contact should be hygienically maintained. Mud, slime, blood etc. which happen to get deposited on these surfaces during fishing, handling and transporting stages provide ideal grounds for bacterial proliferation, unless they are promptly and scrupulously cleaned after each operation.

1.2. Post- Harvest Infrastructure and Marketing: Present Scenario

In the marine fisheries sector, the Central Government has been implementing a Central Sector Scheme and a Centrally Sponsored Scheme since 1964 to provide infrastructure facilities for landing and berthing of marine fisheries vehicles, traditional and motorized fishing craft and deep sea fishing vessels. So far, out of the 1376 fishery centres situated in 3322 costal fishing villages along the Indian coast, only 256 fishing centres have been developed, which form only 18.6 percent of the existing fishing centres. The facilities created so far are adequate to accommodate only about 25-30 percent of the country's MFVs, resulting in over-crowding and a host of other accompanying problems. This proves that, there is an imperative need

to develop more fishing harbours and landing centres to meet the requirements of the existing fishing fleet.

The existing infrastructural gap pushed one to make a scientific estimate of the gap on-board and on-shore in terms of resources and the fisheries management to arrest the post-harvest losses. Such assessment/estimation would strengthen the significance of generating adequate post-harvest infrastructure facilities for marine fisheries in India

1.2.1. Post-Harvest Losses

Fish on a worldwide basis contributes only about 15 percent of the animal protein in the human diet, but it's more important in terms of its value (James, 1984). This is especially true for many countries in South East Asia (FAO 1986.9). Developing countries have a good hygiene laws that in these countries where fish products are important in the domestic market or the export market, there are often specific regulations directed towards their quality assurance (Howgate, 1984).

Nevertheless, world market demand for sea food, prices and consumption are at secured levels buoyed by consumer recognition that eating more fish can be beneficial to human health. Thus the development of new science and technology and novel approaches to reduce post-harvest losses have become more an issues of increasing priority for all fishing nations of the world.

Post-harvest fishery losses are not a new problem. In 1965, Dr. George Borgstrom wrote in the preface of his famous book: "Fish as Food", "Only

through wise utilization and efficient processing, it is possible to save the extremely perishable fishes of the ocean and fresh waters and place them within the reach of the consuming public independent of seasons and of fishing fortunes- mostly from the catching grounds". Most disturbing, however, is the fact that the problem is just serious now as it was earlier. Thus, the challenge to fisheries sector to make greater contribution to the food needs of the poor requires but it is obviously not an easy one. Another factor contributing to the urgency to reduce the post-harvest fishery losses in the realization that world fish stocks are not limited and the meet, therefore, ensure optimum use of available resources.

The study of post-harvest fishery losses is further complicated by the individual characteristics of species, seasonal factors, handling, storage, processing, and transportation characteristics. As in the case of the processing of beef or poultry, we must take into account the technological properties of individual fish species when deciding how they will be handled, processed and marketed. These pose major constraints to assess post-harvest fish losses.

There is no well established method to evaluate and assess the economic losses on account of inadequate post-harvest infrastructure facilities for fisheries sector in India. The losses are varied in nature depending on the different stages of the supply chain from capture to consumer. The primary losses are physical loss, quality loss and market force losses. The study will mainly focus on the economic losses on account of inadequate post-harvest infrastructure facilities for fisheries sector in India.

Post-harvest Food Loss (PHL) in general is defined as the measurable qualitative and quantitative loss along the supply chain, starting at the time of harvest till its consumption or other end uses (De Lucia and Assennato,1994; Hodges, Buzby and Bennett, 2011). In the case of fisheries, PHLs can occur either due to waste or due to inadvertent losses along the way.

Reports of various international institutions and funding agencies indicate that, within the entire post-harvest food system, losses in the small-scale fisheries sector are among the highest for all the food commodities. The post-harvest field with its emphasis on handling, processing, distribution and marketing is a complex series of events that is challenging to the policymaking body/administration. Moreover, post-harvest fishery losses play an important role in maintaining or increasing the domestic supply of fresh fish or fishery products that can be purchased by middle and larger income level family.

Though the sector has transformed in terms of its nature and significance, there are challenges yet to be addressed but reducing or if possible, eliminating economic losses of fisheries due to inadequate post-infrastructure (PHI) facilities is one of the most important of them. Being a highly perishable commodity, fish requires proper landing facilities, processing, storage, transport and distribution facilities running through the entire supply chain from capture to consumer. Adequate provisions of such infrastructure may result in the utilization of fish in a cost-effective and efficient way and absence of such required infrastructure facilities result in considerable wastage and losses. As there is limited scope for horizontal

expansion to cope with the public food demand, vertical intensification through integration of different farm based enterprises and post-harvest loss reductions could help to meet expected increase in production demand and quality (Kevin, 2006). Reduction in poverty and mal nutritious would be a major expected benefit of such integration and post-harvest loss reduction (Kevin 2006). Thus, post-harvest fish losses are one of the immediate policy concerns as it happens in most of the fish distribution chains in India.

However, there is no well established method to evaluate and assess the economic losses on account of inadequate post-harvest infrastructure facilities for fisheries in India. The losses are varied in nature, depending upon stages of the supply chain from capture to consumer. The primary losses are physical loss, quality loss and market loss. The present study, however, will focus on economic loss on account of inadequate post-harvest infrastructure facilities in Tamil Nadu. The assessment of economic loss is derived through a structured questionnaire; by contacting the stake holders involved in the process- right from capture to the consumer (vide annexure V). In pursuance of the approval of the Ministry of Agriculture and Farmers Welfare, Department of Animal Husbandry, Dairying and Fisheries (vide letter No. F.No.9-7/2014-AER-ES, Dated 19th August 2015. See annexure I) the following four fishing harbours were selected for the study.

Quantifying the post-harvest losses is the real challenge that lies before the planner. The first difficulty is the multiplicity of the fisheries and fishes, seasons, fishing gear and methods. Further, the fish landing centres are innumerable, diverse, and dispersed throughout India and in some cases

inaccessible. The complexity gets added by the diversity involved in the fish distribution system which is fragmented and sometimes long and the products are also diverse enough. Then, the stakeholders are also varied in terms of their skill, socio-economic factors, and traditions. These diversities and the associated complexities make the tracking of the supply/value/commodity chain a real challenge and hence estimating the post-harvest losses has to reckon with all these difficulties.

The present study is an attempt to overcome all these challenges in order to evaluate and assess the economic losses due to inadequate post-harvest infrastructure facilities for fisheries sector in India.

The country has a long coastline of 8118 km and equally large areas under estuaries, backwaters, lagoons etc., conducive for developing capture as well as culture fisheries. With the declaration of the Exclusive Economic Zone (EEZ) in 1977, an area of 2.02 million sq km, (comprising of 0.86 million sq. km on the west coast, 0.56 million sq.km on the east coast and 0.60 sq.km around the Andaman & Nicobar Islands) has come under our jurisdiction with absolute right of exploring, exploiting and natural utilization of living resources falling within it. The inland fishery resources include 1.96 lakh kms. stretch of rivers and canals, 29.07 lakh hectare reservoirs, 24.40 lakh hectare ponds and tanks, 7.98 lakh hectare of beels, derelict water bodies and 12.40 lakh hectare brackish water areas.

1.3. Literature Review

There are very few studies about the evaluation and assessment of economic losses on account of inadequate post-harvest infrastructure facilities for fisheries sector in India. The extent of the inadequacy of post-harvest infrastructure facilities is relatively higher for marine fisheries than that of the inland fisheries and the literature for the loss in marine fishery is almost nonexistent at least with reference to India.

However, there are a few studies carried out in countries like Bangladesh. For instance, Dr.A.K.M Nowsad Alam (2010) a conducted a study in Bangladesh and developed a new model to estimate the percent loss of fish at each stage of distribution channel and prescribed some appropriate loss reduction interventions considering the estimated losses of fish and fish products.

The International Fisheries Research Meeting in Paris in 1991 prioritized the need of estimating post-harvest fish losses with the conclusion that there has been no tried and tested methods by which fish loss could be estimated (Ward, 2000). Ward developed a field and desk based tool to estimate post-harvest fish loss in West Aftrica and validated it in many African and Asian countries which dealt with assessment problems in detail touching almost all the aspects of post-harvest fishery losses. The physical loss assessment model was developed based on information on economic value of the fish lost at every step of distribution, collected by participatory rural appraisal that provided qualitative data and the questionnaire on loss assessment method provided quantitative data (Ward, 2000).

About 28 percent of landed fish lost 60-70 percent freshness and hence, the quality before it reached the consumer in local retail wet fish trader's shop. It has been assumed that the trend of post-harvest loss of wet fish is almost similar throughout the country, although the actual loss might be very high.

Studies revealed very high level of post-harvest loss during pre-processing, processing, storage and transportation of fishery products (Nowsad, 2005, 2006). Infestation of sun-dried fish by the blowfly and beetle larvae caused up to 30 percent loss of the products (Bala and Mondol, 2001, Nowsad, 2005). Dried fish contaminated by both insects and harmful insecticides comprises about 80 percent of the total dried products that is considered unfit for human consumption. Salted ilish, Tenualosa ilisha and smoked Metapenaeus shrimp had suffered from qualitative (nutritional loss) and quantitative losses (eaten out by insects, moisture loss and fragmentation) as the raw materials were not adequately handled and the products were preserved and marketed through open bamboo baskets (Nowsad, 2005). Typical fermented fish paste, nga-pi, and semifermented shidhal were found to be prepared under very unhygienic conditions: there were evidences of contamination and deterioration of raw materials and products

Coulter and Disney (1987) found the most serious marketing difficulties occurred in remote fishing communities in the Bay of Bengal and enclosed inland waters which lacked regular supplies of ice and transport, and where fishermen were in a particularly weak position in relation to intermediaries. In these locations much fish were processed into lower valued

cured products and the process of curing involved considerable losses through spoilage and infestation.

There is only one study carried out in India by NRI. However, there is no study carried out earlier by the Department of Animal Husbandry, Dairy and Fisheries, Ministry of Agriculture to evaluate and assess the economic losses on account of inadequate post-harvest infrastructure facilities for fisheries sector in India and hence the present study.

In order to study post-harvest fish losses owing to inadequacy of infrastructure, a study was conducted by the Agro Economic Research Centre, Chennai in the year 2015-16. For this study, the following objectives were found.

1.4. Objectives of the Study

The overall aim of the study is to examine the economic losses on account of inadequate post-harvest infrastructure facilities for the marine fisheries sector in India. The following are some of the specific objectives of the study.

- To examine the growth, composition and the contribution of the fisheries sector in Tamil Nadu;

- To evaluate the availability of the post-harvest infrastructure facilities for marine fisheries sector in Tamil Nadu;

- To review the Government policies and programs for the provision of post-harvest infrastructure facilities for marine fisheries sector in Tamil Nadu;

- To evaluate and assess the economic losses on account of inadequate post-harvest infrastructure facilities for fisheries sector in Tamil Nadu; and

- To arrive at relevant policy implications.

1.5. Need for the Study

If fishermen can sell their fish, in the natural wet form to consumers within a few hours of catching, little post-harvest technology is needed. However, this is seldom the case, and fish has always to be preserved in some way - iced, frozen or cured until it reaches the consumer in distant places. The call for new technology arises from the financial and material post-harvest losses and related problems. The major factors that affect the nutritive value of fish products depend on the way fish is handled, processed or preserved, stored, transported and marketed. The fish is exposed to stress from the time it is caught to landing onshore by the fishing vessel. Moreover, the time lag in transport of fish from the processing/wholesale markets to the consumers' table is very crucial for that determines the quality of fish supplied. The way in which the fish is handled while transporting – it is stored or whether the vehicle is inadequate or protected from the atmospheric temperature-plays a vital role in ensuring the quality of fish that serves the consumers' table. The dictum should be to ensure the quality and thereby enhance the intrinsic value of the fish and eventually offer remunerates prices for the fishers (i.e. producers). Poor storage is subjecting

fish to different kinds of degradation. These losses can be avoided by providing adequate post-harvest infrastructure facilities.

1.6. Data and Methodology

Considering the cost and economics of such a study, the present study is restricted to sample sites identified within the top ranking maritime states, in terms of their marine fish production in India. Table 1 is given below shows the top ranking marine fish producing states in India (2013-14).

Table 1.1: Top Marine Fish Producing States of India: 2013-14

State	Production in '000 tonnes	Rank
Gujarat	696	1
Kerala	522	2
Maharashtra	467	3
Andhra Pradesh	438	4
Tamil Nadu	432	5
Karnataka	357	6
West Bengal	188	7
Odisha	120	8
Goa	110	9

Source: Hand Book of Fishery Statistics, 2015

The study is based on both primary and secondary sources. The secondary sources on growth, species composition, catch disposition, the market and processing infrastructure at state level were collected from the publication of Directorate of Fisheries, Government of Tamil Nadu.

The primary data was conducted at three fishing harbours like Chennai Kasimode, Nagapattinam, Rameswaram and Tuticorin fishing harbours of Tamil Nadu. These fishing harbours have been chosen for collecting the infrastructural gap to arrest post-harvest fish losses in Tamil Nadu. From each site, stakeholders involved in the supply chain viz. fishers,

wholesalers, traders, retailers and small processors and exporters including the administrators were interviewed to collect information on the various aspects including fish quality and loss assessment data. The detailed data on major fish landing and distribution channels in the State as a whole as well as the post-harvest losses (economic losses) at primary level were collected. The major fish varieties in the respective sites were gathered through the detailed discussions with the stakeholders. In the present study, the economic losses in marine fisheries have been defined as the losses (in value term- quality and quantity) of marine fish due to physical damage, spoilage or some other reasons, mainly because of inadequate post-harvest infrastructure.

The primary data were collected from the respondents by administering structured questionnaire. The primary data were collected during month of October 2015 covering immediate three periods spread in the year 2014-15 (October 2014 to September 2015). This also evolved in accessing the efficiencies/shortcomings of the existing practices which make a pointer towards post-harvest fishery losses.

The study was structured in such way that the stakeholders who are involved in the entire supply chain of fish holders were interviewed to arrive at losses at different levels and to assess the problems faced at different levels. For identifying infrastructural gap at each stage of the activity, the following four groups were addressed to infer information about the gap that exists in the post-harvest scenario of the fisheries sector in the state. They are:

- Those who utilize or interact with the fishing harbours, fish landing centres and fishing jetties. These are the Centres/places from where fish caught commence their journey on shore to consuming centres.

- The market (both wholesale and retail), and the consumers.
- The processing plants, where the fish gets a transformation (physical) before being taken to the consumers/export markets and.
- Fishery officials

It is therefore questionnaires were structured and canvass to address the following four broad categories, which have direct linkage with the post-harvest activities concerning the fishery sector.

Category 1: Fishing Harbours/Fishing jetties/Fish landing centres

From these centres, we interviewed the stakeholders, namely, fishing crew members/wage earners-fishermen, fishing harbor management authorities/owners and fishery officials in charge of these centres. The primary objective was to elucidate information on the existing practices of fish handling (onboard and onshore), fishing seasons, fishing trips, fish landings (including species landed), the nearest markets to which the fish is transported, the storage facilities available within and outside the fishing harbours, any surplus quantum that is processed/value added, etc.

Category 2 : Fish markets (Wholesale and Retail markets)

The target audience was the wholesalers, retailers and processors. The consumers who interact with the retailers was roped into infer information on the quality of the product they carry for consumption.

Category 3 Fish Processing Centres: The target audience was the major fish processing units who were incidentally also exporters, small processors and people who were involved in fish trade including dry fish traders.

Category 4 Fishery Officials: The senior officials and the Officials directly involved in marine fisheries and development were also interviewed.

Table 1.2: Number of Selected Sample Size in Tamil Nadu

Fishing Harbour	Category I Fishermen/ FJ/FLC	Category II Fish Market	Category III Processing	Category IV Fishery Officials
Chennai Kasimode Nagapattinam Rameswaram Tuticorin	20*4 =80	Wholesaler 5*4=20 Retailer 10*4=40 Consumer 10*4=40	2*4=8	2*4=8

Source: Field Survey Data

1.7. Organization of the Research Study

The research study is divided into six chapters. The first chapter is introductory in nature; it contains the background, objectives, data base and methodology of the study. The second chapter describes the development of the fisheries in Tamil Nadu. The third chapter analyses the review of policy on marine fisheries and post-harvest infrastructure in Tamil Nadu. The fourth chapter examines the status of marine infrastructure in Tamil Nadu. The fifth chapter deals with the post-harvest fishery losses in the study area. The last chapter provides the concluding remarks and policy suggestions on the basis of the study.

Chapter II
Development of Fisheries in Tamil Nadu

The blue revolution of the 1960 was the complement of India's green revolution in agriculture: a drastic change in fisheries technology would boost catches to levels commensurate with the postulated wealth of the oceans, contribute to the economic development of the country, and last but not least, help feed its burgeoning population.

Picture 2.1: Tamil Nadu Coastal Line

The above revolution of capture fisheries was an all India affair, promoted by the Central Government and adopted with variations in every coastal State in the country simultaneously, with other state Governments. The Government of Tamil Nadu launched its marine fisheries development programme in the Second Five Year Plan Period (from 1956-1961),

increasing financial outlays during the 1960s and gradually terminating them in the following decade. Followed by the opening of the international market for luxury seafood products of the consequent boom in the price of landed fish, private inventors took over, where the government stopped.

2.1. Modernization of Fisheries Sector in India

Policy-makers initially justified the modernization of Indian fisheries by referring to the food needs of a growing population. They also pointed to the wide gap which, in their perceptions, existed between the magnitude of the resources and the capacity of the fishing fleet (Cf Chopra 1951:8). The design to modernize became more urgent when they discovered the sector's ability to bring in foreign exchange. Policy-makers then realized that investments in the development of fisheries were indeed worthwhile, not only for the sector but also for the country as a whole.

The same policy makers pursued the policy of desired increase in fish production could only be achieved by fundamentally altering the fisheries sector. Rather than building on the skills and method of artisanal fishing sector, the central Government and the governments of many coastal states chose to break radically with the past. They vested their hopes in a wholly new type of fisheries enterprise, that of mechanized boat fishing.

On the face of it, India's blue revolution has yielded spectacular results year after year, nominal catch figures increased by leaps and bounds throughout the country. Starting at 7,52,000 tons in 1951, national production skyrocketed as 49,03,659 tones in 1995. The same was true for Tami Nadu. In four decades, marine catches in Tamil Nadu have increased more than

sevenfold. Total landings were estimated to be almost 45,700 tonnes in 1951-52 rising to 3,37,552 tons in 1993.

FAO experts played a key role in introducing not only new types of craft but fishing nets as well. All the boats after the Pablo were meant for trawling, and it was in this field that experts made a large contribution.

New boats and fishing gear formed only one facet of the Fisheries Department's blue revolution programme. To ensure the success of these innovations, it leads to make a substantial investment in the infrastructure as well. These included boat yards, harbours, repair facilities and vocational training schools as well as preservation technology to process the fresh fish. The Fisheries Department took a leading role in establishing a variety of public sector enterprises to meet the needs.

The introduction of new preservation technology thus had a high priority with the Fisheries Department from the First Plan period (1951-56) onwards. They focused on establishing small permanent ice plants not only in towns and cities, but also larger fish landing centres. In the cases of several plan periods, the government constructed thirty seven ice plants throughout the State (MPEDA 1978:44).

In addition to ice plants, the Fisheries Department also established freezing plants, cold storage buildings and processing facilities in the coastal zone.

From the beginning, financial incentives were an important component of the Fisheries Department Programmes' to promote mechanized fishing. Policy makers in Tamil Nadu generally took the blue revolution to be

synonymous with the growth of mechanized boat fishing. However, this does not mean they were oblivious to the needs and problems of the artisanal sector. The assumption seems to have been that of the artisanal fishermen converted to boat fishing, the sector would dissipate and merge with its successor. From this point of view, the quicker the takeoff boat fishing, the sooner could the merger be realized. It was therefore, logical to concentrate human capital investments on the mechanized boat sector, and to neglect the artisanal one. In fact, the state government did implement some programmes aimed at modernizing artisanal fisheries. Artisanal fishermen also benefited in no small measure from new market opportunities and from the development of service facilities.

The most obvious contribution of the Fisheries Department to the artisanal sector in the period before 1986 was in the field of fishing gear. One must remember that until the 1957, nets used by fishermen along the Tamil Nadu coast were exclusively made by hand from natural fibers. One of the Fisheries Department first goals was to replace natural fibres with synthetic ones which were stronger and had a longer life span. To this end, it started distributing synthetic twines and filaments to fishermen cooperatives at subsidized rates. Fishermen were quick to adopt their new materials, as they had a positive effect on catch levels. By 1965, synthetic fibres had virtually replaced natural ones in net-making (State Planning Commission 1972:24).

Table: 2.1 Region-wise Coastal Areas, Demersal and Pelagic Fish Production

Parts of Tamil Nadu Coastal Region	Area and Length in Km.	Demersal fish	Pelagic fish	Important crafts used
Coramandal Region	Pulicat to Kodikarai 350 km	Ribbon Fish Silver bellies Shrimp	Sardines Anchovies Flying fish Tuna Mackerel Seer Fish	Catamarans
Palk Bay and Gulf of Mannar	Tanjore Pudukottai Ramnad Tuticorin Tirunelveli 590km	Silver bellies Perches Silver bellies	Sardines Seer fish Sardines Anchovies Tuna	Athiramapatinam Thiruppalaikudi Type boats Tuticorin Types Vallam and boats Catamarams
Wedge Bank	Southwest Coast of Kanyakumari District 60 km	Shrimp Deep sea Shrimp Lobster		

Source: BOBP, 1983

The blue revolution for fisheries production took almost a decade to gain momentum. The pink gold rules in Tamil Nadu picked up around 1965 when word spread that quick money could be earned in shrimps trawling. Geographically, Tamil Nadu has been divided into four coastal regions for the purpose of marine fisheries. Each of these have distinct features and biological characteristics. A table showing the classification of regions and the types of fishing crafts used in each of them are appended in the Table.

Tamil Nadu Fisheries had undergone a large period of continuous expansion till 1997, suffered a sharp fall during 1998-2004 before recovering to post a new height of 5.33 lakh tonnes of fish production in 2009. There is

every indication that the limits for optimal catch within the shelf area has been crossed with the structure of fisheries increasingly dominated by the low value oil sardine that now constituting over 20 percent of the catch.

Long-terms trend analysis of fish catch for a period of about 20 years (1985-2006) showed that pelagic fish were the most dominant group followed by demersal fish, Crustacean and Molluscs. A general increase in total fish catch along the Tamil Nadu coast was observed during 1990s and then the catches showed a decreasing trend. Generally, the Mean Trophic level (MTL) of the total trawl catch showed a decreasing trend from 1985 to 2006 and MTL of total catch and pelagic fishery showed significant reduction. This reduction in MTL of pelagic fishery along the Tamil Nadu coast indicates exploitation of organisms lower down in the aquatic food chain (primary and secondary producers).

Long term trend analysis of marine fish landing from 1985 to 2006 showed that in spite of improving techniques and increasing effort invested into catching fish, the fishing yield is declining steadily in recent years along with the already declining tropic level. The trend indicates that there will be a considerable decline in fish catch over the next decade, and improperly managed fishing practices could have considerable ecological and economic repercussions for the future.

The open access nature of marine capture fisheries appears to be one of the major reasons for depletions, economic waste and conflict among user groups. The existing regulatory measures/policies restrict the fishing seasons,

fishing areas and the mesh size of gear. However, there is no monitoring and surveillance system in place in Tamil Nadu.

The technological inputs have changed the face of marine fisheries, which is characterized by plywood and fiber glass traditional fishing crafts fitted with out-board motors, synthetic gear which has the adverse influence on the marine life, i.e., fishes, coral reefs and other living organisms.

In the early 1950s, fishing in Tamil Nadu was entirely the preserve of small country craft, propelled by sails, paddles and oars. Starting from the early 1960s, the sector has undergone a rapid transformation. The changes in the fisheries, characterized by continuous expansion of capacity, both in number of fishing units as well as in terms of its unit capacity, were possible only because fish catch also kept increasing during the period. Today in 2015, the entire fishing is by vessels using motors, though non-motorized vessels exist nominally.

2.1.1. Growth of Fish Production in India

India is a major producer of fish in the world. The fisher sector is changed from traditional activity to commercial use during the last six decades. We are exporters of fish products to the foreign countries such as USA, EU, China and Japan and other countries. The export of fish products are increased from 10, 048.53 crores in 2009-10 to 30, 613 crores in 2013-14. The volume of fish exports are increased from 6,78,436 tonnes to 9,83,756 tonnes in the same period.

Table 2.2: Fish Production in India: 1950-51 to 2014-15

Year	Fish Production ('000 tonnes)			Average Annual Growth Rate (Percent)		
	Marine	Inland	Total	Marine	Inland	Total
1950-51	534	218	752	-	-	-
1955-56	596	243	839	2.32	2.29	2.31
1960-61	880	280	1160	9.53	3.05	7.65
1965-66	824	507	1331	-1.27	16.21	2.95
1970-71	1086	670	1756	6.36	6.43	6.39
1973-74	1210	748	1958	3.81	3.88	3.83
1978-79	1490	816	2306	4.63	1.82	3.55
1979-80	1492	848	2340	0.13	3.92	1.47
1980-81	1555	887	2442	4.22	4.6	4.36
1981-82	1445	999	2444	-7.07	12.63	0.08
1982-83	1427	940	2367	-1.25	-5.91	-3.15
1983-84	1519	987	2506	6.45	5	5.87
1984-85	1698	1103	2801	11.78	11.75	11.77
1985-86	1716	1160	2876	1.06	5.17	2.68
1986-87	1713	1229	2942	-0.17	5.95	2.29
1987-88	1658	1301	2959	-3.21	5.86	0.58
1988-89	1817	1335	3152	9.59	2.61	6.52
1989-90	2275	1402	3677	25.21	5.02	16.66
1990-91	2300	1536	3836	1.1	9.56	4.32
1991-92	2447	1710	4157	6.39	11.33	8.37
1992-93	2576	1789	4365	5.27	4.62	5
1993-94	2649	1995	4644	2.83	11.51	6.39
1994-95	2692	2097	4789	1.62	5.11	3.12
1995-96	2707	2242	4949	0.56	6.91	3.34
1996-97	2967	2381	5348	9.6	6.2	8.06
1997-98	2950	2438	5388	-0.57	2.39	0.75
1998-99	2696	2602	5298	-8.61	6.73	-1.67
1999-00	2852	2823	5675	5.79	8.49	7.12
2000-01	2811	2845	5656	-1.44	0.78	-0.33
2001-02	2830	3126	5956	0.68	9.88	5.3
2002-03	2990	3210	6200	5.65	2.69	4.1
2003-04	2941	3458	6399	-1.64	7.73	3.21
2004-05	2779	3526	6305	-5.51	1.97	-1.47
2005-06	2816	3756	6572	1.33	6.52	4.23
2006-07	3024	3845	6869	7.39	2.37	4.52
2007-08	2920	4207	7127	-3.44	9.41	3.76
2008-09	2978	4638	7616	1.99	10.24	6.86
2009-10	3104	4894	7998	4.23	5.52	5.02
2010-11	3250	4981	8231	4.7	1.78	2.91
2011-12	3372	5294	8666	3.75	6.28	5.28
2012-13	3321	5719	9040	-1.51	8.03	4.32
2013-14	3443	6136	9579	3.67	7.29	5.96

Source: Hand Book of Fisheries Statistics, Government of India, 2014

The production of fish in India is increased from 0.75 million metric tonnes (MMT) in 1950-51 to 10.07 MMT in 2014-15. There are tenfold increases in growth of fish production over the period of last six decades. The main reasons for these trends is potential growth of inland fisheries. The marine fish production has increased from 0.53 MMT in 1950-51 to 3.44 MMT in 2013-14. The annual growth rate of marine fish production has increased due to the effective implementation of various fisheries sector scheme in India.

Table 2.3: Year-wise Fish Export from India: 1994-95 to 2013-14

Year	Quantity (Tonnes)	Value (Rs. in Crores)	Unit (Rs./Tonnes)	Unit Value Index	Annual Growth	
					Quantity	Rate
1994-95	307337	3575.3	116331.6	4668.7	26.73	45.28
1995-96	296277	3450.1	116448.5	4673.39	-3.6	-3.5
1996-97	378198	4077.6	107816.5	4326.96	27.65	18.19
1997-98	385818	4649.7	120515.4	4836.6	2.01	14.03
1998-99	302934	4626.87	152735.3	6129.67	-21.48	-0.49
1999-00	343031	5116.67	149160.6	5986.21	13.24	10.59
2000-01	440473	6443.89	146294.8	5871.2	28.41	25.94
2001-02	424470	5957.05	140340.9	5632.25	-3.63	-7.56
2002-03	467297	6881.31	147257.7	5909.84	10.09	15.52
2003-04	412017	6091.95	147856.8	5933.88	-11.83	-11.5
2004-05	461329	6646.55	144074	5782.07	11.97	9.1
2005-06	512163	7245.73	141473.1	5677.69	11.02	9.01
2006-07	612643	8363.52	136515.4	5478.72	19.62	15.43
2007-08	541701	7620.93	140685.2	5646.07	-11.58	-8.88
2008-09	602834	8607.95	142791.4	5730.6	11.29	12.95
2009-10	678436	10048.53	148113.2	5944.17	12.54	16.74
2010-11	813091	12901.46	158671.8	6367.92	19.85	28.39
2011-12	862021	16597.23	192538.6	7727.08	6.02	28.65
2012-13	928215	18856.26	203145.4	8152.76	7.68	13.61
2013-14	983756	30213.26	307121.5	12325.6	5.98	60.23

Source: http://www.mpeda.com.

The growth rate has increased from 2.32 percent in 1955-56 to 9.53 percent in 1960-61 and 25.2 percent in 1989-90. During 2013-14, the growth rate has been deceline to 3.7 percent. The growth rate was negative in 1965-66, 1981-82, 1982-83, 1986-87, 1997-98, 1998-99, 2000-01, 2003-04, 2004-05, 2007-08 and 2012-13(Hand Book of Fisheries Statistics, 2014).

The production of inland fishing sector is increasing from 0.22 MMT during 1950-51 to 6.14 MMT in 2013-14. There is enamors growth of inland fishing sector in India. The average annual growth rate has increased from 2.3 percent in 1955-56 to 7.3 percent in 2013-14. The growth of inland fishing is 5 percent over the period of last six decades. Fishing efforts are largely confined to the inshore water through artisanal, traditional, mechanized sectors. About 90 percent of the present production from the marine sector is from within a depth range of up to 50 to 70 meters and remaining 10 percent from depths extending up to 200 meters. While 93 percent of the production is contributed by artisanal, mechanized and motorized sector, the remaining 7 percent is contributed by deep sea fishing fleets confining their operation mainly to the shrimp grounds in the upper East Coast (MPEDA, 2015).

2.1.2. State-wise Fish Production in India

Fishing sector is one of the predominant sectors in India. The fishing sector is transformed into commercial sector due to quality of fish. Among the different states, Andhra Pradesh is predominately catching the fish. The highest share of the state in total fish production is 19.5 percent and followed by West Bengal (16 percent) and Gujarat (8 percent).

Table 2.4: State-wise Fish Production in India (TE 2014-15)

States	State-wise Fish Production in India 2014- 15 ('000 tonnes)			Percent to Total 2014-15
	2012-13	2013-14	2014-15	
Andaman	36.62	36.95	37.18	0.37
Andhra Pradesh	1808.08	2018.42	1964.43	19.5
Arunachal Pradesh	3.71	3.63	4	0.04
Assam	254.27	266.7	282.7	2.81
Bihar	400.14	432.3	479.8	4.76
Chandigarh	0.05	0.11	0.12	0
Chhattisgarh	255.61	284.96	314.16	3.12
Dadra	0.05	0.05	0	0
Daman and Diu	19.01	19.86	28.77	0.29
Delhi	0.69	0.88	0.67	0.01
Goa	77.88	114.06	117.85	1.17
Gujarat	788.49	798.49	809.93	8.04
Haryana	111.48	105.58	111.2	1.1
Himachal Pradesh	8.56	9.83	10.74	0.11
Jammu & Kashmir	19.95	20	20.3	0.2
Jharkhand	96.6	104.82	106.43	1.06
Karnataka	525.57	555.31	613.24	6.09
Kerala	679.74	708.65	632.26	6.28
Lakshadweep	12.37	18.72	13.19	0.13
Madhya Pradesh	85.17	96.26	109.12	1.08
Maharashtra	586.37	602.68	548.75	5.45
Manipur	24.5	28.54	30.5	0.3
Meghalaya	5.42	5.75	5.89	0.06
Mizoram	5.43	5.94	6.39	0.06
Nagaland	7.13	7.47	7.84	0.08
Odisha	410.14	413.79	439.86	4.37
Puducherry	41.07	42.08	73.5	0.73
Punjab	99.13	104.02	114.77	1.14
Rajasthan	55.16	35.1	46.31	0.46
Sikkim	0.49	0.42	0.44	0
Tamil Nadu	620.4	624.3	697.61	6.93
Telangana			265.38	2.63
Tripura	57.46	61.95	63.56	0.63
Uttar Pradesh	449.75	464.48	494.26	4.91
Uttarakhand	3.85	3.89	3.94	0.04
West Bengal	1490.02	1580.65	1617.32	16.06
India	9040.36	9576.64	10072.4	100

Source: www.indianstat.com

Table 2.5: State-wise Inland and Marine Fish Production in India (2013-14)

States	Production (In ' 000 Tonnes)			Share in Total production		
	Marine	Inland	Total	Marine	Inland	Total
Andaman	36.75	0.2	36.95	1.07	0	0.38
Andhra Pradesh	438.25	1580.17	2018.42	12.73	25.75	20.68
Arunachal Pradesh	0	0.55	0.55	0	0.01	0.01
Assam	0	266.7	266.7	0	4.35	2.73
Bihar	0	432.3	432.3	0	7.05	4.43
Chandigarh	0	0.11	0.11	0	0	0
Chhattisgarh	0	284.96	284.96	0	4.64	2.92
Dadra	0	0.05	0.05	0	0	0
Daman and Diu	18.78	0.23	19.01	0.55	0	0.19
Delhi	0	0.88	0.88	0	0.01	0.01
Goa	109.57	4.49	114.06	3.18	0.07	1.17
Gujarat	695.58	97.84	793.42	20.2	1.59	8.13
Haryana	0	116.9	116.9	0	1.91	1.2
Himachal Pradesh	0	9.83	9.83	0	0.16	0.1
Jammu & Kashmir	0	19.98	19.98	0	0.33	0.2
Jharkhand	0	104.82	104.82	0	1.71	1.07
Karnataka	357.36	197.95	555.31	10.38	3.23	5.69
Kerala	522.31	186.34	708.65	15.17	3.04	7.26
Lakshadweep	18.72	0	18.72	0.54	0	0.19
Madhya Pradesh	0	96.26	96.26	0	1.57	0.99
Maharashtra	467.46	135.22	602.68	13.58	2.2	6.18
Manipur	0	28.54	28.54	0	0.47	0.29
Meghalaya	0	5.75	5.75	0	0.09	0.06
Mizoram	0	5.94	5.94	0	0.1	0.06
Nagaland	0	7.47	7.47	0	0.12	0.08
Odisha	120.02	293.77	413.79	3.49	4.79	4.24
Puducherry	37.81	4.27	42.08	1.1	0.07	0.43
Punjab	0	104.02	104.02	0	1.7	1.07
Rajasthan	0	35.1	35.1	0	0.57	0.36
Sikkim	0	0.42	0.42	0	0.01	0
Tamil Nadu	432.27	192.03	624.3	12.55	3.13	6.4
Telangana	0	0	0	0	0	0
Tripura	0	61.95	61.95	0	1.01	0.63
Uttar Pradesh	0	464.48	464.48	0	7.57	4.76
Uttarakhand	0	3.89	3.89	0	0.06	0.04
West Bengal	188.24	1392.41	1580.65	5.47	22.69	16.2
India	3443.12	6135.79	9578.91	100	100	98.16

Source:www.indianstat.com

The states like Tamil Nadu, Karnataka and Kerala accounted for around 6 percent each in total fish production during the same period. These six states put together accounted for more than 62 percent of total fish production of the country in TE 2014-15.

The share of inland and marine fish production in India is represented to 65 percent and 35 percent, respectively. Among the different states, Andhra Pradesh and West Bengal have highest share in the total production of fish. Both the states accounted for 26 percent and 23 percent of total inland fish production. Both states are having above half of inland production during 2013-14. In the case of marine fish production, Gujarat is having highest share and it accounted for 20 percent and followed by Kerala (15.2 percent), Maharashtra (13.58 percent), Andhra (12.73 percent) and Tamil Nadu (12.55 percent). The five major states accounted for 74 percent of total marine fish production in India. They are having three-fourth of share of marine fish production in India (AERC Research Report, Gujarat).

2.2. Marine Fisheries in Tamil Nadu

Tamil Nadu has 1.9 lakh sq. km and a continental shelf of 41,412 sq. km. The marine fishermen of Tamil Nadu are 9.24 lakh people. They are living in 608 fishing villages in the 13 coastal districts of Tamil Nadu. The inshore waters of 1,016 km length of the coast is located on the eastern side and 60 km length of the coast is on the western side. The marine fish production of the state is 4.32 lakh tonnes against the potential of 7 lakh tonnes (Policy Notes, Government of Tamil Nadu, 2014-15). The Table presents the marine fisheries statistics in Tamil Nadu during 2013-14.

Table 2.6: Fisheries Statistics in Tamil Nadu: 2013-14

Particulars	Statistics
Coastal Length	1,076 km
Number of Coastal Districts	13
Number of Fishing Villages	608
Area: Total Coastal Line of the State (Km)	1076
Total Inland Fishery Resources in Tamil Nadu (ha.)	383834
Reservoirs	62015
Brackish Water Area	56000
Others	237019
Total	355034
Fish Production: Marine (in Tonnes)	432265
Value (Rs. in Lakhs)	674196.45
Inland (in Tonnes)	192029
Value (Rs. in Lakhs)	149642.96
Fishing Vessels (in Numbers)	
Registered: Machined Boats	5253
Traditional Crafts	4907
Motorized Traditional Crafts	25529
Total	35689
Estimated Fisher folk Population Marine(in Lakhs)	9.24
Inland (in Lakhs)	2.26
Fish Exports: Quantity (in Tonnes)	96429
Value (Rs. in Crores)	5316.29
Infrastructural Facilities	
Major Fishing Harbours	3*
Major Fishing Harbours Under Constructions	4 **
Medium Fishing Harbours	4***
Jetties	8
Developed Fishing Landing Centres	25
Other Fishing Landing Centres	363
Marine Products Export 2012-13	86585 MT (Rs. 3331.78 Crores)
Marine Fish Production 2013-14	4.32 Lakh Tonnes

Source: Commissioner of Fisheries, Government of Tamil Nadu, Chennai-05
Directorate of Marine Products Exports Development Authority, Chennai-40
Note: * refers to Chennai, Toticorin, Chinnamuttam, **refers to Thengapattinam, Poompuhar, Colachel, and Muttom ***refers to Phazhayar, Mallipattinam, Nagapattinam and Cuddalore

The inland fishermen population is to 2.26 lakh. The fishing activity is main the livelihood of the fishermen community. The inland fishery resource of the state is consist of reservoirs, major irrigation and long seasonal tanks, short seasonal tanks and ponds. About 5, 000 ha. of ponds and tanks are used for fresh water aquaculture under the Fisher Farmers Development Agency Programme. Under the Intensive Inland Fish Culture and Marketing schme, about 24,600 ha. of ponds and tanks are used for inland fish culture. During 2013-14, the inland fish production is 1.91 lakh tonnes due to the unsuitable monsoon. The inland fishery resources is 3.83 lakh ha. The state is having 78 reservoirs (Policy Notes, Government of Tamil Nadu, 2014-15).

Table 2.7: An Overview of Inland Fisheries in Tamil Nadu

Inland Fishery Resources	3.83 Lakh ha.
Reservoirs (78 Nos*)	62,015 ha.
Large irrigation and short seasonal tanks	2,65,642 ha.
Brackish water spread area	56,000 ha.
Population of Inland Fishers	2.26 Lakh
Inland Fish Production (2013-14)	1.91 Lakh Tonnes

* 61 reservoirs taken over from PWD for fish culture by Fisheries department out of the total 78 reservoirs

Table 2.8: Exports of Fish Production in Tamil Nadu: 2001-02 to 2013-14

Year	Quantity (in Tonnes)	Value (in Lakhs)
2001-02	58482	201640
2002-03	70147	250787
2003-04	68462	207116
2004-05	70809	206804
2005-06	72418	199572
2006-07	72883	206805
2007-08	72644	181314
2008-09	68397	177220
2009-10	73327	198207
2010-11	86181	286019
2011-12	80738	302916
2012-13	86585	333178
2013-14	96429	531629

Source: Director of Marine Products Exports Development Authority, Chennai -40

In Tamil Nadu, the export of fish products has increased from 58,482 tonnes in 2001-02 to 96,429 tonnes in 2013-14. The highest share of export of fish is 96,429 tonnes and followed by 86585, 86 181 tonnes in 2012-13 and 2010-11. On the other hand, the lowest share of export is 58,482 tonnes in 2001-02. The export of fish product value has increased from Rs.2,01,640 lakhs in 2001-02 to 2,50,787 lakhs in 2002-03. Thereafter, it has declined to 1,77,220 lakhs in 2008-09. The value has increased to 531,629 lakhs in 2013-14.

Table 2.9: Coastal Length of Districts in Tamil Nadu

Districts	Coastal Length (km)
Chennai	19
Thiruvallur	27.9
Kancheepuram	87.2
Cuddalore	57.5
Villupuram	40.7
Nagapattinam	187.9
Thanjavur	45.1
Thiruvarur	47.2
Pudukottai	42.8
Ramanathapuram	236.8
Thoothukudi	163.5
Tirunelveli	48.9
Kanyakumari	71.5
Total	1076

Source: Tamil Nadu Marine Fisher folk census 2010- Department of Fisheries

Tamil Nadu is one of the predominant states in maritime fish production. The state has highest inland and marine source of fish. The coastal line of the state is 1076 km and continental shelf area is 41,412 sq. km. It is one of the important maritime states with rich inland and marine fish. Among the distrrcts of Tamil Nadu, Ramanathapuram occupy the longest coastal line of 237 km and followed by Nagapattinam (188 km) and Thoothukudi (163.5 km). On the other hand, Chennai and Thiruvallur occupy the lowest coastal line of 19 km and 28 km, respectively.

Among the 608 fishing villages of Tamil Nadu, Ramanathapuram district is having highest number of fishing villages. It accounted for 180 fishing villages in the state. Followed by Cuddalore and Nagapattinam are having 77 and 53 fishing villages, respectively. On the other hand, Tirunelveli, Tiruvarur and Thoothukudi districts are having lowest 7, 13 and 21 fishing villages in the state of Tamil Nadu.

Table 2.10: Details of Marine Fishing Villages of Tamil Nadu

Name of the Districts	Marine Fishing Villages
Tiruvallur	77
Chennai	44
Kancheepuram	44
Villupuram	19
Cuddalore	49
Nagapattinam	53
Tiruvarur	13
Thanjavur	27
Pudukottai	32
Ramanathapuram	180
Thoothukudi	21
Tirunelveli	7
Kanyakumari	42
Total	608

Source: Tamil Nadu Marine Fisher folk census 2010- Department of Fisheries

Table 2.11: Estimated Marine Fish Production: Craft-wise, District-wise: 2013-14 (Quantity in Tonnes)

District	Mechanized	Non-Mechanized			Total
		Motorized	Non-Motorized	Share-seine Crafts	
Chennai	21944.6	7705.7	5236.0	0	34886.4
Thiruvalllur	0	5887.4	3924.9	0	9812.4
Kancheeepuram	571.6	12029.5	7885.5	348.4	20835.0
Villupuram	360.2	9431.9	6287.9	0	16080.1
Cuddalore	16641.9	5426.7	3417.7	491.8	25978.2
Nagapattinam	45052.5	15822.2	10751.0	0	71625.7
Thiruvarur and Thanjavur	8428.7	2960.1	2011.4	0	13400.1
Pudukkottai	28004.9	9835.1	6682.9	0	44522.9
Ramanathapuram	55331.0	19203.1	13089.3	343.1	87966.5
Thoothukudi	34040.7	11954.8	8123.2	0	54118.8
Tirunelveli	0	5861.5	3907.7	0	9769.1
Kanniyakumari	27216.7	9558.3	6494.8	0	43269.8
Total	237592.9	115676.5	77812.4	1183.3	432265.0
Percentage	55.0	27.0	18.0	0.3	100.0

Source: Commissioner of Fisheries, Government of Tamil Nadu, Chennai-05

Table 2.12: Estimated District-wise Inland Fish Production: 2013-14

Name of the District	Total Quantity in Tonnes	Percent
Chennai Region: Chennai	47.15	0.02
Thiruvallur	13168.35	6.84
Kancheepuram	8887.23	4.64
Vellore	20894.68	10.85
Villupuram	1934.09	1.00
Thiruvannamalai	141.86	0.07
Cuddalore	17382.35	9.03
Cuddalore	17382.35	9.03
Coimbatore Region: Coimbatore	1625.47	0.84
Erode	12178.33	6.33
The Nilgiris	4.48	0
Dharmapuri	2238.86	1.16
Krishnagiri	112.88	0.06
Tiruppur	0	0
Salem	1531.80	0.80
Nammakkal	945.88	0.49
Tiruchirappalli Region: Tiruchirappalli	1011.39	0.53
Karur	540.08	0.28
Perambalur	580.61	0.30
Ariyalur	0	0
Pudukkottai	8987.71	4.67
Madurai Region: Madurai	2753.17	1.43
Theni	3654.38	1.90
Dindigul	2332.12	1.21
Ramanathapuram	12839.54	6.67
Sivaganagai	27091.49	14.07
Virudhunagar	25635.65	13.32
Nagapattinam Region: Nagapattinam	7695.42	4.00
Thanjavur	6369.65	3.31
Thiruvarur	5852.71	3.04
Thoothukudi Region: Thoothukudi	2193.74	1.14
Tirunelveli	4904.91	2.55
Kanniyakumari	7767.43	4.03
Total	192029.14	99.75
TNFDC	476.82	0.25
Grand Total	192505.96	100.00

Source: Commissioner of Fisheries, Government of Tamil Nadu, Chennai-05

With these developments in the background, let us examine the policies of the Government of Tamil Nadu towards fisheries development with a special reference to marine fisheries and post-harvest infrastructure.

Post script: Pictures and photographs for representation purpose only.

Chapter III
Tamil Nadu: A Review of Policy on Marine Fisheries and Post-Harvest Infrastructure

Fisheries comes under the purview of the State Governments and the Government of India takes the role of a coordinator and restrict themselves in the matter of fisheries management beyond the respective territorial waters of the states under the Constitution of India. The Union of India is responsible for framing broad policy guide lines in the matter of fisheries development in the country. They also allocate funds under Union Budget for the centrally sponsored Central and State Collaborative Schemes for development of fisheries in the country. In respect of marine fisheries, the Government of India gives importance for the development marine infrastructure, especially, construction of fishing harbours, fish landing jetties/centres.

The marine fisheries development is mainly guided by the Government of India's Comprehensive Marine Fisheries Policy 2004. It ensures the sustainable development of marine fisheries in due conservation of ecological integrity and biodiversity. The policy calls for adopting fisheries management such as registration of fishing vessel, observation of closed fishing season prohibition of destructive fishing methods, introduction of mesh regulations, reduction of by catches and discards and establishing an effective monitoring, control and surveillance mechanism. The need for conservation and

management was, however, recognized only in the Ninth and Tenth Five Year Plans.

Tamil Nadu is one of the states that have a separate Ministry for Fisheries. However, the Department of Fisheries comes under the administrative control of the Secretary. Department of Animal Husbandry, Dairying and Fisheries (it was tagged with Agriculture and for some time with the Forest Department in the 1960s and 1970s respectively). However, the policies are indirectly stated through its Annual Policy Notes, which are actually, Annual Budget documents and gives out the objectives of the Government of Tamil Nadu towards the development of the sector.

Box 3.1: Policy Note: 2015-16

" To develop fishing occupation which plays an important role in generating employment opportunities, providing protein rich food to the public, developing livelihood of fishermen, generating income, the Government under my leadership is actively implementing schemes such as development of New Fishing Harbours, Fishing Landing Centres, Fish Processing Parks in Coastal Towns, improving Inland fisheries, motivating marketing of fish and modernizing markets besides implementing fishermen welfare schemes"

-Speech by Hon' ble Chief Minister on the Floor of Assembly on 04.08.2014.

The broad objectives of the Government of Tamil Nadu (as culled out in brief from various policy documents) are:

- To optimally utilize the coastal areas for productive utilization and livelihood support for poor.
- To enhance marine fish stocks through sea ranching and setting up of artificial reefs along the coast.
- To reduce post-harvest losses and improve the landing and post-harvest infrastructure for marine fisheries.
- To ensure safety of artisanal and small scale fishers at sea.
- To generate employment opportunities for fisher folk.
- To enable fishermen get remunerative prices for their harvest through improved marketing infrastructure.
- To provide nutritional and food security to the population through increased availability of fish and shell fishes.
- To ensure the quality of fish and fish products and create awareness among consumers.

The recent policy notes have some welcome objectives in tune with the recent developments (Policy Note: 2015-16)

- Protecting the traditional fishing rights of fishermen.
- Providing social security of fishers through various relief schemes.
- Improving the standard of living of the fishers by implementing several welfare schemes.

- Conserving the Fisheries resources by enforcing statutory regulations such as mesh regulations, preventing use of destructive nets/gears and stock enhancement and establishing artificial fish habitats.
- Managing the fishery resources by encouraging diversified fishing options for fishermen to exploit off shore deep sea fishery resources, especially, Tuna by providing financial assistance for deep sea fishing and establishing mid sea fish processing unit.

The above objectives spell out the minds of the policy makers in ensuring sustainable development of the sector as a whole and in particular the marine fisheries. These also clearly indicate that in recent times more expenditure is incurred for the social development of fisher folk, enabling them to have equal opportunities in the society. The policy also brings forth the realization of importance for resource conservation, development and reduction of post-harvest fish losses. These are also reflected in the State Government initiatives in the programmes (Policy Note, 2015-16, Fisheries, Announced in the State Assembly, Demand No. 7).

The management of fisheries is undertaken by the state through licensing, prohibition on certain fishing gears, regulation of gear meshsize and establishment of closed seasons and areas, under the Marine Fisheries Regulation Act. 1983 and the Rules 1986, there on to ensure separate zones for artisanal/traditional fishing craft and mechanized fishing crafts to conduct

fishing and also avoid resource use conflicts. The ban on fishing (season) is adopted to ensure conservation, for 45 days in April-May of every year in the State. This period is considered as spawning and breeding season for majority of species which are commercially important. The fishermen also understood the importance and strictly adhere to this ban period. In fact, there is a demand for enhancing this period to 60 days in a year, which from the point of view fishermen is good enough to allow proper breeding of select species.

The Tamil Nadu Marine Fisheries Regulation Act 1983 and the Rules 1986 also prescribe minimum mesh sizes and prohibit the use of destructive fishing gears to conserve resources and ensure sustainable fishing practices.

Tamil Nadu is a pioneering state in India in the matter of development of fisheries. The State Fisheries Department is perhaps the first one in the country having been established as early in 1907. This is one of the states which propagated the objective of food security as early in 1940s, and Fisheries Development Programmes were considered as one of the most important component of 'Grow More Food campaign'. Community stocking of fish seeds in water bodies were one of the imitatives that had tremendous effect on fish production in fresh water bodies. This also ensured availability of fish, even to common man, especially, in the rural pockets of the state. Rural Development and self-sufficiency in protein (cheap) availability was made possible in the State. It is not an exaggeration to mention that Tamil Nadu showed the way for fisheries development to states like Kerala, Andhra

Pradesh (integrated), Maharashtra, West Bengal and other marine states including Union Territories.

As part of its strategy, Government went on constructing fishing harbours, fish landing jetties and landing centres to ensure not only safe berthing facilities for fishing crafts, but also for hygienic landing of fishes before distribution to consumer. The list of fishing harbours, jetties and fish landing centres in the State is given in appendix...

In the matter of development of post-harvest infrastructure in the country, Tamil Nadu showed its way, by establishing ice plants, cold storage, freezing/chill plants in the State. The ice plants and cold storages were put through States funds to ensure the availability of ice to fishermen to preserve the quality of harvested fish. The cold storages were provided to keep the excess quantity of fish for being marketed in the next few days. Tamil Nadu is one of the beneficiaries of Indo-Norwegian collaborative project for Integrated Development of Marine Fisheries. Apart from the design of trawlers, the project established freezing plants at Mandapam, Ramanadhapuram District. Fish canning were also attempted through this integrated project. Fish meal was yet another major attempt, which helped the fisherman to surrender the miscellaneous fishes for getting a reasonable income, which otherwise would have been discarded as waste. The successful demonstration of the Indo-Norwegian project evinced and attracted private entrepreneurs who came forward to establish fish processing, freezing, ice plants and cold storages. The private entrepreneurs demonstrated the

viability of these post-harvest infrastructures, but also proved the advantages of location economics in setting up such ventures in the State. Their initiatives proved successful, as of today, the major exporter incidentally are also fish processors. Their contribution in enhancing the intrinsic value of post-harvested times (in the marine sector in particular) cannot be over looked by anyone who reviews the marine fisheries development in the State.

Inspite of these initiatives, the post-harvest losses in the State is around 15 percent, which bring forth the fact that post-harvest infrastructures were intended for export markets only. The existing condition of fish landing centres/fish landing platforms in the fishing harbours, auction halls and the fish markets (both wholesale/retail) all need improvement in terms of quality standards on a far with any International Food Security Acts/ Guidelines/ Norms. The fresh fish consumption still dominates the market, which was 63 percent in 2012 (Government of India Ministry of Agriculture, Handbook of Statistics 2014). At the all India level, it is 74.24 percent. These warrant that the Government focuses their policy initiatives in strengthening and improving post-harvest infrastructures in the State. The foremost requirement is improving the hygienic conditions of the fish landing platforms, Auction halls with required adequate washing and drainage facilities. The cold storage and ice crushing facilities also need be established with in the fishing harbours complexes to avoid post-harvest fish losses.

Chapter IV
The Status of Marine Infrastructure in Tamil Nadu

The initial policy aimed at maximizing production and ensuring its availability, especially, as an animal protein substitute to the masses. It was ensured that the fishing boats (dominated by trawlers) had safer birthing places and a place to land the fish catches. The prime value for shrimps in the export market attracted private players in the industry. They established fish processing plants to handle shrimp processing and their export. The attractive price for shrimps lured the fishers to go for selective fishing and enormous by-catches were a by-product of this aggressive fishing. Moreover, it brought into unhealthy competition amongst the motorized fishermen and artisanal fishermen. The 1980s witnessed as a result of their unhealthy competition, a violent sea front warranting the Government to bring in some regulation into effect. The result of this is the Marine Fisheries Regulation Act, and the state of Tamil Nadu also brought its Act 'Tamil Nadu Marine Fisheries Regulation Act 1983 and Rules 1986. The main focus of the Act was to bring forth zonation between the artisanal and mechanized fishermen to avoid conflict over fishing zones as well as ensure minimizing the intensive competition in the inshore region.

The above Act also brought in measures for resource conservation, augmentation and development. The Act also addressed the issue of reducing the pressure in the inshore region. The policy for diversified fishing followed this Act. This brought in the need for developing marine shore

infrastructure which aimed at arresting post-harvest fish losses, improving their quality through construction of hygienic landing platforms, auction halls with drainage facilities, modern fish markets with cold storages, ice crushing units within the FHs etc,.

Picture 4.1: Status of Fish-hold and Handling in Rameshwaram

However, until the XII Five Year Plan, the concept of marine infrastructure/post-harvest infrastructure in India had been evolving around the construction of fishing harbours/fish landing centres with auction halls. Most of the fishing harbours in India (and Tamil Nadu is no exception) aimed at providing adequate/safe berthing places for fishing boats and a place to land the catches. The harbours also had auction halls, but rarely had adequate water supply and drainage system to keep them in a hygienic manner. The vital issue is that the fish need be handled with due care as soon as it is caught. The most important material needed is adequate supply of ice

both on board and on shore so that spoilage is averted before it reaches the consumer. Moreover, the post-harvest infrastructure development influences in the pattern of fish utilization and reach of the consumers.

Table No. 4.1 Number of Major, Minor Fishing Harbours and Fish Landing Centres Commissioned/under Construction by Tamil Nadu (2011-12)

State	Major Fishing Harbour Commissioned	Major Fishing Harbour		Fish Landing Centres	
		Commissioned	Under Construction	Commissioned	Under Construction
Tamil Nadu	1	8	3	26	1

Source: Handbook of Fisheries Statistics 2014, Government of India.

Apart from ice, the nature of fish containers influence the quality of fish handled. Insulated containers are the most preferred. However, the containers with crushed ice for storing fishes are widely used in the State. Some of them still use bamboo baskets.

Picture 4.2: Fish Landing Centre in Rameshwaram

Source: Field Survey Collection

The fish markets, either whole sale or retail give a very pathetic scene resulting in poor quality of fish being marketed within the State. This results in the seller getting lower price for the catches, which would be otherwise, if the quality is maintained. The differential price losses make the fishermen/ (the producer) to lose his due share in the consumers' rupee and the consumers deprived of 'quality fish' for consumption. In other words, in the absence of adequate post-harvest infrastructure, the producer and the consumers are directly affected, apart from the likelihood of spreading unhygienic fish being widely distributed causing health related problems in the society. Food related public health hazard has been defined as a biological, chemical or physical agent in food or a condition of food, which has the potential to cause harm.

Picture 4.3: Improper Handling in Tuticorin Auction Hall

Source: Field Survey Collection

Tamil Nadu was in the fore front in the matter of fisheries development. It ensured that ice was made available in the landing sites and hence put up ice plants and cold storages in the coastal villages as early in late sixties. This resulted in private entrepreneurs putting up ice plants and cold storages in locations which had connectivity advantages, as the distance factor plays a vital role in the quality of fish harvested. The gap in the quality of fish handling and processing of fish for developing and those meant for export market is very wide, which incidentally plays a vital role in the share of consumer rupee by the fishers.

This is in contrast to the stated policy on infrastructure development for marine fisheries, which affirms that the concept of post-harvest handling of fish would also be woven in to the existing project. The policy also says that the implementation of international quality regime for food safety in fish and fishery products would be carried through the nodal agency. A regulatory body would ensure monitoring and verification of compliance. Existing domestic standards for fishery products and by products would be harmonized with the international standards so as to ensure quality of fish and fishery products for domestic consumption on a par with global standards(Comprehensive Marine Fishing Policy, November, 2004).

However, existing fishing harbours, fish landing centres in the state (barring a very few like Tuticorin) most of them do not have cleaner landing centre or auction halls or ice crushing units and cold storages, leave alone washing and drainage facilities for either at the landing platforms or auction halls. In the case of fish markets also, the condition is very appalling,

resulting in wastage of food fishes or lowering their quality depriving the consumers of assured supply of fishes. Low quality of fish and fish products are not only great concern of food security and public health but also of serious economic loss that the small scale fishers or traders suffer year of the year.

Picture 4.4: Status of Fish-hold in Nagapattinam Fishing Harbour

Source: Field Survey Collection

The ice plants are also located away from fish landing platforms/fish landing centres making the fishers to purchase ice from different places and carry on board the fishing vessels. The details of ice plants, cold storages, processing plant in the state are furnished in the appendix.

Table 4.2: Details of Post-harvest Infrastructures in Tamil Nadu

Name of the Plants	Number of Plants	Capacity (Tonnes)
Ice Plant	14	223.00
Chill Plant	15	55.50
Cold Storages	41	15,017.00
Chilled Storage	6	2074.00
Pre-Processing Centre	41	367.03

Source: Marine Products Export Development Authority (as of 15.07.2014)

Longer the distance, higher is the loss. Quality loss situations improved when insulated boxes were used for storing harvested fishes. Similarly, availability of ice and method of icing have been key elements for quality loss in wet fish. Coulter and Disney (1987) identified similar problems in fish marketing like, lack of ice, lack of roads and transport, lack of insulation during transport, inadequate packing, lack of sanitation and reliance on slow non-modernized collector boats.

The existing status on post-harvest infrastructure is well recognized in the Report of the Working Group on XII Five Year Plan (2012-2017). It would be more appropriate to quote the same here. "The inadequacies in infrastructure for landing and berthing facilities for marine fishing fleet and for domestic marketing have been the main reasons for post-harvest losses, which are estimated around 15-20 percent.

Picture 4.5: Fish Unloading in Nagapattinam Fishing Harbour

Source: Field Survey Collection

Creation of additional infrastructure for landing and berthing of fishing vessels and also up-gradation of the existing facilities and development of infrastructure for domestic marketing can reverse the situation. The reduced post-harvest losses can augment the supplies available for human consumption and fish marketed in good condition can also fetch better remuneration for the fishers, who are otherwise finding it difficult to make both ends meet" (Para 2.7). This clearly indicates the gap in the post-harvest infrastructure, implying a policy shift in favor of establishing ice plants and cold storages within the fishing harbors/fish landing centres and encouraging fishermen in the use of insulated/galvanized ice boxes/containers, good transport network to carry fishes within the country and neat and hygienic state of fish markets. The present dual standards in fish marketing i.e., one for the export and another for domestic marketing need be given up to enable realizing good value for the landed catches. These will

enable fish traders to develop marine fish supply chain systems to ensure regular domestic supplies.

Picture 4.6: Improper Icing in Nagapattinam Fishing Harbour

Source: Field Survey Collection

These warrant strengthening the cold chain network to reduce losses. The ambient temperature in the state, in most part of a year is hot and hence the use of ice immediately after fish catch in the process of transport and eventual selling to the consumer is Sine-qua-non. This requires establishing ice plants and cold storages in and around the fishing harbors and fish landing centres so that fishermen are assured of continuous supply. Insulated boxes not only enable fish to be iced but they protect fish from physical change and contamination. Ultimately, fish can be sold for a high price and seller can keep the fish in good condition while waiting for the best price.

It is noteworthy to point out here that infrastructure for marine fisheries sector activities requires improvement of the marketing system and

cold storage chains supporting the landing centres including a frozen logistic system through road and sea routes. Moreover, the performance of the marine fisheries sector is influenced by a number of natural, institutional, technological and policy factors and hence any policy performance should take into account/ consideration the 'dynamics' impacting the sector.

Post script: Pictures and photographs for representation purpose only.

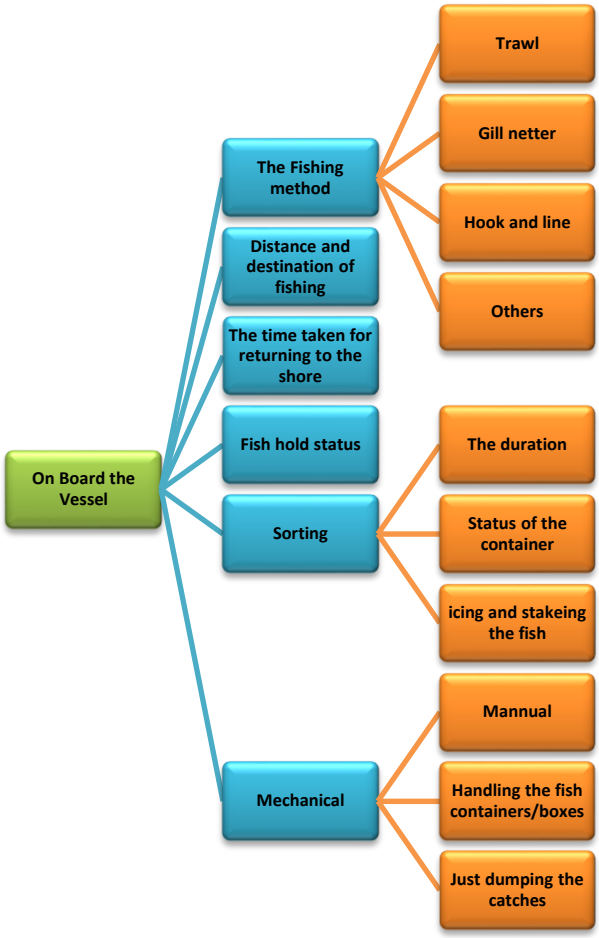
Chapter V
Findings on Post-Harvest Fishery Losses

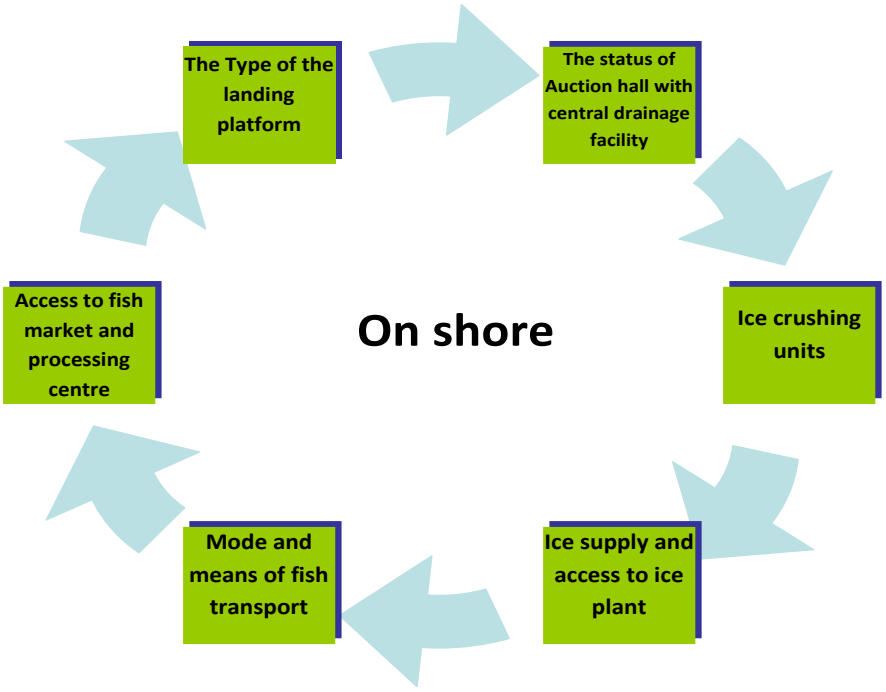
Tamil Nadu is the pioneering state in the matter of fisheries development in India. It is also one of oldest development department established in the year of 1907. It has been playing an active role not only in the resources enhancement but also optimal use of resources and their conservation. It has also set/created new models for marine fisheries development. In spite of these record creating efforts, its development efforts in the post-harvest field had been lacking thrust and sustainability. As mentioned in the previous chapters, planned development of fisheries started along with the planning era in the independent India. However, the First Five Year Plant did not make much impact in this field. With the beginning of the Second Five Year Plan, more thrust was given for exploiting the resources and the construction of marine infrastructure started. The momentum went on with one plan to another and there had been considerable increase in fund allocations. Every plan had been making a mention about post-harvest infrastructure and in spite of these investments and implementation; the post-harvest loss had been around 15-20 percent resulting in considerable income loss to the fishers and non-availability of quality fish to the consumers.

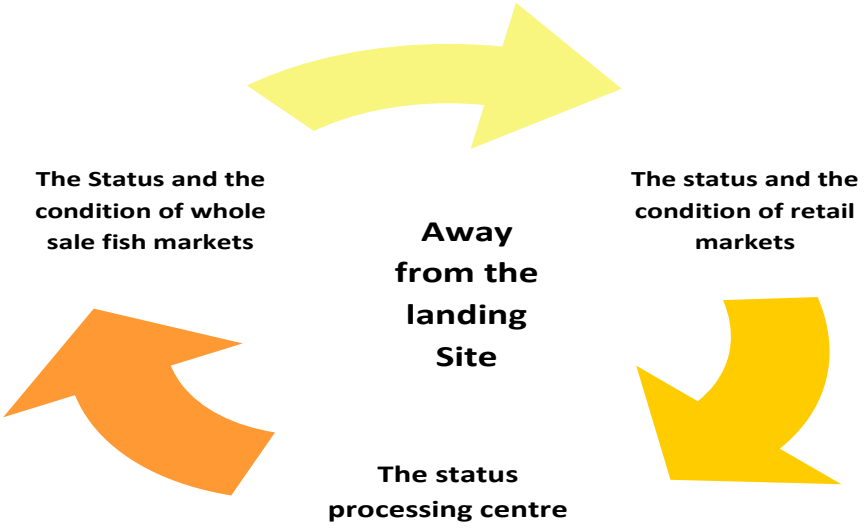
Table 5.1: Fishing Harbours in Tamil Nadu

Name of the Fishing Harbour	District
Kasimode	Chennai
Nagapattinam	Nagapattinam
Rameshwaram	Ramanadhapuram
Tuticorin	Tuticorin

The point of incidence of post-harvest losses can be categorized in the given charts.




The Type of the landing platform
The status of Auction hall with central drainage facility
Ice crushing units
Ice supply and access to ice plant
Mode and means of fish transport
Access to fish market and processing centre
On shore


The Status and the condition of whole sale fish markets
The status and the condition of retail markets
Away from the landing Site
The status processing centre

In the process of field survey, the investigators met and interacted with the following stakeholders, which helped the AERC, Chennai in deriving information on the present status, the needs on the infrastructure front and also the status and lacunae in the policy implementation, the incidences and causes of losses in the post-harvest process, which affects the economy of the stakeholders, especially, the fishers. The fish eating population of the state is also deprived of their due share of quality fish. The list of fisheries officials and other stake holders is given in Annexure III. In all 298 stake holders were contacted and information gathered.

Based on the field survey, with respect to each sample site, the above parameters which have direct bearing on the quality of fish and thereby on post-harvest fishery losses are given in the Table 5.2.

Table 5.2: Fishing Parameters in Tamil Nadu

Parameters	Kasimode	Nagapattinam	Rameshwaram	Tuticorin
Method of Fishing (Percent)	80	100	43	43
Trawl (Percent)	20	--	57	57
Gill Net	--	--	--	--
Hook and line	--	--	--	--
Others	--	--	--	--
Distance and Duration of fishing	Multi day	Multi day	Day	Day
Time taken for returning	8 Hrs	6 Hrs	6 Hrs	8 Hrs
Fish hold status	Good	Good	Average	Good
Hygienic	Yes	Yes	No	Yes
Sorting	On board	On board	On board	On board
Duration	2 Hrs	2 Hrs	2 Hrs	2 Hrs
Method of handling	Good	Good	Poor	Good
Quantum of icing	Adequate	Adequate	In-adequate	Adequate
method of icing	Crushed	Crushed	Crushed	Crushed
Type of containers used	Ice box	Ice box	Ice box	Ice box
Landing				
Mechanized				
Duration				
handling boxes	With ice	With ice	With ice	With ice
(putting them on the landing platform	Dumping	Dumping	Dumping	Baskets
During the catches on the floor of the	Not	Available	Not Available	Available
landing platform	Available	(but not in		
Washing and drainage facilities the		used)		
landing platform)				
Manual duration				
handling boxes	With ice	With ice	With ice	With ice
putting them on the landing platform	Dumping	Dumping	Dumping	Baskets
During the catches on the floor of the	Not	Available	Not available	Available
landing platform	available	(but not in		
Washing and drainage facilities the		used)		
landing platform				
On shore				
Type of Platform				
The status of the auction hall	Not available	Available (but not used)	Not available	Available (very good)
ice crushing units	Available	Available	Not Available	Available
Ice supply and ice plant	Average	Average	Poor	Average
Mode of transport	Mini van	Auto	Head load	Mini Van
Access to fish market and processing centres	Good	Good	Good	Good
Cold Storage	Available	Available	NA	Available
Away from the landing site				
Status and condition of wholesale markets	Average	Average	Poor	Average
Status and condition of retail markets	Good	Good	Poor	Very Good
The status of processing centres	Average	Average	Average	Good

Status of support sanities				
Toilet and wash facilities	NA	NA	NA	Good
Packing	NA	NA	NA	Average
Canteen and provisions	NA	NA	NA	NA
Weather wearing communication	Average	Average	Very Poor	Good

Source: Field Survey Data

5.1. Tuticorin Fishing Harbour

The inferences with reference to the above fact table reveal that Tuticorin fishing harbor can be ranked as a cleaner fishing harbour which helps in minimizing the initial post-harvest fishery losses. The cleaner fish hold, access to ice supply with adequate and timely supply by ice with facilities for ice crushing within the fishing harbour; clean auction hall, good logistics for transport of fish to processing centres; fish market etc., It should be noted with as many as 41 pre-processing sheds; 33 processing plants and 31 cold storages plants it can be ranked as the number one in terms of a post-harvest friendly fishery harbour.

However, it should be noted that this harbour contributes its bulk of the production (landings) towards export. The quantum of export from this harbour is 4.52 percent of all India (total) export for the period from 2005-06 to 2012-13. (Vide Handbook of Fisheries Statistics, 2014). In the case of products intended for domestic fish markets, however, their loss is considerable, merely because of the poor status of the retail market which lack of basic infrastructure. They have specifically 'no roof', leave alone the facilities like neat display platforms, cutting (dressing) and washing facilities and central drainage with in the markets, waste disposal mechanism etc., The percentage of economic loss at the retail level is nearly 12 percent which

implies a lot need be done in the front. The status of the retail market clearly implies the Government Policy to boost export at the cost of domestic consumers. The fishers also lose their income to this extent is proportion to their landings.

5.1.2. Analysis of Incidence of Post-harvest Fishery Losses: Sorting

The fishers sort the fish catches on board the fishing vessel soon after its haul. These fishers use fish containers and ice is taken on board of the vessel before venturing in to the sea. Therefore, icing and staking of sorted fish is done immediately on its haul. This prevents the spoilage of fish and hence spoilage at this stage is almost nil. However, this is done for export varieties and top species (commercially important) which have higher demand and unit price in the market. The miscellaneous species are dumped on the fish hold without icing or being put into the containers. These species are mostly used for reduction into fish meal/or fetch very low price at the markets.

Picture 5.1: On Board Sorting at Tuticorin Fishing Harbour

Source: Field Survey Collection

5.1.2. Method of Fishing

The incidence of post-harvest fishery largely depends on the method of fishing. In respect of trawlers the occurrence of by catches is the major factor that contributes for the post-harvest fishery losses. However, in respect of gill netters, the fish struggles within the net and hence it requires proper icing handling and storages to avert losses. The hook and line and other methods almost have positive effect on the condition of the harvested fish and hence these fishes fetch a very good price in the market. Their fresh condition remains slightly longer than that of the trawling and gill net fishing. Hence, the consumers are even ready to offer premium price for fishes caught through hook and line method of fishing.

In respect of Tuticorin around 16 percent are trawl fishing and the remaining 84 percent are gill net crafts. Another 55 percent of fishing crafts are artisanal crafts which contribute to fish production from this harbour.

The noteworthy feature of this harbour is that the mechanized fishing boats have to adhere to 'time period' of fishing stipulated by the fishing harbour authorities, which varies from 5 to 10 hours for the modernized fishing vessels. This regulation is enforced to protect the interest of artisanal fishermen. The artisanal fishermen go for multi-day fishing and they take ice boxes on board the fishing vessel.

5.1.3. Landing of Fish Catches

Even though the landing platform in this harbour is not epoxy coated it is well maintained and the hygiene of landed catches taken care of. Only fish containers are unloaded and hence edible/high values fishers are taken away to the auction hall/ processing centres as the case may be. The fish coming into contact with external particles/ bacterial load on the fish for disposal are ruled out. However the landing of miscellaneous (non-edible) fishes intended for fish meal and their dumping on the landing platform and subsequent dumping within the fishing harbour complex need be sorted out, as the insects sitting on these miscellaneous fish species likely to spread on the fish intended for consumption.

The noteworthy feature of this harbour is that the auction hall is well maintained and it has a central drainage facility with insect proof screen both for the windows and the main door of the hall. Ice crushing units, which is

functioning within the fishing harbour enables use of adequate ice in right proportion without wastage of ice.

Picture 5.2: Auction Hall at Tuticorin Fishing Harbour

Source: Field Survey Collection

The harbour has good access to fish markets (both domestic and export) with support facilities for fishers utility including toilets, water supply and parking places.

However, a look at the fish markets located in the following places explain as to only the post-harvest fishery losses of the retail level are high, to the extent of 12 percent of total value of fish transacted in the domestic market.

(i) Tuticorin Fishing Harbour

(ii) Threaspuram market

(iii) Savariyarpuram and

(iv) Panimayamadha church

Except the Tuticorin fishing harbour, the other fish markets do not have basic facilities like proper elevated platform with washing, drainage, cutting/dressing facilities and disposal of fish wastes away from the market. No cold storage to store in the case of glut in supply and the fishers are forced to dispose of the catches for a lower price. This is obvious from the fact that the same quality of the fish fetches a higher price in the morning and the price goes down as the time runs out. This is owing to lack of storage/display cabinets (with Freezer boxes/centrally cooling cabinets) at the retail market level. Even the condition of the wholesale market is not different from that of retail markets except to the facility of 'roof over their head'. The interaction with the consumers also revealed that they prefer fresh fish only for domestic consumption.

5.2. Kasimode Fishing Harbour, Chennai

5.2.1. Fishing Method

Trawling is the major fishing method adopted (81 percent) by the vessels based at this harbour. The remaining 19 percent have gill net operations. Of the total number of fishing crafts, 68 percent of these are artisanal fishing crafts indulging in day fishing. The trawlers go for target fishing and hence by catches form the bulk of less valued fish catches caught. These in turn also influence the percentage contribution to post-harvest fishery losses at the landing stage itself. The vessels go for multi-day fishing, which is between 8 to 12 days for a single voyage. On an average, they go for

4 to 5 voyages per month. The fishers carry on board fish containers with adequate ice for preserving the catches. Sorting is done on board the vessel, immediately after each haul and properly preserved in the containers. The by-catches by trawlers account for 10 to 20 percent per voyage. Another 20 percent landings are classified as 'low value' species by the fishers and kept separately in the open boxes on board the vessel. Normally, no icing or inadequate icing is done merely to cut the operational expenditure.

The landing is done by mechanized and manual hauling. The high valued species including export species are unloaded carefully on the landing platform. The miscellaneous fishes are simply emptied from the baskets on the floor for being carried over to nearby open place for disposal. Mostly, they are being sold in heaps for fish meal (non-edible).

5.2.2. Landing Platform

It is non-epoxy coated and not maintained in neat and hygienic way. No drainage/slope for quick drain of waste water from the landing platform.

5.2.3. Auction Hall

Fish auction is done in the open i.e., on the landing platform itself. However, as the major high valued species intended for domestic marketing are sold immediately on their landing (rather auctioned) the quality loss/price loss to the fishers is avoided owing to lack of proper auction hall with central drainage.

Picture 5.3: Chennai Auction Hall: Auction in Open Place

The other varieties are auctioned in heaps and they fetch lower price, as their quality is also considered 'as low' by the intended buyers. The improper handling of the landed fish in the process of 'auction' within the harbour is well depicted in the appended photograph (Source: Field Visit).

5.2.4. Ice Plant and Supply of Ice

The availability of ice plants in the vicinity of the harbour and the ice crushing unit, within the harbour ensures timely and adequate supply of ice to fishers before they venture into the sea. This mitigates the spoilage of caught fish before being landed.

5.2.5. Cold Storage and Processing Facilities

Kasimode being one of the major fishing harbours in the state with an average share of 6.89 percent of total export from the country's total export, has in its proximity cold storage and processing plants, which are well connected by road from this harbour. The catches intended for domestic

marketing are taken by ordinary transport vehicles (mini trunks) in the open, (rather non-insulated vehicles) to the nearby markets. The time lag in reaching the market from landing site (in a non-insulated vehicle) impacts, on the quality of fish taken for marketing. This in turn brings lower price/income to the fishers. This eventually, increase the percentage of loss incurred on such verities by the time products reach the retail market.

5.2.6. Fish Markets in Chennai

The following are the notable (major) fish markets in Chennai which takes their main product from Kasimode fishing harbour:

1. Chindadripet
2. Saidapet Both wholesale and retail
3. Kasimode Fishing Harbour
4. Vanagaram (products also comes from southern part of the state)

For the purpose of study, the Velacherry road side retail vendors, Tamil Nadu Fisheries Development Corporation Limited (TNFDC Limited, a Government Tamil Nadu undertaking) run retail fish stalls and mobile fish marketing (includes value added products) and Spencer Hyper market were also studied to derive conclusions on the status of post-harvest losses, especially, at the retail marketing stage.

The fish market at Chindadripet and Saidapet, which are major sources of fish supply to Chennai metro fish eating population can be classified as the "worst" fish market and they can be considered as one of the "best examples

of how a fish market should not be". They have a building and a roof not even a place of ventilation for the consuming public/purchaser; leave alone a place for 'fishes' 'to breath'. These markets do not have separate places for fish cutting/dressing and the fish wastes are thrown around the selling place. There is no water supply system within the market to wash/clean fishes. No display cabinets/freezer cabinets, storage facility for storing unsold fishes. This results in value loss to the tune of 12 percent at the retail level. (Photograph appended).

On the contrary, the fish market at Vanagram can be classified as a model fish market in the city. The level of satisfaction of consumers is also very high, both in terms of quality of fish and its price. This falls in line with the Government Policy of state of art retail fish market as proclaimed in the Working Paper, XII Five Year Plan.

Similarly, the TNFDC fish stalls and mobile vans are classical examples of retail fish marketing, which minimize the loss to the fishers. The consumer's also get good value for their money. This is getting wider acceptance among the fish consumers, which is evident from its expansion to Type II cities in the state.

Velachery fish market is run on the road side of the Velacherry high road which has no roof or cover for the product which are exposed to pollution in the midst of vehicular traffic on the highway. Velacherry market is a typical retail market, which is widely prevalent in the state. Retail fish

market is the place where more than 12 percent of post-harvest fishery losses occur.

This harbour has now got additional post-harvest infrastructure to the tune of Rs. 16 Crores which would go in the long way of minimizing the post-harvest fishery losses at the landing stage. These include a new auction hall, toilets blocks and other utility services for post-harvest support.

5.3. Nagapattinam Fishing Harbour

This harbour is located in the coramandal coast of Tamil Nadu and has significant role to play in the region. Once it was a port of call for international passenger ships from South-East Asian regions frequenting this part of this country. From the fisheries point of view, especially after its devastation in the Tsunami 2004, this fishing harbour had been re-constructed and developed to take on future developments of the sector. The focus now is on distant water multi-day fishing, which can be considered as part of evolution of fisheries development in the state.

Information obtained orally from the Assistant Director of Fishers (Fishing Harbour) Kasimode.

Picture 5.4: Interaction with Fishermen by AERC Staff at Nagapattinam Fishing Harbour

Source: Field Survey Collection

The fishing is conducted throughout the year, except during the fishing ban period from the April 15th to May 29th. The month of October to December of every year is considered as off-season owing to bad weather conditions influenced by North-east monsoon. This harbour is located in the open coast of the state and hence vulnerable for floods and cyclones

5.3.1. Method of Fishing

Almost all mechanized fishing boats operate for trawl fishing. The artisanal fishing crafts operate gill nets, some of the fishing boats go for multiday fishing between 5 to 7 days. Some of the trawlers go for deep sea fishing operation, which lasts for 15 to 20 days. The artisanal fishers go for 6 to 10 hrs of fishing. The fishing ground is 24 nautical miles from the coast. The landings of fish is two tonnes in an average day, hauling of catches is by

using mechanized device (winch) and it takes 5 to 6 hrs if done manually. The fishers take ice and fish containers on board the vessel before venturing in to the sea. Sorting of fish takes place on board the craft and landing takes place on the floor of the landing platform. This harbour has facilities for cleaning and drainage and hence a clean landing site is visibly seen in and around the harbour, low value catches constitute 10 to 20 percent and by catches by trawlers also account for another 10 to 20 percent of the total landings. The grey area in post-harvest issue is therefore, narrowed down to these 20 percent of total landings which needs attention of planners to make use of these losses for edible purposes through developing post-harvest infrastructure.

The status of each of the elements which has direct bearing on the post-harvest fishery losses is given below based on the field survey report.

5.3.2. On-board

The sorting of catches is done on-board the fishing craft and they are stored in the fish containers with due quantum of ice, the incidence of post-harvest losses at this stage for commercially important species is almost nil.

The by-catches/low valued fishes are however, off loaded on the fish hold without icing and hence around 15 percent of the total landings (from the point of human consumption) is vulnerable for post-harvest loss. These are off loaded on the floor of these landing platforms and auctioned in heaps. Of the total by-catches and low valued fishes, about 10 percent can be very well used for human consumption if support infrastructures like ice and fish

containers are effectively used for these species. The consumers would also get cheaper but highly nutritious fish supply at an assured quality.

This harbour has two cold storage plants within premises and they can be put into use to ward off the issue of spoilage of fish catches in case of huge landings.

5.3.3. Auction Hall

The existing auction hall can be effectively utilized for fish auctioning and there by landing platform could still be used in a very hygienic way.

Picture 5.5: Auction Process at Nagapattinam Fishing Landing Centre

Source: Field Survey Collection

5.3.4. Fish Market

Marketing of fish is taking place in these centres, viz., Nagapatinam fishing harbour, Thonithurai and Gandhi Nagar. Except Nagapattinam, where the landing platform which is clean, the others two fish markets do not

have hygienic environment. These also do not have central drainage and waste disposal facilities resulting in price loss of fishes marketed. The loss in this segment is around 12 percent and the consumer also deprived of a good quality fish. These markets do not have cold storages and hence they are compelled to sell/dispose the whole quantity. These results in low price for the some species as when compared to its prevailing price in the morning/in an institutional market where these draw backs are absent.

The consumers in the state also don't have awareness in testing the quality of the fish and demand for the same. This goes to the advantage of the retail merchant.

5.3.5. Transport of Fish

Except those intended for export and distant urban markets (like Chennai and some of the major towns) only open type of trucks/mini vans are used for transport fish for domestic consumption. The fishes are either carried in basket or open crates without proper and adequate icing, which accelerates the spoilage in fish. The resultant price reduction affects the income of fishers.

5.3.6. Price Information

The fishers do not have price information for their fish catches which compels them to go by the price dictated by the middle man/auctioneers as the case may be. This has a lot of bearing on the interest shown by fishers to ensure hygienic and careful handling of the catches to fetch higher prices.

5.4. Rameshwaram Jetty/Fishing Harbour

Located in the district of Ramandhapuram this harbour and its fishermen frequently hit the headlines an account of their IBL crossing with Sri Lanka. These traditional fishermen claim their fishing rights over Katchathevu (now with Sri Lanka) which was once a traditional fishing ground for them. Intense competition and more number of trawlers being engaged in the fishing have resulted in depletion of fishery resources. This makes these fishermen to hunt for resources elsewhere and the proximity of Sri Lankan waters attracts them. The Government of India and Sri Lanka took effort to bring the conflicting fishers to the table resolve the issue. However, their sight of an end to the conflict is eluding owing to various reasons, especially, the most important among them being the resource use and conservation. These apart, this island is one of the oldest fish landing centre in the state and hence its study has more relevance in the matter of minimizing post-harvest fishery losses. Hence, AERC Chennai took up this harbour for sample survey.

Picture 5.6: Fish Landing Platform at Rameshwaram Fishing Jetty

Source: Field Survey Collection

5.4.1. Method of Fishing

Trawl fishing contributes 43 percent and the remaining 57 percent operate with Gill net in this harbour. However, 859 fishing crafts based at this harbour operate mainly for trawl fishing. Hence the incidence of by-catches is also high from this harbour. The average landing from this harbour is 1.20 tonnes per tonnes. Twenty eight percent of the landings are exported. In the remaining, (72 percent) bulk of the landings is procured by the merchants from Kerala, where consumers' preference for some of the species landed from this harbour is very high.

Diversification has just made a beginning, with one Tuna long liner engaged in operations. Fisherwomen play a major role in fish marketing.

Parameters that have a bearing on the incidence of post-harvest fishery loss are discussed as detailed below:

5.4.2. On board

The hygiene of the fish hold is comparatively poor, than that of the fishing harbour at Kasimode, Nagapattinam and Tuticorin. The fishers take around four hours to sort the fish in terms of export, high value species for domestic marketing and miscellaneous. The former two varieties are put in containers with proper icing. However, small and miscellaneous varieties are kept in the fish hold and dumped in heaps on the landing platform for auctioning. The fishing ground is around 15 nautical miles. The process of landing the catches takes about two hours at the harbour.

5.4.3. Landing Platform

Even though, the landing platform is made of concrete, there are no slopes for draining the waste water. No washing facilities available at the landing platform and the fishers use sea water (taken from the harbour basin, which is polluted due to oil spill) to wash the catches. The care taken for the high value species is not adopted for the low value/small edible fishes. These types of dualism in quality approach cause post-harvest fishery losses.

5.4.4. On-shore

The harbour has no auction hall, cold storage and ice plant in its premises. The ice is procured from the mainland viz., Ramanadhpuram which involves time lag in supply. During peak seasons/bulk landings, the

ice suppliers raise the unit price of ice which compels the fishers to use the ice selectively to bring down the operational expenditure on fishing. Containers are used only for export and premium varieties of fishes, resulting 10 to 12 percent wastage in post harvest fishery losses.

Picture 5.7: Fishing Handling at Rameshwaram Fishing Jetty

Source: Field Survey Collection

5.4.5. Fish Markets

The retail fish markets are similar as in the case of other fishery harbours mentioned above. No centralized drainage facility, washing and cutting/dressing facilities and storage facilities. The retailers have to take advantage of the time of arrival of fish and fix the price. The compulsion to sell fish on the same day or discard them as waste largely depends on the seasons and the demand fish for fish, the infrastructure at the retail market level of poor are almost absent. Hence, at the retail market level, the post-harvest economic losses estimated to be as high as 12 percent at this stage.

Chapter VI
Conclusions and Recommendations

The Government has been imitating policies and programmes aiming at improving the post-harvest infrastructure in the State. The foregoing analysis, however, reveal that the post-harvest fishery losses owing to inadequate infrastructure continue to rule between 10 to 12 percent (as against all India 10 to 15 percent). This is mainly because, even through the Government initiatives and thrust had been framed with over all perspective of post-harvest fishery loss reduction, it is not sustained and focus oriented in the entire supply chain of fishery marketing.

The prevailing status of the post-harvest infrastructure in the state can be inferred from the above field survey, which is summed up as follows:

i. The landing platforms in most of the fish landing centres needs to be upgraded with facilities for washing and drainage to ensure hygienic condition for the landed fish.

ii. Auction halls should have central drainage with insect screen, put on the windows and the entrance.

iii. Ice crushing units need be put up in major fish landing centres to ensure effective use of ice as a preservative for the landed catches.

iv. Ice supply to be augmented in the state as the ratio of ice supply versus fish production is in the ratio of 1:3 and the likely hood of this gap widening in the future is very visible (vide diagram 5.1) Ice is the most

cost effective medium to retard spoilage and maintain quality of landed catches. These also help to prevent price loss to the fishers.

Table: 6. 1 Projected Fish Supply and Ice Supply in Tamil Nadu

(in Lakh Tonnes)

Years	Marine Fish	Ice	Deficit in Ice Supply
2015	0.457	0.0489	0.4081
2016	0.4737719	0.050695	0.42307727
2017	0.49115933	0.052555	0.43860421
2018	0.50918488	0.054484	0.45470098
2019	0.52787196	0.056483	0.47138851
2020	0.54724486	0.058556	0.48868846
2021	0.56732875	0.060705	0.50662333
2022	0.58814971	0.062933	0.52521641
2023	0.60973481	0.065243	0.54449185
2024	0.63211208	0.067637	0.5644747
2025	0.65531059	0.07012	0.58519092
2026	0.67936049	0.072693	0.60666743
2027	0.70429302	0.075361	0.62893212
2028	0.73014057	0.078127	0.65201393
2029	0.75693673	0.080994	0.67594284
2030	0.78471631	0.083966	0.70074995
2031	0.8135154	0.087048	0.72646747
2032	0.84337141	0.090243	0.75312882
2033	0.87432314	0.093554	0.78076865
2034	0.9064108	0.096988	0.80942286
2035	0.93967608	0.100547	0.83912868

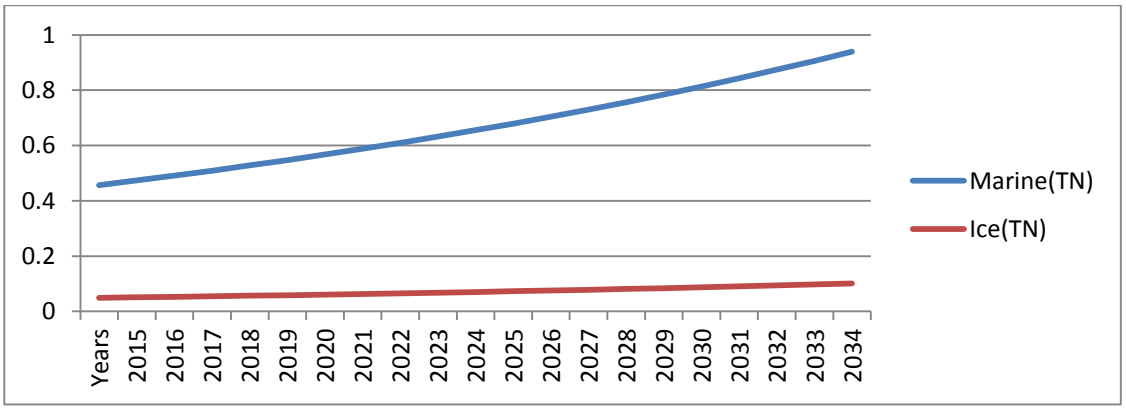
Source: MPEDA, 2014

Table: 6.2 Projected Trend in Fish Production and Ice Supply in Tamil Nadu

Years	Marine Fish	Ice	Deficit in Ice Supply
2015	0.46	0.05	0.41
2016	0.47	0.05	0.42
2017	0.49	0.05	0.44
2018	0.51	0.05	0.45
2019	0.53	0.06	0.47
2020	0.55	0.06	0.49
2021	0.57	0.06	0.51
2022	0.59	0.06	0.53
2023	0.61	0.07	0.54
2024	0.63	0.07	0.56
2025	0.66	0.07	0.59
2026	0.68	0.07	0.61
2027	0.70	0.08	0.63
2028	0.73	0.08	0.65
2029	0.76	0.08	0.68
2030	0.78	0.08	0.70
2031	0.81	0.09	0.73
2032	0.84	0.09	0.75
2033	0.87	0.09	0.78
2034	0.91	0.10	0.81
2035	0.94	0.10	0.84

Source: MPEDA, 2014

Diagram 6.1: Trend of Marine and Ice Productions in Tamil Nadu at 3.67 Percent Growth Rate



v. Domestic fish market (both wholesale and retail) are without required infrastructure facilities resulting in huge loss in post-harvest fishes.

These had been discussed in the earlier analysis/field survey report in brief. However, the issues that require immediate focus of the policy makers and planners/administrators are presented below:

6.1. Fishing Method

Trawl by-catches which constitute bulk of small fish species and consumed low value constitute around 0.41 percent of total landings (vide CIFT, Cochin, 2008). The fisheries research institute of Tuticorin and other ICAR institution have developed viable technologies to convert low value fishers as value added products for marketing. Moreover, extension efforts must be conducted for fishermen who go for trawl fishing to avoid fish by-catches through suitable modification of mesh sizes of trawl nets. The fishermen can also be educated to minimize such losses in their own interest of conserving sea resources. The low value catches can be sued for human consumption provided proper handling and preserving methods are adopted by fishers.

The use of insulated/ice boxes for fishes caught need be emphasized at all levels (fishers, boatmen, the merchants and harbour authorities) to ensure total avoidance of fish spoilage on board.

The upkeep and periodical (after each voyage) washing of fish holds can be propagated as this is the birth place of micro-organism with which fishers come into contact and spoilage level is activated.

The fishers must be educated in the method of fish handling, icing, staking and maintenance of insulated/ice boxes, which would literally prolong the shelf life of landed fishes. Handouts can be widely distributed to all fishers or it can be pasted in the fish hold of each fishing boat so that fishers get accustomed with the scientific method of fish staking in insulated /ice boxes. Physical loss, spoilage due to improper handling and exposures to ambient temperature brings the percentage of spoilage to the above 0.41 percent. This excludes, fish discards and throw away in the midst of sea. This is attempted as the fish hold would not have space to store such huge unwanted by-catches.

6.1.1. Fish Landing Platforms/Centres

Most of the landing centres in the state do not have proper slope, pucca platforms with water supply for washing the landed catches. Epoxy coating of the landing platform would ensure simple and periodical upkeep and maintenance of platforms.

In the absence of proper slope and water supply arrangements, the fishers use the sea water available within the wharf area which is contaminated due to oil spill from the berthed fishing vessels. These are major draw backs on account of this practice that the fished wounded fishes would get contaminated with the dirty water leading to microbial affect on the edible fish, leading to health hazards. Another is that the fish may carry the smell of lube oil its skin leading to rejection by the potential consumers. The modernization efforts of fishing harbour/fish landing centres must

ensure that these basic infrastructures are constructed keeping in view the potential impact they will have on the quality of fish.

Picture 6.1: The Status of Fish Basin in Rameshwaram Jetty

6.1.2. Carrier Vessel Concept

To minimize the potential time lag and also bring the issue of holding huge catches owing to the limited capacity of fish holds, some of the fishing vessels can be converted into carrier vessels with Refrigerator Sea Water (RSW) facility, which can bring the catches from the fishing vessels. These not only ensure catches being brought to the shore in a very fresh form, but also enhances the fishing time of the vessels and ensure avoidance of spoilage on-board the craft. This will also bring down the fishing pressure/effort in the already resource starved sector. These will eventually eliminate another two percent of post-harvest fishery losses.

6.1.3. Auction Halls

Major fishing harbours and fish landing centres to have model fish auction halls with central drainage system. Insect screens, with proper ventilation can go a long way in ensuring the avoidance of fish spoilage. The size of the auction halls can be decided in line with the volume of landings over the last ten years so that the complaint of inadequacy over capacity of space in the auction hall can be avoided. Such auction halls within the harbours ensure that edible fishes are treated well and protected over insect infestation/microbial affect. The unit value of such landed commodity on board increase considerably as with regard to fish the size and the quality have direct impact apart from the species preferred by the consumer.

6.1.4. Ice Crushing Unit

Location of ice crusher units within the harbour ensures effective use of ice on landed catches. It also ensures even flow of cool air and cost effectiveness of very popular and cheap preservative for fishes.

6.1.5. Ice Plants

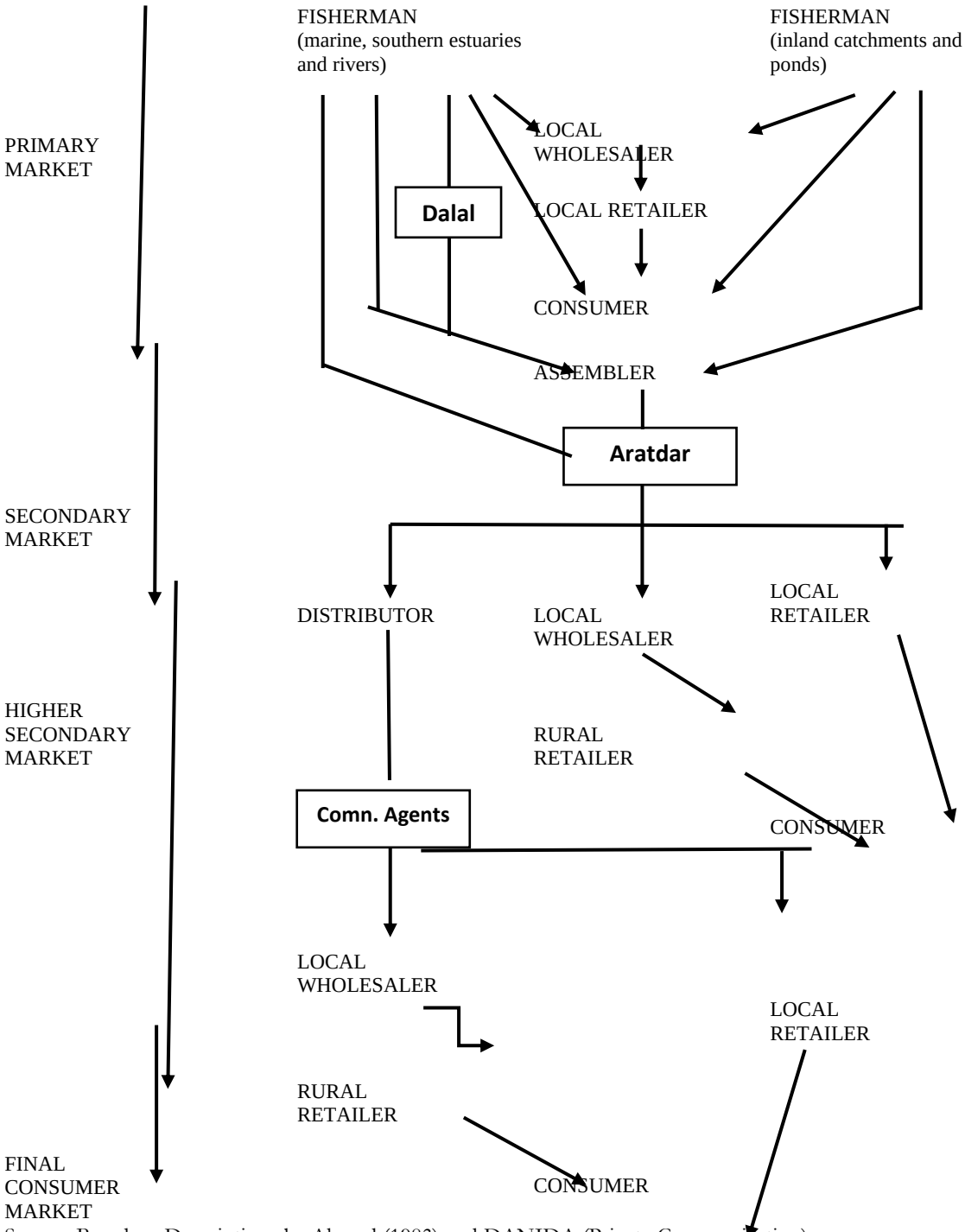
As the ice is in short supply in the state, putting up ice plants by the small and medium entrepreneurs can be encouraged. Their supply should be smooth and price fluctuation (in seasons of heavy fish landings) to be avoided. Putting of such ice plants with in vicinity of the fishing harbours/landing catches need be given special incentives in terms of un-interrupted power supply, fresh water supply. Even a policy measures like to declare this as an essential support service under the "Food Security Act" would be more than it's worth.

6.1.6. Transport of Fish

Fish transport in containers only to be encouraged so that the spoilage while in transport to consuming centres/markets is eliminated. The present system of carrying fish in open baskets/aluminum/crates should be prohibited. The Government must through their extensions education to fish merchants bring forth the economic and social advantages of such methods of fish transport. The fisher's co-operatives/harbour authorities can own as insulated truck (capacity to be decided in line with the volume of fish traded in the domestic markets) and price them at a reasonable rate to fish merchants. The ambient temperature which is having a direct impact on the fish when they are transported in open containers through mini-trucks/auto rickshaws get spoiled resulting in loss of value of fish traded in the market. The potential price loss is another two percent (a quantity of 9140 tonnes of fish is vulnerable for quality loss and thereby the price loss).

6.2. Fish Marketing Scenario in Tamil Nadu

The typical market channel as is obtaining in Tamil Nadu is depicted in the following chart: 6.1



Source: Based on Descriptions by Ahmed (1983) and DANIDA (Private Communication)

The scenario and the characteristics of different market channels is well explained in the Table. 6.3.

Table 6.3: Main Characteristics of the Major Market

Market Characteristics	Fresh Local	Traditional Dry Fish	Distance - urban	Export	Livestock or Fish Feed
The Supply	Cheaper species, lower quality	Cheaper species, lower quality	Higher priced species and outlets; better quality	Narrow range of higher prices and higher quality species	Cheap, low quality fish Often discards
Customer & distribution	Know local customers	Varies; some processing with left-over fish.	Weak; focus on maximizing sales volume	Insufficient production and volume focus	Usually good local knowledge
Logistics & distribution	Transport sanitation & cold chain poor	Transport and sanitation poor	Cold chain and sanitation with fishers at landings a weak line.	Cold chain and sanitation at landings needs improving	Transport and sanitation poor, but improving
Information & communication	Informal and adequate	Informal but adequate with local consumers, inadequate with distant consumers	Insufficient information flow; Consumers' knowledge could be widened	Insufficient information flow' promotion needs more brand focus, and industry participation	Informal for local market; but more formal for fish meal processing
Chain relationships	Credit/loans difficulties weaken this supply chain	Credit/loans difficulties weaken this supply chain	Trade is not transparent, fishers tied into loans. Relations weak	Trade with fishers not transparent; need stronger relations with customers	Credit/loans difficulties weaken this supply chain

Source: India Marine Fisheries, Study Background Papers.

6.2.1. Wholesale and Retail Market

Much has been proclaimed in this respect to have a hygiene fish market and it has been eluding the reality. More so as a 'dream' the State Government in their recent annual budgetary announcement and also the NFDB's support in this respect is encouraging. However, such announcements and proclamation more or less remain in paper. The typical example is the case of Saidapet and Chindadripet fish markets in Chennai and the case of any fish markets in the State. The initiatives to be sustained with the active involvement of private participation as most of the fish trade/markets are under the central of private individuals only.

The fish marketing in the state can be institutionalized with the active participation of stakeholders. Institutional fish marketing is not only profitable to traders and the fishers but also to the consuming public. The State Government have to make institutional marketing a reality and a widely practical one, by brining the two organizations in a tie-up arrangement, viz., the TNFDC Ltd and the TAFCOFED for fish marketing. The former is having experience in fish marketing and the later has active fishermen as its members. The tie-up would ensure that the TNFDC can look to the TAFCOFED for fish supply directly from the landing sites at a very competitive price. Quality would also be far letter as a number of intermediaries in the present setup is avoided for the TNFDC which procures fish by biding in auctions/enter in to arrangement with the wholesalers. The above tie-up arrangement not only benefits both the organization in

fulfillment of their set goals, but also serves not in their procurement function as well as a in collection of their dues (loans) advanced to fishers TAFCOFED for their fishing operations. As per the TAFECFED's set goals the members/fishers have to surrender their fish catches to the federation which would be pa a reasonable price for their catches. The consumers also assured of a good quality fish at a very reasonable price, as the marketing intermediaries are eliminated altogether.

Such revamping of retail markets and the institutional arrangements for the fish marketing would save the Government /public money to the tune of more than 4.23 Crores annually suffered at the point of retail side. This, however, is exclusive of other losses owing to improper handling, sorting, icing, transport etc., This implies that the fish eating population of the state assured good quality (additional) fish supply of 34,840 tonnes, which is otherwise considered as spoiled and sold for a throw away price or discarded as waste/miscellaneous fish for reduction as poultry feed. At this juncture, it is to recall that the per capita fish availability in the state is already lower than that of all India.

The retail fish markets are similar as in the case of other fishery harbours mentioned above. No centralized drainage facility, washing and cutting/dressing facilities and storage facilities. The retailers have to take advantage of the time of arrival of fish and fix the price. The compulsion to sell fish on the same day or discard them as waste largely depends on the seasons and the demand fish for fish, the infrastructure at the retail market

level are almost absent. Hence, at the retail market level, the post-harvest economic losses estimated to be as high as 12 percent.

6.2.2. Price Information

The landing price of top/select species landed in the state need be widely made known to fishers so that they are not cheated by the traders/auctioneers who purchase/procure fish from the fishing harbours/fish landing centres. The TAFCOFED can advance credit to fishers to meet operational expenditure, annual maintenance of fishing crafts and gears, for which the fishers normally look up on to middlemen/merchants for credit support. This dependency aspect on the creditors tells upon the income of the fishers and also the quantum and quality of fish traded. As the TAFCOFED is to procure fish, (if the above suggestions are put into practice ad there is no legal or administrative block in implementing this suggestion by the federation) getting back the recovery in kind would not be a problem. The share percentage of the consumer's rupee is bound to increase for the fishers. The economic status of the fishers is also bound to increase and in turn their dependency upon the Government subsides and doles and alms would eventually vanish.

In this connection it would be appropriate to quote what has already been mentioned in the XII Five Year Plan Document of the State on Fisheries Department apart from imparting training and creating awareness of hygiene and cleanliness among stakeholders, seed money has to be provided for operational expenses at least for the first year of operations. At the level

of artisanal fishers also the spoilage percentage in high i.e., 4.30 percent (owing to faulty handling, improper icing and exposure of fish to ambient temperature, vide CIFT Cochin 2008). The same plan document says that 'it suggests to have a relook of even new fishing harbour and fish landing centres on the infrastructure meant for landing and handling of fishes and facilities provided to the fiberglass reinforced plastic boat (FRP) owners for ensuring hygiene and cleanliness'.

Table 6.4: Procurement and Retail Price of fishes in Tamil Nadu

Name of the Species (Top 15)	Price at the landing centre (procurement) Rs./Kg	Price at the whole sale market Rs./Kg	Price at the institutional retail market Rs./Kg	Price the local/unorganized retail market Rs./Kg	Price loss at retail level (Percent)
Seer (Big)	434	477	543	475	12.52
Seer (Medium)	416	458	520	455	12.50
Seer (Small)	400	440	500	440	12.00
Black pomfret	448	493	560	490	12.50
White pomfret (B)	900	990	1125	1010	10.22
White pomfret (S)	1140	1254	1425	1280	10.18
Bekti	416	458	520	455	12.50
Perch	312	343	390	340	12.82
Red snapper	240	264	300	265	11.67
Kala	424	466	530	465	12.26
Sankara	224	246	280	245	12.50
Cuttle fish	200	220	250	220	12.00
Mocksel	160	176	200	175	12.50
Prawn (Big)	544	598	680	610	10.29
Sillaya (B)	288	316	360	315	12.50

Note: 1. Procurement at the landing site and hence at the wholesale level no/negligible loss occurs. However, as the channel multiplies and the level of infrastructure support is also poor/absent, at the retail level price loss is to the tune of almost 12 percent.

Of course, with the above small measures, which are small in terms of investment and easy to adapt and implement would prune the present post-harvest fishery losses in the state from its prevent 15 percent to almost negligible.

6.2.3. Use of Ice Boxes/Insulated Containers

Loss reduction initiatives will not be wholesome if there are no sustained efforts to popularize the use of insulated boxes for preserving fish catches. The insulated boxes not only enable fish to be iced effectively and extend the shelf life of both fish and the ice. They also protect the fish from any physical damage and contamination. This helps to a greater extent in loss reduction, irrespective of the ambient temperature and the condition of the floor at the landing site.

Picture 6.2: Staking Fish in Ice Box

Source: Field Survey Collection

There are methods of staking of fish, which helps to ensure that the fishers staked in the bottom of the box does not undergo much stress and the

cool air flow with in the box is even so that the fish with in ice boxes are secure and fresh. Through leaflets such staking methods can be arranged to be distributed to all fishers. This should be done periodically until visible changes are there in this front. To save cost and time do's and don'ts in fish sorting, storage, handling of fish can be displayed on the wharf itself through display boards. Fluorescent electronic sign boards can be used in this respect. Information as to the price level, demand side and the value of the species of fishes can also be highlighted through such electronic display leves. Messages on 'sea safety' weather warming, 'Distress call' and Helpline numbers First Aid, services in the midst of sea/voyage can be added to the list of such information, which would bring both a 'sea change' in the attitude of fishers. Slogans like 'clean fish better life' can be displayed at short intervals on the display boards in all the landing sites.

- The major harbour should have at least Thirty insulated truck with a capacity of 3 to 5 tonnes specifically earmarked for domestic supply net work.

- The domestic fish marketing system in India is neither efficient not modern and is mainly own by private hands with a huge number of intermediaries between producer and consumer thereby reducing the fishermen's share in consumer rupee. Tamil Nadu is no exception to this fact. Moreover, physical facilities and infrastructure in all types of fish markets are far from satisfactory (FAO (2001)

- Wholesale and retail markets should be developed and modeled in line with Hypermarkets with storage facilities, display cabinets, fish cutting/dressing and waste disposal mechanism and with adequate water supply systems. Frozen/chill cabinets to be provided at the retail level to ensure enhanced hygiene of the fish. For sustainable

management of markets, Revolving Funds to be established with the involvement of stakeholders so that their upkeep and maintenance are take care of. Inspection by the 'local body' and the 'state fisheries officials' should be made mandatory, so that the issue of health and hygiene of fish markets are ensured. This helps the sellers to keep the fish in good condition, while waiting for best price.

- Consumers should be-educated about their right to have healthy fish, free from spoilage and unhygienic environment, including their right to have value for their money. This can be through effective use of media, which would be cost effective and would have far reaching impact. The road side vending of fish to be banned through appropriate legal mechanism.

- The price information should be through public media so that both the producer and the consumers have equal footage in the matter of getting each others' worth.

The institutional fish marketing with the active participation of the stakeholders have been successful. It is better such institutional fish marketing is encouraged. The Government can initiate programmes to create awareness amongst stakeholders the benefits of such initiatives. These initiatives will contribute towards loss reduction. The reduction in post-harvest losses have a direct impact on local and regional trade flows. This improvement in trade will also contribute and sustain foreign exchange reserves.

Production, accessibility, marketing and consumption pattern of freshwater aquaculture products in Asia, A crore country comparison).

References

A Handbook of Fisheries Statistics, Ministry of Agriculture (Department of Agriculture and Farmers Welfare, Animal Husbandry, Dairying and Fisheries) Government of India, (2013-14 and 2014-15)

Anderson, James L. (1987), *Strategic Design and Marketing of Aqua cultured Products, Paper* presented at the 18th Annual Meeting of the World Aquatic Society, January 18-23.

Bala, B. K. and Mondol, M.R.A (2001), *Experimental Investigation of Solar Drying of Fish using Tunnel Dryer*, Drying Technology, 19(2):1-10

Borgstrom, G (1965), *Fish as Food*, Volume III Proceedings, New York

Bostock, T.W (1987), *Report on a List to Gujarat, India to Assess Losses in Fish and Identity Means of Improving Utilization*, November-December 1986, Report of Tropical Development and Research Institute, London, United Kingdom

Carpenter, K.J. (1979), *Fish in Human and Animal Nutrition, Advances in Fish Science and Technology,* Edited J.J. Connall, Fishermen survey, England, 124-130.

Central Institute of Fisheries Technology (2008), Government of India, Cochin, Kerala

Central Planning Commission (2011), Working Paper on Twelfth Five Year Plan, Government of India, New Delhi.

Comprehensive Marine Fishing Policy(2004), Government of Indian Ministry of Agriculture, Department of Animal Husbandry, Fisheries and Dairying, New Delhi, November.

Coulter, J.P. and Disney, J.G. (1987), *The Handling, Processing and Marketing of Fish in Bangladesh*, ODNRI Bulletin No. l

De Lucia and D. Assennato, (1994), *Agricultural Engineering in Development: Post-harvest Operations and Management of Foodgrains*, Technical Report, FAO

Dublin, J.V. Mc Loughlin and B.M.Mc.Kenna, Boole Pren, Dublin, *Economics and Sea Food Quality, James Anderson, Department of Resource Economics,* University of Rhode Island, Kingston & John Gray Anderson, Consumer Affairs Program, Department of Resource Economics, university of Rhode Island, Kingston, Rhode Island.

FAO (1985) *World Catch and Trade of Fishery Products in 1984*, Infofish Marketing Digest No. 3:25.

FAO (1986a.1984) *Year Book of Fishery Statistics*, Fishery Commodities, Vol.59, FAO, Rome

FAO (1986b), *The State of Food and Agriculture 1985*, FAO, Rome

Hodges, R.J., J.C. Buzby, and B. Bennett (2011) *Postharvest Losses and Waste in Developed and Less Developed Countries: Opportunities to Improve Resource Use,* Journal of Agricultural Science, Vol. 149

India Marine Fisheries, Study Background Papers

James D (1984), *The Future for Fish in Nutrition*, Infofish Marketing Digest No. 4:41.

James, D. H. (1984), *Fish for the Future?, Proceedings 6th International Conference on Food Science Technology*, September 1983

Marine Product Export Development Authority (1978), Government of India, New Delhi

Monsoon Season Post-harvest Fish Losses in India, Desk Review of Secondary Source Data and Suggestions for Research Themes, February/March 1997, Project No. A0665, Natual Resources Institute, University Resources Institute

National Research Council (1978), *Post-harvest Food Losses in Developing Countries,* U.S. National Academy of Sciences, Washington D.C

Nowsad, A. K. M. A. (2005), *Low Cost Processing of Fish in Coastal Bangladesh,* BGD/97/017 Field Doc: 05/2005, Food and Agriculture Organization of the United Nations, Dhaka.

Nowsad, A. K. M. A. (2006), *End of Assignment Report, Empowerment of Coastal Fishing Communities for Livelihood Security Project*, Food and Agriculture Organization of the United Nations, Dhaka

Nowsad, A. K. M. A. (2010), *Post-harvest Loss Reduction in Fisheries in Bangladesh: A Way Forward to Food Security*, Department of Fisheries Technology, Bangladesh Agricultural University, Mymensingh

Pariser, E.R.(1973), *Proteins of Aquatic Origin as Food for Human Consumptions,* Advances in Food 20:189

Policy Note of Government of Tamil Nadu (2015-16),Demand No. 7-Fisheries, Chennai

Policy Notes (2015-16), *Animal Husbandry and Fisheries Department*, Government of Tamil Nadu, Chennai-05

'Post-harvest Fishery Losses', Proceedings of an International Workshop held April, 12-16, 1987, at the University of Rhode Island, Edited by Michael T. Morrissey. Co-spondered by the U.S. Agency for International Development (USAIID) and The International Centre for Marine Resouce Development (ICMRD) at the University of Rhode Island, Published by ICMRD, 1988.

Slavis, J. (1982), *Utilization of the shrimp by-Catch In: 65th By-Catch Bonus from the Sea,* Report of a Technical Consultation on –by Chatch Utilization held in Georgetown Centre, Ottawa, Canada

State Planning Commission (1972) Government of Tamil Nadu, Chennai

State Planning Commission (2012-17), *Twelfth Five Year Plant Document*, Chennai

Ward, A. R. (2000), *Field and Desk based Tools for Assessing Fish Losses: Adaptation and Validation in West Africa,* Final Technical Report on Research Project R7008. Report 2564, Natural Resource Institute, Chatham, 45 pp.

Ward, A. R. and Cheke, R. A. (1997), *Modelling Post-harvest Fish Losses*, Aquaculture News no. 24, December

Ward, A. R. and Jeffries, D. J. (2000), *A Manual for Assessing Post-harvest Fisheries Losses*, Natural Resources Institute, Chatham, UK.

Twelfth Five Year Plan Documents (2012-2017), Planning Commission, Government of India, New Delhi

Annexure I

F.No.9-7/2014-AER-ES
Government of India, Ministry of Agriculture
Department of Agriculture & Cooperation
Directorate of Economics& Statistics
(A.E.R. Division), 119, Shastri Bhawan, New Delhi

Dated: 19th August, 2015

Office Memoranum

Subject: Evaluation and assessment of economic losses on account of inadequate post harvest infrastructure facilities for fisheries sector in India.

The undersigned is directed to refer to AERC, Chennai's letter dated 15.07.2015 on the above mentioned subject seeking to involve AERC, Visva Bharati and V.V Nagar to cover the States of West Bengal and Gujarat for this study. AERC, Chennai will coordinate and cover the States of Tamil Nadu and Kerala. As this has been discussed with Director, AERC, Visva Bharati and V.V Nagar and they have agreed to conduct the study in their respective States within time frame.

It is, therefore, requested that AERC, Visva Bharati and V.V Nagar initiate the study in their respective states and complete the study timely. And AERC, Chennai is requested to make available methodology and questionnaires of the study to them immediately and make sure that study could be completed timely in all respect.

(Nagender Jatav)
Deputy Economic Adviser (AER)
Tel.-23387039

1. Dr. K.Jothi Sivagnanam , Director-Incharge, Agro-Economic Research Centre, University of Madras, CHENNAI-600 005.
2. Ex-Officio-Director, Agro-Economic Research Centre, Visva-Bharati University, Shantiniketan
3. Director, Agro-Economic Research Centre, Sardar Patel University, Distt. Kheda, Vallabh Vidyanagar.

Annexure II

Tamil Nadu Fisheries list of Officials interviewed

1. Tmt. Noorjahan Additional Director of Fisheries
2. Tmt. Chandra Joint Director of Fishers/General Manager TNFDC Ltd.,
3. Mr. Antony Xavier, Deputy Director of Fisheries
4. Mr. Sri Raman, Additional Director of Fisheries (FIMSUL)
5. D.M Fish stall, TNFDC Ltd., Teynampet
6. Mr. Manoharan Additional Director of Fisheries (Fishing Harbour) Kasimode
7. Mr. M. Subburaj, Joint Director of Fishers, Nagapattinam
8. Mr. R. Amol Xavier, Joint Director of Fisheries, Tuticorin
9. Mr. Sivakumar, Joint Director of Fisheries, Tuticorin
10. Mr. Gopinath, Additional Director of Fisheries, Rameshwaram
11. Dr. G. Jayashakila, Associate Professor, Fisheries College, Tuticorin
12. Managing Director, Britto Sea Food, Tuticorin
13. Managing Director, Baby marine Sea Food Pvt Ltd., Mandapam
14. Managing Director, Nila Sea Food Ltd., Nagapattinam

Annexure III

Questionnaire for Fishing Harbours/Fishing jetties/Fish landing centres

1. Name of the Centre…….
    a. Taluk/Village…….
    b. District…….
    c. State …….
2. Number of Fishing crafts
    a. Trawlers…….
    b. Gill netters…….
    c. Deep sea Trawlers…….
    d. Long liners for Tuna……
    e. Squid Jigging …….
    f. Others …….

II. Number of Traditional fishing crafts

a. Motorized …….

b. Non-Motorized…….

c. Others…….

d. Shore seining…….

III i. Fishing seasons

a. January to March ☐
b. April to September ☐
c. October to December ☐

ii. Average Fishing days per Season

a. January to March …….
b. April to September ……
c. October to December…….

iii. Number of Fishing Trips …….

iv. Type of fishing vessel – day fishing or multi-day fishing vessel

vi. Number of days of fishing in each trip for multi-day fishing operation

vii. Average Fish landed per trip (in terms of Kgs/tons)

Export/ Local Market……

vii. Number of Fishing trips undertaken by each type of Fishing craft

(a) Motorized …….

(b) Non-Motorized ……..

(c) Others ……...

(d) Shore seining …….....

viii. No. of Fishermen on-board the vessel……... ……

IV Number and type of fishing gears taken per fishing trip…….

i. Distance of the fishing ground from the shore (in kilometre)……..

ii. Approximate time taken for fishing (for each trip):……

iii. Approximate time taken for landing

a. Handling by (Machine) Mechanical Device……..

b. Handling Manually ……

iv. Whether the fish is dumped on the shore? Yes☐ No☐

v. Quantum of fuel taken on board the vessel and utilized per each trip

vi. Total operational expenses per fishing trip

V Infrastructure on-board the Fishing Vessel

i. Fishhold capacity ……
ii. Number of ice boxes/insulated boxes (with capacity):……
iii. Facilities for hauling the fish ……..
iv. Status of Fishhold …….
v. Washing/cleaning facilities onboard :……
vi. Duration for sorting fishes:……
vii. Whether the sorting is done on-board/onshore.
viii. Whether the vessel has on-board processing facility? If so the type of processing – (icing, freezing, canning, smoking or any other) and the capacity, quantum of fish waste generated and mode of disposal of such waste.

VI Approximate quantity of fish treated as miscellaneous/low value (in terms of Kg /tons) :……..

i. How much proportion/percentage is classified as by-catch?

(7) The facilities on the shore (i.e. within the FH)

a Landing platform (whether epoxycoated) …….

b. Status of washing/cleaning facilities

c. Storage facilities

Storage facilities	Nos.	Capacity
Chill Plants		
Cold Storage		
Ice plants		
Flake ice plants		
Insulated vans		

d. Drainage facilities Yes ☐ No ☐

e. Communication and approach facilities

(8) The facilities away from the shore (please mention the distance in kms.)

a. Chill Plants……..
b. Cold Storage……..
c. Ice plants……...
d. Flake ice plants Flake ice plants…….
e. Insulated vans…….

(9) Fish Markets

i. Distance of the fish wholesale market from the shore (in Kms) …..

ii. Number of intermediates between fishers wholesaler/retailers…….

iii. Duration of transport of landed fish from the shore to the Market(Wholesale market/retailmarket/Processors/Exporters)..…

iv . The System/Practice of disposal of catches

Export ☐

Inland/domestic market ☐

v. i. Mode of handling catches

Export ……..

Inland/domestic market…….

ii. Quantity of the product intended for the:

Export

a. Edible …….
b. Fish Meal…….

Inland/domestic market

a. Edible …….
b. Fish Meal…….

Questionnaire for Fish Markets

1. Name of the Fish Market……
    a. Taluk/Village……
    b. District……
    c. State ……
2. Sources of fish supply and species ……..
3. Seasons and average quantum of fish supply
    a. January to March ……
    b. April to September…….
    c. October to December……
4. Targeted consumers
    a. Within a radius of 1-5 km ☐
    b. Between 5 -20 kms ☐
    c. Beyond 20kms ☐
    d. Major urban centres ☐
5. How is the supply of ice?
    a. Is it adequate? Yes ☐ No ☐
    b. Timely Yes ☐ No ☐
    c. Uninterrupted Yes ☐ No ☐
    d. Whether price of ice is stable or changes depending upon the fish arrival?
        Yes ☐ No ☐
6. Status of the fish markets
    Whether wholesale? If so,
    - Capacity of the wholesale market (in tones)…….
    - Types of cold storage facilities (with capacity)…….
    - Linkage with other markets and consuming centres
    - Type of transport (insulated/non-insulated vehicles)……

- Type of cold storage facilities including capacities (cold storage/freezer boxes/chill plants)……
- Whether fish supply is regular and in assured qualities? Or whether the supply is highly irregular……..
- Whether the fish market has the capacity to hold huge supplies in times of large arrivals?.....
- How the marketing activities are done (Open auction/Direct sale/Electronic bidding/Any other mode of transaction)……
- Number of people involved in the wholesale business…….

7. The bottlenecks faced by the wholesaler
    a. In terms of supply ……
    b. In terms of marketing……
       In terms of upkeep of the market ……
    c. Is there in the adequate supply to local market?.....
    d. In terms of market storage facilities Yes NO
        - If inadequate what is need in terms of type and capacity of the storage ……
    e. What do you expect from the supplier? ……

       a. Fish Markets, whether whole sale or retail are not hygiene in general. In that context how and what would you endeavor for maintaining a cleaner of the market ……..

b. What kind of role do you envisage for the Government to attain a cleaner the fish market…….
c. Would you came forward for a participatory management of fish markets, where in all stake holders would have an effective role in the running and management of the market?.....

Questionnaire for Fish Processing Centres

1. Name of the Fish processing centre……..
    a. Taluk/Village .
    b. District
    c. State
2. Capacity of the plant (in terms of installed capacity and utilization)
3. Sources and species of fish taken up for processing for each season
    a. January to March …….
    b. April to September…….
    c. October to December……
4. Mode of transport of raw materials (fish):
    a. Insulated Van
    b. Fishes stacked in ice boxes/insulated boxes/ thermal boxexs
    c. Whether grading /sorting is done.
    d. If so, whether it is on-board or on the landing shore?
5. Whether the plant is incompliance with
    a. EIA (Export Inspection Agency of India) Norms ☐
    b. EU (European Union) Norms ☐
    c. F&D of USA ☐
    d. HACCP ☐
    e. Whether registered with the MPEDA ☐
6. Types of value addition undertaken and the targeted market

    Whether ready to cook & eat products are prepared
7. Linkage with the consuming centres (specify the type of linkage)
8. Countries of Export ……
9. Commodities, their quantity and value exported…….

10. Which of the post-harvest facilities you consider would be more helpful in minimizing post-harvest loss of fishes
    a. A cleaner landing platform with washing and drainage facilities
    b. Insulated storage boxes on board the fishing vessel
    c. Cold/storage/chill plants with in the FH premises
    d. Cold Chain facility/network and Any other please specify

Questionnaire for Fishery Officials

1. Name of the State…….
2. Name of the Station…….
3. Name & Designation of the official……
4. Policy of the State Government for marine fisheries development
    a. Marine fishing ……
    b. Marine fisheries infrastructure like cleaner Fishing Harbour/Fish Landing Centres/Fish Markets etc
    c. Post-harvest infrastructure facilities
        i. Fish Landing platform
        ii. Fish Auction Hall
        iii. Fish Storage
        iv. Cold storage/Chill plants
        v. Processing Centres-Freezing /chilling/curing/value addition
        vi. Wholesale and retail markets

    d. Fund allocation for post-harvest facilities
        i. Are they adequate
        ii. Are they timely
        iii. Any impediments in the way of policy guidelines/Modalities of fund disbursement
5. A. Environmental and sea pollution that affects Fish Health
   B. Whether the environmental guidelines are in tune with protecting the quality of the landed fish?.....

   C. Whether the existing guidelines enabling the creation of post-harvest facilities within the fishing harbour/Landing Centres? If not, please elaborate:……..

6. Your views on excess fishing efforts and policy measures to control/minimize the same ……..
7. Policy initiatives for human resource development to minimize post-harvest losses due to improper handling of catches on-board and onshore …….
8. Any other constraints faced in the development of marine fisheries
    a. At the level of policymaking……
    b. Inadequacy of delegation of powers
        i. Administrative……
        ii. Financial ……
        iii. Overlapping of jurisdiction ……
9. Any other views (relating to post-harvest fish losses) …..