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TECHNOLOGICAL CHANGE AND THE DEVELOPMENT OF THE PRIMARY FISHING INDUSTRY OF KERALA- A STUDY OF LIMITED GROWTH

Thesis submitted to the
Cochin University of Science and Technology
for the award of the Degree of
Doctor of Philosophy in Economics
Under the Faculty of Social Sciences

By

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1987

CERTIFICATE

Certified that the thesis 'Technological Change and the Development of the Primary Fishing Industry of Kerala - A Study of Limited Growth' is the record of bonafide research work carried out by Shri Ramakrishnan Korakandy under my supervision. The thesis is worth submitting for the Degree of Doctor of Philosophy in Economics.

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DECLARATION

I declare that this thesis is the record of bonafide research work carried out by me under the supervision of Dr.K.C.Sankaranarayanan, Professor and Head of the Department of Applied Economics, Cochin University of Science and Technology, Cochin - 22. I further declare that this thesis has not previously formed the basis for the award of any degree, diploma, associateship/fellowship or other similar title of recognition.

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ACKNOWLEDGEMENTS

I express my profound gratitude to Dr.K.C.Sankaranarayanan, Professor and Head of the Department of Applied Economics, Cochin University of Science and Technology, for the invaluable guidance, help and encouragements he has given at all stages of my work. He has taken special pains to see that I complete the work in time by even sharing part of my teaching work in the Department of Industrial Fisheries during the early stages of this work. It is solely due to his inspiring guidance and persuation that I am able to complete the work at this stage.

I will be failing in my duty if I do not acknowledge my gratitude to Dr.K.Gopalan, former Vice-Chancellor of the University, Dr.C.N.Satyapalan, former Registrar and Shri V.J.Papoo, the present Registrar of the University (formerly Director of Planning and Development), for nominating me for the National Associateship Scheme of the U.G.C. while working on this problem. I, further, record my sincere gratitude to Professor C.A.Abdussalam, Pro-Vice-Chancellor of the University for granting me extension of time for submitting the thesis. My gratitude is also due to Dr.C.T.Samuel, Dr.M.Shahul Hameed, Dr.C.Hridayanathan, Dr.Kuruvila Mathew and Shri John Mohan, my colleagues in the Department of Industrial Fisheries for the cooperation they have extended.

Shri H. Krishna Iyer, Scientist S-3, Central Institute of Fisheries Technology, Cochin, Shri K. Appukuttan Project Chief, Department of Fisheries and Ports, Government of Kerala, Shri John Kurien, Research Associate, Centre for Development Studies, Trivandrum, all have helped me at different stages of this work. Professor P.G.K.Panikkar, former Director of the Centre for Development Studies, Trivandrum, was kind enough to grant me the previlege of using the facilities of the Centre during my visitsat the Centre in 1984 and 1985 under the National Associateship Scheme of the U.G.C. Shri M. Swaminath, Director of CIFNET was quite liberal in granting me copies of the Institute's publications for my reference. I record my indebtedness to them all. Further, I have benefitted greatly from the services of a large number of staff of the University Library, the Libraries of the Department of Applied Economics the School of Marine Sciences, the CIFT, the CMFRI and the Centre for Development Studies. I record my gratitude to them all. Similarly, I have been assisted by countless other persons from within and outside the country by sending literature, suggesting sources of information and in several other ways at all stages of my work. I remember them with gratitude. With this I also wish to express my indebtedness to my friend Shri K.V.Chandran of the Department of Hindi, Cochin University of Science and Technology, who has taken great care and pains to type the manuscript of the thesis in the present form. Finally, I admit that the short comings of this work are, however, solely due to my inadvertence.

(Ramakrishnan Korakandy)

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CHAPTER I

INTRODUCTION

1. The Primary Marine Fishing Industry of Kerala - Growth and Crisis

The Primary Marine Fishing Industry of Kerala is one of the premier natural resource industries of the state which provides employment and earnings to a large section of the population and an acceptable source of protein to the majority of the people[1]. It is also a major earner of foreign exchange for the country and a potential source for promoting regional development in the state. Hence the growth and development of this industry is of vital importance to the economy of the state[2].

It was in view of this that the development of the primary marine fishing industry of Kerala has been given a pride of place in the five year plans of the state. It appeared, nevertheless, that this industry after an initial expansion has failed to gather momentum and has dipped

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1. See Chapter VII - for details of employment, earnings, fish consumption, etc.

2. The economic importance of this industry can be gauged partly from its contribution to the state's domestic product which is given in Appendix Table I.1.

to the status of a depressed industry. The output of the industry which reached the peak in the first half of the seventies dwindled in the second half[1]. The first half of the eighties also showed no sign of real recovery. The output showed only marginal improvements during the period[2]. The state which was ranked 'first' in marine fish production in the country during the last three and a half decades (prior 1985) is now relegated to the 'second' position with Maharashtra taking the leading position[3].

The declining output of the primary marine fishing industry of Kerala has caused serious concern among the fishermen, fish processers, fish merchants and the public at large. The state's administration is also beleagured of this problem. The decline in the output of the industry, particularly after 1975, has led to serious protests and out-cry from the traditional fishermen whose major demands are protection of their traditional

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1. See Appendix Table I.2 and Figure I.1.
2. See Appendix Table I.3.
3. See Appendix Table I.4 for the relative output of the different coastal states of India.

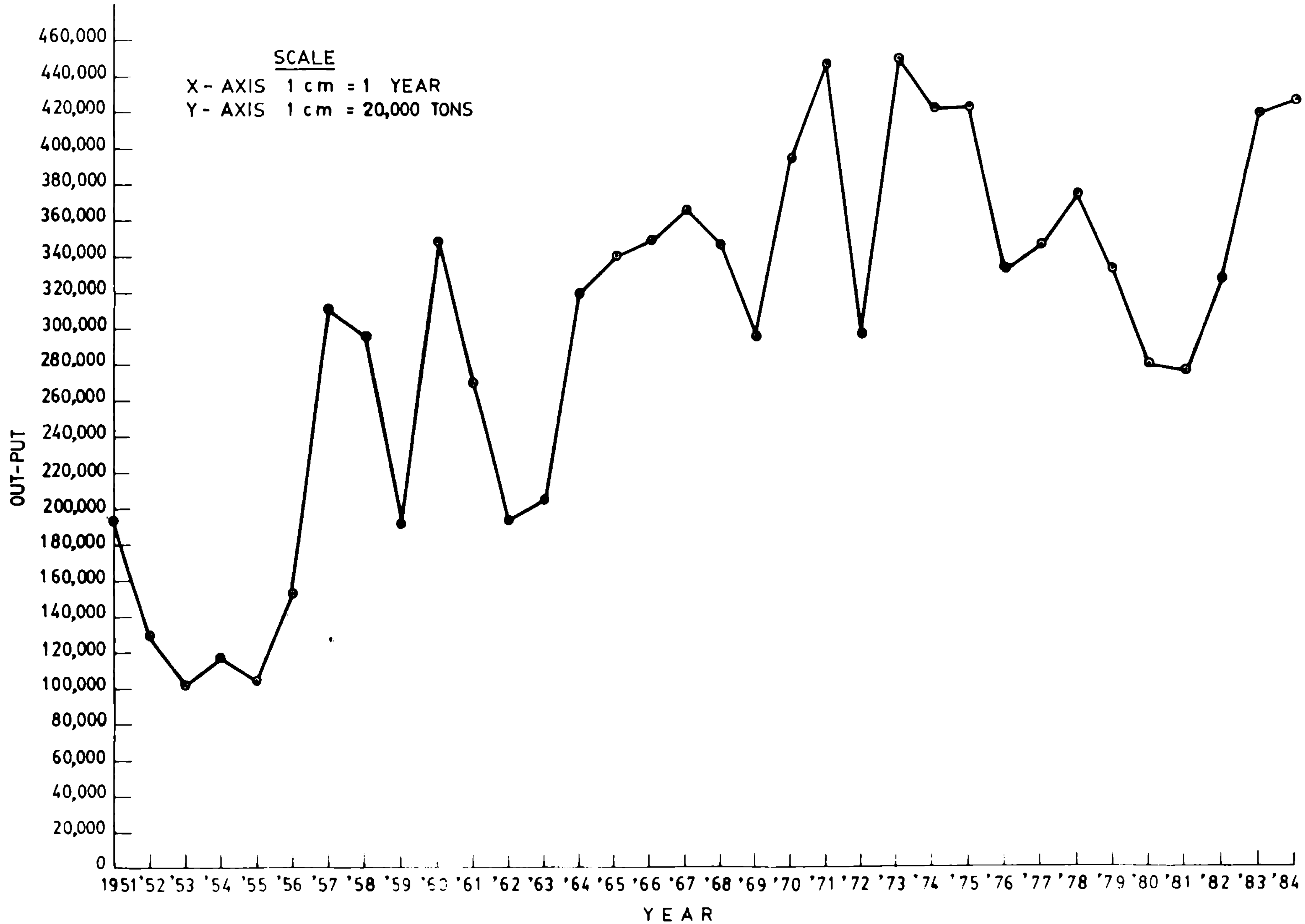

FIG. I-1. TREND IN THE OUT-PUT OF THE PRIMARY MARINE FISHING INDUSTRY OF KERALA (1951-1984) fishing rights and the conservation of the fishery resources of the state. The mechanised sector of the industry which has been the focal point for development in the past has been alleged to be responsible for the present crisis in the industry.

2. Need for the study

Induction of growth in the primary marine fishing industry of Kerala is a sine qua non for improving the economy of the fishermen, the state's domestic product as well as earning more foreign exchange for the country. The State Administration has been trying to instil growth into the industry eversince the output of the industry showed marked sign of decline (particularly after 1975). Significantly, it has attempted to strengthen the traditional sector, (which is considered to be the crucial sector of the primary marine fishing industry of the state) by introducing intermediate technology and by revamping the organisational structure of the industry. But it appears that the production system in the primary marine fishing industry of Kerala has been severely constrained by the existing technology, organisation of production and marketing institutions. Regeneration of growth in the industry calls forth an understanding of the 'process' of growth in the industry and the need to reorganise it with new technology, and new organisations. The present study is an attempt to unraval the process of growth in the primary marine fishing industry of Kerala since 1951.

3. Objective, Scope, Hypothesis and Methodology

a) Objective

The primary objective of this study is to explain the process of development in the primary marine fishing industry of Kerala during the period from 1951 to 1985. Specifically, this study seeks to identify the factors that contributed to its growth in the initial stages of development and the factors that led to its decline in the later stages. This study has the additional objective of offering certain suggestions for the future development of the industry.

b) Scope

The scope of this study is limited to an analysis of the process of growth in the primary sector or the catching branch of the marine fishing industry of

Kerala. The secondary and tertiary sectors of the industry viz. the processing and marketing branches are excluded from the scope of the present study for obvious reasons of differences in objectives, techniques and organisation of production (activity) in the three branches of the industry and the practical constraints of time and resources available to the researcher. The inter-linkages of production, processing and marketing and their impact on the development of the primary sector are, however, recognised and discussed. The time covered in this study is from 1951 to 1985.

c) Hypothesis

The major hypothesis of this study is that the development achieved by the primary marine fishing industry of Kerala since 1951 is primarily the result of various technological changes that took place in the industry during this period. The development achieved by the industry during this period was, however, 'limited'. It was limited because of the limited technological changes, weak public policy and poor market linkages.

d) Methodology

The methodology and conceptual framework followed in this study are discussed in chapter three.

4. Limitations of the study

A major limitation of this study is that its scope is limited to the catching branch or the primary sector of the fishing industry only. In view of this, a complete picture of the development process in the marine fishing industry of the state has not been offered in this study. The vital links in development in the catching branch are, however, not lost sight of.

Another problem with which this study had to content through out was the prevailing gap in the data which made it not amenable for any sophisticated statistical analysis. The major conclusions of this study have, however, been reached on the basis of several leading indicators and effects of technological change. Considering the long period covered in this study, these indicators and effects can give a satisfactory picture of the development process.

Yet another limitation, as in most other macro-economic studies of technological change based on time series data, is that this study has not made any attempt to verify the effects of technological change with sample data. From the historical point of view of the development process, such an effort was redundant.

However, if technology assessment is the objective, such case studies will be quite useful. This, we propose for our future line of work.

5. Plan of study

This study is spread over eight chapters. Chapter One gives a brief outline of the research problem, the need, objectives and scope of the study. It also gives the plan of study.

Chapter Two makes a general review of the classical, neoclassical and current literature relating to the fishing industry.

Chapter Three presents the conceptual framework and methodology followed in this study.

Chapter Four gives an account of the traditional sector of the Primary Marine Fishing Industry of Kerala, with particular reference to the technology, organisation and output of the sector.

Chapter Five furnishes, a detailed account of the 'process' of technological change in the Primary Marine Fishing Industry of Kerala. Specifically, it discusses the research and development efforts for fishery resources, fishing craft, fishing harbours, fishermen training, etc.

Chapter Six makes a detailed study of the 'indicators' of technological change and development in the Primary Marine Fishing Industry of Kerala.

Chapter Seven identifies and discusses the various effects and characteristics of technological change and development in the Primary Marine Fishing Industry of the state.

Chapter Eight presents the summary of findings of the study and offers certain suggestions for accelerating growth in the industry.

CHAPTER II

ECONOMIC THEORY AND PRIMARY MARINE FISHING INDUSTRY - A REVIEW OF CLASSICAL, NEO-CLASSICAL AND CURRENT LITERATURE

Economics, the queen of social sciences, has inherited a wide range of tools and techniques that help to analyse the socio-economic problems of the society. Economists over the years have evolved newer and newer techniques and thus enriched the subject. It is natural for students of economics who try to explore such virgin fields as fisheries development to borrow the tools and techniques of economics which are handy to explain the phenomenon of growth and development of the industry. Here an attempt is made to review the classical, the neo-classical and the current literature relating to fishing industry in order to understand what tools and techniques are available for studying the 'process' of development in the primary marine fishing industry of Kerala. We start with a review of the classical literature.

1. Fisheries and the Classical School

It should be noted at the very outset that the fishing industry of the world or any particular country was scarcely the subject for any systematic study by the classical economists[1]. This was perhaps, because of the minor or insignificant role which fisheries played in the economy of the world or any particular country. It was perhaps also owing to the absence of any 'grave' economic problem within the industry. The industry was run on a small scale, operating along narrow coastal belts, exploiting the abundant resources of the inshore waters. The operations were more seasonal. Occasional prosperity and depressions were considered as characteristic of the industry. This does not mean that the classical economists were totally ignorant of the problems which existed in the industry. Adam Smith, for example, made extensive references to the fishing industry in his discussions on supply, demand and price of commodities, rent of land, wages of labour, stock and profit, capital and its employment etc.

In Chapter VI of Book I of the Wealth of Nations, while discussing the component parts of the price of commodities, Smith notes the absence of rent as an element

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1. It was true that the growing maritime feud between the various European nations during the sixteenth and seventeenth centuries had prompted Hugo Grotius (1583-1645) a leading jurist of the time to write on international maritime problems, but economists had seldom approached this problem in a systematic manner as it belonged to a different domain.

of price. Smith[1] points out 'in the price of seafish, for example, one part pays the labour of the fishermen, and the other profits of the capital employed in the fishery. Rent very seldom makes any part of it, though it does sometimes'. Smith, however, also recognises the instances where rent enters into the price of fish. For instance, in Chapter XI of Book I which discusses the rent of land Smith states:

> The sea in the neighbourhood of the islands of Shetland is more than commonly abundant in fish, which make a great part of the subsistence of their inhabitants. But in order to profit by the produce of the water, they must have a habitation upon the neighbouring land. The rent of the landlord is in proportion, not to what the farmer can make by the land, but to what he can make both by the land and by the water. It is partly paid in seafish, and one of the very few instances in which rent makes part of the price of that commodity, is to be found in that country[2].

Again, Chapter X of Book I makes a significant reference to the condition of the fishermen and their earnings:

> (Hunting and) fishing, the most important employment(s) of mankind in the rude state of society,

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1. Adam Smith, An Inquiry into the Nature and Causes of the Wealth of Nations (The Modern Library, New York, 1937), p. 51.

2. Ibid., p. 145.

become in its advanced state their most agreeable amusement, and they pursue for pleasure what they once followed from necessity. In the advanced state of society, therefore, they are all very poor people who follow as a trade, what other people pursue as a past-time. Fishermen have been so since the time of Theocritus ... The natural taste for those employment makes more people follow them than can live comfortably by them, and the produce of their labour, in proportion to its quantity, comes always too cheap to market to accord anything but the most scanty subsistence to the labourers[1].

Chapter XI, Book I discusses the effects of various improvements (technical) in the economy upon the supply and price of certain rude produce of the state. Smith identifies three types of rude produces: the first, those which it is difficult in the power of man to 'multiply' at all, the second, which he can 'multiply' in proportion to demand and the third in which the efficacy of industry is either limited or uncertain. In the first category, are included the greater part of the 'rare and singular birds and fishes'. Adam Smith notes that the 'high price paid by the Romans in the time of their greatest grandeur, for rare birds and fishes, may in this manner easily be

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1. Ibid., pp. 100-101. Parentheses is mine.

accounted for[1]'. Seafish in general are included in the third category. Adam Smith points out:

> In multiplying (increasing) another very important sort of rude produce, the quantity of fish that is brought to market, it is likewise both limited and uncertain. It is limited by the local situation of the country, by the proximity or distance of its different provinces from the sea, by the number of its lakes and rivers, and by what may be called the fertility or barrenness of those seas, lakes and rivers, as to this sort of rude produce. As population increases, as the annual produce of the land and labour of the country grows greater and greater, there come to be more buyers of fish, and those buyers, too, have a greater quantity and variety of other goods, or, what is the same thing, the price (income) of a greater quantity and variety of other goods to buy with. But it will generally be impossible to supply the great and extended market without employing a quantity of labour greater than in proportion to what had been requisite for supplying the narrow and confined one. A market which, from requiring only one thousand, comes to require annually ten thousand tonnes of fish, can seldom be supplied without employing more than ten times the quantity of labour which had before been sufficient to supply it. The fish must generally be sought for at a greater distance, larger vessels must be employed, and more expensive machinery of every kind made use of. The real price of this commodity, therefore, naturally rises in the progress of improvement. It has accordingly done so, I believe, more or less in every country[2].

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1. Ibid., p. 218.
2. Ibid., p. 235. Words in parenthesis and emphasis are mine.

Continuing this observation, Adam Smith further speaks of the nature of uncertainty prevailing in the fishing industry thus:

> Though the success of a particular day's fishing may be a very uncertain matter, yet, the local situation of the country being supposed, the general efficacy of industry in bringing a certain quantity of fish to market, taking the course of a year, or of several years together, it may perhaps be thought, is certain enough, and it, no doubt, is so. As it depends more, however, upon the local situation of the country than upon the state of its wealth and industry; as upon this account it may in different countries be the same in very periods of improvement, and very different in the same period; its connection with the state of improvement is uncertain, and it is of this sort of uncertainty that I am here speaking.[1]

Chapter I of Book II of the Wealth of Nations, which discusses the division of stock (capital), identifies two types of capitals and their productivity in the fishing industry. It notes:

> Land, mines, and fisheries, require all both a fixed and a circulating capital to cultivate them; and their produce replaces with a profit, not only those capitals, but all the others in the society ... Land even replaces, in part at least, the capitals with which fisheries and mines are cultivated. It is the produce of land which draws the fish from the waters; and it is the produce of the

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1. Ibid., p. 235.

surface of the earth which extracts the minerals from its bowels.

The produce of land, mines and fisheries, when their natural fertility is equal, is in proportion to the extent and proper application of the capitals employed about them. When the capitals are equal and equally well applied, it is in proportion to their natural fertility[1].

Chapter V of Book II which deals with the different employment of capitals distinguishes four ways of using the capital and explains the first as 'in the first way are employed the capitals of all those who undertake the improvement or cultivation of lands, mines, or fisheries ...'[2]

In Chapter V of Book IV of the Wealth of Nations Adam Smith makes an incisive analysis of the 'bounty' (subsidy) system. Speaking on the bounty prevailing in the fishing industry of England, Smith notes:

... Something like a bounty upon production, however, has been granted upon some particular occasions. The tonnage bounties given to the white-herring and Whale-fisheries may, perhaps, be considered as somewhat of this nature. They tend directly, it may be supposed, to render the goods cheaper in the home market than they otherwise would be. In other respects their effects, it must be acknowledged, are the same as those of bounties

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1. Ibid., pp. 267-268.
2. Ibid., p. 341.

upon exportation. By means of them a part of the capital of the country is employed in bringing goods to market, of which the price does not repay the cost, together with the ordinary profits of stock ...[1]

On the working of the herring buss bounty[2] in England Smith points out:

... it has ruined the boat fishery, which is, by far, the best adapted for the supply of the home market, and the additional bounty ... upon exportation, carries the greater part, more than two thirds, of the produce of the buss fishery abroad[3].

After a thorough probe into the merits and demerits of the bounty system, Adam Smith concludes that 'the usual effect of such bounties is to encourage rash undertakers to adventure in a business which they do not understand and what they loss by their own negligence and ignorance, more than compensates all that they can gain by the utmost liberality of government ...[4]

In retrospect it may now be recognised that Adam Smith has dealt at length with several of the problems of the fishing industry, such as low earnings of the fishermen, low productivity, high uncertainty,

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1. Ibid., p. 484.
2. The Herring buss bounty was granted to decked vessels of twenty to eighty tons burthen. The small boats were not entitled for this subsidy.
3. Ibid., p. 487.
4. Ibid., p. 488.

effects of technical improvements, the question of subsidy, etc. It is true that Smith was not directly concerned with the problems of the fishing industry. But, it should be emphasised that most of his observations are still relevant to the conditions of the fishing industry in most parts of the world and they merit attention in any study of development of the fishing industry of any country.

It is the contention of this researcher that the writings of Adam Smith, as far as the fishing industry is concerned, though devoid of any specific framework for analysis are ripe with problems and gives insight for any study of fisheries development. It may be noted at this stage that the writings of the other classical writers scarcely give any material information about the fishing industry, or give any idea of the pattern of development of the industry.

2. Fisheries and the Neo-Classical School

The pure theorists of the neo-classical school, especially the older generation, were generally not much concerned with the problems of the fishing industry[1]. Alfred Marshall, as the champion of the neo-classical school, however, made some notable observations on the

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1. Alfred Marshall was an exception to this general observation.

problems of the fishing industry. He made particular reference to the question of supply, demand, cost and price in the long run. Marshall writes in an earlier chapter on 'The Fertility of Land' thus:

> ... in river fisheries the extra return to additional applications of capital and labour shows a rapid diminution. As to the sea, opinions differ. Its volume is vast, and fish are very prolific; and some think that a practically unlimited supply can be drawn from the sea by man without appreciably affecting the numbers that remain there; or in other words, that the law of diminishing returns scarcely applies at all to sea-fisheries; while others think that experience shows a falling-off in the productiveness of those fisheries that have been vigorously worked especially by steam trawlers[1].

Marshall continues in another chapter on the 'Long-run Supply and Demand' stating:

> The sources of supply in the sea might perhaps show signs of exhaustion and the fishermen might have to resort to more distant coasts and to deeper waters, Nature giving diminishing returns to the increased application of capital and labour of a given order of efficiency. On the other hand, those might turn out to be right who think that man is responsible for but a very small part of the

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1. Alfred Marshall, Principles of Economics, (Mac Millan, London, 1974), edn. 8, p. 138.

distruction of fish that is constantly going on; and in that case a boat starting with equally good appliances and an equally efficient crew would be likely to get nearly as good a haul after the increase in the total volume of the fishing trade as before. In any case the normal cost of equipping a good boat with an efficient crew would certainly not be higher, and probably be a little lower after the trade had settled down to its now increased dimensions than before. For since fishermen require only trained aptitudes, and not any exceptional natural qualities, their number could be increased in less than a generation to almost any extent that was necessary to meet the demand; while the industries connected with building boats, making nets, etc. being now on a larger scale would be organised more thoroughly and economically. If, therefore, the waters of the sea showed no signs of depletion of fish, an increased supply could be produced at a lower price after a time sufficiently long to enable the normal action of economic causes to work itself out; and, the term 'normal' being taken to refer to a long period of time, the normal price of fish would decrease with an increase in demand[1].

It should be noted from the above observations of Marshall that he was neither sure nor convinced of the long-term developments in the fishing industry and his prognosis of the future course of development in the industry is very much different from Smith's forecast. Marshall's predictions regarding the nature of forces working behind changes in supply and their effects on

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1. Ibid., p. 308.

long term costs and normal price appears to be unfounded. As Gerhardsen pointed out 'since this was written a number of changes have occurred in the fishing industry ...'[1] and this probably invalidates Marshall's pronouncements.

Now, while turning to the writings of the other economists of the early neo-classical school, especially those who wrote in the 19th and early 20th century one finds a near complete vacuum in this regard. The middle of the 20th century, however, witnessed a spate of writings highlighting the problem of 'optimisation' in the fishing industry. Much of these writings, it may be noted, are couched in abstract mathematical language of the general equilibrium order. It is not the intention of this researcher to review all such literature for more than one reason. First of all, a painstaking review of such literature will not reward him in his effort to explain the 'process' of development in the primary marine fishing industry of Kerala. This is primarily because of the fact that the artifacts of theory required to explain the phenomenon of growth are seldom found in these writings.

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1. G.M. Gerhardsen, 'A Note on Costs in Fisheries' in Ralph Turvey and Jack Wiseman (Eds.). The Economics of Fisheries (Food and Agricultural Organisation, Rome, 1956), p. 1.

Secondly, the numerous mathematical equilibrium models postulated by the neo-classical writers depict only the conditions of the over-developed, over-exploited fishery of the Northern hemisphere and not the one craving for development, as in the present case. Moreover, these models are built on highly restrictive assumptions of individual producing units (firms) operating under conditions of constant costs, stocks (fish population), knowledge and technology, all of which are conditions seldom found even in the advanced fishery. As such, they are of limited value in understanding the problems and process of development of an underdeveloped fishery. It would be interesting in this context to note the observations of a third world economist. Stanley A. Hetzler a Latin American economist points out:

> ... western economics, however, appears to be not only irrelevant to the development of the technologically retarded society, but actually suppressive of its advancement. Economic theory did not in truth guide western development, but eventually grew out of it as an instrument for rationalising its maldistribution of goods and services, and its other social devices ... The society which sincerely aspires to development will have to turn a deaf ear to western economic cliches ...[1]

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1. Stanley, A. Hetzler, Applied Measures for Promoting Technological Growth (Routledge and Kegan Paul, London, 1973), pp 5-6.

Notwithstanding the above limitations of the neo-classical models, an attempt is made here to give a broad listing of the notable writings in this area. One of the early attempts to offer an economic theory of commercial fishing was made by Gordon, H. Scott (1953)[1]. Gordon presented an economic model of fishing in which fish catch is related to fishing effort, corresponding to a given stock of fish. Gordon also pointed out the possibility of over-fishing in an open access fishery. This was soon followed by a spate of writings, comments and rejoinders in the following one or two decades. Gordon (1954)[2] himself took the initiative of explaining the economic wastes involved in exploiting the common property natural resource like the fishery and pointed out the likelihood of it being exploited at less than optimum. In the very next year Anthony Scott (1955)[3] put-forward his theory of 'Sole ownership' for the effective management of

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1. H.S. Gordon, 'The Economic Theory of a Common Property Resource', Journal of Political Economy, Vol. 62, pp. 124-142, April 1954.

2. H.S. Gordon, 'An Economic Approach to the Optimum Utilisation of Fisheries Resources', Journal of Fisheries Research Board of Canada, Vol. 10, pp. 442-457, 1954.

3. A. Scott, 'The Fishery: The Objective of Sole Ownership', Journal of Political Economy, Vol. 63, No.2, pp. 116-124, April 1955.

an otherwise over exploited fishery. The theory put forward by Gordon and Scott became quite popular and began to be treated as the traditional or classical theory of fishing after sometime[1]. Milner B. Schaefer[2], an internationally renowned American fishery biologist wrote three articles (1954,1957 and 1959) integrating the economic theory of production to a natural resource industry, the fishery. James A. Crutchfield and Arnold Zelner (1962)[3] wrote on the economic aspects of managing the Pacific Halibut fishery. They provided an explicit dynamic model of competitive fishing and a calculus of variations approach to optimal fishing over time using the quadratic biological growth law.

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1. Later literature described it as the traditional theory of fishing.

2. M.B.Schaefer, i) 'Some Aspects of the Dynamics of populations Important to the Management of Commercial Marine Fisheries', Inter-American Tropical Tuna Commission, Bulletin, Vol. 1, No.2, pp. 25-56, 1954.

   ii) 'Some Considerations of Population Dynamics and Economics in Relation to the Management of the Commercial Marine Fisheries', Journal of Fisheries Research Board of Canada, Vol. 14, No.5, pp. 669-681, September 1957.

   iii) 'Biological and Economic Aspects of the Management of Commercial Marine Fisheries', Translations of the American Fisheries Society, Vol. 88, pp. 100-104, 1959.

3. J.A.Crutchfield and A. Zelner, 'Economic aspects of the Pacific Halibut Fishery', Fishery Industrial Research, Vol.1, No.1, pp. 1-173, 1962.

Ralph Turvey (1964)[1], an economist of the London School of Economics who wrote in the neo-classical tradition presented the criteria for optimisation in marine fisheries regulations.

One of the most remarkable and widely discussed treatise on the subject of fisheries exploitation under common property regime was that of Christy (Jr.) and Scott (1965)[2]. Christy and Scott gave a vivid exposition of the concept of common property natural resource, their exploitation and the tendency for the dissipation of rent/profit in an unmanaged (unregulated) fishery. They explored the benefit of introducing sole (monopoly) ownership right from a theoretical plane and found it a sound proposition from the efficiency point of view. But, they simultaneously recognised many practical difficulties in introducing sole ownership rights in a fishery which was traditionally considered as common property. The practical difficulties included the displacement of labour and capital in the catching branch, creation of excess capacity in the processing branch and the dislocation of the marketing branch. Christy and Scott suggested the possibility

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1. Ralph Turvey, 'Optimisation and Sub-optimisation in Fishery Regulations', American Economic Review, Vol.54, No.2, pp. 64-76, March 1964.

2. F.T.Christy (Jr.) and A.D.Scott, The Common Wealth in Ocean Fisheries, (Baltimore, John Hopkins Press, 1965).

of devising some suitable means for compensating the net losers in the event of introducing sole ownership rights through a system of limited entry by licensing of the fishing units.[1] It may be noted here that the Christy and Scott model was more general and less exacting in terms of mathematical formulations. The model was, however, criticised by a handful of economists, the chief among them being Vernon, L. Smith[2]. Smith's main criticism to the model is that it is based on wrong assumptions of constant cost and fixed prices. Smith also finds flaw in the relationship postulated between, fish population and catch under sustainable yield condition[3]. In fairness to the work of Christy and Scott it may be pointed out that their model, although based on certain static assumptions of constant costs and prices, is not altogether rigid in as much as they recognised the various externalities and make provision for change in fishing effort, know-how and technology in their modified model of fisheries exploitation. Smith himself admitted that 'these criticisms do not, however, alter the validity of the authors' principal conclusion that under conditions of competitive ownership the exploitation of the

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1. Ibid., p. 85.

2. Vernon, L. Smith, 'Common Wealth in Ocean Fisheries' - Book Review in American Economic Review, Vol. 56, pp. 1341-43, December 1966.

3. Ibid., p. 1341.

fishery is economically inefficient[1]. Comitini and Huang (1967)[2] made a study of production and factor shares in the Halibut fishing industry of the U.S.. Their study demonstrated the nature of returns to scale, the relative shares of productive factors and the degree of technical progress during the study period (1958-64).

Smith (1968 and 1969)[3] wrote two articles trying to incorporate the theory of the firm with the traditional economic theory of commercial fishing. In this attempt, Smith pointed out that commercial fishing is characterised by three key economic and technological factors that are relevant to the formulations of an economic theory of fish production. They, as stated by Smith, are:

1. A fishery resource, although conceivably exhaustible, is replenishable; that is, it is subject to laws of natural growth which define an environmental bio-technological constraint on the activities of the fishing industry.

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1. Ibid., p. 1343.

2. S. Comitini and D.S. Huang, 'A Study of Production and Factor Shares in the Halibut Fishing Industry'. Journal of Political Economy, Vol. 75, No.4(1), pp. 366-372, August 1967.

3. V.L. Smith, 1) 'Economics of Production from Natural Resources', American Economic Review, Vol. 58, pp. 409-31, June 1968.
2) 'On Models of Commercial Fishing', Journal of Political Economy, Vol. 77, pp. 181-98, March/April 1969.

2. The resource and the activity of production from it form a stock-flow relationship. The new growth in the population (fish mass) depends upon the harvest rate relative to natural recruitment to the stock. If the harvest rate exceeds the recruitment rate, the stock declines, and vice-versa.

3. The recovery or harvesting process is subject to various possible external effects (externalities) all of which represent external diseconomies to the firm: The three externalities include (a) Resource (stock) externalities, which result if the cost of a fishing vessel's catch decreases as the population of fish increases, (b) Mesh externalities which result if the mesh size (or other kinds of gear selectivity variables) affects not only the private costs and revenues of the fisherman but also the growth behaviour of the fish population and (c) Crowding externalities which occur if the fish population is sufficiently concentrated to cause vessel congestion over the fishing grounds and, thus, increased vessel operating costs for any given catch. All these various types of externalities arise fundamentally because of the common property, unappropriated character of most fishery resources, especially ocean and large lake fisheries[1].

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1. Ibid., (2), pp. 181-182.

Using these premises Smith developed a dynamic competitive model of the interaction between investment (or the number of firms) in a fishing industry and the population of an exploited fish species. The model of commercial fishing by Smith was further modified by James,P. Quirk and Smith[1]. The new model sought to incorporate the externality and growth characteristics of a fishery into a dynamic model of general equilibrium and to compare such a competitive model with a model of optimal fishing overtime.

The model of commercial fishing as presented by Smith was, however, seriously criticised by a couple of economists[2] of the Bureau of Commercial Fisheries of the U.S. Department of Commerce. The main criticism of the Bureau Economists was that Smith made 'a number of assumptions which, when combined with the basic structure

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1. James,P. Quirk and Vernon L. Smith, 'Dynamic Economic Models of Fishing' in A.D. Scott (Ed.), Economics of Fisheries Management, (Institute of Animal Resource Ecology, The University of British Columbia, Van Couver, 1970), p. 3.

2. Richard,F. Fullenbaum, Ernest W. Carlson and Frederick, W. Bell, (1) 'Economics of Production from Natural Resources - Comment', American Economic Review, Vol. 61, pp. 483-487, June 1971.

   (2) 'On models of Commercial Fishing: A Defense of of the Traditional Literature', The Journal of Political Economy, Vol. 80, No.4, p. 761, July/August, 1972.

of his model, lead to results which are intuitively implausible and dynamically inconsistent. Smith was severely criticised for making two improper assumptions viz. (1)'one firm equals one unit of fishing effort' and (2) biomass as the independent variable in the model[1]. Smith[2] wrote two articles defending his model; but the task of integrating the traditional economic theory of commercial fishing with the theory of the firm remained an unfinished task.

With the turn of the 1970s and with advancements in other fields of natural resource economics, a number of economists, particularly of the U.S. turned their attention to the study of management and optimisation in the fishing industry. Frederick, W. Bell[3] of the U.S. Bureau of Commercial Fisheries made an empirical study of the Northern Lobster fisheries bringing out the technological externalities arising from common property characteristics.

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1. Ibid. (2), pp. 762-63.

2. V.L. Smith, (1) 'Economics of Production from Natural Resources: Reply', The American Economic Review, Vol. 61, No. 3(1), pp. 488-91, June, 1971.
   (2) 'On Models of Commercial Fishing: The Traditional Literature Needs No Defenders'. The Journal of Political Economy, Vol. 80, No.4, pp. 776-78, July/August 1972.

3. F.W. Bell, 'Technological Externalities and Common Property Resources, An Empirical Study of Northern Lobster Fishery', The Journal of Political Economy, Vol. 80, pp. 148-58, 1972.

Lee, G. Anderson[1], another U.S. economist, then at the Miami University wrote extensively on the subject integrating the traditional economic theory of fishing with the theory of the firm. Anderson was successful in incorporating the biological, technological and economic (market) factors in his analysis. The two major drawbacks of the Smithian model, viz. wrong assumptions of identical fishing units and biological and technological independence of the biomass were removed by Anderson. Anderson assumed that fishery resources are biologically and technologically not independent but interdependent and their size very much

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1. Lee, G. Anderson, a) 'Optimum Economic Yield of a Fishery, given a Variable price of Output', Journal of the Fisheries Research Board of Canada, Vol. 30, No.4, pp. 509-518, 1973.

b) 'Optimum Economic Yield of an Internationally Utilised Common Property Resource', Fishery Bulletin, Vol. 73, No. 1, pp. 51-56, 1975.

c) 'Analysis of Open-Access Commercial Exploitation and Maximum Economic Yield in Biologically and Technologically Inter-dependent Fisheries', Journal of the Fisheries Research Board of Canada, Vol. 32, pp. 1825-42, October 1975.

d) 'The Relationship between Firm and Fishery in Common Property Fisheries', Land Economics, Vol. 52, No.2, pp. 179-91, May 1976.

e) Economics of Fisheries Management (John Hopkins Press, Baltimore, 1977).

depend upon fishing effort, which is an economic variable controlled by man. Anderson's model appeared to be more plausible and applicable in the management of fishery and other natural resources. It is, however, felt that the analysis is made under severely simplified assumptions and the conclusions produced are of great generality[1]. In 1979 Hector[2] presented an economic analysis of the overfishing problem. Here it is proposed to take a brief stock of the neo-classical literature on fishing as discussed above. It should be noted that the entire neo-classical literature on fishing was centred round the subject of optimisation, both biological and economic, and the chief questions treated in the literature are: (1) what is the optimal rate at which to withdraw fish? (2) why might the maximum sustainable yield not be optimal? (3) how do

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1. Dan, Huppert, 'Living Marine Resources', in Gardner M. Brown (Jr.) and James A. Crutchfield (Eds.), Economics of Ocean Resources: A Research Agenda, (Washington Sea Grant Programme, University of Washington, Seattle, Washington, 1982), p. 47.

2. M. Hector, 'Overfishing: An Economic Analysis', Journal of Agricultural Economics, Vol. 30, No.2, pp. 107-23, 1979.

optimal and competitive behaviour differ? and (4) under what conditions will extinction of fishery take place?[1]. It may be noted that most of these questions have been answered by the neo-classical school in great generality. But as pointed out by Dan Huppert, a Washington based fishery economist:

> ... fisheries (economic) theory is like most economic theory. For pedagogical purposes generality and abstraction are most welcome, since an uncluttered theory brings out potential issues in sharp relief. But for the specific, applied analysis ..., the empirical content of theory must be improved and ecological and structural complexities must be met head-on ..., further theoretical development is warranted in the areas where current theory is most abstract. Work is needed to specify underlying bio-physical relationships, assumptions about industry structure and market power and the uncertainty arising from both Nature and the market[2].

One can easily agree with Huppert in that 'a number of theoretical issues remain to be adequately addressed. Among these are the treatment of multiple purpose fishing vessels, multi-species resource systems, and uncertainty in

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1. Frederick, M. Peterson and Anthony, C. Fisher, '<u>The Economics of Natural Resources</u>, (University of Meryland, February 1976), p. 7.

2. Dan, Huppert, Op. cit., p.45. The Word in parenthesis is mine.

environmental and market conditions'[1]. It appears that western economic theory is attending these problems. But it is still not clear whether the western economic theory of the neo-classical school will be able to offer any tools for analysing the development of the primary marine fishing industry of Kerala. In view of the problems posed and the nature of tools developed by the neo-classical school, it is necessary that the student of economics trying to analyse the development of the primary marine fishing industry of Kerala look for alternative approaches for the study of the process of fishery development.

3. Fisheries and the Current Literature

The object of this section is to have a cursory look at the current literature relating to the fishing industry, particularly economic literature[2]. Much of this literature may be categorised as developmental, which are either narrative or explanatory of the process of development in the

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1. Dan,Huppert, Ibid., p. 46.

2. Included in this category are primarily the literature which became available after 1950 and which deal mostly with developmental problems. From this category are, however, excluded the literature which are written in the neo-classical tradition of equilibrium analysis and optimisation, which have already been discussed.

fishing industry of both the developed and developing countries. A major chunk of this literature has its origin in the work and programmes of the Food and Agriculture Organisation of the United Nations. A notable part of this literature also came from the departments of fisheries or other concerned departments of the various countries. Quite a few independent studies of different aspects of fisheries development in the developed and developing countries are also available at present. The review in this section has, for convenience of exposition divided the relevant literature into two categories; (a) National and (b) International. The International sources are further divided into 'FAO-based' and 'others'. In this section, the international sources are reviewed first.

a) International Sources

i) FAO-based Studies

The FAO, ever since its inception in 1945 and the joining of it by several newly independent countries after 1950, has been instrumental in promoting fisheries development in the less developed countries of the world. It has spear-headed several studies relating to the fishing industry, first in Europe and then in the developing countries. One of the early studies of the FAO related to the fishing industry of Great Britain[1]. It outlined the services rendered by the government for the benefit of the industry. Another study related to the fishing industry of Sweden[2]. This gave an account of the working of the fishermen's organisations and the regulations of fish prices in Sweden. A third study related to the sea-fish marketing in the Federal Republic of Germany[3]. The studies of the FAO concerning the less developed countries ranged from fish-stock assessment to the management of the industry. Much of these studies are the result of the working of its various technical committees and expert groups on different issues for different regions. In 1957, the FAO published the proceedings of a Round Table organised by it in colaboration with the International Economic Association[4]. This study brought out nine articles by leading economists on the subjects

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1. F.M.G. Wilson, Governmental Services to the Sea-Fish Industry of Great Britain, (FAO, Rome, 1957).

2. Christian, Hessle and Sigmund, Verstandiz, Fishermen's Organisations and the Regulation of Fish Prices in Sweden, (FAO, Rome, 1957).

3. Klaus-Hinrich, Krohn and Arnold, Alewell, Sea-Fish Marketing in the Federal Republic of Germany, (FAO, Rome, 1957).

4. Ralph, Turvey and Jack, Wiseman (Eds.), Economics of Fisheries, (FAO, Rome, 1957).

which included topics like costs in fisheries, fishermen's remuneration, optimal utilisation and control of fisheries, port-markets, etc. The most noteworthy of these articles as far as fisheries development in the less developed countries is concerned is the one by E.S.Kirby and E.F.Szczepanik[1]. In their article, Kirby and Szczepanik have identified the several problems facing fisheries development in less developed countries. The problems stressed by these authors included that of identification of resources, ignorance and lack of capital and organisational weaknesses among the fishermen. The authors' main conclusion is that in most of the poor countries, the physical conditions for fishery expansion are present, but often the resources are not known or not proved. The low degree of exploitation in these countries is explained primarily by the ignorance of the fishermen and their lack of capital. Generally speaking, government efforts to tackle these problems were found to be inadequate[2]. It may be noted that the article by Kirby and Szczepanik is quite illuminating as far as the problems of fisheries development in less developed countries are concerned. Another notable

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1. E.S. Kirby and E.F. Szczepanik, 'Special Problems of Fisheries in Poor Countries' in Ralph Turvey and JackWiseman (Eds.), Economics of Fisheries, (FAO, Rome, 1957).

2. Ibid., p. 107.

contribution of the FAO during this period was the publication of the Report of the Technical Meeting on Costs and Earnings of Fishing Enterprises in 1958[1]. The Report presented the purposes of costs and earnings studies in fisheries from the point of view of the industry, government and other public authorities. It further highlighted the concepts, definitions and conventions prevailing in different countries and also the merits of different methods of data collection and analysis. In 1960, FAO published its study entitled 'Financial Assistance Schemes for the Acquisition or Improvement of Fishing Crafts'[2]. This gave an outline of the policies prevailing in the member countries and patterns for adoption by developing countries.

As part of its training and development programme, the FAO initiated a number of studies on fishermen's cooperatives as early as 1957 and published a handful of reports on fishermen's cooperative. Between 1958 and 1960 it published two reports of the FAO Training Centre in Fishery Cooperatives and Administration. Volume I of this report

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1. FAO, Report of the Technical Meeting on Costs and Earnings of Fishing Enterprises, (FAO, London, 1958).

2. C. Beever and K. Rudd, Financial Assistance Schemes for the Acquisition or Improvement of Fishing Craft, (FAO, Rome, 1960).

dealt with fishermen's cooperatives in the Indo-Pacific region[1]. The second volume 'The Economic Role of Middlemen and Cooperatives in Indo-Pacific Fisheries' was published in 1960[2]. This report, briefly reviewed the post-war growth of the fishing industry in two fishing communities, one in Thana district in the then Bombay State of India and the other in the Hongkong region. The study brought to light the co-existence of middle-men and cooperatives in the fisheries of the two areas. In the Indian example, the middlemen's activities have been confronted with the competitive influence exerted by the cooperative societies, while the cooperative societies in Hongkong were found to be working primarily as saving and lending agencies. In the Bombay region, the societies were found undertaking credit distribution, cooperative purchase of various commodities and marketing of fish. This study brought out the basic policy question of the proper roles to be assigned, respectively, to the cooperative movement, the middlemen, and government in the development of fisheries.

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1. E.F. Szczepanik, Fishermen's Cooperatives in the Indo-Pacific Region, (FAO, Rome, 1958).

2. E.F. Szczepanik (Ed.), The Economic Role of Middlemen and Cooperatives in Indo-Pacific Fisheries (FAO, Rome, 1960).

The FAO's interest in fishermen's cooperatives was long established and it organised a technical meeting on fishery cooperatives at Naples in May 1959 in cooperation with the International Cooperative Alliance. The working papers were published by the FAO in collaboration with the International Cooperative Alliance in 1959[1]. Based on the proceedings and working papers of the technical meeting on Fishery Cooperatives at Naples, Margaret Digby of the Plunkett Foundation for Cooperative Studies, London, prepared a hand-book entitled 'Cooperation for Fishermen', which was published by the FAO in cooperation with the International Cooperative Alliance in 1961[2]. This book outlined the role of cooperatives in the fishery economy, government participation in cooperatives, management of cooperatives and cooperative education and training.

The experience gained by the FAO in the field of costs and earnings studies after the Technical Meeting on Costs and Earnings in 1958 was crystallised in its later publication entitled 'Costs and Earnings Investigations of Primary Fishing Enterprises' in 1961[3]. This report outlined

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1. FAO/ICA, Technical Meeting on Fishery Cooperative, Working Papers, (FAO/ICA, Naples, 1959).

2. Margaret,Digby, Cooperation for Fishermen, (FAO, Rome, 1961).

3. A.V.Ovenden, Costs and Earnings Investigations of Primary Fishing Enterprises: A Study of Concepts and Definitions, (FAO, Rome, 1961).

the principal concepts and definitions followed in costs and earning studies in primary fishing enterprises. The basic problems of organising and administering credit schemes for fishery development in developed and developing countries are brought out by the FAO in the publication, 'Financial Assistance Policies and Administration of Fisheries', in 1962[1].

The FAO organised a technical session on economic effects of fisheries regulation in the member countries at Ottawa in 1961 and brought out its voluminous report on 'Economic Effects of Fishery Regulation' in 1962[2]. The report outlined and illustrated the direct and indirect effects of different types of regulations in the fishing industry of leading fishing member countries. In June 1964, the FAO organised a meeting on business decisions in fishery enterprises at Rome which culminated in the publication of

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1. E.S.Holliman, Financial Assistance Policies and Administration for Fisheries, (FAO, Rome, 1962).

2. Hamlisch, R. (Ed.), Economic Effects of Fishery Regulation, FAO Fisheries Report No.5, (FAO, Rome, 1962).

a three volume report in 1965[1]. Volume I of this report gave an outline of the meeting and the discussions held and the other two volumes, the text of the working papers presented in the language of the participant countries. In all, 38 papers on various aspects of the fishing industry are included in the last two volumes.

The role of FAO in the dissemination of modern technology among member states has been well recognised and it had organised three congresses on fishing boats of the world, each resulting in the publication of a major commemorative report[2]. These reports, apart from providing technical details to naval architects, fishing boat builders, Heads of fishing companies, engine manufacturers, etc.

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1. FAO, (1) Report of the Meeting on Business Decisions in Fishery Industries, (Vol. 1 Report), FAO Fisheries Report No. Fle/R 22.1, (FAO, Rome, 1965).

   (2) Report of the Meeting on Business Decisions in Fishery Industries, (Vol. 2, Working Papers), FAO, Fisheries Report No. Fle/R 22.2, (FAO, Rome, 1965).

   (3) Report of the Meeting on Business Decisions in Fishery Industries, (Vol. 3, Working Papers), FAO, Fisheries Report No. Fle/R 22.3, (FAO, Rome, 1965).

2. The First Congress held at Paris and Miami in 1953 led to the publication of the volume Fishing Boats of the World in 1955. The second congress held at Rome in 1959, saw an even bigger publication in 1960, entitled Fishing Boats of the World:2. The last congress held at Gothenburg in Sweden in 1965, resulted in the publication in 1967 of Fishing Boatd of the World:3, which is the most comprehensive document on fishing boats of the world.

brought out the practical experience of fishermen and fishery administrators for consideration in research and development in the field. From the point of view of the present study, the last volume is most significant in as far as it presents some of the crucial points and issues involved in the development of the fishing industry of any country[1]. This volume is divided into six sections of which the first deals with factors influencing the design of boats in various communities, the second with the performance capabilities of craft in practical operations, the third with materials (such as wood, aluminium, plastics, fibreglass reinforced plastic, etc.) the fourth with engineering problems relating to engine location, engine types, deck machinery and refrigeration equipment, the fifth with small boat operation, and the last with recent developments in new craft for stern trawling, tuna vessels, combination vessels (amongst others) and with the potential value of catamarans for certain types of fishing. Section one of this report, among other things, brings out the influence of social and economic factors in technological

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1. Jan-Olof Traung (Ed.), Fishing Boats of the World:3, (Fishing News (Books) Limited, London, 1967). This report is also regarded as the 'finest and most complete upto-date summary of development and future trends of fishing vessels'.

development in the fishing industry[1]. This is the main justification for the inclusion of this, otherwise purely technical publication in the present review of literature. Since the reorganisation of the FAO in 1966 it has been taking a more direct interest in the development of fisheries in the developing countries. In 1968, it assessed the role of fisheries in the world food economy and published the booklet, 'Fisheries in the Food Economy'[2]. In 1969, the FAO published the proceedings of the International Seminar on Possibilities and Problems of Fisheries Development in South East Asia, held at Berlin in 1968[3]. In the same year it published a document on fisheries investments in the developing countries of Asia[4]. In 1971 the FAO prepared a plan for the development of fisheries in the Indian Ocean region which was documented

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1. R. Hamlisch, 'The Influence of Social and Economic Factors on Technological Development in the Fishing Sector' in Jan-Olof Traung (Ed.), Fishing Boats of the World:3, (Fishing News (Books) Ltd., London, 1967), pp. 33-51.

2. FAO, Fisheries in the Food Economy, (FAO, Rome, 1968).

3. FAO, The Fisheries of Asia and Their Development Prospects, (FAO, Rome, 1969).

4. Seiji, Konda, Fisheries Investments in the Developing Countries of Asia, (FAO/ICIF, Rome, 1969).

in the same year[1]. A companion volume on economic planning for fishery development was published by it in the same year[2]. This year also witnessed the publication of a volume entitled fishery economics by one of its economists[3]. This report outlined the contribution of fisheries to the economies of countries bordering the Indian Ocean and discussed the organisation and performance of fisheries in the economy of those countries. An attempt to assess the economic and social effects of fisheries development was made by the FAO in 1973[4]. In 1974 it issued the volume entitled 'Guidelines for Fishery Management'[5]. This volume outlined the objectives, policies and strategies to be followed in the management of fisheries at the various stages of development.

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1. John,C. Marr, D.K.Ghosh, Giulio,Pontecorvo, Brian,J. Rothchild and Arlon,R. Thssing, A Plan for Fishery Development in the Indian Ocean, Indian Ocean Programme, IOFC/DEV/71/1, (FAO, Rome, 1971).

2. A.R. Tussing, Economic Planning for Fishery Development, Indian Ocean Programme, IOFC/DEV/71/19, (FAO, Rome, 1971).

3. A.R. Tussing, Fishery Economics, Indian Ocean Programme, IOFC/DEV/71/13, (FAO, Rome, 1971).

4. FAO, The Economic and Social Effects of the Fishing Industry, A Comparative Study, FAO Fisheries Circular No. 314, (FAO, Rome, 1973).

5. J.A. Gulland, Guidelines for Fishery Management, FAO/UNDP Series, IOFC/DEV/74/36, (FAO, Rome, 1974).

By the middle of 1970s, the FAO's interest in the development of fisheries in the Indian Ocean region began to focus more on small scale fisheries and since then it began to study the condition of the artisanal fisheries of the region. It published a number of country profile reports on the artisanal fisheries of the region, especially of countries bordering the upper Indian Ocean region under its (FAO/UNDP) Indian Ocean Programme. A general description of the small scale fisheries of the region was made by the FAO/UNDP Project in a number of working papers serialised and published between 1977 and 1980[1]. In 1978, the FAO and the UNDP prepared a project for the development of small scale fisheries in the Bay of Bengal region with Swedish funds in trust. Volume 2 of the project report gave a clear picture of the artisanal fisheries and fisheries development in the three Indian Ocean countries, viz. Bangladesh, India and Sri Lanka[2]. In the same year the FAO and the Government of Norway held a workshop on the fishery resources of the North Arabian Sea and published a report on the role of fishing technology in fisheries development[3].

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1. A general description of the small-scale fisheries of the various coastal states and Union Territories of India appeared as FAO/UNDP working papers (Nos. 4,7,9,12,13,23,24, 28,29 and 30) between 1977 and 1980.
2. FAO/UNDP, Project for the Development of Small Scale Fisheries in the Bay of Bengal, IOFC/DEV/78/44.2 (FAO, Rome, 1978).
3. J.Scharfe, The Role of Fisheries Development: FAO/IOFC/DEV/78/43.2, (FAO, Rome, 1978).

With the turn of the 1980's, FAO's fisheries activities in the Indian Ocean region began to concentrate more on the small-scale fisheries of the Bay of Bengal region, which was financed largely by the Swedish International Development Authority (SIDA). Under its Bay of Bengal Programme (BOBP), the FAO/SIDA brought out a number of reports, working papers, and information documents[1]. The BOBP working paper No. 25 gives an evaluation of the traditional fishing craft developed in Kerala in recent times[2]. The BOBP information documents Nos. 3,4 and 5 give a general description of the small-scale fisheries of India (combined) and Andhra Pradesh and Tamil Nadu separately[3].

It is prudent at this stage to look at the main issues and problems generally brought out and discussed in the FAO-based literature reviewed here. It is apparent that

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1. Details of the working papers and other documents published by the FAO/SIDA are given at the end of each of its publication.

2. Gulbrandsen, Fishing Craft Development in Kerala: Evaluation Report, FAO/SIDA, BOBP/WP/25 (BOBP, Madras, 1984).

3. FAO/SIDA, (1) Marine Small-Scale Fisheries of India: A General Description, BOBP/INF/3, (BOBP, Madras, 1983).

   (2) Marine Small-Scale Fisheries of Andhra Pradesh: A General Description, BOBP/INF/4, (BOBP, Madras, 1983).

   (3) Marine Small-Scale Fisheries of Tamil Nadu: A General Description, BOBP/INF/5 (BOBP, Madras, 1983).

much of the FAO based literature is the result of a piecemeal and haphazard effort of an international body faced with wide and varying problems of development. It can, nevertheless, be pointed out that most of its earlier studies were, by and large, focussing on problems or conditions prevailing in the industrially advanced countries and only with the turn of the third development decade (1970s) that it has fully geared itself to study the problems of the newly developing countries. This observed lag on the part of the FAO in dealing with the problems of the developing countries is perhaps due to historical, social and cultural shackles under which the international body had to work and partly because of the lack of appreciation of the problems of the less developed countries by the body. A major characteristic of the earlier studies is that they are aimed at improvement or optimisation in the fishery industry of the advanced countries, through better cooperation, organisation or transfer of information (for which FAO is the link). This characteristic of the earlier FAO based studies is analoguous of the early neo-classical writings which are concerned with optimisation and equilibrium determination. The later publications of the FAO on the other hand, reveal the growing recognition of the importance of fisheries in the economies of the less developed countries and the role which FAO is called upon to play in promoting fisheries development in those countries. It is, however, distressing to note that the role of FAO in promoting development in those countries have been marginal since its activities have been confined to small pockets of artisanal fisheries[1]. Viewed from this angle, the FAO based literature does not provide much coverage or analytical tools for an indepth study of development in the primary marine fishing industry of Kerala, or other parts of the world. One may, however, legitimately expect to gain a fairly general knowledge of the fishery situation in different parts of the world from a perusal of the several literature mentioned in the review and the vast array of FAO documents left untouched in this review.

ii) Other studies

Outside the fold of the FAO, several independent studies have been conducted by economists and institutions belonging to different countries. In the remaining part of this section it is proposed to give a brief account of the leading international sources and to comment upon their

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1. This issue will be discussed in greater detail in Chapter V while discussing the technological changes in the primary marine fishing industry of Kerala.

relevance from the point of view of the present study[1].

One of the early efforts to charter the progress of the fishing industry of the world was made by Robert Morgan[2] in 1956. Morgan, in his pioneering work, World Sea Fisheries, assessed the relative importance of fisheries in the major fishing regions of the world and the physical and economic factors behind their development. He noted:

> No fishery develops haphazardly, but always in response, not always consciously ordered to certain conditions. Changes in these conditions lead to repercussions, and then new tendencies towards equilibrium at a different stage. The fishery is the channel between the fish in the sea and in the inland market place, and it reacts sensitively to stimuli from both ends; to changes in conditions of supply in the sea, and to changes in conditions of demand in the shops. The geographical unit of a fishery, to be complete, must, therefore, embrace its fishing grounds, its fishing ports, and their hinterland markets with their lines of communication[3].

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1. It is worth noting here that an extensive review of such literature is not possible here since much of those writings are not in the reach of this researcher, as they remain in the file manuscripts and shelves of many distant countries. It should, however, be acknowledged that this researcher has been able to draw some of these sources through personal correspondences with agencies like the Bureau of Commercial Fisheries of the United States and Dept. of Fisheries of Canada, which released some of their documented studies.

2. Robert, Morgan, World Sea Fisheries, (Mithuen and Company Ltd. London, 1956).

3. Ibid., pp. xiii - xiv.

These and other observations of Morgan are quite illustrative of the development process in the fishing industry of most parts of the world and can be brought to explain the phenomenon of growth in the primary marine fishing industry of Kerala too.

Macfarlane (1957)[1] made an analysis of the labour productivity in the primary fishing industry of the Maritimes and British Columbia in Canada. This study outlined the various concepts of productivity in the context of the fishing industry, and made an attempt to measure the labour productivity in selected segments of the primary fishing industry of the two provinces of Canada. The study gives good theoretical insight into the working of the fishing industry.

Buchanan and Campbell (1957)[2] made an appraisal of the earnings of the Salmon fishermen of British Columbia for the period 1953-54. The study demonstrated the use of

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1. D.A.Macfarlane, Labour Productivity in the Primary Fishing Industry of the Maritimes and British Columbia, (Dept. of Fisheries of Canada, Ottawa, 1957).

2. D.R.Buchanan and B.A. Campbell, The Incomes of Salmon Fishermen in British Columbia, 1953-54, (Dept. of Fisheries of Canada, Ottawa, 1957).

costs and earning studies in identifying the depressed segments of the industry and gave suggestions for their improvement.

C.J.Bottemanne (1959)[1] made a classic attempt to conceptualise the structure and dynamics of development in the fishing industry. In this work he presented the basic facts of the industry: The fishery resources, their dynamics, the general principles of development and the problems in development. Referring to the developing countries, he wrote:

> For transitory countries wanting to build up a stronger maritime position, the development of fisheries is usually much more important in these respects and for the development of their economy than is generally understood. Maritime resources should be developed integrally[2].

Bottemanne's study, despite the many incongruities, throws light on certain facets of development in the industry, such as boom and depression, the tendency for vertical and horizontal integration, etc. The study undoubtedly offers some of the conceptual tools for studying the process of development.

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1. C.J.Bottemanne, Principles of Fisheries Development, (North-Holland Publishing Company, Amsterdam, 1959).

2. Ibid., p. 647.

Lionel Walford of the U.S. Fish and Wildlife Service in 1963[1] made another effort to portray the process of development in the fishing industry in the advanced countries and to apply the same logic to underdeveloped countries. Walford gave a general outline of the process of development in the fisheries of the United States and pointed out the great advantages that such developments confer on developing fisheries. He noted: 'new fisheries have at their immediate disposal the advantages of this long developmental work; they can grow very much faster than was possible for the older fisheries, for they have at once the technologies and the experience of others to guide them'[2]. Walford continued to state: 'where modern technologies of catching, processing, preserving, storing and transporting fish are fully available, a fishery can grow very rapidly upto the limits imposed only by human need and by the capacity of the resources'[3]. A summary of the development process in fisheries is given by Walford here.

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1. Lionel Walford, 'Development of Modern Fisheries: Experience in the United States', in Science, Technology and Development, Vol. III, Agriculture, (U.S. Govt. Printing Office, Washington D.C., 1963).

2. Ibid., p. 236.

3. Ibid., p. 241.

Charles Butler, H.B.Allen and Lee Alverson of the Bureau of Commercial Fisheries of the United States in 1963[1] gave a brief outline of the factors to be considered in the initial development of a planned food fish delivery system in underdeveloped countries. The need for an integrated and coordinated approach to the development of fisheries and the necessity of recognising the various social consequences of development in underdeveloped countries are pointed out by the U.N. in 1963[2].

George Borgstorm in 1963[3] presented a scintillating account of the 'resurgence' of the Japanese fisheries after the second world war. Borgstorm identified the chief factors that contributed to the rapid expansion in the output of the Japanese fisheries and pointed out that these developments are not based on the 'simple profit analysis'[4].

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1. Charles, Butler, H.B.Allen and Lee, Alverson, 'Improvement of Production and Preservation Methods in An Underdeveloped Fishery Through Upgrading Fishing Vessels, Gear and Sanitary Procedures', in Science, Technology and Development, Vol. III, Agriculture, (U.S. Govt. Printing Office, Washington D.C., 1963),p. 250.

2. United Nations, Science, Technology and Development, Vol. III, Agriculture, Report of the U.N.Conference on the Application of Science and Technology for the Benefit of the Less Developed Areas, (U.N., New York, 1963), pp. 163-67.

3. George, Borgstorm, Japan's World Success in Fishing, (Fishing News (Books) Ltd., London, 1964).

4. Ibid., p. 304.

Frederick, W. Bell in 1966[1] made an economic evaluation of the post-war development of the New-England Fishing Industry in the United States. Bell found the New-England Fishing Industry technologically backward and stressed the need for introducing new technology with public support for strengthening it. This study is inspiring in as much as it throws light on how an age old industry can remain backward for want of favourable public policy and having to work under severe restrictions.

Raymond Firth in 1966[2] gave a vivid account of the social, cultural and economic life of the Malay fishermen. A general review of the price systems at the landing stage in the OECD countries is given by the OECD in 1966[3].

Frederick, W. Bell and J.E.Hazleton in 1967[4] made a joint effort to combine the recent developments and research

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1. Frederick, W. Bell, The Economics of the New-England Fishing Industry; The Role of Technological Change and Government Aid , (Federal Reserve Bank of Boston, Boston, 1966).

2. Raymond, Firth, Malay Fishermen, Their Peasant Economy, (Routledge and Kegal Paul, London, 1966).

3. OECD, Price System at the Landing Stage in Fishing Industries of OECD Member Countries, (OECD, Paris, 1966).

4. F.W.Bell and J.E.Hazleton (Eds.), Recent Development and Research in Fisheries Economics, (Oceana Publications, Dobbs Ferry, New York, 1967).

in fisheries economics. They brought together some of the previous contributions in the field of production economics in fisheries and management.

Miller, B. Spangler in 1969[1] recognised and explained the role of new technology in improving the U.S. position in world fisheries development. Spangler first made a review of the U.S. and World position in fisheries prior to 1967 and pointed out the barriers to technological progress in the U.S. He then identified the gains of promoting new technology and pleaded for developing a cohesive national programme for fisheries development[2].

Swift in 1969[3] discussed the problems of credit and indebtedness in traditional fishing communities of Malayala and the institutional arrangements there.

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1. Miller, B. Spangler, New Technology and Marine Resource Development, Praeger Special Studies in U.S. Economic and Social Development, (Praeger Publishers, New York, 1969).

2. Ibid., pp. 319-62.

3. M.G.Swift, 'Capital, Saving and Credit in Malay Peasant Economy' in Raymond Firth and B.S.Yamey (Eds.), Capital, Savings and Credit in Peasant Societies, (Allen and Unwin, London, 1969).

Anthony Scott in 1970[1] gave an outline of the economic obstacles to marine (aquaculture) development. The chief factors identified by Scott are demand factors and the absence of property rights over the resources.

Michael Roemer in 1970[2] studied the contribution of fisheries to the economic development of Peru from 1950 to 1967. Roemer first outlined the staple theory of export-led growth which he used to explain the various linkages of growth and the overall development of the Peruvian economy since 1950.

A general description of the financial support policy for the fishing industry in the OECD (Organisation for Economic Cooperation and Development) countries of Europe was given in 1971[3].

Frederick, W. Bell and Richard K. Kinoshita of the National Marine Fisheries Service of the United States in 1971[4] made a statistical and analytical study of the labour

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1. Anthony Scott, 'Economic Obstacles to Marine Development', Marine Aquaculture, (Oregon State University Press, Corvallis, Oregon, 1970).

2. Michael, Roemer, Fishing for Growth: Export-led Development of Peru, 1950-1967, (Harward University Press, Cambridge, Massachusetts, 1970).

3. OECD, Financial Support to the Fishing Industry, (OECD, Paris, 1971).

4. Frederick, W. Bell and Richard K. Kinoshita, The Measurement and Analysis of Labour Productivity Changes in United States Fisheries, File Manuscript No. 106, National Marine Fisheries Service, Rockville, 1971).

productivity changes in the U.S. fishing industry during the period from 1950 to 1967. The study brought to light the declining trend in the productivity of U.S. fisheries which was attributed to the existing pressure on the resource base and increased fishing effort per worker[1].

Lawrence, W. van Meir in 1971[2] presented a general description of the major economic changes in the U.S. fisheries during the fiftees and sixtees. Van Meir identified three major changes: rising cost of labour and capital (technology), falling productivity and rising prices of fishery products.

G.L.Kesteven and G.R.Williams in 1971[3] gave a descriptive picture of the conflicts arising from the introduction of fishing regulations. Brian, J. Rothschild in 1973[4] discussed certain questions of strategy in the

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1. Ibid., pp. 1-21.

2. Lawrence, W. van Meir, 'Economics in Fisheries' in Sidney Shapiro (Ed.) <u>Our Changing Fisheries</u>, (National Marine Fisheries Service, Washington, 1971).

3. G.L.Kesteven and G.R.Williams, 'Fishery Regulations: Conflicts in Exploitation of Fishery Resources' in G.L.Kesteven *et al*. (Eds.), *Essays in Fishery Science*, (Common Wealth Scientific and Industrial Research Organisation, Melbourne, 1971), pp. 33-91.

4. Brian, J. Rothschild, 'Question of Strategy in Fishery Management and Development', *Journal of Fisheries Research Board of Canada*, Vol. 30, No.12, Part 2, pp. 2017-30, 1973.

management and development of common property fisheries.

J.A.Gulland in 1974[1] presented a systematic account of the objectives, strategies and techniques to be followed in the management of fisheries at different stages of development.

N.P.Sysoev in 1974[2] gave an excellent treatment of the development of the Soviet fishing industry since 1861 (year of abolition of serfdom). Sysoev outlined the role of the fishing industry in the Soviet economy, the main stages of development and planning, the raw material basis, and the material and technical foundations of the industry.

David Cushing in 1975[3] gave a brief but interesting account of the fishery resources of sea and their management.

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1. J.A.Gulland, The Management of Marine Fisheries, (University of Washington Press, Seattle, 1974).
2. N.P.Sysoev, Economics of the Soviet Fishing Industry, (Israel Programme for Scientific Translations, Jerusalem, 1974).
3. David Cushing, Fisheries Resources of the Sea and Their Management, (Oxford University Press, London, 1975

N.N.DeSilva in 1976[1] presented the role of technology in the development fisheries in Ceylon.

C.L.Yap in 1977[2] gave an outline of the impact of trawling on employment and resource use in the fisheries of the west-coast of Peninsular Malayasia.

Lee,G. Anderson and others in 1977[3] brought out the economic impact of extended fisheries jurisdiction by the United States in 1976.

Frederick,W. Bell in 1978[4] gave the economic and political issues involved in the management of ocean fisheries.

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1. N.N.DeSilva, 'The Role of Technology in Fishery Development in Ceylon', Bulletin of the Fisheries Research Station, Ceylon, Vol. 17, No.2, pp. 257-265, 1976.

2. C.L.Yap, 'Trawling - Its Impact on Employment and Resource Use on the West-Coast of Peninsular Malayasia' in Small-Scale Fisheries Development, Social Sciences Contribution, (East West Centre, Honolulu, 1977).

3. Lee,G. Anderson (Ed.), Economic Impacts of Extended Fisheries Jurisdiction, (Ann Arbor Science Publishers Inc. Ann Arbor, Michigan, 1977).

4. Frederick,W. Bell, Food From the Sea: The Economics and Politics of Ocean Fisheries, (West View Press, Inc. Boulder, Colarado, 1978).

C.P.Idyll in 1978[1] discussed the economic and biological potential of the sea in alleviating (combating) hunger in the world.

M. Ben-Yami in 1980[2] highlighted the role of community fishery centres in the transfer of technology to small-scale fisheries in under developed countries.

D.K.Emerson in 1980[3] pointed out the need for emphasising the development of industrial fisheries in developing countries.

G.Kent in 1980[4] gave a preliminary account of the working of transnational corporations in the Pacific fisheries.

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1. C.P.Idyll, The Sea Against Hunger (Thomas Crowell Company, New York, 1978).
2. M.Ben-Yami, 'Community Fishery Centres and the Transfer of Technology to Small Scale Fisheries' in IPFC/80/SMMP/SP/Z/IFP/Symposium Proceedings 1980.
3. D.K.Emerson, 'Rethinking Artisanal Fisheries Development, Western Concepts, Asian Experiences', World Bank Staff Working Paper No. 423, (Washington, 1980).
4. G.Kent, 'Transnational Corporations in Pacific Fishing', Research Monograph No. 10, (Faculty of Economics, University of Sydney, 1980).

G.C.Eddie in 1983[1] discussed succinctly the techno-economic and administrative problems in the management of fisheries.

W.H.L.Allsopp in 1985[2] presented a general description of the fishery development experiences in less developed countries since 1950.

Theodore Panayotou and others in 1985[3] made a socio-economic study of the small-scale fisheries in Asia. This study investigated the social, technical and market (economic) factors affecting the viability and operation of fishing enterprises in the Asian region.

It is essential at this stage to take a retrospective view of the literature reviewed here. Among the other international sources cited, one can find a number of studies dealing with the problems in productivity,

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1. G.C.Eddie, Engineering, Economics and Fisheries Management, (Fishing News (Books) Ltd., Surrey, England, 1983).
2. W.H.L.Allsopp, Fishery Development Experiences, (Fishing News (Books) Ltd., Surrey, England, 1985).
3. Theodore Panayotou (Ed.), Small Scale Fisheries in Asia: Socio-Economic Analysis and Policy, (International Development Research Centre, Ottawa, 1985).

employment, earnings, conservation, management,etc. at the international level and dealing primarily the cases of developed countries and quite a few concerned with the problems of the developing fisheries[1]. It is imperative at this stage to look at the national sources and see how far the national literature captures and explains the process of development in the primary marine fishing industry of Kerala or other parts of the country.

b.) National Sources

National efforts for the study of the condition of the fishing industry was initiated during the second half of the last century by the British Administration. Dr.Francis Day's investigation of the freshwater fisheries of South India was the major effort during this period. Following this, the British Government asked Dr.Day to study the fish and fisheries of the whole of British India. As a sequel to this study Day published two reports. They are (1) 'The Freshwater Fish and Fisheries of India and Burma' in 1873[2] and 'The Seafish and Fisheries of India'

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1. Quite a few exceptions to this observation can be cited. The study by Morgan, Bottemanne and Roemer, for instance, are more illustrative and general and can be adapted to explain the process of development in the less developed or developing countries.
2. Francis, Day, The Freshwater Fish and Fisheries of India and Burma, (Superintendent of Govt. Printing Press, Calcutta, 1873).

in 1872[1]. In the former, Day drew attention to the widespread practice of killing of breeding fish by dynamitising and poisoning by the local population and suggested legislative measures to protect the fishery. In pursuance of this the British Government passed the Indian Fisheries Act of 1897. This Act absolutely prohibited the killing of fish in specified waters for two years. In the second report Day recommended measures for proper exploitation and development of sea fishery resources of the country[2].

The dawn of the 20th century witnessed a wave of interest in the development of fishing industry in the country. In 1906 the Presidency Government of Madras deputed Sir Frederick, A. Nicholson to investigate the conditions of the fishing industry of the region. In 1907 Nicholson submitted a 'Note on the Fisheries of Japan', with proposals for the development of fisheries of Madras. In the same year the Government of Madras constituted a small Department of Fisheries with Sir Nicholson as its first Honorary Director. Following this, the Department of Fisheries

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1. Francis, Day, The Seafish and Fisheries of India, (Superintendent of Govt. Printing Press, Calcutta, 1878).

2. Following Day's recommendations, the British Government granted duty free salt to the fishermen of Bombay and Madras for curing fish within fenced enclosures in the coastal areas. This arrangement was continued till 1947, when the Government of India abolished the duty on salt.

conducted a number of detailed studies on the fisheries of the Presidency under the able guidance of Sir Frederick, A. Nicholson[1], Dr.James Hornell[2] and Rao Bahadur, V. Govindan[3]. Similar studies for other parts of the country were made by eminent biologists and administrators during the following years. For example, Sir K.G.Gupta enquired into the fisheries of Bengal (including Bihar and Orissa) in 1906. Mr. W.H.Lucas investigated the fisheries of Bombay (including Sind) in 1908 - 1910. Mr.H.S.Dunford studied the fisheries of Punjab in 1911. Mr. E.H.H.Ddye reported on the fisheries of United Provinces in 1923. James Hornell prepared a report on the fisheries of Baroda in 1930. Dr.H.T.Sorely submitted a revised report on the marine fisheries of the Bombay Presidency (including Sind) in 1931. These reports and studies resulted either

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1. In 1907 Nicholson Published The Note on Fisheries in Japan and in 1908, The Preservation and Curing of Fish.

2. Dr.James Hornell was the second Director of Fisheries of the Presidency. Hornell conducted a series of investigations on the fisheries of the Presidency which were published in the Madras Fisheries Bulletins between 1910 and 1938. 'The Fishing Methods of the Madras Presidency Part I - The Coromandel Coast' was published in 1924 and 'Part II - The Malabar Coast' in 1938.

3. Rao Bahadur, V. Govindan was an able administrator of the Department of Fisheries of the Presidency. He compiled the report 'The Fishery Statistics and Information - West Coast and East Coast' in 1916.

in the constitution of a separate department of fisheries in many states or the provision of some assistance to the fish curing industry. Despite all these, The Royal Commission on Agriculture in 1928 noted the failure of the Government to develop the fisheries of the country as a source of food and deprecated the short range policy of the local governments in viewing the fishery as a source of revenue for the states and not developing the full potential for growth[1].

In 1941, the Directorate of Marketing and Inspection published a report entitled 'Preliminary Guide to Indian Fish, Fisheries, Methods of Fishing and Curing'[2]. The report gave a broad outline of the fishing industry of India. In 1943, Dr.Baini Prasad, the then Director of the Zoological Survey of India, submitted a 'Memorandum On the Post-war Development of Indian Fisheries' to the Policy Committee on Agriculture, Forestry and Fisheries[3]. This memorandum gave valuable suggestions and recommendations for the development of the fishing industry of India; the chief recommendation being the establishment of a Central Institute for the promotion of fisheries research in India.

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1. Government of India, Report of the Royal Commission on Agriculture in India, (1928), p. 495.

2. Directorate of Marketing and Inspection, 'Preliminary Guide to Indian Fish, Fisheries, Methods of Fishing and Curing, Marketing Series No. 24, (Government of India, Nagpur, 1941).

3. Baini Prasad, Post-war Development of Indian Fisheries, (Zoological Survey of India, Banaras, 1943).

In 1943 B.N.Chopra[1] presented a preliminary account of the prawn fisheries of India. The sub-committee on Fisheries of the Policy Committee on Agriculture, Forestry and Fisheries submitted its report in 1945[2]. The Committee put forward several recommendations for increasing fish production in the country and suggested reforms in all branches of the fishing industry.

In 1946, the Directorate of Marketing and Inspection published another report on the marketing of fish in India[3]. This report outlined the conditions prevailing in the different branches of the fishing industry, viz. the catching, processing and distribution branches, with suitable statistical supplementaries.

The Directorate of Marketing and Inspection in 1951[4] published a revised report on the marketing of fish in the

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1. B.N.Chopra, Prawn Fisheries of India, (Proceedings of the Indian Science Congress, 1943), pp. 153-73.

2. Ministry of Agriculture, Report of the Fisheries Sub-committee of the Policy Committee on Agriculture, Forestry and Fisheries, (Government of India, New Delhi, 1945).

3. Directorate of Marketing and Inspection, Report on the Marketing of Fish in India, (Government of India, Nagpur, 1946).

4. Directorate of Marketing and Inspection, Report on the Marketing of Fish in the Indian Union, (Manager of Publications, Government of India, New Delhi, 1951).

Indian Union. This report presented the postwar developments in the industry upto 1948-49. In the same year (1951)[1] the Ministry of Agriculture prepared a Handbook on Indian Fisheries for the third meeting of the Indo-Pacific Fisheries Council held at Madras. It gave a general picture of the marine, estuarine and inland fishery resources of the country and catching, processing and marketing activities. It also outlined the socio-economic condition of the fishermen. In 1952 Panikkar[2] provided a brief account of fisheries research in India. This was followed by a note by Gopinath (1954)[3] on deep-sea fishing experiments conducted in India during that period. In the next year (1955)[4] Panikkar and Menon presented a preliminary account of the prawn fisheries of India. In 1958 S. Jones (Ed.)[5] gave a general description of the fisheries

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1. B.N.Chopra (Ed.), Handbook of Indian Fisheries, (Ministry of Agriculture, Government of India, New Delhi, 1951).

2. N.K.Panikkar, 'Fisheries Research in India', Journal of the Bombay Natural History Society Ltd., pp. 741-65, Bombay, 1952.

3. K.Gopinath, 'Note on Some Deep-Sea Fishing Experiments off the South Western-Coast of India', Indian Journal of Fisheries, Vol.1, pp. 163-81, 1954.

4. N.K.Panikkar and M.K.Menon, 'Prawn Fisheries of India', Proceedings of the Indo-Pacific Fisheries Council, Section III, pp. 328-44, 1955.

5. S.Jones (Ed.), 'Fisheries of the West-Coast of India', (Central Marine Fisheries Research Institute, Mandapam Camp, 1958).

of the West Coast of India. Again, in 1959, Panikkar[1] submitted a report on Fisheries Education in India. The FAO Experts on the Fishing Boats of India submitted their first report to the Government of India in 1958[2]. This report identified the major boat types of the country and suggested modifications to the existing boats along with introduction of new boat designs.

The Fishing Gear Advisor of the Technical Cooperation Mission (TCM) submitted the two year report to the Ministry of Food and Agriculture in 1959[3]. It gave certain recommendations for the development of fisheries in India. This report *inter alia* gave details of experimental fishing by two vessels during 1956 and 1957. A third report on Marketing of Fish in India was published by the Directorate of Marketing and Inspection in 1961[4].

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1. N.K.Panikkar, *Report of the Committee on Fisheries Education*, (Government of India, New Delhi, 1959).

2. FAO, *First Report to the Government of India on Fishing Boats Based on the Work of Kjeld Rasmussen and Paul B. Zeiner*, (FAO, Rome, 1958).

3. John,Lewis Burrough, *Two Year Report of the Fishing Gear Advisor to the Ministry of Agriculture, Government of India*, (United States Technical Cooperation Mission to India, Bombay, 1959).

4. Directorate of Marketing and Inspection, *Report on the Marketing of Fish in India*, (Government of India, Nagpur, 1961).

In 1965 Bhattacharya[1] published a book describing the role of fisheries in the economy of certain states of India. In the same year (1965) the National Council of Applied Economic Research[2] published its study report on the export prospects of fish and fish products from India. In 1967 Warrier[3] made a socio-economic survey of the fishermen in Madras City. In 1966 Panikkar[4] gave an account of the fishery resources of the Indian Ocean.

Jones[5] in 1967 summarised the progress achieved in marine fisheries research in India during 1947-67. The Conference (1968) volume of the Indian Society of Agricultural Economics discussed the role of fisheries in the Indian economy and presented case studies of the contribution of fisheries to the regional economies of some of the

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1. S.N.Bhattacharya, Fisheries in the Indian Economy, (Metropolitan Book Company (P) Ltd., Delhi, 1965).

2. National Council of Applied Economic Research, Export Prospects of Fish and Fish Products, (NCAER, New Delhi, 1965).

3. K.M.Warrier, A Socio-Economic Survey of Fishermen in Madras City, (Unpublished Report), (Loyola College, Madras, 1967).

4. N.K.Panikkar, 'Fishery Resources of the Indian Ocean', Second International Oceanographic Congress, Moscow, (1966).

5. S.Jones, Two Decades of Marine Fisheries Research, (Central Marine Fisheries Research Institute, Cochin, 1967).

Indian States[1]. In the same year (1968) Samuel[2] presented a general description of the marine fisheries of India with details on production, utilisation and export. This was followed by a study on the mechanisation of fishing boats in India by Professor G.M.Gerhardsen[3]. This study drew attention to the wide differences in the performance of mechanised boats operating from the various states and suggested measures for making the operations viable.

The Proceedings of the Symposium on Development of Deep Sea Fishing held at Cochin in 1970 by the Government of India highlighted the general problems of the fishing industry[4]. It paid specific attention to the problems of shortage of capital, trained manpower, materials and designs for fishing craft, gear and other equipment and the need for the development of harbour facilities, product development

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1. Indian Society of Agricultural Economics, 'Development of Fisheries - Economic Aspects', Indian Journal of Agricultural Economics, Vol. 23, No.4, 1968.

2. C.T.Samuel, Marine Fisheries in India, (S.T.Reddiar and Sons, Cochin, 1968).

3. G.M.Gerhardsen, A Special Study of Fishing Boat Mechanisation in India - A Note Prepared by Mr. Gerhardsen, (Government of India, New Delhi, 1968).

4. Central Institute of Fisheries Operatives, Proceedings of the Symposium on Development of Deep-Sea Fishing, (Government of India, Cochin, 1970).

and quality control. In 1970 Gnanadoss[1] presented an overview of the changes in fishing craft and gear and their impact on Indian fisheries. In the same year (1970) The Indian Institute of Foreign Trade[2] surveyed the potential for export of marine products from India to various countries. The Survey Report in six volumes, discussed the strategy, position, and problems of production, processing and export of marine products from India, items exported from India, export potential, and global agencies associated with marine products industry. Volume III of the report specifically focussed on the problems of production.

The Programme Evaluation Organisation of the Planning Commission of India evaluated the programme of mechanisation of fishing boats in India in 1971[3]. It studied the organisation and administration of fisheries in the maritime states and the operational efficiency of mechanised and non-mechanised boats. The general impact of mechanisation on the fishing economy of those states was also studied.

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1. D.A.S.Gnanadoss, 'Some Advances in Fishing Gear and Craft Technology and Their Impact on Indian Fisheries', Central Institute of Fisheries Operatives, Recreation Club Souvenir, (Cochin, 1970).

2. Indian Institute of Foreign Trade, Survey of India's Export Potential of Marine Products, (Government of India, New Delhi, 1970).

3. Planning Commission, Evaluation of the Programme of Mechanisation of Fishing Boats, (Government of India, New Delhi, 1971).

The Proceedings of the Symposium on the Living Resources of the Seas around India, held at Cochin in 1973 discussed among other things, the resource potential, level of exploitation and strategies for the exploitation of those resources[1].

In 1973 Sambu Dayal made an attempt to project the trend for supply and demand for fish in India.

In 1976 a number of studies were published. Important among them are the 'Report of the National Commission on Agriculture','Prawn and Prawn Fisheries of India' by Kurian and others, 'Exploited Marine Fishery Resources of India - A synoptic Survey with Comments on Potential Resources' by Silas and others, 'Cost-Benefit Analysis - A Case Study of the Ratnagiri Fisheries Project' by Misra and Beyer and 'Two Decades of Mechanisation in Retrospect' by Gnanadoss.

The Report of the National Commission on Agriculture (1976) gave detailed description of the fishing industry of India[2]. It discussed the current trends and

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1. Central Marine Fisheries Research Institute, Proceedings of the Symposium on the Living Resources of the Seas Around India, (CMFRI, Cochin, 1973).

2. Ministry of Agriculture, Report of the National Commission on Agriculture - Part VIII, Fisheries, (Government of India, New Delhi, 1976).

problems in the field of production, supply, demand, marketing, etc. It also gave a number of recommendations to promote the growth of the industry.

Kurian and Sebastian[1] gave an authentic account of the prawn fishery resources of the country, the fishing methods and their commercial utilisation. Silas and others[2] on the other hand made a synoptic survey of the exploited marine fishery resources of India with details of catch by mechanised and non-mechanised vessels (from 1969 to 1974), fishing effort by the states and the potential for exploitation of Pelagic and Demersal fishery resources in the country.

Misra and Beyer in 1976[3] conducted a cost-benefit analysis of the Ratnagiri Fisheries Project in Maharashtra.

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1. C.V.Kurian and V.O.Sebastian, Prawn and Pran Fisheries of India, (Hindustan Publishing Corporation, Delhi, 1976).

2. E.G.Silas, S.K.Dharmaraja and K.Rengarajan, Exploited Marine Fishery Resources of India - A synoptic Survey with Comments on Potential Resources, CMFRI Bulletin No. 27, (CMFRI, Cochin, 1976).

3. S.N.Misra and John Beyer, Cost-benefit Analysis, A Case Study of the Ratnagiri Fisheries Project, (Hindustan Publishing Corporation (India), Delhi, 1976).

The dominant conclusion of Misra and Beyer was that the Ratnagiri fisheries project had a high social profitability with internal rate of return (IRR) ranging from 17 per cent to 25 per cent. Gnanadoss's study[1] gave a brief review of the fishing boat mechanisation programme.

A general review of fisheries development in India since the inception of the five year plans in the country was made by the All India Fisheries Cooperative Conference held at Ernakulam in 1976[2]. It evaluated the problems in the working of fisheries cooperatives in the country and suggested reforms in the structure and organisation of cooperatives.

As in the case of 1976 a number of studies appeared in 1977 also. Important among them are 'Indian Fisheries - 1947-77' edited by Silas and published by CMFRI, 'Fishery Resources of the Indian Economic Zone' by George and others, 'Diversified Fishing Methods to Exploit the Fishery Resources of Indian Waters' by Varghese and others, 'Whither Mechanisation' by Gnanadoss and 'Report of the Committee to go into the Allegations against Big Houses in the Marine Products Industry' by MPEDA.

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1. D.A.S.Gnanadoss, 'Two Decades of Mechanisation in Retrospect', Seafood Export Journal, Vol. VIII, No.1, January 1976.
2. National Cooperative Development Corporation, Background Papers of the 'All India Conference on Fisheries Cooperatives' held at Ernakulam During 19th-20th February 1976.

Indian Fisheries - 1947-77 edited by Silas presented the diverse aspects of fisheries development in India since 1947 to '77. This include developments in fisheries research, technology, education, training and extension. Similarly, Fishery Resources of the Exclusive Economic Zone of India by George and others presented a general description of the fishery resources of the exclusive economic zone. So also, Varghese and others gave a brief account of the diversified fishing methods for the exploitation of fishery resources of the Indian waters. Gnanadoss, on the other hand, pointed out the declining pace of mechanisation in the fishing industry of India. He also traced the genesis of the crisis in mechanisation and stressed the need for diversification in the fishing industry. The Report of the Committee to go into the Allegations against Big Houses in the Marine Products Industry noted that although the working of large industrial houses have not generally affected the small scale units, it has a distinct disadvantage with reference to the availability of raw materials at reasonable prices to the small scale operators.

John Kurien in 1978[1] made a preliminary analysis of the impact of the entry of big business houses into the fishing

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1. John Kurien, 'Entry of Big Business Houses into Fishing - Its Impact on the Fish Economy', Economic and Political Weekly, Vol. 13, No.36, pp. 1557-65, 1978.

industry. In the same year (1978) The Department of Statistics of the Government of Tamil Nadu[1] made a statistical study of the socio-economic condition of the fishermen in Tamil Nadu.

The National Council of Applied Economic Research in 1980[2] made an analysis of the demand for fish and its storage and transportation in the cities of Bangalore, Calcutta and Delhi.

Similarly Kurien (1980), Kurien and Vijayan (1980), Vijayan (1980) and Mukundan and others in 1980 conducted studies on different aspects of fishing industry. Kurien[3] discussed the influence of social factors in the economic organisation of small scale fishing in India. Kurien and Vijayan[4], on the other hand, made an attempt to explain the capitalistic relations of production in the traditional sector of fishing industry.

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1. Department of Statistics, Report of the Survey of Socio-Economic Condition of Fishermen in Tamil Nadu, (Government of Tamil Nadu, Madras, 1978).

2. National Council of Applied Economic Research, Demand for Fish and Its Transportation and Storage in Selected Cities, (NCAER, New Delhi, 1980).

3. John Kurien, 'Social Factors and Economic Organisation of the Traditional Small-Scale Fishermen of India', Social Action, Vol. 30, No.2, 1980.

4. John Kurien and A.J.Vijayan, Capitalistic Relations in Traditional Fishing - The Case of the Goan Rampon, (Fisheries Research Cell, Working Paper 1, Trivandrum 1980).

Vijayan[1] made an effort to study the phenomenon of fishermen's migration to Orissa. Mukundan and others[2] discussed the development of purse-seine fishing in Indian waters. These authors discussed the projects, techniques and experiments carried out for promoting purse-seine fishing in India prior to 1980.

The Task Force[3] appointed by the Government of India in 1981 discussed the outstanding problems of the marine products export industry. It identified several problems, the chief among them being the rising cost of fuel, depletion of resources, poor quality of the products and insufficient credit facilities. In the same year (1980) the Planning Commission[4] made an evaluation of selected fishing harbour projects in the country.

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1. A.J.Vijayan, Migrant Fishermen in Paradeep, Orissa, (Indian Council of Social Sciences Research, Fisheries Research Cell, Trivandrum, 1980).

2. M.Mukundan and L.A.Hakkim, Purse Seining Development in Indian Waters, (Integrated Fisheries Project, Bulletin No.3, Cochin, 1980).

3. MPEDA, Report of the Task Force for Marine Products, (Government of India, Cochin, 1981).

4. Planning Commission, Evaluation Report On the Fishing Harbour Projects, (Government of India, New Delhi, 1981).

The Department of Fisheries, Government of Maharashtra in 1981[1] reported the comparative profitability of different types of fishing operations in Maharashtra for the period from 1969 to 1977. Similarly Ramakrishnan Korakandy[2] in 1981 highlighted the need for fixing minimum price for fish in India.

In 1982 Jhingran[3] gave a general description of the fish and fisheries of India.

Subha Rao[4] made a case study of the mechanisation of fishing boats and its effects on the traditional fishing economy of Andhra Pradesh in 1982. Srivastava and others[5] made a general review of the working of the marine fishing industry of India with particular reference to the state of Gujarat. This study highlighted the strategies followed for the development of the marine fishing industry in India, the

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1. Department of Fisheries, Report of the Survey to Study the Economics of Different Types of Fishing Operations in Maharashtra (1969-70 to 1976-77), (Government of Maharashtra, Bombay, 1981).

2. Ramakrishnan Korakandy, 'On the Issue of Fixing Minimum Price for Fish - A Perspective', Annual of the Industrial Fisheries Association, 1981, pp. 55-61.

3. Jhingran, V.G., Fish and Fisheries of India, (Hindustan Publishing Corporation (India), New Delhi, 1982), Edn. 2.

4. Subha Rao, 'Mechanisation and Its Effects: A Case Study of Marine Fishermen in Visakhapatnam' - (Unpublished Ph.D. Thesis, Andhra University, Waltair, 1982).

5. Srivastava, U.K., M.Dharma Reddy and V.K.Gupta, Management of Marine Fishing Industry, (Oxford and IBH Publishing Company, New Delhi, 1982.

working of the harvesting and processing sectors, and the functioning of the marketing system.

Gokhale (1982)[1] presented a critical note pointing to the disadvantages of developing a deep-sea fishing fleet for India. Gokhale argued that while deep-sea fishing will help only a handful of persons and some foreign companies, inshore fisheries can benefit a large population. Rao in 1982[2] presented a general outline of the Indian fishing industry, with details of vessels, catch, processing and marketing.

John Kurien and Sebastian Mathew in 1982[3] presented a status paper reviewing the social science research in fisheries in India and suggesting problem areas for investigation. This paper first outlined the socio-economic basis of fisheries development in India and then gave an account of the fishery resources, fishing technology and the problems involved in the adoption and use of new technology.

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1. S.V.Gokhale, 'The Mania Called Deep-sea Fishing', Science Today, Vol.16, No.8, pp. 5-8, August, 1982.

2. P.S.Rao, Fisheries Economics and Management in India, (Concept Publishing Company, New Delhi, 1982).

3. John Kurien and Sebastian Mathew, Technological Change in Fishing - Its Impact on Fishermen, (Centre for Development Studies, Trivandrum 1982).

It further suggested the setting up of a national research project to investigate the various aspects of technical change. This paper also gave a few 'technical notes' on the characteristics of different types of fisheries, fisheries technology, fishing and overfishing, fisheries regulation and management measures and the sources of fisheries data in India. It may be noted that this report merely presents an agenda for future line of work and makes no effort at them. Srivastava and Dharma Reddy (Eds.)[1] in 1983 highlighted certain aspects of policy relating to fisheries development in India including production and marketing.

In 1983[2] M. Swaminath explained the present state of mechanised fishing in India and the need for introducing a new generation of fishing vessels for exploiting the offshore fishery resources of the country.

Krishna Iyer and others made an assessment of the excess capacity prevailing in the fish processing industry of India in the same year[3].

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1. U.K. Srivastava and M.Dharma Reddy, Fisheries Development in India, (Concept Publishing Company, New Delhi, 1983).
2. M.Swaminath, 'Is There Need for a New Generation of Mechanised Boats', Annual of the Industrial Fisheries Association, 1983, pp. 21-29.
3. H.Krishna Iyer, et al., 'Is There Any Excess Capacity in Our Fish Processing (Freezing) Plants?', Seafood Export Journal, Vol. 15, No.2, February 1983.

The Indian Institute of Management, Ahmedabad[1] in 1984 published the findings of a statistical study of marine fish marketing in India. The study report in six volumes, presented the current situation in production and marketing of fish in eight maritime states of India. It gave projections of supply and demand for fish, infra-structural outlook and marketing channel lay-out. Sreekumar Sreedharan in 1984[2] studied the problem of industrial sickness in the seafood exporting industry.

Ramakrishnan Korakandy in 1984[3] pointed out the economic and political issues involved in the chartering of foreign vessels for operation in Indian waters.

The CIFT in 1985[4] published a brief account of the technologies developed at the Central Institute of Fisheries Technology, Cochin.

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1. Indian Institute of Management, Marine Fish Marketing in India, (IIM, Ahmedabad, 1984).

2. Sreekumar Sreedharan, Sickness in the Seafood Exporting Industry - An Investigation with Special Reference to Commercial Bank Financing (Kerala Agricultural University, Mannuthy, 1982).

3. Ramakrishnan Korakandy, 'Chartering of Fishing Vessels - Economics and Politics', Economic Times, (Bombay, 8th May 1985).

4. Central Institute of Fisheries Technology, Technologies Developed at CIFT, Special Bulletin No.11, (CIFT, Cochin, 1985).

Subha Rao in 1986[1] presented a brief account of the development of fisheries in Andhra Pradesh since the inception of the five year plans and the factors that contributed to it. Similarly, Srivastava and others in 1986[2] made an attempt to assess the impact of mechanisation on the artisanal fishermen of Gujarat State.

It is evident from the above review of the national literature (excluding studies on Kerala) that scarcely any study has been made to explain the process or nature of development of the primary marine fishing industry of India[3]. Keeping this national scenario in mind it is necessary that we now turn to a review of specific studies on Kerala.

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1. N. Subha Rao, Economics of Fisheries - A Case Study of Andhra Pradesh, (Daya Publishing House, Delhi, 1986).

2. Srivastava, U.K., M.Dharma Reddy, B.Subrahmaniam and V.K.Gupta, Impact of Mechanisation on Small Fishermen - Analyses and Village Studies, (Concept Publishing Company, New Delhi, 1986).

3. A partial exception to this observation may be a case study of Andhra Pradesh by N. Subha Rao, just listed above.

C) Studies on Kerala

The fishermen and fishing industry of Kerala have drawn the attention of scholars much earlier than those of most other parts of the country[1]. For instance, in the early 19th century (1807), Francis Buchanan wrote about the Kerala fishermen thus: 'the Muccua or in the plural Muccuar are a tribe who live near the sea coast of Malayala ... their proper business is that of fishermen ... in the southern part of the province most of them have become Mussalmans, but continue to follow their usual occupation'[2]. The fish and fisheries of Malabar were investigated by Dr.Francis Day in 1865[3] and by Edgar Thurston in 1900[4]. The results of a fishery cruise made in 1908 along the Malabar Coast was published in the same year[5]. Govindan (1916)[6] gave a

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1. The 'Sangam' literature of the 1st to 4th century A.D. and the writings of travellers to India like Pliny, who wrote in the 1st century AD bear testimony to this. For earlier references, see Government of Kerala, 'Master Plan for Fisheries Development - Kerala State, Trivandrum, 1969, p.4.

2. Francis Buchanan, Journey from Madras Through the Countries of Mysore, Canara and Malabar, Vol. 1, (Madras AD 1807), p. 527.

3. Francis Day, Fishes of Malabar, (Madras, 1865).

4. Edgar Thurston, Fisheries of Malabar and South Canara, (AD 1900).

5. Madras Fisheries Department, The Results of a Fishery Cruise Along The Malabar Coast and to the Laccadive Islands in 1908, Madras Fisheries Bulletin, No.IV, (Government of Presidency, Madras, 1908).

6. V.Govindan, Fishery Statistics and Information, West and East Coasts, Madras Fisheries Bulletin, No. IX, (Madras Fisheries Department, Madras, 1916).

description of the fisheries of the Malabar Coast. Panikkar (1937)[1] presented an outline of the prawn fisheries of the Malabar Coast. Similarly, James Hornell in 1938[2] gave a descriptive account of fishing methods of the Malabar Coast. Mampilli J. Cherian in 1943[3] reported the socio-economic condition of the Araya fishermen of Travancore. In 1948, Nataraj[4] studied the prawn fisheries of Travancore. In 1954,[5] Bog published the findings of a statistical survey of the Indo-Norwegian Project area at Neendakara in Quilon District. Sandven[6] gave a general factual account of the working of the Indo-Norwegian Project

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1. N.K.Panikkar, 'The Prawn Industry of the Malabar Coast', Journal of the Bombay Natural History Society, Vol. 39, No.2, pp. 343-53, 1937.

2. James Hornell, The Fishing Methods of the Madras Presidency - Part II; The Malabar Coast, Madras Fisheries Bulletin No. 27(1), (Government of the Presidency, Madras, 1938).

3. Mampilli J. Cherian, 'A Study of the Socio-Economic Condition of the Araya Community', Indian Journal of Social Work, Vol. 3, 1942/43.

4. S.Nataraj, The Prawns of Travancore, Report of the Department of Research, (University of Travancore, Trivandrum, 1948).

5. P.Bog, A Statistical Survey of Economic Conditions in the Project Area - Indo Norwegian Project Report No.2, (The Norwegian Foundation For Assistance to Under Developed Countries, Oslo, 1954).

6. P.Sandven, The Indo-Norwegian Project in Kerala, (Norwegian Foundation For Assistance to Under Developed Countries, Oslo, 1959).

at Neendakara in 1959. V.R.Pillai in 1959[1] made a study of the economy of the fisherfolk of south Kerala. The District Census Handbooks of Kerala (1961 Census[2]) and the Village Survey Monographs of Trivandrum District[3] gave a general account of the fishing industry of the coastal districts of Kerala. T.R.Thankappan Achari[4] in 1962 reported the findings of an economic assessment of fishing by small mechanised boats and canoes in the Indo-Norwegian Project area at Neendakara. The District Gazetteers of Kerala published by the Government of Kerala in 1962 gave an account of the fishing industry of selected coastal districts of Kerala[5]. The Department of Fisheries[6]

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1. V.R.Pillai, <u>A Study of The Economy of the Fisherfolk of Kerala</u>, (Economic Research Council, Trivandrum, 1959).

2. Directorate of Census Operations, <u>District Census Handbooks of Kerala</u>, (Government of India, Trivandrum, 1961).

3. Directorate of Census Operations, <u>Village Survey Monographs of Kerala - Trivandrum District</u>, (Government of India, Trivandrum, 1961).

4. T.R.Thankappan Achari, <u>Economic Assessment of Fishing by Small Mechanised Boats and Canoes in the Indo-Norwegian Project Area</u> (Mimeographed Report of INP, INP, Quilon, 1962).

5. A.Sreedhara Menon, <u>District Gazetteers of Kerala</u>, (Government of Kerala, Trivandrum, 1962).

6. Department of Fisheries, <u>Socio-Economic Survey of the Fisherfolk in the Districts of Cannanore, Kozhikode, Palghat and Trichur</u>, (Government of Kerala, Trivandrum, 1963/64).

in 1963 conducted a socio-economic survey of the fisherfolk in Cannanore, Kozhikode, Palghat (now in Malappuram District) and Trichur districts. Achari and Menon in 1963[1] conducted a study of the impact of the Indo-Norwegian Project on the socio-economic condition of the fishermen of the project area at Neendakara-Sakthikulangara. This study noticed a general improvement in the economy of the fisherfolk, with mechanisation bringing higher earnings, greater employment and better standard of living. The report also recognised the better health and education facilities provided by the project. It however found the existence of wide disparity in the magnitude of benefits accrued to the fishermen of Neendakara and Sakthikulangara villages, the former received less benefits than the latter.

Klausen in 1968[2] made a socio-anthropological study of the responses of two fishing communities - The Araya fishermen and the Latin Catholic fishermen - of the project area at Neendakara - Sakthikulangara. Klausen found that the responses of the Araya community to the project's activities were inadequate and that of the Latin Catholics impressive.

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1. T.R.Thankappan Achari and M.Devidas Menon, A Report on the Assessment of the Indo-Norwegian Project on the Socio-Economic Conditions of the Fishermen of the Indo-Norwegian Project Area, (NORAD, Oslo, 1963).

2. Arne Martin Klausen, Kerala Fishermen and the Indo-Norwegian Pilot Project, (George Allen and Unwin, London, 1968).

Krishna Iyer, Rajendran and Roy Choudhury in 1968[1] studied the relative performance of three different size-groups of trawlers (viz. 30 ft., 32 ft. and 36 ft.) operating along the Kerala Coast (Cochin base). The authors found the performance of the 36 ft. vessels much better than that of the other two categories.

In 1969 the Kerala State Planning Board[2] evaluated the comparative efficiency of different types of fishing vessels operating along the Kerala Coast. The Board found that the performance of all vessels except the 32 ft. vessels and the country boats was unsatisfactory. It, however, noted that the 25 ft. vessels operating from Calicut were earning some profit.

Achari in 1969[3] prepared a new report on the impact of the Indo-Norwegian Project on the growth and development of Indian fisheries. The report identified seven major benefits accruing from the project. They are growth of

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1. H.Krishna Iyer, R.Rajendran and R.L.Roy Choudhury, 'Comparative Fishing Ability and Economic Efficiency of Mechanised Trawlers Operating Along the Kerala Coast', Fishery Technology, Vol.V, No.2, pp. 71-80, 1968.

2. State Planning Board, Comparative Efficiency of Fishing Crafts in Kerala, (Government of Kerala, Trivandrum, 1969).

3. T.R.Thankappan Achari, The Impact of the Indo-Norwegian Project on the Growth and Development of Indian Fisheries, (State Planning Board, Trivandrum, 1969).

mechanised fishing, development of new fisheries, improvements in the living standards of the fishermen, greater dispersion of ownership of the means of production (capital), growth of the processing sector, increase in exports and the boom in employment.

The Directorate of Fisheries in 1969[1] presented a brief account of the fisheries development in the state in the past and prepared a master plan for the development in the future. The Master Plan aimed at expansion in production with programmes for introduction of additional fishing vessels, construction of fishing harbours, fish processing plants, ice factories, boat building yards, net making unit, marine diesel engine factory and several other shore establishments, all planned to be introduced over a period of 20 years extending from 1969 to 1989.

Saxena in 1970[2] made an economic appraisal of the shrimp fisheries off the Kerala Coast.

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1. Directorate of Fisheries, Master Plan for Fisheries Development - Kerala State, (Government of Kerala, Trivandrum, 1969).

2. B.S.Saxena, 'Use of Economic Perimeters in the Rational Exploitation of Deep-Sea Fisheries with Particular Reference to Shrimp Fishery off Kerala Coast', Indian Seafoods, Vol. VIII, No.1, pp. 19-29, June 1970.

Prakasam[1] in 1972 studied the socio-economic transformation taking place in the Araya fishing community of Vypeen in Ernakulam district. So also Joseph[2] in 1973 worked out the economics of operating the 17.5 m indigenous streel trawlers along the Kerala Coast.

Prakasam[3] again in 1974 reviewed the impact of mechanisation on the fishermen of Vypeen Island.

Galtung[4] in 1974 highlighted the technological externalities which arose following the setting up of the Indo-Norwegian Project in Kerala.

In 1976 Ramakrishnan Korakandy[5] made a critical study of employment, organisation and productivity in the

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1. M.S.Prakasam, 'Socio-Economic Metamorphosis of the Arayans', Journal of Social Research, Vol. XV, No.2, September 1972.

2. K.M.Joseph, 'Economics of Operation of the 17.5 m Indigenous Steel Trawlers Along the Kerala Coast', Seafood Export Journal, Vol. VII, No.7, pp. 25-33, July 1973.

3. M.S.Prakasam, 'Impact of Mechanisation on Fishermen', Voluntary Action, Vol. XVI, Nos. 2 and 3, March-June 1974.

4. John Galtung, 'Technology and Dependence - The Internal Logic of Excessive Modernisation in a Fisheries Project in Kerala', CERES, pp. 45-50, Sept. - Oct. 1974.

5. Ramakrishnan Korakandy, 'Some Aspects of Employment, Organisation and Productivity in the Fishing Industry of Kerala - A Spatial Analysis', (Unpublished M.Phil Dissertation, Jawaharlal Nehru University, New Delhi, 1976).

fishing industry of Kerala. In the same year Valsala John[1] made an attempt to study the structure of the marine products export industry and the backward linkages operating in it. The Resuscitative Committee[2] for fishery cooperatives in 1976 studied the working of the fishery cooperatives in the state.

Ramakrishnan Korakandy[3] in 1977 made a pioneering study of the process of capitalist development in the fishing industry of Kerala. Similarly Kurien[4] made a preliminary analysis of the trends in production, distribution, technology and organisation in the fishing industry of Kerala in 1978.

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1. Valsala John, 'The Marine Products Export Industry of Kerala - Some Aspects of Its Structure and Backward Linkages', (Unpublished M.Phil Dissertation, Centre for Development Studies, Trivandrum, 1976).

2. Resuscitative Committee for Fishery Cooperatives, Report of the Resuscitative Committee for Fisheries Cooperatives, (Government of Kerala, Trivandrum 1976).

3. Ramakrishnan Korakandy, 'Evolution of a New Capitalist Structure in the Fishing Industry', Seafood Export Journal, Vol. 9, No. 12, December 1977.

4. John Kurien, Towards an Understanding of the Fish Economy of Kerala State, CDS Working Paper, No. 68, (Centre for Development Studies, Trivandrum, 1978).

In the same year Mathur[1] provided a descriptive account of the Mappila fishermen of Tanur with respect to their organisation, technology, trade, credit, capital and savings.

Noble and Narayanankutty[2] in 1978 made a case study of the economics of indigenous fishing vessels operating from Cochin.

Vattamattom[3] in 1978 made an attempt to identify the factors that determine the earnings of the fishermen at the Poonthura village in Trivandrum district. In 1979 Ramakrishnan Korakandy[4] made an analysis of the structure and pattern of employment in the fishing industry of Kerala.

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1. P.R.G.Mathur, The Mappila Fisherfolk of Kerala, (Kerala Historical Society, Trivandrum,1978).
2. A.Noble and V.A.Narayanankutty, 'Economics of the Indigenous Fishing Units of Cochin - A Case Study', CMFRI, Special Publication No. 4, (Central Marine Fisheries Research Institute, Cochin, 1978).
3. Joseph Vattamattom, 'Factors that Determine the Income of Fishermen - A Case Study of Poonthura Village in Trivandrum District', (Unpublished M.Phil Dissertation, Centre for Development Studies, Trivandrum, 1978).
4. Ramakrishnan Korakandy, 'An Analysis of the Structure and Pattern of Employment in the Fishing Industry of Kerala', Annual of the Industrial Fisheries Association - 1979.

In the same year, Bhushan[1] made a preliminary effort to evaluate the technological changes in the fishing industry of Kerala. This study investigated the nature of the technological changes, their implications for the fishermen, the fishing industry and the fishery resources of the state. Bushan found that the changes in technology while contributing to increases in production (both in terms of quantity and value) have resulted in structural and organisational changes in the industry involving greater division of labour, higher skills, changes in ownership pattern and changes in the mode of sharing the output. The emergence of the conflict between the mechanised and non-mechanised sectors in exploiting the same stock of fish in the inshore waters and their adverse consequences for the fishery economy and the fishery resources of the state have been pointed out. This study is, however, narrow in its approach in as far as it has confined itself to a historical sketch of the process of mechanisation of the fishing boats without paying sufficient attention to the various other aspects of technological change, such as fisheries research,

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1. Bharat Bhushan, 'Technological Change in Fishing in Kerala - 1953-1977', (Unpublished M.Phil Dissertation, Centre for Development Studies, Trivandrum, 1979).

education, training and infrastructural development. It gave no account of the investments made in the industry, either public or private during the period under study. It has also failed to take account of the effects of technological changes on employment, earnings, productivity (capital-output ratios), savings, investment, etc. John Platteau _et al._[1] in 1979 presented an account of the credit and indebtedness among the traditional fishermen of south Kerala. In the same year (1979)[2] Ramakrishnan Korakandy presented a preliminary analysis of the productivity trend in the fishing industry of Kerala. Kurien[3] presented a brief critique of the fishermen's cooperatives in Kerala in 1979. Abdul Hakkim[4] in 1980 studied the role of cooperatives in the mechanisation of fishing boats and their impact on the traditional fishermen

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1. J.P. Platteau, _et al._, _Credit and Indebtedness Among the Marine Fishermen of South Kerala_, (FUCID/ISI/ Joint Project Report, Namur, 1979).

2. Ramakrishnan Korakandy, 'Productivity in Kerala's Fishing Industry', _Eastern Economist_, Vol. 72, No. 28, June 29, 1979.

3. John Kurien, _Fishermen's Cooperatives in Kerala - A Critique_ (BOBP/Misc/1, Bay of Bengal Programme, Madras, 1980).

4. V.M. Abdul Hakkim, 'Mechanisation and Cooperative Organisation - Their Impact on Traditional Fishermen of Kerala', (Unpublished M.Phil dissertation, Centre for Development Studies, Trivandrum 1980).

of Kerala. Krishnakumar[1] in 1980 gave the details of a new strategy and action programme for fisheries development and fishermen's welfare in Kerala State.

Ramakrishnan Korakandy[2] in 1980 studied the role of price-spreads in escalating fish prices. Similarly Kurien and Jayakumar[3] in 1980 made a preliminary assessment of the motorisation of traditional canoes in Purakad village in Alleppey district. M.J.George _et al._[4] in 1980 investigated the problem of depletion of the shrimp resources along the Neendakara Coast.

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1. S. Krishnakumar,, _Strategy and Action Programme for a Massive Thrust in Fisheries Development and Fishermen Welfare in Kerala State (1980-83)_, (Government of Kerala, Trivandrum,1980).
2. Ramakrishnan Korakandy, 'The Role of Price Spreads in Escalating Fish Prices - A Preliminary Analysis', _Annual of the Industrial Fisheries Association_, 1980.
3. John Kurien,and S.R.J.Jayakumar, _Motorisation of Traditional Canoes - The Purakad Experiment_, (Fisheries Research Cell, Trivandrum,1980).
4. M.J.George, _et al._, 'A Case of Over-Fishing - Depletion of Shrimp Resources Along Neendakara Coast, Kerala', _Marine Fisheries Information Service_, _No. 18_, (Central Marine Fisheries Research Institute, Cochin, 1980).

In 1981, Sathiadas and Venkataraman[1] studied afresh the impact of mechanised fishing on the socio-economic condition of the fishermen of Sakthikulangara-Neendakara area of Kerala. This study found improvements in housing, literacy, employment, infrastructure, production, exports and earnings of the region. It, however, recognised the rise in the level of indebtedness of the fishermen households which was attributed to the bank loans taken by the households for purchase of fishing vessels. The study further pointed out lack of a fishing harbour as the major constraint affecting the development of the project area[2]. A major drawback of this study is that it is a case study of the sort of 'pure' impact analysis with no effort to explain the process or dynamics of development in the industry. The structural or organisational changes that took place in the industry are not explained by this study. This study has also failed to take into account the changes in the production function, productivity and other improvements in the industry. It may, nevertheless, be noted that this study had only the limited objective of

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1. R. Sathiadas and G. Venkataraman, 'Impact of Mechanised Fishing on the Socio-Economic Condition of Fishermen of Sakthikulangara-Neendakara, Kerala', The Marine Fisheries Information Service, No. 29, pp. 1-18, (Central Marine Fisheries Research Institute, Cochin, 1981).

2. Ibid., p. 17.

assessing the general impacts of mechanisation on production, employment, earnings etc.

Panikkar and Alagaraja[1] in 1981 analysed the socio-economic condition of the fishermen at the Puthiaopa - Puthiangadi region in Kozhikode district. This study found clear improvements in the socio-economic condition of the fishermen. It also recognised the prevalence of indebtedness among the fishermen households, which it considered was because of the loans taken for financing the fishing units. A major drawback of this study is that it also falls into the realm of pure impact analysis without taking into account the structural and organisational linkages within the industry. It should, however, be noted that this study had no such wider objectives.

During 1980-81 Kurien and Willmann[2] made a comparative study of the costs and earnings of artisanal

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1. K.K.P.Panikkar and K.Alagaraja, 'Socio-Economic Status of Fishermen Community of Calicut Area', Marine Fisheries Information Service, No. 33, pp. 2-12, (CMFRI, Cochin, 1981).

2. John Kurien and Rolf Willmann, Economics of Artisanal and Mechanised Fisheries in Kerala, A Study of Costs and Earnings of Fishing Units, (FAO/UNDP/ Working Paper No. 34, Madras, 1982).

and mechanised fishing boats operating in Kerala. This study found that among the twentytwo craft-gear combinations studied, all but five were operating at a profit. Profitability ratios (returns on investment) were found to be the highest in the case of encircling net/plank canoe, cotton shore-seine/plank canoe and hook-and-line/kattumaram combinations. The mechanised vessels on the other hand were found to be incurring losses. The authors, however, cautioned that the findings of this study should be treated as purely tentative as the 1980-81 fishing season was reported to be exceptionally poor due to bad weather.

The Babu Paul Committee on Marine Fishery Resources[1] presented the background of the conflict in the fishing industry of Kerala and the views of traditional fishermen, mechanised boat owners and scientific community regarding the need for conservation and regulation in the industry. The opinion of the Committee was, however, divided on the question of depletion of marine fishery resources and the need for regulation of trawling and other type of fishing by mechanised boats[2].

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1. D.Babu Paul, Report of the Committee to Study the Need For Conservation of Marine Fishery Resources During Certain Seasons of the Year and Allied Matters, (Government of Kerala, Trivandrum, 1982).

2. Ibid., p. 71.

Krishna Iyer and others[1] in 1983 again studied the comparative economic efficiency of selected 32 ft. (9.82 m) and 36 ft. (11 m) trawlers operating along the Kerala coast. This study found that the performance of the 9.82 m vessels was better than that of the 11 m vessels.

Sathiadas and Venkataraman[2] in 1983 conducted a case study of indebtedness and credit utilisation in the two fishing villages of Sakthikulangara and Neendakara. This study found that approximately 61 per cent of the households in Neendakara and 65 per cent of the households in Sakthikulangara were in debt. It was also seen that while about 90 per cent of the credit in Sakthikulangara was utilised for investment purposes, the percentage in Neendakara was only 63 per cent[3].

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1. H.Krishna Iyer, et al., 'Comparative Economic Efficiency of Fishing Trawlers of 9.82 m (32 ft.) and 11 m (36 ft.) OAL Operating Along the Kerala Coast', Fish Technology News Letter, Vol. III, No. 7, pp. 7-8, March 1983.

2. R.Sathiadas and G.Venkataraman, 'Indebtedness and Utilisation of Fisheries Credit in Sakthikulangara and Neendakara, Kerala, A Case Study', Marine Fisheries Information Service, No. 54, pp. 1-6, (CMFRI, Cochin, 1983).

3. Ibid., p. 4.

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Ramakrishnan Korakandy[1] in 1984 offered an economic analysis of the conflict in the purse-seine fishing industry of Kerala.

Leela Gulati[2] in 1984 presented a study of the impact of technological changes in the fishing industry of Kerala upon the fisher-women of the state.

Kurien[3] in 1984 made a preliminary study of marine fish marketing in Kerala. Again in 1985,[4] he provided a profile of the conditions of labour and employment in the fishing industry of Kerala. In the same year Kurien[5] made a reappraisal of the objectives and achievements of the Indo-Norwegian Project in Kerala.

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1. Ramakrishnan Korakandy, 'The Purse-Seine Fishing Industry in Kerala - Its Economics and Politics', Economic and Political Weekly, Vol. XIX, No.13, March 31, 1984.

2. Leela Gulati, Fisher-women on the Kerala Coast - Demographic and Socio-Economic Impact of a Fisheries Development Project, (International Labour Organisation, Genewa, 1984).

3. John Kurien, The Marketing of Marine Fish Inside Kerala State - A Preliminary Study (Mimeo), (Centre for Development Studies, Trivandrum, 1984).

4. John Kurien, Fish Workers in Kerala - Profile of Conditions of Labour and Employment (Mimeo), (Centre for Development Studies, Trivandrum, 1985).

5. John Kurien, Technical Assistance Projects and Socio-Economic Change - The Norwegian Intervention in Kerala's Fisheries Development Experience (Mimeo), (Centre for Development Studies, Working Paper No. 205, Trivandrum, 1985).

Platteau and others[1] presented a study of the inter-linkages of technology, credit and indebtedness in the marine fishing villages of Kerala in 1985. In the same year the Expert Committee on Marine Fisheries[2] in Kerala submitted its report to the Government of Kerala. The Committee investigated the question of overfishing and conservation in the marine fishing industry of Kerala, It found no instance of major over fishing but gave a number of suggestions and recommendation to the government to conserve the fisheries as well as to protect the traditional fishermen and to enhance fish production in the state.

Having made a perusal of the long list of literature on the fishing industry of Kerala, it is abundantly clear that there are only a handful of studies concerned with the process of development of the industry. It may be noted that even those studies[notably the studies by John Kurien (1978) and Bharat Bhushan (1979)], while presenting the trend in the

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1. Jean-Philippe, Jose Murickan and Etienne Delbar, Technology, Credit and Indebtedness in Marine Fishing - A Case Study of Three Fishing Villages in South Kerala, (Hindustan Publishing Corporation (India), Delhi, 1985).

2. A.G.Kalawar, M.Devaraj and A.H.Parulekar, Report of the Expert Committee on Marine Fisheries in Kerala (Mimeo),(Central Institute of Fisheries Education, Bombay, 1985).

development of the industry have failed to examine and explain the process of development of the industry. This failure, it must be pointed out, is primarily the result of the lack of a theory or a framework to explain the process of development in the industry. The need for a fresh theoretical approach is obvious. Hence, in the next chapter an attempt is made to evolve a theory of development for explaining the growth of the Primary Marine Fishing Industry of Kerala.

CHAPTER - III

CONCEPTUAL FRAMEWORK AND METHODOLOGY

In the last chapter a comprehensive survey of literature on the subject was made. In this chapter it is proposed to present the conceptual framework in which this study is undertaken and the methodology followed.

In perusing the literature on the subject it has been the endeavour of this scholar to find out a theory of fisheries development. But it became apparent that no such theory existed. Hence, it became incumbent on this researcher to evolve a theory capable of explaining the process of development in the primary marine fishing industry of Kerala[1].

In the absence of a well established theory capable of explaining the process of development in the primary marine fishing industry of Kerala, this scholar is forced to take recourse to the world of economic theory - economic development in particular - to find a suitable

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1. It may be noted that quite a lot of literature existed on models of commercial fishing but practically very little on fishery industrial development.

model capable of explaining the development process. Development economics literature is rampant with models of growth, stage theories and patterns of development. But the objective here is limited to offer a plausible explanation of the 'process' of growth. Hence our effort here is to present a plausible model of growth. It is presumed that this approach, notwithstanding the practical problems and inherent limitations, will help in identifying and explaining the complex process of development in one of the most traditional industries of the state.

1. The Model of Technological Change and Economic Development

Economic development in the present century is explained largely in terms of advances in science and technology. For e.g. much of Europe's and North America's economic progress in the first half of this century is attributed to 'changes in technology'. Some of the influential studies by Fabricant, Abramovitz and Solow in the 1950,s showed that approximately 80 to 90 per cent of the increase in the output per worker in the U.S. economy since 1870 was due to technical progress rather than an increase in the use of other factor inputs[1]. A similar study by Denison[2] in the early sixtees for the U.S. for 1929-57 concluded that about 40 per cent of the increase in national income per capita was the result of 'advance of knowledge'. Massel[3] found that approximately 60 per cent of the increase in output per worker in the U.S. manufacturing industry during the early part of the century was due to technical change and improved working force quality. Schultz[4] concluded that approximately 83 per cent of the increase in U.S. Agricultural Production between 1910-14 and 1945-49 was due to improvement

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1. For a review of these studies see Charles Kennedy and A.P.Thirlwall, 'Surveys in Applied Economics - Technical Progress'. The Economic Journal, Vol. 82, No. 325, pp. 11-72, March 1972. For details of the findings, see (1) Solomon Fabricant, 'Economic Progress and Economic Change', 34th Annual Report of the National Bureau of Economic Research - New York, 1954, (2) Milton Abromovitz, 'Resource and Output Trends in the United States since 1870', American Economic Association, papers, May 1956, and (3) R.M.Solow 'Technical Change and Aggregate Production Function', Review of Economics and Statistics, August 1957.

2. E.F.Denison, The Sources of Economic Growth in the U.S. And the Alternatives Before Us, (Committee for Economic Development, Library of Congress, New York, 1962).

3. B.F.Massel, 'Capital Formation and Technological Change in U.S. Manufacturing', Review of Economics and Statistics, May 1960.

4. T.W.Schultz, 'Investment in Human Capital', American Economic Review, March 1961.

in 'skill and knowledge' or 'investment in human capital'. Schultz made similar estimates for other countries for different periods. The results of his study are: 'Argentina (1912-1914 to 1945-1949) - 62 per cent, Brazil (1925-1929 to 1945-1949) - 45 per cent and Mexico (1925-1929 to 1945-1949) - 50 per cent.

In the U.K., Reddaway and Smith[1] found that only a quarte of the increased output per worker during the period from 1948 to 1954 could be accounted for by increases in the use of factor inputs such as labour and capital. Three-fourths of the increase in output per worker had to be explained by other factors such as higher education, better skills and improved techniques. Similar conclusions were reached by Aukrust and Bjerke[2] for Norway and Niitamo[3] for Finland.

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1. W.B.Reddaway and A.D.Smith, 'Progress in British Manufacturing Industries in the Period 1948-54', Economic Journal, March 1960.

2. O.Aukrust and J.Bjerke, 'Real Capital and Economic Growth in Norway 1900-56', in IARIW, The Measurement of National Wealth, (Income and Wealth - Series VIII, Bowes and Bowes, London, 1959).

3. O.Niitamo, 'The Development of Productivity in Finnish Industry 1925-52', Productivity Measurement Review, November 1958.

The empirical findings cited above are only indicative of the predominant role which technological changes played in the economic development of advanced countries. The role of technological change in the development of less developed countries is now widely recognised and it had drawn the attention of several third world economists. Economists like Lall[1] and Katz[2] emphasised the need for creating a strong technological basis in the LDCS for promoting economic development. The characteristics of the technology or rather its 'appropriateness' was emphasised by others like Stewart[3] and White[4]. Graham[5] stressed the need for a proper transfer and diffusion of technology in under-developed countries.

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1. S. Lall, Developing Countries as Exporters of Technology, (MacMillan, London 1981).

2. J. Katz, 'Technological Change, Economic Development and Intra and Extra Regional Relations in Latin America', IDB/ECLA/UNDP/IDRC Regional Programme of Studies on Scientific and Technical Development in Latin America, Working Paper No. 30, (Bueness Aires, 1978).

3. Francis Stewart, 'Micro Policies For Appropriate Technology - An Introductory Classification', (Mimeo), (Queen Elizabeth House, Oxford, 1982).

4. L.J. White, 'The Evidence on Appropriate Factor Proportions for Manufacturing in Less Developed Countries - A Survey', Economic Development and Cultural Change, Vol. 27, 1978.

5. Graham Jones, The Role of Science and Technology in Developing Countries, (Oxford University Press, London, 1971).

The predominant role of technological progress in Indian economic development was adequately portrayed by Bhattacharya[1] in 1972. The model of technological change and economic development presented by Bhattacharya is worth noting. In a predominantly agricultural economy like ours, with large labour surplus, the rate of increase in agricultural output sets the limit within which industrialisation can take place.

The economy with heavy pressure on agriculture for wagegoods and export of primary produce for import of capital goods will have practically very little resources (savings) for industrialisation. With limited potential for continuous foreign aid and meagre capacity for increasing domestic savings, the inherent tendency towards stagnation in these economies could be checked only by continuous technological improvements[2]. The ability to devise and introduce on a broad scale, improved techniques and cultivation practices such as crop rotation, pest control, seed breeding, fertilizer use, etc. that is, anything which

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1. Debesh Bhattacharya, The Role of Technological Progress in Indian Economic Development, (The World Press Private Limited, Calcutta, 1972).

2. Ibid., p. 4.

would increase the total agricultural output, represents the key to a successful development effort. A continuous upward shift in the production function of a labour surplus underdeveloped country is possible only with major additions of new technological and related knowledge[1].

Technological progress that improve the productivity of land and labour is a necessary condition for economic development in developing countries.

2. Meaning of Technological Change

The term 'technical progress' or 'technological change' is used in several different senses to describe a variety of phenomena. Thirlwall[2] has distinguished three senses in which the term is used: First, it refers to the 'effects' of changes in technology, or more specifically the role of technical change in the growth process. In this sense it implies advances in knowledge which improve human welfare quantitatively through increases in real income per head and qualitatively through widening man's choice of goods and extending his

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1. Ibid., p. 4.
2. A.P. Thirlwall, Growth and Development, MacMillan, 1972, p. 105.

leisure. As such, technical progress may take several different forms including new processes of production, new goods and new methods of industrial organisation, especially in the fields of management and marketing[1]. The term is used as a semantic umbrella to cover all those factors which contribute to the growth of 'total' productivity[2]. Its essential characteristic is to shift the production function (embodying all previously known techniques) enabling greater output to be produced with the same volume of inputs, or the same output with lesser inputs[3]. Second, it is used in a narrow specialist sense to describe the 'character' of technological improvement, which is often prefaced for this purpose by the adjectives 'labour saving', 'capital saving' or 'neutral'[4].

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1. Charles Kennedy and A.P.Thirlwall, 'Surveys in Applied Economics, Technical Progress', The Economic Journal, Vol. 82, No. 325, p. 12, March, 1972.

2. Gustav Ranis, 'Technological Change Theories', International Encyclopaedia of Social Sciences, Vol. IV, p. 413.

3. Charles Kennedy and A.P.Thirlwall, Op. cit., p. 12.

4. For a description of the different types of technical change see R. Harrod, Towards a Dynamic Economics, (MacMillan, London, 1948) and J. Hicks, The Theory of Wages, (MacMillan, London, 1932), More Complex Classifications of Technical Progress have been attempted by M.J.Beckmann and R.Sato in 'Aggregate Production Functions and Types of Technical Progress - A Statistical Analysis', American Economic Review, March, 1969.

Third, the term is used more literally to refer to 'changes' in technology itself, defining technology as useful knowledge pertaining to the art of production. Used in this sense, the emphasis is on describing improvements in the design, sophistication and performance of plant and machinery, and the economic activities through which improvements come about - research, invention, development and innovation[1]. Here we are concerned with the knowledge - creating activities of research, invention and development, together with the process of absorption of new knowledge into the productive system[2].

According to Williams[3] technical progress includes better organisation and management, more skillful and effective labour, as well as improved materials, process and equipment. Quoting Solow, Bradbury[4] states that it is a portmanteau word to include any kind of shift in the production function: showdowns, speed ups, improvements in the education of labour force and all sorts of things. Debesh Bhattacharya summarises the meaning of the term thus:

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1. A.P.Thirlwall, op. cit., p. 105.
2. Charles Kennedy and A.P.Thirlwall, op. cit., p. 12.
3. B.R. Williams, Technology, Investment and Growth, (Chapman and Hall, London, 1967), p. 67.
4. F.R. Bradbury,'The Economics of Technological Development' in Trevor I Williams (Ed.), History of Technology, p. 74.

'In terms of a wide definition, technological progress includes all the ways in which advances of knowledge promote economic growth. It comprises all the productivity benefits of increased education, and product innovations attributable to research, of economies of scale, of the introduction of money into agriculture, the predominant sector of the economy which is partly non-monetized, and of import substitution. This list could be carried on indefinitely to include anything which would bring an increase in productivity in technological progress. In a narrower sense, technological progress refers to the introduction of new or improved processes, which require fewer or cheaper inputs per unit of output, and of new or improved products; increased mechanisation and automation exemplify the former, plastics and computers the latter. In this sense, there could be either 'process' or 'product' innovation. The type of technical progress where fewer or cheaper inputs are needed per unit of output of a given product is called process innovation. This process innovation takesplace because of a change in the nature of inputs such as introduction of a new capital goods, new labour or management skills, etc. Hence, mechanisation and automation are sometimes equated with technological progress, the former represents the extension of man's physical efficiency through the substitution of machine energy for human energy, while the latter supplement his mental and sensory processes as well. Product innovation refers to the introduction of new products, that is the products with which the population is not yet familiar'[1].

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1. Debesh Bhattacharya, op. cit., pp. 1-2.

According to Salter[1], it (the process) involves the interaction of inputs and outputs of the production activity with market forces and the progressive disturbance of these relatives by further innovation and technological change. The impact of new knowledge, of invention and innovation, is to lead to new production functions, each of which is superior to its predecessors in the sense that less of one or more of the factors of production is required to produce a given output.

3. Measurement of Technological Change and Economic Development

At the very outset we admit that there is no precise and scientific method for measuring technological change and economic development. However, in any analysis of technological progress and economic development the problem of measurement still arises and the usual practice is to measure technological change by its effects on the production function[2].

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1. W.E.G. Salter, Productivity and Technical Change, (Cambridge University Press, 1969).

2. Charles Kennedy and A.P.Thirlwall, op. cit., p. 13.

a) The Production Function Approach

The production function approach to the study of technological progress and economic development has been widely used by economists following the pioneering work of Charles Cobb and Paul Douglas[1] in 1928. Jan Tinbergen was the first to explicitly use the production function approach in an estimate of technical progress using the exponential time trend to production data[2]. S. Valavanis[3], however, was the first actually to use the productivity term (representing technical change) in the Cobb-Douglas form in an estimate of technical progress in the American Economy over the period 1869-1948. Following these, several estimates of technical progress using empirical data of manufacturing and agriculture have been made by economists for U.S. and other countries

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1. C.W. Cobb and P.H. Douglas, 'A Theory of Production', American Economic Review, (Supplement), March, 1928.

2. This is as reported by Charles Kennedy and A.P.Thirlwall in their review article, 'Surveys in Applied Economics - Technical Progress', published in the Economic Journal, Vol. 82, No. 325, March, 1972, Tinbergen's article was written in May 1942.

3. Valavanis's article, 'An Econometric Model of Growth, USA, 1869-1953' was published in the American Economic Association Papers in May 1955.

including Great Britain. The notable among these studies are those made by Abramovitz (1952)[1], Schmookler (1952)[2], Fabricant (1954)[3], Solow (1957)[4], Massel (1960)[5], Kennedy (1961)[6], Kendrick (1961)[7], Brown and Decane (1962)[8], Lave (1962)[9], Denison (1962)[10],

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1. M. Abramovitz, 'Resource and output Trends in the United States since 1870', American Economic Association Papers, May 1956.

2. J. Schmookler, 'The Changing Efficiency of the American Economy 1869-1938', Review of Economics and Statistics, August 1952.

3. S. Fabricant, 'Economic Progress and Economic Change', 34th Annual Report of the National Bureau of Economic Research, New York, 1954.

4. R.M. Solow, 'Technical Change and the Aggregate Production Function', Review of Economics and Statistics, August 1957.

5. B.F. Massel, 'Capital Formation and Technological Change in U.S. Manufacturing', Review of Economic and Statistics, May 1960.

6. C. Kennedy, 'Technical Progress and Investment', Economic Journal, June 1961.

7. J.W. Kendrick, Productivity Trends in the United States, (National Bureau of Economic Research, Princeton University Press, 1961).

8. M. Brown and J.S. Decane, 'Technological Changes in the United States 1950-1960', Productivity Measurement Review, May 1962.

9. L.B. Lave, 'Empirical Estimates of Technological Change in U.S. Agriculture - 1850-1958', Journal of Farm Economics, November 1962.

10. E.F. Denison, The Sources of Economic Growth in the U.S. and the Alternative Before Us, (Committee for Economic Development, Library of Congress, New York, 1962).

Griliches (1963)[1], Nelson (1964)[2] and Mansfield (1968)[3] for the United States and those by Carter and Williams (1957)[4], Reddaway and Smith (1960)[5] and Salter (1966)[6] for the United Kingdom. The studies by Aukrust and Bjerke for Norway (1959)[7] are also noteworthy. Domar in his 1961[8] article has attempted to measure technological change using a production function model. Notwithstanding the

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1. Z. Griliches, 'The Sources of Measured Productivity Growth: United States Agriculture - 1940-1960', Journal of Political Economy, August 1963.

2. R.R. Nelson, 'Aggregate Production Function and Medium Range Growth Projections', American Economic Review, September 1964.

3. E. Mansfield, Industrial Research and Technological Innovation - An Economic Analysis, (W.W.Norton, New York, 1968).

4. C.F. Carter and B.R. Williams, Industry and Technical Progress, (Oxford University Press, London, 1957).

5. W.B. Reddaway and A.D. Smith, 'Progress in British Manufacturing Industries in the Period 1948-1954', Economic Journal, March 1960.

6. W.E.G. Salter, Productivity and Technical Change (Ed. 2), (Cambridge University Press, 1966).

7. D. Aukrust and J. Bjerke, 'Real Capital and Economic Growth in Norway 1900-1956', in I.A.R.I.W. The Measurement of National Wealth, (Income and Wealth Series VIII), (Bowes and Bowes, London, 1959).

8. D. Domar, 'On the Measurement of Technological Change', Economic Journal, December 1961.

diversity in the variables and the models specified in the above studies, the common approach was to measure technological change by its effects on the production function as reflected in the productivity parameter[1].

i) The Basic Production Function Model Incorporating Technological Change

The model assumes two things; (1) that economic development is reflected in an improvement in productivity and (2) that technological progress leads to an increase in productivity[2]. A model which incorporates the productivity factor (technological change) in the production function is given by Solow[3] in the multiplicative form:

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1. The productivity parameter invariably showed an improvement because of better inputs, better processes and better management under changed technological matrixes.

2. Technological change (new inputs and new processes) helps in improving the productivity by making it possible to produce more output with the same input or the same output with less inputs. This in effect helps in reducing the cost per unit of output which is the primary indicator of an improvement in productivity.

3. R.M. Solow, 'Technical Change and the Aggregate Production Function', Review of Economics and Statistics, August 1957.

$$Q = P(t)\ f\ (L^{\alpha}\ K^{1-\alpha}) \qquad \ldots 1$$

where Q = output; K = capital inputs; L = labour inputs; while α and A are parameters.

Note that P is determined by time (t) or technological change.

In estimating form the equation for technological change is:

$$\frac{\dot{P}}{P} = \frac{\dot{q}}{q} - w_k \frac{\dot{k}}{k} \qquad \ldots 2$$

where q is the output per worker

k is the capital per worker

Wk is capital's share of total output

and . denotes derivatives with respect to time.

Here technological change (or technological progress) is defined as that part of the change in output per worker not accounted for by a change in capital per worker weighted by capital's share of output[1].

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1. A.P. Thirlwall and Charles Kennedy, op. cit., p. 14.

ii) Adaptation of the Model to the Fishing Industry

For most industries the production function may be written as:

$$Q = AK^{\alpha} L^{1-\alpha} \qquad \ldots 3$$

where Q = output; K = capital inputs; L = labour inputs; while α and A are parameter and constant respectively. This well-known Cobb-Douglas production function is specified as one exhibiting constant returns to scale (i.e. a one per cent increase in inputs will result in one per cent increase in output)[1]. Adding a trend variable to reflect shifts in the production function due to technological improvements we get.

$$Q = AK^{\alpha} L^{1-\alpha} (1 + n)^{\Gamma} \qquad \ldots 4$$

Dividing equation (4) by L we can derive the average labour productivity for both industry and individual firm:

$$\frac{Q}{L} = A\left(\frac{K}{L}\right)^{\alpha}(1 + n)^{\Gamma} \qquad \ldots 5$$

Equation (5) states that the average labour productivity for a typical firm in an industry depends on the capital per worker and a secular time trend which represents technological progress.

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1. P.H. Douglas, 'Are There Laws of Production', The American Economic Review, Vol. 38, pp. 1-41, March, 1948.

In the case of the fishing industry, the individual firm is also influenced by technological externalities. According to Mishan[1] '... an external effect arises wherever the value of a production function or a consumption function, depends directly upon the activity of others. What the notation above does not succeed in conveying, however, is that the essential of an external effect is that the effect produced is not a deliberate creation but an unintended or incidental by-product of some otherwise legitimate activity'. It has been shown by Gordon[2] and Scott[3] that because of the rising supply function in the fishing industry, economic rents will be created as demand expands. The expansion in demand will induce more firms to enter the industry since the resources are common property and not owned by any one. Entry by additional firms will depress the catch rates since there are now more firms fishing a fixed resource. We can therefore specify that the average labour

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1. E.J. Mishan, 'The Postwar Literature on Externalities: An Interpretative Essay', Journal of Economic Literature, Vol. 9, No. 1, pp. 1-28, March 1971.

2. H.S. Gordon, 'The Economic Theory of Common Property Resources: The Fishery', The Journal of Political Economy, Vol. 62, No.2, pp. 124-42, April 1954.

3. Anthony D. Scott, 'The Fishery: The Objective of Sole Ownership', The Journal of Political Economy, Vol. 63, pp. 116-24, April 1955.

productivity for the typical firm (and for the industry as well) will be influenced by the level of aggregate economic activity associated with the fishery resource. Operationally, the single most used measure of economic activity associated with the fishery resource is embodied in a concept called 'fishing effort'. Conceptually, fishing effort is a measure of the ability of capital and labour to render mortality (i.e., to catch fish) to a fish stock expressed in some standard units. Under the most simplified assumptions, fishing effort is merely the summation of the number of homogeneous firms working a fishery resource. For most fisheries, 'measured' fishing effort is a rough proxy for inputs of capital and technology[1]. If E_1 is the fishing effort for the individual firm, then $\sum_{i=1}^{N} Ei$ is the total fishing effort applied to the resource base. It is the latter measure which influences average labour productivity. We shall include this externality directly in the production function in the following manner:

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1. F.W. Bell and R.K. Kinoshita, The Measurement and Analysis of Labour Productivity Changes in United States Fisheries, File Manuscript No. 106, (National Marine Fisheries Service, U.S. Department of Commerce, Rockville, 1971), p. 33.

$$(\frac{Q}{L})_i = A(\frac{K}{L})_i^{\alpha} \quad (1+n)_i^T \quad (\sum_{i=1}^{N} Ei)^{\beta} \qquad \ldots 6$$

where N is the number of firms in the industry. The sign of β is hypothesised to be negative since increases in fishing effort should <u>ceteris paribus</u>, decrease labour productivity. For the industry as a whole this relation can be modified as

$$\left[\frac{\sum_{i=1}^{N} Q_i}{\sum_{i=1}^{N} L_i}\right]_T = A\left[\frac{\sum_{i=1}^{N} E_i}{\sum_{i=1}^{N} L_i}\right]_T^{\alpha} (1+n)^T \left[\sum_{i=1}^{N} E_i\right]_T^{\beta} U_T \qquad \ldots 7$$

where $\sum_{i=1}^{N} Q_i$ = total industry catch

$\sum_{i=1}^{N} L_i$ = total industry employment (fishermen)

$\sum_{i=1}^{N} N_i$ = total industry fishing effort

U = stochastic term (i.e. other unspecified variables)

T = time

and α is hypothesised to be less than unity but greater than zero while β is hypothesised to be less than zero. Notice that we have substituted effort per worker as a proxy for capital per worker in equation (7). To the extent the measured series of effort reflect changes in technology (T), this will be reflected in the magnitude of the parameter α (embodied technical change). T will then reflect any residual influence of secular factors. It should be pointed out that n is usually thought to be positive for most industries. However, this may not be true for the fishing industry since T can also measure secular changes in the environment (e.g. pollution) that may be detrimental on balance to labour productivity. Hence it is difficult to hypothesis a sign for n. In addition to the variables specified in equation (7) above, we may also recognise four other types of variables which affect labour productivity. They are (1) other production function variables, (2) environmental variables, (3) institutional variables and (4) statistical adjustments. A general description of these is in order. It was shown in equation (6) that there were no economies of scale[1]. However, fishermen's productivity may increase

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1. This is according to the property of the production function stipulated which was showing constant returns to scale.

through the use of larger vessels[1]. The crew size can be a rough proxy for vessel size[2]. This factor may be classified as an additional production function variable. Environmental factors which affect the catch and productivity of the fishermen are salinity, temperature, weather, etc. Various man-made institutions also influence labour productivity. Legal restrictions on craft, gear, ground, season, etc. affect the output per fisherman. Statistical adjustments include modifications in the time series to standardise the variables for 'uniform' quality. Statistical adjustments are usually made for correcting for changes in 'species-mix' and changes in the ratio of part-time to full-time fishermen.

iii) Drawbacks of the Model

The production function approach to the study of technological change has the inherent weakness that it

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1. Larger vessels will help the fishermen to stay longer at sea , catch more fish, preserve it on board and enhance his productivity.

2. Vessel size can be directly incorporated in the production function by taking the length of the boat, or tonnage or horse power of the engine. The crew size can also indicate vessel size, since it varies directly in relation to the vessel size. Larger vessels employ larger crew.

treats technological development implicitly in the model[1]. It simply measures productivity increases and arbitrarily attributes them to advances in knowledge or technological improvements. It does not explicitly study the relationship between the two, i.e., how technology advances and contributes to higher productivity. As a statistical function it fails to recognise the inter-linkages of technology, productivity and economic development.

The approach also suffers from the practical difficulties of identifying and measuring the chief variables in the production function viz. capital and labour. Measurement of capital poses two problems. The first concerns with the technique of measurement and the second, the variations in the quality and use of capital. The non-homogenity of the factor, because of the different 'vintages' and variations in the rate of use, presents serious problems in the way of production function analysis. Labour too, presents problems for measurement because of the differences in quality due to variations

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1. R.R. Nelson, M.J. Peck and E.D. Kalachek, Technology, Economic Growth and Public Policy, (The Brookings Institution, Washington D.C., 1967), p. 7.

in the level of training, education, experience, etc. Measurement problems are felt on the output side as well. New products, particularly, raise difficulties. Their valuation may be done quite arbitrarily and sometimes even ignoring the relative prices. Similarly, improvements in the quality of existing products may defy proper measurement. Accounting of these significant changes are important, but index numbers often fail to take account of these factors. Mansfield[1] points out 'the customary measures are plagued by the difficult problems both theoretical and practical, in evaluating entirely new products'. A serious problem in less developed countries for the use of production function approach to the study of technological change is the lack of suitable data[2]. Yet another difficulty with the production function approach relates to the contribution of other factors to productivity advances, such as economies of scale, substitution of capital for labour, resource shifts within and between industries, organisational improvements, etc. The measured index of productivity will then give only a misleading indication

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1. E. Mansfield, Industrial Research and Technological Innovation, (W.W. Norton, New York, 1968).

2. Debesh Bhattacharya, The Role of Technological Progress in Indian Economic Development, (The World Press, Calcutta, 1972), p. 25.

of technological progress and a wrong interpretation of the process of technological change and economic development.

b) The Alternative Approach - A Study of Process, Indicators and Characteristics

In the light of the practical difficulties in using a production function approach and its limitations, this study uses the alternative approach of studying technological change in the primary marine fishing industry of Kerala by referring to its process, indicators and characteristics[1]. It may be noted in favour of this approach that it has the advantage of being a more 'comprehensive' method, as it covers the various aspects of technological change. This approach also combines the two distinct approaches in the literature; one dealing with 'causes' and the other, with 'consequences'[2]. This approach in fact integrates the received doctrines of technological change in the sense that it brings together the various elements of the different approaches. A brief explanation of the general approach is given below.

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1. This alternative of studying technological change by its characteristics is indicated by Francis Stewart. For more details see Francis Stewart, 'A Note on Comparative Studies of Technological Change - Basic Concepts' in Erik Baark (Ed.), Comparative Technological Change: Methodology and Theory, (University of Lund, Lund, June 1982), pp. 4-8.

2. Francis Stewart, op. cit., p. 9.

i) Process

The 'Process' of technological change which involves primary stages research and development, invention, innovation and diffusion of innovations has already been indicated. But the importance of learning, education and resource shift was not discussed there. Here it is proposed to discuss these aspects in some detail.

Learning

The learning process, as far as labour is concerned, refers to the effect of cumulative experience on labour productivity[1]. Applied to the economy as a whole, it refers to the accumulation of experience by workers, managers and owners of capital in the course of production which enables productive efficiency to improve in the future. It is this factor which Arrow called as 'learning by doing'[2]. This phenomenon is now expressed in the notion of a learning curve, or progress function, which generally, though not exclusively, relates direct labour input per unit of output, on the average or at the

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1. Charles, Kennedy and A.P. Thirlwall, op. cit., p. 38.
2. K.J. Arrow, 'The Economic Implications of Learning by Doing', Review of Economic Studies, June, 1962.

margin, to cumulative output. Empirical studies made in the U.S. for some industries showed that the labour input per unit of output declined between 10 and 20 per cent for each doubling of cumulative output, with corresponding rise in the productivity of labour[1]. This outcome must be the result of improved skills acquired by workers through long experience and specialisation. The importance of 'learning' and experience as a determinant of productivity in the fishing industry is well known. Recognition of this factor is important to an understanding of the 'process' of growth in the fishing industry of Kerala.

Education

Following the pioneering works of Schultz[2] and Becker[3], the idea is now firmly established that education is an investment in human capital. It is an input in the productive system from which more output is generated[4]. Investment in human capital can overcome many of the characteristics of labour force that act as impediments to

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1. W.Z. Hirsh, 'Manufacturing Progress Function', Review of Economics and Statistics, May, 1952.

2. T.W. Schultz, 'Investment in Human Capital', American Economic Review, March, 1961.

3. G.T. Becker, 'Investment in Human Capital - A Theoretical Analysis', Journal of Political Economy, (Supplement), October, 1962.

4. Charles Kennedy and A.P. Thirlwall, op. cit., p. 39.

greater productivity, such as poor health, illiteracy, unreceptiveness to new knowledge, fear of change, lack of incentive and immobility. Improvements in health, education and skill of labour can increase considerably the productivity and earnings of labour and may be considered as preconditions for the introduction of more sophisticated, advanced technology applied to production. The capacity to absorb physical capital may be limited, among other things, by low investment in human capital. It is in this respect that there is likely to be a close interrelationship between the main springs of technological progress and education. With technology changing, the advantage to workers (and their employers) of an education beyond that which is needed for a particular job will be significantly greater. This is not because the new technology is inherently more complex than the old, but because, it is different. Consequently, there is a premium on the ability to learn new techniques rapidly and, sometimes, to work with those as yet unroutinized. The demand for well educated workers actually reflects the fact that they are relatively easy to train for a variety of jobs, and thus are particularly valuable when the composition of the job changes[1].

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1. R.R. Nelson, M.J. Peck and E.D. Kalachek, Technology, Economic Growth and Public Policy, (The Brookings Institution, Washington D.C., 1967), p. 17.

The above effect is not just on the production work force. Technological advance changes the whole pattern of information that must flow between economic units. High remuneration of technically trained salesmen in the electronic industry, for example, relates to their ability to communicate new developments to the potential market. Returns to trained management also reflects their ability to assess new alternatives and to deal expertly and imaginatively with the problems created by new techniques. The economic advantage of education here extends far beyond the imparting of specific skills to deal with specific probbems. It lies in the added flexibility to learn new things and understand new kinds of opportunities and problems that some types of education impart and which rapid technological change make important.

Rapid technological advance not only enhances the contribution of physical capital and education, but also spurs their expansion.

The interactions exist in other directions as well. If current technical advance creates high levels of demand for educated personnel, current investment in education affects the future cost of generating and diffusing technical change. The rate of advance of technical understanding in recent years has probably been closely related to the number of educated personnel engaged in R and D. The spread of new technology or the diffusion process also depends on the availability of people capable of evaluating and perceiving potential markets, communicating technical information and dealing with the problems which invariably arise in the early stages of production before techniques become routinized. Thus education helps the creation and spread of new knowledge in the economic system. Detailed empirical studies on the relation between education and economic growth have been undertaken by Schultz[1], Becker[2], Denison[3] and others for the United States and Blaug[4] for Great Britain. According to Schultz

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1. T.W. Schultz, 'Capital Formation by Education', Journal of Political Economy, December, 1960, 'Investment in Human Capital', American Economic Review, March, 1961 and 'Reflections on Investment in Man', Journal of Political Economy (Supplement), October 1962.

2. G.T. Becker, op. cit., and Human Capital, (Columbia University Press, New York, 1964).

3. E.F. Denison, op. cit., and Why Growth Rates Differ: Post-War Experience in Nine Western Countries, (Brookings Institution, Washington, 1967).

4. M. Blaug, 'The Rate of Return on Investment in Education in Great Britain', Economica, February 1963.

the stock of education (investment in Human Capital) in the United States increased by 850 per cent between 1900 and 1956 and that of reproducible capital by 450 per cent (at constant 1956 prices). Schultz[1] observed that between 1929 and 1956 about 29 to 56 per cent of the unexplained (residual) growth[2] (which was found to be 60 per cent) in the U.S. economy could be explained in terms of higher returns to increased education of the labour force. Becker's estimate of the social returns on male college graduates in America including 'spill over' was 12.5 per cent[3] which is the same as Blaug's estimate for Great Britain for the last three years of secondary schooling[4]. Denison[5] has calculated the contribution of education to measured growth rates in the U.S. economy between 1929 and 1957 as 23 per cent. All these estimates

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1. T.W. Schultz, 'Investment in Human Capital', in Edmund S. Phelps (Ed.), <u>The Goal of Economic Growth</u> ,(W.W.Norton and Company, Inc. New York, 1962), p. 117.

2. Unexplained growth here refers to that part of the growth which is not accounted for by increases in factor inputs, such as labour and capital. It is the residual sum which is sought to be explained by technological change and its components such as learning, education, etc.

3. G.T. Becker, op. cit., (1964), This estimate was raised to 25 per cent by Becker later, (See C. Kennedy and A.P. Thirlwall, op. cit., p. 41).

4. M. Blaug, op. cit.

5. E.F. Denison, op. cit., (1962).

show that education apparently can go a long way in explaining the growth of total factor productivity as conventionally measured through production functions. The importance attached to education in the growth process of developed countries has invoked considerable response in the less developed countries where investment in human capital is viewed as a precondition for growth. Lewis[1] has remarked that allowing for some absorption of labour into farming and for the expansion of non-agricultural employment, a developing economy needs to have at least 50 per cent of its children in primary schools. The argument is that traditional customs and attitudes of these countries cannot be changed significantly until a large section of the community at a fairly young age is exposed to new ideas and ways of doing things.

Some of the major programmes which improve the skill and efficiency of workers as pointed out by Schultz[2] are (1) health facilities and services broadly conceived to include all expenditures that affect the life expectancy, strength and stamina, and the vigour and vitality of a people; (2) on-the-job training including old-style

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1. A. Lewis, Development Planning, (Allen and Unwin, London, 1966), p. 109.

2. T.W. Schultz, op. cit., p. 112.

apprenticeship organised by firms; (3) formally organised education at the elementary, secondary and higher levels; (4) study programmes for adults that are not organised by firms, including extension programmes notably in agriculture and (5) migration of individuals and families to adjust to changing job opportunities. Our analysis of the process of development in the fishing industry of Kerala will take these factors into account.

c) Resource-shifts

The movement of resources from within and between industries is a major characteristic or consequence of technological change. It is in fact part of the process itself[1]. Shift of resources from low productivity to high productivity industries was recognised by Kuznets[2] long ago, when he drew attention to the large gains in income per head due to this factor. More recent studies by other economists have also confirmed this factor. Massel[3] in his 1961 study of nineteen American manufacturing industries in the post-war period found that approximately 30 per cent of the technical progress parameter

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1. Indeed this factor is considered as one of the major forces which can cause economic decay in one region and prosperity in another. See Earl O. Heady, Economics of Agriculture Production and Resource Use, (Prentice Hall of India, New Delhi, 1964), p. 794.
2. S. Kuznets, National Income: A Summary of Findings, (NBER, New York, 1946).
3. B.F. Massel, 'A Disaggregated View of Technical Change', Journal of Political Economy, December 1961.

(productivity gain) was contributed by resource shift or changes in the composition of output. Denison[1] also made similar estimates for some of the European countries considering shifts of labour from agriculture to industry. Denison found that migration from agriculture to industry over the period 1950-1962 has contributed to about 15 per cent of the annual growth rate in national income in Italy, 10 per cent in Germany, and 13 per cent in France. Thirlwall[2] points out that the potential scope for growth from this source in less developed countries must be enormous. Our investigation will look into this aspect of the development process.

ii) Indicators

We have dismissed the productivity index as an arbitrary measure of technological progress. By doing so we have only postponed the problem of measurement and not overcome that. The complex nature of the problem (technological change) is obvious from the description of the 'process' and the 'characteristics'. It defies any direct measurement of the change. In the light of the

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1. E.F. Denison, op. cit., (1967).

2. A.P. Thirlwall, Growth and Development (MacMillan, London, 1972), p. 57.

practical difficulties in measuring technological change by any single 'index' we propose to measure its presence through a series of primary or causative indicators and secondary or resulting 'indicators'[1] which make its operation visible.

a) Primary indicators

The following primary indicators are taken in this study. (1) Increase in the number of mechanised boats and gear (new vintages of capital)[2]. (2) Increase in the number of skilled and educated man-power employed in the industry[3]. (3) Progressive increase in the infra-structure for fishing, processing and marketing[4].

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1. The division as 'primary' and 'secondary' indicators is only one of convenience. Yet, the former may be said to be associated with the causes (process) and the latter with the 'effects' of technological change.

2. The fact that new technology is embodied in new capital equipment justifies the inclusion of this factor as an indicator of technological progress. The role of investment in technical progress has been pointed out by Solow in his article, 'Investment and Technical Progress in K. Arrow, S. Karlin and P. Suppas (Eds.), Mathematical Methods in Social Sciences, (Stanford University Press, 1960).

3. This indicator has been adopted by Bhattacharya in his study The Role of Technological Progress in Indian Economic Development, (The World Press Ltd., Calcutta, 1972), p. 26.

4. This is just another kind of investment which is essential for technological progress to work.

(4) Progressive increase in the expenditure on these items by the Central and State Governments[1]. (5) Export Promotion[2]. (6) Import substitution[3].

A brief explanation of the above indicators is warranted.

(1) Increase in the Number of Mechanised Boats and Gear (new vintages of capital)

Mechanised vessels are considered as the carriers of new technology in fishing. New methods of fishing such as 'trawling', 'gillnetting'[4] and 'purse-seining' could be carried out only by mechanised boats. Increase in the number of these boats and gear indicates the progressive shift in the 'production function' or technological change in the industry.

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1. This indicator has been followed by Bhattacharya, op. cit., p. 26.

2. The justification for the inclusion of this factor is the predominant role that is attached to this factor and the technological linkage that this factor has generated and maintained in the industry.

3. Import substitution has been cited as a major indicator of technical progress by Bhattacharya, op. cit., p. 26.

4. Gillnetting was practised by traditional fishermen as well using country craft but their use became popular with the use of small mechanised boats.

(2) <u>Increase in the Number of skilled and educated man-power employed in the industry</u>

The availability of skilled, and technically trained man-power is considered essential for the application of new knowledge and scientific know-how in production. The increase in the number of such personnel is a direct indicator of the change and progress in the industry.

(3) <u>Progressive increase in the Infrastructure for Fishing, Processing and Marketing</u>

Fishing being a highly complex activity involving catching, processing and marketing, representing the primary, secondary and tertiary sectors of the industry, the infrastructure required for its development is vast. It includes the facilities for landing, berthing, repair, maintenance, storage, transportation, communication and marketing. Progressive increase in these facilities are considered a must for easing the bottlenecks in production or for smoothening the production function.

(4) <u>Progressive increase in Expenditure for Fisheries Development</u>

The outlay and expenditure for fisheries development have increased continually over the years. The main components of this expenditure are (a) mechanisation of fishing craft (b) training of fishermen (c) provision of harbour facilities (d) modernisation of fishing gear (e) provision of storage, transportation and marketing facilities and (f) research, statistics and progress reporting[1]. Progressive increase in this expenditure is a rough indicator of the progress in various fields.

(5) Export Promotion

Export promotion has been a major objective of fisheries development in the state and technological development was tuned to this objective. The objective behind export promotion was 'import substitution' in the long run[2]. In the short run it aimed at earning the foreign exchange required for import of essential capital items and components required for developing the domestic industry.

(6) Import Substitution

Import substitution is a long run objective of planning in India where national 'self sufficiency' and

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1. 'Progress reporting' seems to have been included under the plan provisions because of the executive commitment to monitor the achievement of the plans.

2. In the long run, it is expected that the economy will be able to produce the essential capital equipment and the machineries required for full-scale industrialisation. Import of foreign capital (machineries) is only a temporary arrangement.

self-reliance are marked as major goals. Technological developments in the fishing industry are expected to promote this goal by reducing the dependence on foreign know-how and capital and thereby contribute to national self-sufficiency and self-reliance. The two objectives of export promotion and import-substitution are inter-related.

b) Secondary Indicators

The secondary indicators in this study are (1) changes in the organisation of production, (2) changes in employment, (3) changes in productivity, (4) changes in output, (5) changes in earnings, (6) changes in income distribution, (7) changes in profitability, (8) changes in health, sanitation and housing and (9) changes in the spatial distribution of output. These indicators are discussed in the course of the study as they explain the process, effects and characteristics of technological changes introduced in the industry.

iii) Characteristics

A study of characteristics ideally looks at the nature of technological change with respect to input uses - of manpower, machinery, materials and power, and output turnover. This would help in understanding the nature of inputs and outputs, their quality (efficiency), their complementarity/substitutability and their relative importance in the given socio-economic context. As pointed out by Stewart[1], each technique is associated with a set of characteristics. These characteristics include the nature of the product, the resource use ... the scale of production, the complementary products and services involved, etc. Any or all of these characteristics may be important in determining whether it is possible and or desirable to adopt a particular technique in a particular country and the implication of so doing. Stewart has further suggested a vector approach for the study of technological change and its characteristics. The vector approach is shown schematically below[2].

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1. Francis Stewart, Technology and Underdevelopment (Ed. 2), (The MacMillan Press Ltd., London, 1978).

2. Francis Stewart, op. cit., pp. 5-8.

Table III.1. Technology matrices

Techniques				Products			
Characteristics (e.g.)	Ti	Tii	Tiii	Characteristics (e.g.	Pi	Pii	Piii
Unskilled labour	ai	aii	aiii	Major function	api	apii	apiii
Semi-skilled labour	bi	bii	biii	Efficiency of function fulfilment	bpi	bpii	bpiii
Skilled labour	ci	cii	ciii	Packing/Promotion	cpi	cpii	cpiii
Managerial requirements	di	dii	diii	Market type - high/low income	dpi	dpii	dpiii
Raw materials	ei	eii	eiii	Technique characteristics	Ti	Tii	Tiii
Energy requirements	fi	fii	fiii				
Scale of production	gi	gii	giii				
Product characteristics	pi	pii	piii				

Source: Ibid., p. 7.

It is clear that any technique, Γi shown above possesses a set of characteristics ai, bi, ci, di ... where a,b,c,d ... each describe certain aspects of the technique. For example, they would include the various input requirements the technique makes for unskilled labour, skilled labour of various types, materials in quantity and quality, energy, machinery and scale of production. In addition, the vector of techniques would also include the characteristics of the product the technique produces, which also consists of a vector of characteristics. Associated with Γi then is a product Pi which has a set of characteristics api, bpi, cpi ...; the product characteristics include the functions it fulfills (and the efficiency with which it fulfills them), the market for which the product is designed and so on.

The characteristics of the technology in use - or of what we have described as the technology matrix - are of major importance in determining the pattern of development of the society in question. The technology in use is a major determinant of the availability of employment opportunities and the distribution of income from employment. The product matrix largely determines the availability of consumption goods (in quantity and quality) and consequently local consumption patterns. In developing countries the characteristics of the technology matrix are especially important because so much of the technology set is imported from advanced countries and are not designed with the resource and needs of LDCs in view. Much of the imported technology consequently has inappropriate characteristics for poor countries, being over capital-intensive, large-scale, skill-intensive and producing sophisticated high-income products. Quite a large amount of the inequality and poverty observed in low income countries are attributed to the inappropriate characteristics of imported technology. Further, changes in the technology matrix or technology are important because they radically affect economic and social development. For example, technical change which is capital-intensive and involves very large scale technologies may distort development patterns of poor countries, causing dualism and unemployment. If the new technologies are very large scale, many economies may not be able to use them efficiently at all[1]. Notwithstanding the above dimensions and characteristics of technology this study has focussed mainly on the input-output characteristics of the new technology and the market linkage developed leading to technological dualism in the industry.

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1. Francis Stewart, op. cit., p. 9.

iv) Limitations of this Approach

A major limitation of this approach is that it is somewhat general (macro) compared to the production function (micro) approach. It is general because it concentrates on several aspects of technological change including the characteristics, process and indicators. Accordingly it fails to offer a single indicator of the progress. But this feature of the approach can be considered as its major advantage as it looks at the different dimensions of technological change and offers a better understanding of the process of growth.

A second major problem with this approach is the practical difficulty of identifying the various characteristics of technological change and in discerning their implication for cumulative growth.

A third difficulty with this approach is in pin-pointing the various stages of technological change or what we described as the 'process'. The various stages of technological change such as 'learning', 'education', 'research', 'invention', 'development', 'innovation', 'diffusion', etc. need not be consecutive stages and their identification as sequential 'processes' is liable to be misleading. One can, however, overcome this problem with proper understanding of the 'process' and the interrelationships involved at every stage. Yet another practical difficulty with this approach is the severe dearth of appropriate data (indicators) to show the various aspects of technological changes. This is particularly a problem in the fishing industry of Kerala. To this we will turn in the next section.

Despite the above limitations and difficulties it may be categorically said that this approach is quite superior to the production function approach and together with the latter it can satisfactorily explain the process of development in the primary marine fishing industry of Kerala. It is admitted that this approach is disaggregated but it looks at the 'process' in much greater detail, and this is our justification for its use.

4. Data-base for the Study

This study is based mainly on secondary data. The major sources of data used in this study are (1) The Department of Fisheries, Government of Kerala, Trivandrum and (2) The Central Marine Fisheries Research Institute, Cochin. The Department of Fisheries supplied data regarding catch and value for the period from 1951 to 1984.

Most of these details were obtained from the Annual Administration Reports of the Department of Fisheries of Government of Kerala. Details of plan outlays, expenditure, and other details on technological changes in the fishing industry of the state were obtained from the occasional publications of the Department of Fisheries and the State Planning Board. In this connection, 'Kerala Fisheries - Facts and Figures 1980', a publication of the Department of Fisheries, and the various five year plan documents of the State Planning Board are worth noting. The Central Marine Fisheries Research Institute, apart from providing statistics of catch, furnished details of fishermen, fishing effort and catch by mechanised and non-mechanised vessels for selected years. These details were obtained from their occasional bulletins (Bulletin 13 and 27) and the new series on Marine Fisheries Information Service (MFIS - 41 and 52). MFIS-30 gave details of fishermen, fishing craft and gear employed in the state in 1980.

Another major source of information for this study is the Quinquennial Livestock Census Reports which provided details of fishermen, fishing craft and gear used in the state in 1966, 1972, 1977 and 1982. The General Economic Tables of the 1961 and 1971 censuses of Kerala provided details of fishermen engaged in different fishery based activities in the state. This study has further benefitted from the statistical information contained in some of the Expert Committee Reports on the Fisheries of the State.

In this connection the reports of the two expert committees appointed by the Government of Kerala are important[1]. These reports gave details of catch and effort by mechanised and non-mechanised vessels in the state for selected years. In addition to these various sources, this study has made use of historical data available in various other studies mentioned in the review of literature above.

It is important to note in this connection that much of the information mentioned above were not in readily usable form. They were often disaggregated, discontinuous and dissimilar and had to be rearranged and retabulated and sometimes even discarded. It should be noted that technological change and development are essentially long term phenomena, and the data required for this study are mostly of a time series nature, which only institutional

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1. The two Expert Committees appointed by the Government of Kerala are (1) The Committee to Study the Need for Conservation of Marine Fishery Resources During Certain Seasons of the Year and Allied Matters, under the Chairmanship of D.Babu Paul in 1981 and (2) The Expert Committee on Marine Fisheries in Kerala, under the Chairmanship of A.G.Kalawar in 1984.

sources can afford to collect and maintain on a long-term basis. This is the 'raison de'tre' for heavily depending on published data in this study.

CHAPTER IV

THE PRIMARY MARINE FISHING INDUSTRY OF KERALA - A VIEW OF THE TRADITIONAL SECTOR

Here it is proposed to discuss the traditional or non-mechanised sector of the marine fishing industry. Such a discussion is necessary to have clear understanding of the capability and potential of this sector for promoting growth and development of the industry as well as its limitations. First we deal with technology of the traditional sector.

1. Technology of the Traditional Sector

Different types of craft and gear combinations represent the technology of the traditional sector. These craft and gear combinations use varying amounts of labour inputs to catch different species of fish during different seasons of the year.

a) Craft

The predominant craft types employed here are Catamarams, Dug-out Canoes and Plank-built Boats.

Catamarams

The catamarams are the most primitive fishing craft of Kerala which is presumed to be of Egyptian origin[1]. They are a kind of keelless craft made out of a few logs of light wood (Albizza species) tied together at the two ends by coir ropes and supported by wooden pegs called Kadamarams[2]. The catamarams are found in two broad sizes: one of 7.50-8.50 m length with about 0.80 m width and another of 4 - 5 m length with about 0.60 m width. The former can accommodate three to five persons while the latter only two persons on board. The catamarams are propelled manually with the help of bamboo oars and sails. The catamaram is an extremely versatile craft, and can be launched in almost all seasons at all points on the shore, except rocky places. This craft is used predominantly in Trivandrum district for gill-net fishing and for hook and line fishing in rough surf conditions. The investment required for the craft is estimated to vary between Rs 2000/- and Rs 3000/- depending upon its size[3].

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1. Directorate of Fisheries, Master Plan for Fisheries Development - Kerala State, (Government of Kerala, Trivandrum, 1969), p. 4.

2. P.R.G. Mathur, The Mappila Fisherfolk of Kerala, (Kerala Historical Society, Trivandrum, 1978), p. 130.

3. These are own estimates for 1985. Cost of gear is not included.

Dug-out Canoes

The dug-out canoes are undecked craft made by scooping out material from the large trunk of Aini (Ailanthus) or Cheeni (Austiarie) wood. The dug-out canoes are of three types. The large dug-out canoe called Odam is 11 to 13 m long, 0.90 - 1.50 m wide and 0.80 - 0.90 m deep. The medium sized dug-out called Thoni is 8.00 - 9.00 m long, 0.90 - 1.20 m wide and 0.75 - 0.90 m deep. The small dug-out called Bepputhoni is about 6.00 - 7.00 m long, 0.60 - 0.70 m wide and 0.45 - 0.60 m deep. The Odams can carry a crew of 10 - 15 fishermen, Thonies carry 5 - 8 fishermen and the Bepputhoni only 1 - 2 fishermen. The displacements of these craft vary from 1 to 5 tons. The dug-out canoes do not have rudders and are propelled by paddles and sails. The larger dug-out canoes are used in pairs for operating Thanguvala (boat-seines) and the smaller ones for gillnetting and hook and line fishing. Fishing with Odams is confined to a narrow coastal belt of 12 - 15 km while the Thonies and Bepputhonies go far out in the sea for hook and line fishing. The main catches of these craft are oil sardines, mackerels, anchovies, etc. caught in the inshore waters.

The dug-out canoes are used for about eight months during a year - from October to May[1]. The large dug-out canoes catch on an average about 15 - 20 tons of fish per annum[2]. A large dug-out is now estimated to cost between Rs 30,000/- and Rs 35,000/- and a small one about Rs 10,000/- to Rs 15,000/- depending upon the wood[3]. The dug-out canoes are concentrated in the northern districts of Malappuram, Kozhikode, Cannanore and Kasargode.

Plank-built Boats

The plank-built boats which resemble dug-out canoes in form and shape are constructed by seaming together planks of Cheeni or Aini wood using coir ropes and copper nails. These are undecked craft, like dut-out canoes, and are of two types: the large ones called Thanquvalloms and the small ones called Kochuvalloms. The large one is about 11 to 13 m long, 1 -1.5 m wide and 0.70 - 0.80 m deep. The small one is about 6 - 7 m long, 0.9 - 1.0 m wide and 0.50 - 0.60 m deep. The Thanquvalloms can carry a crew of 12 - 15 persons and the Kochuvalloms about 4 - 6 persons. Their displacement range from 3 to 5 tons. The craft is

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1. Directorate of Fisheries, op. cit., p. 7.

2. FAO/UNDP, Identification of Development Projects for Small-Scale Fisheries - Kerala, (Small-Scale Fisheries Promotion in South Asia, Madras, 1981), p. 30.

3. These are own estimates made in 1985. Cost of gear is not included.

propelled by paddles and sails. The principal gear used is the Thanquvala, a kind of boat-seine. These boats also use other kinds of nets like gillnets for catching oil sardines, mackerels, prawns and anchovies. The average catch of a Thanquvallom is about 15 - 20 tons per annum[1]. The average investment in these boats range between Rs 15,000/- and Rs 20,000/- for a large unit and from Rs 10,000/- to Rs 12,000/- for a small unit[2].

Comparative picture of the various Craft

As pointed out earlier all these craft are undecked craft and use manpower for propulsion. The range of their operation is limited to inshore waters upto a distance of 10 - 15 kms and in terms of depth, they seldom go beyond 8 - 10 fathoms[3]. As regards the stability of the craft, the catamarams are the most stable of all craft. The dug-out canoes can withstand rough weather without capsizing but the plank-built boats are liable to damage without any warning to the fishermen[4]. The plank-built boats, on the other hand can be launched

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1. FAO/UNDP, op. cit., p. 30.
2. Own estimates made in 1985. Includes the cost of boat only.
3. The catamarams are reported to go further deep out to the sea for catching shark, tuna and other bottom dwelling fishes. The Master Plan for Fisheries Development reported 10 fathoms as the usual limit upto which the catamarams go for fishing.
4. P.R.G. Mathur, op. cit., p. 136.

even if the waves are violent whereas the dug-outs are unserviceable during such situations. Mathur reports that the plank-built boats are not subject to capsizing as quickly as the dug-outs as the former can withstand the waves on account of their plasticity[1].

As regards the repair and maintenance of these craft, it may be noted that the catamarams need minimum repair. The damaged parts can be easily replaced as the craft consists of only a few logs of wood. The dug-out canoes on the other hand cannot be repaired easily at short notice as the damaged parts have to be covered by fixing a wooden plank over it, and this to a large extent weakens the craft. The plank-built boats can be repaired easily by changing the damaged planks. The cost of repairing the dug-out canoe is also higher than that of the plank-built boats[2].

The life span of these craft also vary considerably. The catamarams normally last for only about 10 years since they are made of light wood and the dug-outs on the other hand

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1. Ibid., p. 136. Mathur further quotes the fishermen as saying that the plank-built boats have the quality of taking the vibration and hence resist the lashing of the waves. This is quite true as the stability of the vessel increases to a large extent with the size.

2. P.R.G. Mathur, op. cit., p. 137.

survive for about 20 to 25 years. The plank-built boats have a relatively shorter life span compared to the dug-outs. They last for about 10 to 15 years. In general, it may be said that the life span varies considerably depending on the quality of the wood, the make, the use and the maintenance and the general care of the operators.

The displacement of these craft also vary much. The catamarams usually have a displacement of less than one ton and the dug-outs have a displacement ranging from one ton to three tons. The plank-builts have a higher displacement of three to five tons. Some of the major characteristics of the traditional craft employed in Kerala are given in Table IV. 1.

It is apparent from Table IV. 1 that the different types of fishing craft used in Kerala have certain unique characteristics which are quite important in their selection, operation and maintenance in the future. It is evident, for example, that the different craft in use are of different capacities, require different levels of investment, have varying life span and employ varying number of crew, use different types of gear and operate during different seasons of the year in different parts of the state. The common

Table IV.1. Some Major Characteristics of the Traditional Crafts used in Kerala

Craft and size (meters)	Cost per unit[*] (Rs.)	Life span (Years)	Mode of propulsion	Displacement (Tons)	Crew size	Principal gear used	Main fishing season	Major areas of use	Approximate distance fished (kms)	Approximate depth range fished (fathoms)	Average catch/year (tons)	Major species caught
Catamarans												
Large												
L:7.50–8.50 W:0.80	3000	10	Manually by oars and sail	< 1	3–5	Gillnet and hook and line	August to June	South Kerala coast	Inshore areas upto 12–15 km	15–20	3–5[a]	Shark rays, pomfrets, etc.
Small												
L:4.00–5.00 W:0.60	2000	-do-	-do-	-do-	2	-do-	-do-	-do-	-do-	-do-	2–3[a]	-do-
Dug-out Canoes												
Large (Odam)												
L:11.0–13.00 W:0.90–1.50 D:0.80–0.90	30000 to 35000	20–25	Manually by paddle and sail	2–3	10–15	Boat-seines, gillnets and hook and lines	October to May	North Kerala coast	-do-	10–20	15–20[b]	Sardines, mackerels, Anchovies, Prawns, Catfish, etc.
Medium (Thoni)												
L:8.00–9.00 W:0.90–1.20 D:0.75–0.90	20000 to 25000	-do-	-do-	1–1.5	5–8	-do-	-do-	-do-	-do-	-do-	10–15[a]	-do-
Small (beputhoni)	10000 to 15000	-do-	-do-	< 1	1–2	Gillnets, castnets, and hook and lines	-do-	-do-	-do-	-do-	5–10[a]	-do-
Plank-built												
Large (Thanguvallom)												
L:11.0–13.00 W:1.00–1.50 D:0.70–0.80	15000 to 20000	10–15	Manually by paddle, ruddar and sail	3–5	12–15	Boat-seines, gillnets, and hook and lines	July to October	Central Kerala coast	-do-	10–15	15–20[b]	-do-
Small (Kochuvallom)												
L:6.00–7.00 W:0.90–1.00 D:0.50–0.60	10000 to 12000	-do-	-do-	1–2	4–6	-do-	September to March/April	-do-	-do-	-do-	5–10[a]	-do-

a Own estimates for 1985.

b FAO/UNDP estimates for 1981 from FAO/UNDP, op. cit., p. 30.

Sources:
1. Directorate of Fisheries, Master Plan for Fisheries Development, Kerala State, (Government of Kerala, Trivandrum, 1969), pp. 4–7 and p. 178.
2. P.R.G.Mathur, Mappila Fisherfolk of Kerala, (Kerala Historical Society, Trivandrum, 1978), pp.130–38.
3. Directorate of Marketing and Inspection, Marketing of Fish in India, (Government of India, Ajmeer, 1943), p. 7.
4. Bharat Bhushan, 'Technological Change in Fishing in Kerala, 1953–77', (Unpublished M.Phil Dissertation, Centre for Development Studies, Trivandrum, 1979), p. 10.
5. FAO/UNDP, Identification of Projects for small-scale fisheries, Kerala, (Small-scale Fisheries Promotion South-Asia, Madras, 1981), p. 30.

characteristics of all these craft however, are that they are all operated manually and work in the inshore waters of the state, almost in the same depth range. All these characteristics have implications for the future growth and development of the industry. We will turn to these aspects later in the course of our discussion of the output of the traditional sector. We now have a look at the number of these craft as observed at different points of time in the past. The estimates of these craft as given by different agencies for different periods, and sometimes for the same period, are quite inconsistent and incomparable. We, however, present them for a general understanding of their relative importance in the traditional sector of fishing and for elucidating their technological importance.

First of all, it should be noted that interpretation of table IV.2 should be done with extreme care. For one thing, the figures are incomplete and for another, they are not quite comparable. In certain cases the figures are under-estimates and in certain others over-estimates. For example, the figures for 1977 according to the first source seems to be an under-estimate and according to the second, an over-estimate. The FAO/UNDP estimate for 1981 tallies with the Livestock Census Estimate for 1972, but disagrees with the 1982 figures. All these show the

Table IV.2. Estimates of Traditional Fishing Craft in Kerala

Year	Number			Total
	Catamarams	Dug-out canoes	Plank-built boats	
1957-58[1]	8280	8774	3173	20227
1959[2]	6534	3792	8237	18563
1961-62[3]	NA	NA	NA	20667
1966[4]	6056	8964	12476*	27496+
1972[5]	9719	9865	1104	30594+
1973[6]	3708	16672	4720	25100
1973-77[7]	9690	8191	3837	21718
1977[8]	NA	NA	NA	20667
1977[9]	7401	11090	3764	32377+
1979[10]	9367	11090	6514	26971
1980[11]	11480	10415	4376	26271
1981[12]	10000	15000	5000	30000
1982[13]	5709	9016	5381	26719+

N.A. - Data not available

* includes small and large boats

\+ includes beach seines and 'other' craft used for both marine and inland fishing.

Sources: 1. Department of Fisheries, 'Census of Fishermen's Assets and Liabilities', 1958. Reported in Administration Report for the Year 1957-58, Government of Kerala, Trivandrum, 1960, pp. 96-97.

2. Directorate of Marketing and Inspection, Marketing of Fish in India, (Government of India, Nagpur, 1961), Edn. 3, p. 7.

Sources Contd.

Table IV.2 Contd.

Sources: 3. CMFRI, Marine Fish Production in India, 1950-68, Bulletin No.3, (CMFRI, Cochin, 1969), p. 141.

4. Directorate of Economics and Statistics, Indian Livestock Census, 1966, Vol. 2, (Government of India, New Delhi, 1972).

5. Department of Animal Husbandry, Livestock Census, 1972, (Government of Kerala, Trivandrum, 1973), p. 9.

6. Development Department, Integrated Fisheries Development Project for Kerala, (Government of Kerala, Trivandrum, 1975).

7. CMFRI, Census of Marine Fishing Villages, Fishermen Population, Fishing Craft and Gear (1973-77), Kerala, Marine Fisheries Information Service No.3, (CMFRI, Cochin, September 1978).

8. E.G.Silas (Publisher), Indian Fisheries - 1947-77, (CMFRI, Cochin, 1977), p. 87.

9. Department of Animal Husbandry, Livestock Census - 1977, (Government of Kerala, Trivandrum, 1979), p. 72.

10. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), p. 50.

11. CMFRI, All India Census of Fishermen - Craft and Gear 1980, Marine Fisheries Information Service, No. 30, (CMFRI, Cochin, 1981), p. 23.

12. FAO/UNDP, Identification of Development Project for Small Scale Fisheries - Kerala, (Small-Scale Fisheries Promotion in South Asia, Madras, 1981), p. 29.

13. Department of Animal Husbandry, Livestock Census Report 1982, (Government of Kerala, Trivandrum, 1984), p. 32.

discrepancies in the data. This discrepancy has to be explained partly by the inclusion of inland fishing craft in the data and partly by errors of estimation.

Notwithstanding the above inconsistencies and errors in the data we can discern some trend or direction form the data. It appears from the table that the total number of traditional fishing craft in the state has increased from 20,227 in 1957-58 to 21,718 by 1977 and to 26,719 by 1982. It shows an increase of 32.09 percent during the whole period or an average annual increase of 1.28 per cent. The number of catamarams, dug-out canoes and plank-built boats, all have shown comparable growth rates. The number of catamarams increased by 38.64 per cent, dug-out canoes by 18.70 per cent and plank-builts by 37.91 per cent between 1957-58 and 1980. The relative significance of these increases can be understood only if we know whether it has contributed to higher output per worker. Since the traditional craft are, all, of the old designs and do not involve any new skills or new knowledge for their operation, the increase in their number cannot be construed as contributing to higher output per worker, unless the craft (capital) per worker has increased[1].

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1. The increase in the number of traditional craft in the industry will not lead to any deepening of capital in the industry as the techniques involved are old and since the population and the number of working fishermen in the industry are expected to have increased. We will turn to these points shortly.

The possibility of the fisherman's output (output per worker) increasing from this source has to be investigated. Ruling out the possibility of other sources, such as higher learning, better education, greater skills and better equipment, the possibility of higher (physical) capital per worker, contributing to higher output can be examined. We, however, have no index of the capital per worker to compare with the output per worker during any of these periods[1]. To have an inkling of the possibility of the capital per worker rising, we may look at whether the number of active fishermen in the traditional sector has increased during these years and if so to what extent, and whether this increase is more than the increase in the number of fishing equipment (fishing craft)[2]. As before, we are constrained by the paucity of data to show the precise increase in the number of active fishermen during the period under

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1. It is important to note that it is practically difficult to work out an index of capital owing to the diversity (non-homogenity) of craft and gear combinations used in the state. Their monetary equivalents also could not be worked out owing to the lack of reliable time series data on the number of craft and gear in use.

2. Fishing gear can be ignored for the time being, assuming that they are part of a production system (production function), where the relevant gear (factor) will be used in combination with the particular craft.

reference or for any comparable period. We, however, propose to make an estimate of the number of fishermen for the relevant period and get an idea of the increase in the number of working fishermen in the traditional sector between 1957-58 and 1980.

We first try to estimate the total number of working fishermen in the state (this includes those engaged in the mechanised sector too) during 1957-58. The total number of working fishermen in Kerala in 1957-58 was estimated to be 59813[1]. From this we deduct the number of fishermen engaged in the mechanised sector which was found to be 455[2]. This gives us the total number of fishermen engaged in the traditional sector in 1957-58 as 59358.

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1. This estimate is based on the assumption that the percentage of fishermen found working in a nearby year (1961-62) will hold good for 1957-58 as well; the percentage of fishermen working in 1961-62 was 22.23 per cent (estimate from CMFRI Bulletin No. 13, p. 141). The figure given above i.e. 59813 is 22.23 per cent of the total fishermen population which was 269064 in 1957-58 (Source: 'Census of Fishermen's Assets and Liabilities - 1958 as Reported in Administration Report of the Department of Fisheries for the Year 1957-58'.

2. This estimate is based on the assumption that the total number of mechanised boats in operation in Kerala in 1957-58 was 91 (Source: 'Report of the Committee on Fisheries and Other Living Aquatic Resources of Kerala', (Committee on Science and Technology, Trivandrum, 1973, p. 40) and that each vessel employs about five persons. This gives the total number of fishermen employed in this sector to be 455.

The number of fishermen engaged in the traditional sector in 1980 was estimated to be 115911[1]. It appears from the above figures that the number of fishermen working in the traditional sector has increased by 95.27 per cent between 1957-58 and 1980. It is alarming to note that the increase in the number of active fishermen in the state is quite disproportionate to the increase in the number of fishing equipment in the state. (The increase in the number of fishing craft was only 32.09 per cent). The consequence of this unmatched increase in the number of fishermen will be a fall in the capital intensity or capital per worker and a corresponding fall in the output per fisherman or his productivity. The fall in the capital intensity is exemplified by the rise in the part-time and occasional component of working fishermen. The part-time component has increased from 14.53 per cent in 1977 to 19.98 per cent in 1982. It reflects more than anything else, the inability of the industry to accommodate all the willing fishermen on a full-time basis with the

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1. This estimate is obtained after deducting the number of fishermen working in the mechanised sector from the total working fishermen. The total working fishermen in the state in 1980 was 131101 (Source: All India Census of Marine Fishermen, Craft and Gear - 1980, MFIS 30, CMFRI, 1983, p.3). From this the number of fishermen engaged in the mechanised sector in 1980 was deducted. This number was estimated to be 15190. (For details of this estimate see Table VI.4 infra). This gives us 115911 (131101-15190) as the number of traditional fishermen in 1980.

existing craft. The consequence of this situation is rising pressure on the limited capital stock of the industry and the limited fishery resources of the inshore waters, both of which will lead to a fall in the productivity or output per fishermen in the traditional sector of the industry. This is somewhat evident from the sharp decline in the catch per unit of effort which declined from 7.21 kg/hour during 1960-62 to 5.73 kg/hour during 1979-81[1]. The implications of this fall in the productivity of the fishermen will be highlighted when we discuss the output of the traditional sector.

We now turn to a brief description of the different types of fishing gear employed in the traditional sector of the fishing industry of Kerala.

b) Gear

The principal fishing gear employed in the traditional sector of the fishing industry in Kerala are gillnets, boat seines, shore seines and hooks and lines. In addition to these, several other minor gear such as

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1. These figures are worked out from the Report of the Expert Committee on Marine Fisheries in Kerala (pp. 207-15). We have taken the three year average for the first period (1960-62) and the average of 1979 and 1981 for the second period. Details for 1980 were not available.

castnets, stakenets and chinesenets are used locally. In this section we make a brief description of the four principal gear of the state as mentioned above.

Gillnets

The gillnets are single walled nets which may be set in either just above the sea-bed when fishing is for demersal species, or any where from mid-water to the surface when pelagic fish are being sought. When working inshore, in relatively shallow waters, the nets are usually set and anchored in position. Alternatively, it is allowed to drift in which case it is free to move according to tide and wind conditions[1]. The drift type of gill nets are attached to the side of a catamaram or canoe and the craft and the net are allowed to drift alongwith the current. Fish are caught in the net when they swim into it and get their gills entangled in the mesh[2]. The drift gillnets are particularly useful in catching mackerel. They are very significant as large

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1. John,C. Sainsbury, Commercial Fishing Methods - An Introduction to Vessels and Gears, (Fishing News (Books) Ltd., London, 1971), p. 94.

2. John Kurien, Towards an Understanding of the Fish Economy of Kerala State, (Centre for Development Studies, Trivandrum, 1978), p. 25.

areas of water can be covered and can be used in catching even scattered fishes[1]. It is the position of the net and the mesh size which determines the type of the fish caught. The position of the net is varied by attaching or removing weights (sinkers) attached to the lower end of the net. The gillnets are used all along the Kerala coast. These nets are locally called as Ayila calavala (the gillnet for mackerel), Olukkuvala (the gillnet for seers, eel and catfish), Thirandivala (gillnet for skates and rays), Nettalvala (gillnet for white baits), Baminvala (gillnet for threadfins) and Sravuvala (gillnet for sharks). The traditional gillnets were made of cotton which have been progressively replaced by gillnets made of nylon[2]. The gillnets can be operated by a minimum of two persons on a catamaram or a maximum of 12 persons on a large dug-out canoe, depending on the length and the weight of the net[3]. The cost of these nets vary depending on the length and the weight. Mathur found these nets (Ayila calavala) to cost between Rs 2500/- and Rs 3200/- in 1977[4]. The current cost of these nets is estimated to vary between Rs 7000/- and Rs 10000/-[5].

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1. P.R.G. Mathur, The Mappila Fisherfolk of Kerala, (Kerala Historical Society, Trivandrum, 1978), p. 146.
2. The impact of this only innovation in the traditional sector of the fishing industry has not been assessed properly. Much of the increase in the output of the traditional sector is attributed to this factor.
3. John Kurien, op. cit., p. 25. 4. P.R.G. Mathur, op. cit., p.148.
5. Own estimates made in 1985.

Boat-seines

The boat-seines are a kind of encircling nets[1] which are either conical, bell-shaped, or bag-shaped with or without wings attached to it and made of cotton or nylon filaments. The open end of the boat-seines normally have larger mesh size which decreases towards the closed end (codend). The stricking characteristics of the boat-seines in Kerala are that they are equipped with a strong central bag for preventing the fish from escaping and two long wings of equal length attached to either side. These wings enable the net to encircle the fish in a larger area. The warps attached to these nets help in driving the fish and hauling the net. The two free ends of the warps are hauled in such a way that they close together herding the fish inwards and into the path of the net to be scooped up and brought aboard the operating boat.

The boat-seines are operated with the help of canoes or catamarams, which pull at either end of the wings thus keeping the mouth of the net open and allowing the fish to swim towards the narrower end. Sometimes,

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1. John,C. Sainsbury, op. cit., p. 85.

scaring devices made of wood or coconut leaf are used to beat the water or the side of the boats to drive the fish into the nets. Boat-seines are used in Kerala to fish for pelagic and mid-water shoaling species[1]. This net is used all over the Kerala coast to fish for sardines, mackerels, prawns, soles, etc.[2] It is used when these species of fish are available in the inshore waters. This net is usually operated by 8 to 10 men from two boats. This number can increase to as many as 25 depending on the type of craft used and the size of the seine and the nature of the fish to be caught. It is generally shot at a depth of 10 to 20 fathoms[3].

The traditional boat-seines of Kerala have a number of variants, each meant for fishing selected species during specific period of the year. Some of these are (1) Muyyanvala for catching prawns, jew fish, silver bellies and horse-meckerel, (2) Mattikollivala[4] for catching sardines, (3) Odakollivala for catching sardines and mackerels, (4) Peyittamvala for catching sole, (5) Ettavala for catching catfish and (6) Avolivala for catching pomfret.

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1. John C. Sainsbury has suggested that this net is of particular importance in the harvesting of demersal species of fish. See Sainsbury, op. cit., p. 85.
2. P.R.G. Mathur, op. cit., p. 161.
3. Ibid., p. 161.
4. This net is called as Tattuvala in Quilon and Trivandrum Districts.

With the introduction of mechanised fishing and the availability of nylon, many of these nets have been standardised and their specificity seems to have been lost. Now, by changing certain parts of the net and with suitable adjustments in the depth of operation, the fishermen can modify their catch and thereby their earnings. The average investment required for these nets in 1977 was reported to range between Rs 400/- and Rs 1500/-[1]. The current cost of these nets range between Rs 3000/- and Rs 5000/-[2].

Shore-seines

The shore-seines are bag shaped nets with two coir-wings of extensive lengths (over 1500 m) and operated from the shore. The shore-seines, called Karamadis or Kambavalas are operated in Kerala with the help of a boat or canoe. The net is operated in such a way that the Kamba (warp) of one wing remains on the shore while the bag and the wings are carried to the sea by a boat. The boat in its outward journey first releases the first wing of the net and then the bag and finally returns to the shore by

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1. P.R.G. Mathur, op. cit., pp. 161-70.
2. These are own estimates made in 1985.

releasing the second wing. The boat in this process takes a semi-circular course and returns to the beach at a distance of some 100 - 200 m from the starting point, depending of course on the length of the net. Once the boat reaches the shore, the two ends (warps) of the net are simultaneously and gradually pulled in by two parties, each of 15 to 20 fishermen[1]. Mathur observed that a Vanchi (boat) with a crew of seven is employed in shooting the net and about twenty to twenty five persons are employed for pulling the net. The net is shot at depth of 1/2 to 1 fathom[2]. The shore-seines are used all along the Kerala coast, mainly during the calmer seasons between November and March/April[3]. The main varieties of fish caught are pelagic shoaling fish such as sardines, mackerels, anchovies, etc. Compared to the other two types of nets, viz. gillnets and boat-seines, the shoreseines have only limited significance in the traditional sector of the fishing industry. These nets now cost between Rs 2000/- - Rs 3000/-[4].

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1. John Kurien, op. cit., p. 24.
2. P.R.G. Mathur, op. cit., p. 160.
3. John Kurien, op. cit., p. 24.
4. These are own estimates based on enquiries made in 1985.

Hooks and lines

Hook and line fishing is one of the most traditional methods of fishing in Kerala. This method of fishing has been used by Kerala fishermen for ages for catching a large variety of fish such as sharks, seer, skates and rays, eels, catfish, etc. The basic method involves the setting out of a long length of line, to which short lengths of line carrying baited hooks are attached at every two to six feet. The fish are attracted by the bait, hooked and held by the mouth until they are brought aboard the operating vessel, which periodically hauls the gear[1]. The type of fish caught depends upon the depth to which the line is set and the size of the hooks.

In Kerala, three different types of fishing lines are used. They are (1) Hand-lines (Kaichunda), (2) Long-lines (Beppu or Ayiram chunda), (3) Chain-lines (Changala chunda) with big shank hooks.

The Hand-line is the simplest of fishing lines. It consists of a line, a lead, a cast and a hook[2]. The line

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1. John, C. Sainsbury, op. cit., p. 100.

2. Andres, von Brandt, Fish Catching Methods of the World, (Fishing News (Books) Ltd., London, 1972), p. 42.

sets the depth of operation. The lead-weight which is tied between the cast and the line serves as a sinker and minimises the jerk when a fish bites the bait. Hand-lines are generally cast from a single anchored dug-out canoe (Bepu thoni). The long-line is made of a master line (main line) with equi-distant thinner branch lines called snood or dropper-lines and hooks attached to them. The master line is kept afloat using wooden, bamboo, coconut or tin floats. The number of hooks attached depends upon the length of the line. The long-lines are operated by a crew of four men using dug-out canoes. The chain-lines are different from the long-lines in that their branch lines are usually made of metal chains or thicker yarn. They are used for catching sharks and use doubly strong and long hooks. These lines are said to be three times heavier than the long lines[1]. The cost of the hook and line set varies depending on the length of the line and the number of hooks. A long-line set of 100 hooks is now estimated to cost between Rs 500/- and 800/-.

The hook and line method is generally used for fishing in deeper waters or in uneven grounds where other

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1. P.R.G. Mathur, op. cit., p. 141.

2. Own estimates for 1985.

types of fishing cannot be easily undertaken. Fishing with hook and line is carried out by only a small number of fishermen in Kerala. This is because of the greater depths to which the fishermen have to go for catching the larger quality fishes, the longer time that it takes and the very arduous nature of the work. It is, however, noted that fishing with the help of hook and line is the primary occupation of the Beppukar or Cundakar of Malabar[1].

The other traditional gear of Kerala, such as stakenets, chinese-nets and cast-nets are mainly operated in the backwater fisheries of the state, particularly in districts like Ernakulam, Trichur and Alleppey. Considering their limited role and the paucity of space for detailed description, we restrict our discussion of the gear at this stage.

Having given a brief description of the major traditional fishing gear of Kerala and their operation we can now have a glimpse of their relative importance by looking at their number. We, however, make it clear that these gear, unless they are viewed as complements of a production system (craft-gear combination), will have no

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1. P.R.G. Mathur, op. cit., p. 139.

meaning. Assuming that these gear (nets) are used with appropriate craft types during different seasons of the year and their availability or otherwise determines the extent of use of the craft (capital employed in the industry), we make an attempt to examine the relative importance of the different traditional fishing gear of the state. This is done by looking at their absolute number without looking into their quality in terms of size, age, make or brand, etc..

Table IV.3 shows the number of different types of traditional fishing gear of Kerala as estimated by different agencies for different years.

Table IV.3. Estimates of Traditional Fishing Gear in Kerala*

Year	Type of gear				Others	Total
	Drift/Gillnets$^{\alpha}$	Boat seines	Shore seines	Hooks and lines (sets)		
1957-58[1]	35778	21281	4501	16312	90206	168078
1966[2]	30907	15393^{+}	6617	NA	136851	189768
1972[3]	35919	19988^{+}	8224	NA	54222	118353
1973-77[4]	17816	9575$^{\infty}$	1739	2887	1379	33396$^{\sigma}$
1977[5]	20732	26119^{+}	5168	NA	46608	98627
1980[6]	23307	9779	2926	2949	6371	45332$^{\sigma}$

* includes inland fishing gear.

α includes nets operated by small mechanised vessels. Their number would, however, be less than 1000 assuming a fleet of 382 small mechanised gillnetters in 1982.

+ includes dragnets. ∞ includes 279 encircling nets.

σ excludes inland fishing gear and gears owned by non-fishermen. NA: Not Available

Sources: 1. Dept. of Fisheries, 'Census of Fishermen's Assets and Liabilities - 1958'. Administration Report for the year 1957-58, (Government of Kerala, Trivandrum, 1960), p. 98.

2. Directorate of Economics Statistics, Indian Livestock Census 1966, Vol. II, (Government of India, New Delhi, 1972).

3. Dept. of Animal Husbandry, Livestock Census 1972, Schedule III, (Government of Kerala, Trivandrum, 1973), p. 9.

4. CMFRI, Census of Marine Fishing Villages, Fishermen Population, Fishing Craft and Gear (1973-77), Kerala, (Marine Fisheries Information Service, No.3, CMFRI, Cochin, 1978).

Sources: Contd.

As before the data presented in the Table IV.3 are not quite comparable. For one thing, the Livestock Census figures include quite a large number of minor gear (employed in the inland sector) in the total[1]. The CMFRI data on the other hand, although confined to the marine sector, do not take into account the gear owned by non-fishermen communities staying outside the fishing villages[2]. More over, the classification of the gear followed by the two agencies are also different and it varied for each agency during the different census periods covered in the table. For example, the Livestock Census gave details of boat-seines in 1966, but gave no details of that gear in 1972 and 1977. Instead, it seems to have classified it under the category of dragnets. We have, for consistency, included it under the category of boat-seines. The Livestock Census further gives no account

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1. Many of these gear are used with or without the help of fishing craft.

2. CMFRI, All India Census of Marine Fishermen, Craft and Gear: 1980, MFIS 30, (CMFRI, Cochin, 1981), p. 3.

Sources: Continued

5. Dept. of Animal Husbandry, Livestock Census - 1977, (Government of Kerala, Trivandrum, 1979), pp. 72-74.

6. CMFRI, All India Census of Marine Fishermen, Craft and Gear: 1980, (Marine Fisheries Information Service, No.30, CMFRI, Cochin, 1980).

of hooks and lines. The CMFRI data too are misleading. While it gave details of boat-seines and encircling nets[1] separately for 1973-77, it combined (or omitted) the two in 1980. Considering the two as belonging to the same category of nets, we have combined the two for 1973-77 as well.

It is apparent from Table IV.3 that gillnets constituted the predominant traditional fishing gear of the state. The gillnets are, however, considered to be 'less efficient' compared to the boat-seines which formed the next important gear of the traditional sector in terms of their number. We have, however, no idea of the relative contribution of these gear to the total output of the industry. Shore-seines and hooks and lines are relatively less important as these gear are used only seasonally and by a minority of fishermen in the state. As regards the number of the different gear, we find a generally decreasing trend in all cases over the years. This, as we pointed out elsewhere, should be considered as partly the result of some standardisation of the various traditional gear and partly the result of the growing displacement of the traditional

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1. This net is different from the modern purse-seine nets used by the purse-seine boats. It should be noted that the state had no purse-seine fleet before 1979. It was only since 1979 that the purse-seine fleet began to develop in the state.

gear by modern gear such a trawlnets and purse-seines. To these points we will turn in the next chapter.

Now let us explain some of the major characteristics of the traditional gear used in the state. Table IV.4 presents the major characteristics of the traditional fishing gear of Kerala.

Table IV.4. Some Major Characteristics of the Traditional Fishing Gear of Kerala

Name of Gear	Material	Average size (length in m)	Mesh size (cms)	Average depth range of operation (fathoms)*	Durability (year)	Cost+ Rs
Gillnet (Thanguvala)	Cotton, hemp and nylon	48 - 125	5 - 6	10 - 15	1	7000-10000
Boat-seine	-do-	50 - 65	2 at cod end	10 - 20	1	3000-5000
Shore-seine (Kambavala)	Coir, cotton and nylon	316	0.80 at cod end	0.5 -1	1 - 2	2000-3000
Hook and line	Galvanised iron hook with cotton/ nylon thread	450 - 1800 m and 100 to 200 hooks per set	15 - 20 (length of hook)	8 - 10	NA	500 - 800
Stake-nets	Cotton and nylon	12 - 30	1 - 2 at cod end	3 - 4	1	3000-3500
Cast-nets	-do-	2.50 to 6.00 in radius	1.20	0.50 - 1	1 - 2	800 -1000

* The depth-range indicated shows the usual limits. Fishermen operated the gear at different depths depending on the suitability of the craft, seasons and the availability of fish.

\+ own estimates for 1985.

Sources: 1. CMFRI, Indian Fisheries 1947-77, (CMFRI, Cochin, 1977), p. 56.

2. P.R.G. Mathur, op. cit., pp. 141-42.

It is apparent from Table IV.4 that the material used in the making of these gear (nets) are cotton, hemp or nylon. It may be noted that the availability of synthetic materials indigenously has helped in progressively reducing the gear made of natural fibres. There is still a considerable percentage of traditional gear made of cotton and hemp in the traditional sector of the industry (see Appendix Table IV.1). It is evident from this table that about 40 per cent of the gillnets and 58 per cent of the boat-seines were made of natural fibre in 1977. This indicates the heavy dependence of the traditional fishermen on natural fibres which is partly due to their relative cheapness and partly due the non-availability of synthetic materials at acceptable prices.

Another feature or characteristic of the traditional gear which is apparent from Table IV.4 is that these gear are of relatively small size ranging from 50 m to 125 m in length. It indicates the limited catching potential of these gear.

As regards the mesh size of these gear (gillnets and boat-seines), it can be said that they are quite selective and not very harmful to the stock.

The depth range of operation of these nets are almost the same and to that extent there is a likelihood of these gear concentrating in the same fishing grounds and competing for the same resources. It is inevitable that these gear operate for the same pelagic or mid-water species such as sardines, mackerels, anchovies and the like, which migrate inwards and reach the range of operation of the traditional craft. The potential for increasing the output of these gear is limited by the limited range of their operation.

As regards the durability of these gear it is seen that they have generally a life span of only one year[1]. The implications of these various characteristics of the traditional gear in relation to their costs, production, productivity and development of the industry are enormous. Some of these implications have been already pointed out. We will draw on the rest when we discuss the output of the traditional sector.

2. Organisation of Production in the Traditional Sector

Fishing is essentially a collective activity which involves some form of organisation. The form of this organisation, however, will depend upon the level of

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1. Strictlv speaking, a net is never discarded as it always undergoes repair and replacements. This is particularly true of the traditional gear which can be easily mended.

development of the industry or more precisely upon the level of technological development. In the traditional sector of the fishing industry, the form of this organisation is seen to depend largely on the type of craft/gear used and the amount of capital invested in the fishing unit.

In this section we give a brief outline of the nature of organisation prevailing in the sector and the changes taking place in the organisational set up. Specifically, we will refer to the ownership pattern, organisation of work and the system of sharing of the produce. We will discuss these by referring to the different craft-gear combinations.

a) Ownership of the Means of Production

The means of production involved in fishing are the fish stock and the fishing equipment. The former represents the 'objects' of labour and the latter the 'instruments of labour[1]. As far as the fish stocks[2] are

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1. The 'objects' of labour are the things upon which people work and the 'instruments' of labour, the things or instruments with which people work on the objects of labour. For details of these concepts, see L. Leontyev - A Short Course on Political Economy, (Progress Publishers, Moscow, 1968), p. 13.

2. Since there are more than one variety of stock (species of fish) the term can be used in plural.

concerned, there is still the freedom of entry for the fishermen and they are considered to be the communal or common property of the society[1]. Within the traditional fishing communities there is said to be some form of social control over the use of the resources by members from within the fishing village. Outsiders are generally prevented from entering the traditional fishing grounds of the village[2]. Within the traditional set up the fishery resources (fish stock) are common to all, although there might be customary controls which restrict this freedom. The resources are, yet, not owned by any individual fishermen or groups.

The question of ownership of the means of production is then primarily related to the ownership of

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1. For a description of the characteristics of these resources, see Francis, T. Christy and Anthony, Scott, The Common Wealth in Ocean Fisheries: Some Problems of Growth and Economic Allocation, (John Hopkins University Press, Baltimore, 1965), pp. 1-75. In the context of Kerala, it may be noted that the Government of Kerala have introduced a system of registration and licensing of fishing vessels in 1980 under the provisions of the Kerala Marine Fishing Regulation Act of 1980. The main objective of the Act was to regulate fishing in the inshore waters of the state rather than restricting it.

2. Mathur notes, 'as a matter of fact the infringement of their rights by the fishermen of other villages is sometimes very much resented', P.R.G. Mathur, op. cit., p. 220.

the craft and gear employed in fishing. As far as the traditional sector is concerned, there are broadly two categories of ownership in Kerala. They are (i) individual ownership and (ii) collective ownership. We will discuss collective ownership first.

i) Collective Ownership

As pointed out earlier, fishing is a collective activity where several people join together to conduct the operation of fishing. Cooperation is an essential component of the fishing activity. This is essential because of two factors (1) the diverse skill required for the operation and (2) the large capital investments required for different types of fishing. The skills required for a fishing expedition are many. It requires several people specialised in rowing the boat, sighting the shoal, shooting the net, hauling the catch and doing several other works requiring minute care. The skill required are discussed in the next section alongwith organisation of work in the traditional sector. We now look at the requirements of capital and its impact on the ownership pattern.

The capital required for a fishing unit, even by the standards of the traditional fishermen, is often beyond the reach of most individual fisherman. A large dug-out canoe of Malabar now costs between Rs 30000/- - Rs 35000/- and a small one between Rs 10000/- - Rs 15000/-. The Comparative costs of different types of traditional craft and gear as estimated by different sources are given in Appendix Table IV.2. The current costs of these equipment are certainly beyond the reach of average fisherman. The consequence of this type of situation will be some move towards some form of collective ownership of the means of production. This has manifested in the prevailing situation in the traditional sector where each fisherman own some components of a fishing unit and bring them to operate on a collective basis. This situation has been illustrated by Mathur in the case of boat-seine operators at Tanur. Mathur writes:

> A fishing unit of Valakkar consists of one or more valas (nets) two tonis (plank-built boats), two cukkans (rudders) and eight Tandus (oars), eight mokkus (wooden pegs for fixing the oars in the gunwale), one or more kadankanis (coirwings), one or more kambas (warps) and an eight-man crew. A fishing unit is owned either by single individual or by a number of persons. The general pattern is the joint ownership ... A fisherman can get a share in the ownership of the unit by contributing to any of the fishing tools mentioned above. A person can acquire a small share in a net by supplying even a kadankani (coirwing) or a Kamba (coir rope or warp). The smallest share that a

fisherman can acquire in a fishing unit is Mahani (one sixteenth of the unit) and the maximum is Mukkalarakkal (seven eight of the unit). In a fishing unit the shareholders are called Mahanikkarans (owners of 1/16th share), Arakkal pakutikkar (owners of 1/8th share), Kalpakutikkar (owners of 1/4th share), Kalearakkal pakutikkar (owners of 3/8th share), Arapakutikkar (owners of one half share), Ara-Arakkal pakutikkar (owners of 5/8th share), Mukkal pakutikkar (owners of 3/4th share) and Mukkal Arakkal Pakutikkar (owners 7/8th share). The owner of the entire unit is called Valakkaran[1].

Referring to the ownership of nylon nets introduced in the late sixtees at Tanur, Mathur noted:

> ... it is beyond the means of an average fisherman to own a nylon net individually. Consequently such a net is owned by a number of shareholders who constitute a fishing unit. Each shareholder has to contribute a fixed amount of cash or a section of the net; ... out of the total number of 175 nylon nets presently in use in Tanur, only 25 are owned by single individual fisherman and the rest are jointly owned

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1. P.R.G. Mathur, op. cit., pp. 163-84. The shareholders in a fishing unit are called Pakutikkar and the overwhelming majority of them work in their units as fishing labour. Each Pakutikkar (shareholder) is responsible for providing not only the appropriate share of the fishing implements but also the Orrakkanmar (fishing labourers). For instance, an Arakkal Pakutikkaran provides an Orral (one fishing labourer) if he cannot himself be present in the expedition as one of the members of the crew. This principle is followed in the case of other shareholders like Ara Pakutikkar, Arakkal Pakutikkar, etc.. The former provides four fishing hands, whereas the latter, six labourers.

by more fishing units ... Majority of the nylon nets are owned by two or three fishing units collectively. Some of the nets are owned by 8 to 16 fishing units [1].

The system of collective ownership of the means of production as described above is not universal. Individual ownership of the means of production seems to be prevalent in certain segments of the traditional sector and is progressively replacing the collective ownership pattern.

ii) Individual Ownership

Individual ownership implies that a single person owned all the components of a fishing unit, i.e. both the craft and the gear. Individual ownership is the most prevalent form of organisation in Trivandrum district where catamaram fishing is the most common method of fishing[2]. The predominance of individual ownership in this fishery is

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1. Ibid., pp. 185-86.

2. This is apparent from the fact that all the 7854 catamaram units operating in Trivandrum district in 1979 was found to be in the hands of 6243 households. A similar pattern was seen in Quilon and Alleppey districts as well, where 1575 and 67 catamaram units were owned by 949 and 68 families respectively. See, S. Krishna Kumar, Strategy and Action Programme for a Massive Thrust in Fisheries Development And Fishermen Welfare in Kerala State (1980-83), (Government of Kerala, Trivandrum, 1980), p. 367.

largely attributed to the relatively small amount of capital investment required in this fishery[1]. Kurien recognises this factor by saying that, 'this enables nearly every fisherman to own at least one catamaram and one kind of gear'[2].

Individual ownership of the craft and gear was found to some extent in the hook and line fishery of Malappuram district as well. Mathur notes that out of a total of 120 Beppukar (hook and line fishermen) families of Tanur, 19 were owning 22 fishing units in 1977[3]. It means that the owning families were owning one unit in full and had share in other units as well. Individual ownership was found in canoe fishing too. For example, in a sample of 100 units studied 20 per cent was found to be owned by individuals[4].

The ownership pattern in the traditional sector except for these cursory observations is not well documented. We may, however, conjecture that there is a growing tendency for individual ownership to develop in this sector. At least

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1. John Kurien, op. cit., pp. 36-37.
2. John Kurien, op. cit., pp. 36-37.
3. P.R.G. Mathur, op. cit., p. 182.
4. Ibid., p. 183.

four major factors can be identified to account for this phenomenon. They are (1) rising competition and falling resources, (2) rising capital requirements, (3) growing population, (4) unfavourable trade and credit conditions.

The rising competition among the fishermen for the resources of the inshore waters will force many of the fishermen having only nominal shares in the unit to leave or abandon their partnership rights as they are not worth the responsibility and risk they have to bear. Instead, they would prefer to join the heirarchy of ordinary fishermen with only labour power to contribute. The fishermen who possess the larger part of the investments in the vessel are likely to buy the remaining rights for complete ownership, thus paving the way for individual ownership. This is particularly true in the context of declining resources or lean fishing seasons.

Rising capital requirements also force many traditional fishermen to forsake their existing rights in the fishing unit. This happens when these fishermen are not able to fulfil their commitments to replace the capital or parts there of as per their ownership rights. Here also, the rich or well-to-do partners will be persuaded to take the full responsibility of owning and managing the unit.

A third factor mentioned above is the growth in the population which increases the dependency ratio in the sector in the short period. The increase in the family size, without corresponding rise in the adult workers will force many marginal owners of capital to dispose of their ownership rights whenever the family faces a deficit budget. The likely consequence is a fall in the number of collective owners and a rise in the number of individual owners.

The fourth factor mentioned above is the unfavourable trade and credit conditions working in the industry. The fishing industry, like traditional agriculture, is notorious for the exploitative trade and credit systems which disposses the primary producers (fishermen) of their rightful property - the fishing craft and gear. It may be noted that the trade and credit mechanism in the traditional sector are quite successful in displacing the original producers of their limited rights (share) in the means of production and making them 'wage workers' or 'bonded' workers[1]. This possibility is portrayed by Swift when he wrote:

> In an industry such as fishing where the most productive forms of activity require continuous and heavy investment in nets and boats, there is scope for the man with capital to acquire control of the independent producer through capital advances, especially if the fisherman's problems are complicated by a season during which he receives very little if any income. Control by capitalists in different degrees has been the common fate of... fishermen[2].

Mathur gives some evidence of the concentration of ownership in the hands of a few individuals or households. He reports:

> About 5 per cent of the households of the Mappila fisherfolk of Tanur own about 600 boats ... As the cost of a boat varies from Rs 2000/- to Rs 3000/- it is impossible for poor fishermen to own a boat exclusively[3].

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1. The possibility of the poor fisherman becoming a 'bonded' labourer is illustrated by Mathur. He says 'The System of bonded labour helps one to get loans from his Karanavan (Headman) for maintenance of the family during off-seasons and crisis. It prevents exploitation of the poorer fishermen by outsiders. This system keeps the Orakkanmar (fishing labourers) tied to their patrons'. P.R.G. Mathur, op. cit., p. 243. The words in parentheses is mine.

2. M.G. Swift, 'Capital, Saving and Credit in Malay Peasant Economy', in Raymond Firth and B.S. Yamey (Eds.), Savings, Credit and Peasant Societies, (Allen and Unwin, London, 1966), p. 155.

3. P.R.G. Mathur, op. cit., p. 205.

Kurien also corroborates this point.
He points out:

> In the case of a canoe fishing unit the level of investment is very high and the number of persons who can muster the means to invest in one are few (sic). This results in a greater degree of concentration of assets in the hands of fewer individuals. Moreover, the fact that five persons is the normal crew size and as many as 12 - 15 will be required for the more complicated type of fishing, reduces the scope of partnership between the few owners and several non-owners. The relationship tends to be one of employer-labourer and less of partnership[1].

The tendency for 'employer-employee relations' or what is called capitalistic relations to develop in the fishing industry of Kerala has been pointed out by this researcher in an earlier study[2]. This study found that the percentage of fishermen (employers and employees) engaged in the capitalist sector increased from 33.71 per cent

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1. John Kurien, op. cit., p. 36. Emphasis is mine.
2. Ramakrishnan Korakandy , 'Some Aspects of Employment Organisation and Productivity in the Fishing Industry of Kerala - A Spatial Analysis' (Unpublished M.Phil Dissertation, Jawaharlal Nehru University, New Delhi, 1976), pp. 59-76.

in 1961 to 66.59 per cent in 1971[1]. This development in the traditional sector of the industry has ominous potential for its survival in the traditional state. This has already been revealed by recent innovations in this sector by more enterprising fishermen (boat owners) who went for the introduction of outboard engines to their traditional craft to make their operations viable and challenging[2]. The further consequences of these developments will be probed in the course of our discussion of the technological changes in the fishing industry in the ensuing chapters. We now turn to the organisational aspects of work in the traditional sector.

b) <u>Organisation of Work in the Traditional Sector</u>

Organisation of work here essentially refers to the division of labour or distribution of work among members of

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1. Ibid., p. 73. Some minor corrections were made in the original finding, since the general economic tables of the 1971 Census were published later with some corrections in the manuscript data supplied for the original study in 1975. It should also be noted that the increase observed in the percentage of employers and employees relate to workers engaged in both the mechanised and non-mechanised (traditional) sectors of the industry. The basic trend observed, however, will not be altered even if the mechanised component is removed as it constitutes only a small fraction of the total fishermen engaged in the industry.

2. It was at once challenging and paying for the more enterprising fishermen to introduce outboard engines to their traditional craft.

a fishing team. The division of labour in the traditional sector varies according to the size of the craft. In the small catamaram units manned by a crew of two or three persons, the work may be shared equally and inter-changeably. In the case of larger units, however, the work will be more complex and well defined. In the case of canoe fishing, for example, the fishermen divide a five member crew into one Cukkankaran (Steersman) and four Tandukaran (oarsmen) all of whom are proficient in fishing and seamanship. Sometimes the Karanavan or head of the unit himself works as the Cukkankaran. The Tandukarans are assigned different tasks to be performed from different kallis[1] (compartments) of the boat which they normally occupy[2]. The Tandukarans

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1. Mathur has identified eight kallis (compartments) in the plank-built boats of Tanur. These kallis are made of bamboo or wooden planks and they extend from the stern (Amaram) to the prow (Aniyam) of the boat. These kallis are called (1) Cukkan kalli, (2) Tamman kalli, (3) Idakalli or Kadakalli, (4) Kumbidikalli, (5) Nallakalli, (6) Mumbakalli or Kambakalli, (7) Vittalakalli and (8) Kombankalli. Each kalli has a definite and prescribed role during fishing operations. See, Mathur, op. cit., p. 134.

2. The tandukarans are usually called after each kalli. Thus, the four Tandukarans are known as (1) Tamman kallikaran or Tamman tandukaran, (2) Kadakallikaran or Kadatandukaran/ Idakallikaran or Idathandukaran, (3) Nallakallikaran or Nallatandukaran and (4) Mumbakallikaran or Mumbatandukaran.

are subordinate to the cukkankaran and assist him in rowing, paddling, shooting and hauling of the net. The cukkankaran is in overall charge of the unit, and fishing operations are conducted under his directions. He is usually responsible for the maintenance of the boat and nets though not for its replacements, unless he is the owner. It is also the prerogative of the cukkankaran to select the members of the crew, irrespective of the fact whether he is the owner or not. He is required to have a good knowledge of wind, weather, current, tides, habitat of fish and other relevant factors in fishing. He must know where to find the fish and must have 'good eyes' to locate the different species of fish[1].

The cukkankaran and tandukaran have specific duties to perform during fishing operations. The cukkankaran normally shoot the net with the help of the tamman thandukaran. The tamman tandukaran, one of the important oarsmen, hauls up the net when the fish is entangled and puts the net back into his kalli. The Idathandukaran helps his colleague, the Nallathandukaran in shooting the net as well as in hauling it up. It is the duty of the Nallatandukaran to fix the sail according to the direction of the wind and remove it when the boat

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1. P.R.G. Mathur, op. cit., p. 199.

is rowed against it from the _nallakalli_. The _Mumbatandukaran_ sets the coir rope and anchor in position. The _Kumbidikallikaran_ takes care of the catch and the nets before shooting. The _Vittalakallikaran_ has the duty of keeping in safe custody the floats, sinkers, coir rope, coir net, hammers etc. during the fishing expedition. He also assists the other oarsmen in shooting and hauling the coir rope, coir net, sinkers and floats[1].

It is clear from the above description that all the oarsmen cooperate with each other under the leadership of the steersman during a fishing operation. The success of a fishing trip is essentially dependent on the competence and team spirit of the crew. The ability of the steersman is, however, the most important factor.

In this description of the division of labour among the traditional fishermen who work in different capacities in the fishing units, we find the question of their acquiring the requisite skills unanswered. It may be noted that the traditional fishermen acquire these skill through the long process of 'learning by doing' or from their cumulative experience. This learning process is illustrated by Mathur thus:

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1. P.R.G. Mathur, op. cit., pp. 201-202.

The manner in which the technology of fishing is acquired for generations is interesting. There is no special mechanism by which the skill is transmitted. (Mappila) boys generally learn the technique of fishing by accompanying fishing units and through involvement in the operations. They learn the technique by the hard way. The transmission of the know-how is generally done on the basis of kinship. Instruction is imparted to the kins either in a particular technique or in some special gear or craft. The children in the age group of 3 - 6 are given models of boats to play with on sandy beaches. Those between the age group of 7 - 12 are asked to carry fishing tools like coir ropes, rudder, oars, etc. from home to the boats. They are detailed for draining of the water from the boats, if any. Teenagers are asked to accompany the boats to the mid-sea and help the elders in propelling the oars. They are given rigorous training in plying the rudder in the last stage. This apprenticeship training is given for a year or so. When they are competent to substitute a member of the crew in any vacancy, he is given a fixed share of the catch. It appears, however, there is no closely defined set of conditions linking the imparting of the technological know-how[1].

Notwithstanding the above observation by Mathur we may recognise the significant role of formal education which fishermen-children get in schools and fishermen training centres in the state. We will discuss this aspect

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1. Ibid, pp. 179-80. Parentheses is mine.

in the next chapter. It may, nevertheless, be noted here that this formal education and training which fishermen boys get are particularly useful in the mechanised sector of the fishing industry.

Another facet of the division of labour in the traditional sector of the primary marine fishing industry of Kerala, which we have not discussed so far is the division of work on the shore. It is seen that the Karanavan (Headman) of a fishing unit generally remains on the shore specialising in the management of the unit. His primary duty is to see that the unit is functioning properly without any interruption. In order to achieve this objective, he recruits the labourers (wage workers) purchases the equipment and arranges for the regular disposal of the catch. He distributes the quantum of pre-arranged shares to the members of the crew including the wage workers. He keeps an account of the daily catch of the unit and settles the account of each share-holder fortnightly, monthly or even quarterly. His other responsibility is to maintain the crew, including the wage-workers, during off-seasons. He may even take loans from fish-merchants, money-lenders and fish-mongers in order to provide for the members of his unit. The loans are generally secured against personal credit and on the understanding that the catch would be supplied to the creditors at reduced rates. Sometimes, the Karanavan may be of good economic standing and he will do the entire supervision of the unit including the marketing of its catch. He may also own the bulk of the share in the boat and perform the task of financing the members of his crew and marketing their share of catch. He may receive interest and commission for these services and make deductions for any other service rendered by him. It is generally understood that it is this section of the so-called fishermen who exploit the primary producers or the actual fishermen in the traditional sector. The presence of this category of fishermen has historically served the purpose of keeping the fishing industry in the traditional state without any change in the industry. But with the introduction of new technology and new forms of organisation from outside (by the Government), this section of fishermen has learnt to adapt to the changed institutions and processes.

c) The System of Sharing of the Produce

The system of sharing the output of the fishing unit varies directly depending upon its size and the ownership pattern. In the case of small catamaram units, where the ownership is vested in the hands of the individual of the family, and employing no hired labour, the output is not shared with any body. It accrues solely to the individual or the household. This is likely to be the case with the hook and line fishermen, where the number of participants are limited (one or two) and they all belong to the same family. In all these cases the income earned by the unit is a composite quantity with no distinction between wages and profits. The income earned is the income received from the individual or family labour involved. In these cases there is no exploitation of wage labour by the individual or the household.

In the case of larger fishing units, however, the situation is quite different. These units are very often owned by a number of fishermen (see collective ownership) and are operated by a large number of fishermen including wage workers or hired workers (orakkanmars). Sharing of the produce becomes inevitable in such cases. The sharing system is also prevalent in cases where the boat is owned exclusively by an individual and when he employs other fishermen as his crew to operate the boat.

Generally, the total money value of the catch from a fishing trip is divided into two components - one for the owner and the other for the workers. The owners get their shares in proportion to their contribution to the craft and gear. If the owner happens to be a worker he gets one additional share from the divisible share of the workers.

The proportion in which the money value of a day's catch is shared between owners and workers differs across boats with different combinations of craft and gear. In some parts of Trivandrum district, for example, the shares of the owners and workers are reported to be 25 per cent and 75 per cent respectively for a fishing unit consisting of two catamarams and a net[1].

The following patterns of sharing the earnings were given by Joseph Vattamattom for different craft-gear combinations in Poonthura village in Trivandrum district.

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1. Joseph Vattamattom, 'Factors that Determine the Income of Fishermen, A Case Study of Poonthura Village in Trivandrum District', (Unpublished M.Phil Dissertation, Centre for Development Studies, Trivandrum, 1978), p. 23.

Table IV.5. The Sharing Patterns in Selected Craft Gear Combinations in Trivandrum District

Category of equipment	No. of persons required	Total value of catch (%)	Rent on equipment (%)	Workers' share (%)
1. Small catamaram - hook and line	1 - 2	100	34	66
2. Double catamaram and net	4 - 6	100	25	75
3. Big catamaram and shark net	3 - 4	100	40	60
4. Big catamaram and drift net	3 - 4	100	40	60
5. Row boat and shore-seine	20-40	100	40	60

Source: Joseph Vattamattom, op. cit., p. 23.

The relatively low percentage of rent given for the first two categories of equipment must be due to their lower marginal efficiency and greater supply in the district.

A more detailed description of the sharing system in the traditional fisheries of Kerala is given by John Kurien and Rolf Willmann[1]. Kurien and Willmann gave

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1. John Kurien and Rolf Willmann, Economics of Artisanal and Mechanised Fisheries in Kerala, (Small-Scale Fisheries Promotion in South Asia, FAO/UNDP, Madras, 1982), pp. 43-44.

the following scheme of distribution between the crew and owners for different craft-gear combinations.

Table IV.6. The Sharing Patterns in Different Traditional Craft-Gear Combinations in Kerala

Crew share (%)	Owners' share (%)	Craft-gear combinations
40-50	50-60	Prawn nets with catamarams
50-60	40-50	Shore-seine with dug-out canoes and sardine net with catamarams
60-70	30-40	Anchovy and large mesh drift nets with catamarams, hooks and line/ encircling net/shore-seine/small-mesh drift net with plank built boats and large-mesh drift nets/ lobster net with dug-out canoes.
70-80	20-30	Boat-seines and hook and lines with catamarams and sardine nets/ prawn nets/boat-seines/hook and lines/encircling nets with dug-out canoes.
80-90	10-20	Cast net with dug-out canoes and shore-seine with plank-built boats.

Source: John Kurien and Rolf Willmann, op. cit., p. 44.

The above table indicates wide variations in the sharing pattern among crew and owners for different craft/ gear combinations. Fishermen operating boat-seines, hooks and lines and large mesh gillnets (with catamarams) and those operating castnets (with dug-out canoe) and other type of nets such as prawn nets, sardine nets, boat-seines, etc. (with dug-out canoes and plank-built boats) are getting a higher percentage (60 - 90%) of the value of the catch. Those operating prawn/sardine nets with catamarams and shore-seine with dug-out canoe are seen to get only a relatively smaller share (40 - 60%) of the catch.

The method of sharing the money value of the catch is found to be somewhat different among the traditional fisherfolk of Tanur in Malappuram district. The general procedure is to first divide the value of the catch among the owners on the basis of their shares in the unit and then to divide these shares between them and the crew employed by them. The <u>orakkanmar</u> (hired workers) employed by the owners are reported to get 5 - 12 per cent of the catch either after setting apart shares for the nets and boats or before doing so. This share is increased or decreased depending upon his indebtedness to the employer[1].

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1. P.R.G. Mathur, op. cit., pp. 186-187. The implications of this credit and sharing system on the morale of the fishermen will be too many. Mathur notes '... the prices of some of the ordinary tools are comparatively low - A <u>peyittamvala</u> does not cost more than Rs 250/- but to my surprise I found that a number of labourers had never taken interest in getting a share even in this most ordinary fishing gear. Similarly the <u>Beppukar</u> seem to have not made any attempt to save money and buy a <u>Peyittamvala</u> or a cheap net. A <u>Beppukaran</u> generally cannot save money since he cannot meet his expenses by hook and line fishing. I have noticed that they do not take any initiative in learning the technique of launching the net ... This lack of initiative prevented them from acquiring ownership rights in fishing units ... The inability of the fishermen to get easy credit is the most important reason for his continued poverty and low economic position ...' (Ibid., pp. 234-35).

Despite this apparent difference, the general procedure of sharing in all these cases is more or less the same[1]. It involves the division of the earnings into the required number of shares which is normally one more than the number of crew on the fishing unit. The rationale of this division is that all the working members will get an equal share and the extra share is what goes to the craft and gear and therefore appropriated by the owner. If the owner is also a worker, he is entitled for two shares - one as worker and the other as owner. Notwithstanding these principles, if the capital investment in the unit is more, the number of extra shares due to the owner will automatically increase.

It seems that in this scheme of distribution of the earnings, the skill of the crew gets less weightage. Only the amount of capital and the number of workers count. The role of education and training is unnoticed and unpaid. The implications of this sharing system for higher productivity and increased output are obvious. Restrained by the trade and credit mechanism, this will only discourage the traditional fishermen from bettering their performance. Taking their total environment - the village community, their production

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1. John Kurien and Rolf Willmann, op. cit., p. 43.

conditions and the ecology of the sea - the output of the traditional fishermen will be an unimpressive quantity subjected to all the uncertainties of the trade, which modern technology can certainly overcome[1]. The sharing system helps in perpetuating backwardness by preventing initiative and technological change in the sector.

3. Output of the Traditional Sector

Having given an outline of the technology and organisation of production in the traditional sector of the primary marine fishing industry of Kerala, it is now important to see how the output of this sector has behaved over the years. A clear picture of the output in terms of its quantity and value and also its trend overtime will help us in understanding the role and potential of this sector in contributing to the further development of the industry as well as in suggesting measures for its improvement in the future. Our main task in this section is, therefore, to give an outline of the output of this sector during the past three and a half decades. We should, however, add

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1. The question whether modern technology has helped in overcoming the uncertainty of output in fishing is a crucial point under investigation in this study. The answer to this question is partly given in Chapter VII.

at once, that this attempt of ours is thwarted as before by the paucity of relevant statistics of catch of the traditional sector for an extended period of time. It may be noted that the available statistics of catch as reported by the Central Marine Fisheries Research Institute and the Department of Fisheries do not give a break up of the catch by mechanised and non-mechanised (traditional) sector on a regular basis. These sources have, however, given such break-ups for certain stretches of time like 1969-74, 1979-81, 1982 and 1984. Most of these details have since been combined by the Expert Committee on Marine Fisheries in Kerala in 1984 and a general series of catch by mechanised and non-mechanised craft have been presented in its report in 1985[1]. This report, however, does not give the details on a species-wise basis for studying the qualitative aspects of production or the value of output of the traditional sector. We may, therefore, use this information to study the broad trend in the output of the traditional sector and supplement this with the other available species-wise details to estimate the value of output of this sector. We first examine the general trend in the output of this sector. Table IV.7 shows

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1. Expert Committee, The Report of the Expert Committee on Marine Fisheries in Kerala, (Expert Committee, C/o. Central Institute of Fisheries Education, Bombay, 1985).
   The Expert Committee has in fact given a series of output of the mechanised and non-mechanised sector for the whole period covered in this study except 1951-56 and 1984.

the quinquennial output of the traditional sector between 1951 and 1984[1].

Table IV.7. Quinquennial (average) Output of the Traditional Sector from 1951-84

(Quantity in lakh tons)

Quinquennium (period)	Quantity	Increase (+)/decrease (-) over the previous period (%)	Annual compound growth rate (%)
1951-55	1.31	-	-11.31
1956-60	2.57	96.18	37.87
1961-65	2.62	1.94	3.23
1966-70	3.29	25.57	0.45
1971-75	3.14	-4.55	-3.01
1976-80	2.29	-27.07	10.96
1981-84	2.13	-6.98	20.60
1951-84	2.50	-	11.39

Source: Appendix Table IV.3.

1. The last one year of the 1981-85 quinquennium is not included here as the data for that year were not available at the time of analysing the data.

It is clear from Table IV.7 that the output of the sector showed considerable increase during the first four quinquenniums when output increased from an average of 1.31 lakh tons during the first quinquennium ending in 1955 to 3.29 lakh tons during the fourth quinquennium ending in 1970[1]. The overall growth in output during this period was 151.14 per cent. This output, however, started declining during the fifth quinquennium when the average output came down to 3.14 lakh tons. There after this output has been declining steadily and reached 2.29 lakh tons during the sixth quinquennium and 2.13 lakh tons during the first four years of the seventh quinquennium ending in 1985. The extent of decrease during this period is about 35.25 per cent. The average annual compound growth rate for the whole period was 11.39 per cent. In addition to the above, the output of the sector also showed significant year to year fluctuations during the whole period. This is evident from Appendix Table IV.3 and Figure IV.1. Appendix Table IV.3 further reveals the decline in the relative share of output of the traditional sector in the total output of the industry. The sector which almost maintained its share to near

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1. This increase in the output of the sector must be explained more in terms of the extensive use of synthetic gear materials rather than any increase in the fishing effort applied by the sector. The fishing effort applied by the sector had actually shown a decrease, of the order of 192 per cent between 1956 and 1970. (See Appendix Table IV.4).

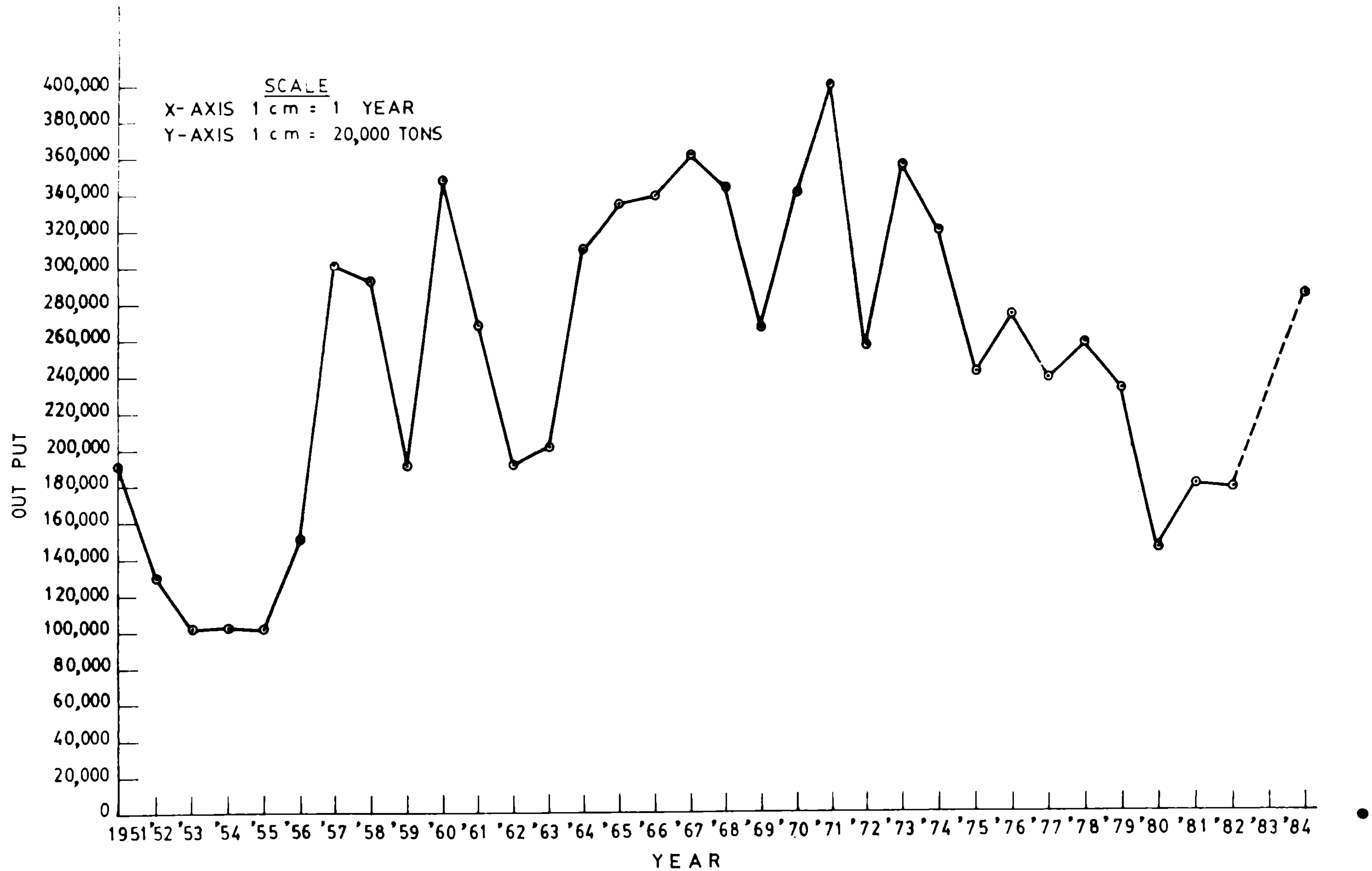

FIG. IV-1. TREND IN THE OUT PUT OF THE NON-MECHANISED SECTOR (1951-1984).

100 per cent till 1969 began to lose its hold thereafter[1]. The turn of the eightees marked a further fall in the output of the sector[2]. The economic effects of this fall-effects on productivity, employment, earnings, etc. - upon the traditional fishermen and their response to the changing economic conditions are issues to be discussed in this study. This exercise is, however, postponed to Chapter VII where the effects of technological change are discussed[3].

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1. This, as pointed out earlier coincided with the vigorous implementation of the programme of mechanisation of fishing boats in the state. The details of this programme and its impact on the fishery economy of the state will be discussed in the following chapters.

2. As pointed out above, this period marked the beginning of a new strategy to strengthen the traditional sector by introducing outboard engines to the craft. This strategy has contributed to increase the output of the sector in the initial years but the benefits are reported to be not sustained.

3. The justification for this postponement is the fact that the decline in the output of the traditional sector and its impact on the economy of the traditional fishermen cannot be viewed independently of the changes taking place in the mechanised sector. It may be noted that the two sectors are strongly counter-poised in our analysis of development. Our effort in this chapter is primarily to give a portrait of the traditional sector, which is subjected to heavy pressures from within and outside. From within, it is forced to adapt new technology and organisation and from outside to move to new fishing grounds and markets. We will discuss these changes in the ensuing chapters.

Let us now have a look at the nature of the output of the sector in terms of its quality (species) and value. We will first examine the species composition of the output and see the trend in the output of those species. The statistical constraints are as insurmountable as before. In fact we have no time-series of the output of the sector with species-wise break-up. What we have at best is the species composition for a limited number of years ranging from 1969 to 1976, and from 1979 to 1982. The break-up for 1969 to 1976 is only for three major species and a combined group called 'rest of the species'. For the remaining years the data available are again not for homogeneous groups. Considering the practical difficulties in compiling the tables and the complexities involved in the comparison of the data,we have confined our analysis of the species composition of the catch to three major species (viz. - oil sardines, mackerels and prawns) and a combined group called 'others'[1]. Table IV.8 presents the species-wise catch (output) of the traditional sector during the period from 1969 to 1976 and from 1979 to 1982.

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1. The combination of all the remaining species into one category called 'others', though theoretically unsound was practically unavoidable because of several other constraints. For one thing, most of the species included in this group are caught only in nominal quantities and they show violent fluctuations in their quantity. Even bulk species like anchovies and ribbonfish included in this category are subjected to heavy annual fluctuations and their separation will only complicate the work of comparison. Other species like pomfrets and seerfish, which are included in this group, although high priced varieties, are caught only in limited quantities.

Table IV.8. Species-wise Catch (output) of the Traditional Sector for the period from 1969 to 1976 and from 1979 to 1982.

(Quantity in tons)

Year	Species				Total
	Oil sardines	Mackerels	Prawns	'Others'	
1969	136911	29449	22033	78207	266600
1970	186124	53858	14019	86299	340300
1971	189809	94427	10376	102592	397204
1972	104300	34484	17877	100515	257176
1973	122643	19780	28392	184587	355402
1974	101727	10159	20636	182323	314845
1975	97121	14845	5165	122961	240092
1976	120396	19783	10580	120478	271237
Average of the period*	132379 (43.35)	34598 (11.33)	16135 (5.28)	122245 (40.03)	305357 (100)
1979	113365	18128	2955	101282	235730
1980	57625	13407	6463	66743	144238
1981	111676	12175	5960	49678	179489
1982	84298	6855	4886	81088	177107
Average of the period*	91741 (49.82)	12641 (6.86)	5066 (2.75)	74698 (40.56)	184146 (100)
Percentage change over the former period	-30.69	-63.46	-68.60	-38.89	-39.69

* Figures in parentheses are percentages of the total.

Sources: 1. John Kurien, Towards an Understanding of the Fish Economy of Kerala, (Centre for Development Studies, Trivandrum, 1976), p. 63.

2. Department of Fisheries, Kerala Fisheries, Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 8-9.

3. Directorate of Economics and Statistics, Statistics for Planning 1983, (Government of Kerala, Trivandrum, 1984), p. 190.

It is clear from Table IV.8 that oil sardines constituted the major species contributing approximately 43 per cent of the total output of the sector during 1969-1976 and 49.82 per cent during 1979-1982. The next major species group was 'others' which constituted about 40 per cent of the total output during both the periods. Mackerels and prawns formed only a small component of the catch in both the periods. In fact the relative share of these species had shown a decline. Mackerels which contributed approximately 11 per cent of the output during 1969-1976 contributed only 6.86 per cent during 1979-1982. The share of prawns declined from 5.28 per cent to 2.75 per cent during the same period. The above Table further indicates the extent of decrease in the output of the four species groups and the total during the latter period. The output of oil sardines decreased by 30.69 per cent, mackerels by 63.46 per cent, prawns by 68.60 per cent and 'others' by 38.89 per cent[1]. The output as a whole fell by 39.69 per cent. The extent of this fall in individual species as well as the total output would be much greater if account is taken of the catch of earlier years prior to the

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1. The sharp decrease in the output of oil sardines and mackerels during this period must be the result of the introduction of purse-seine fishing in the state by mechanised vessels since 1979.

introduction of mechanisation of fishing craft on a large scale in the state (i.e., the period prior to 1969)[1].

Appendix Table IV.5 which shows the output of the industry as a whole by the four major groups illustrates this. It can be gathered from this table that the output of oil sardines and mackerels constituted approximately 55 - 65 per cent of the total output of the industry during the second, third and fourth quinquenniums, when technological changes were just in the offing and when the lion's share of output was contributed by the traditional sector. The average output of oil sardines during the fourth quinquennium ending in 1970 was 2.03 lakh tons and that of mackerel 0.20 lakh tons. Prawns constituted 0.30 lakh tons and 'others' 0.94 lakh tons. Much of this output should be viewed as the contribution of the traditional sector and it is from this superior position (the contribution of the sector to the total output of the industry was never less than 86 per cent during this period[2]) that the sector lost its absolute and relative share of output in the ensuing years.

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1. The year 1969 marked the beginning of a new strategy for the development of mechanised fishing in the state with integrated facilities for catching, processing and marketing.

2. See Appendix Table IV.3.

Another feature which emerges from Table IV.8 is that the relative share of the 'other' species has remained steady at about 40 per cent in both the periods. This must be viewed as the result of the traditional fishermen's strategy to fight the decline in their total catch and their economic position. With limited technological know-how and meagre capital investments the traditional fishermen are naturally forced to diversify their fishing effort to catch all the 'sundry' species that come their way after escaping the nets of the mechanised boats. As pointed out by Kurien and Willman:

> ... the strategy that makes most economic sense in these circumstances is therefore to adapt the methods of capture to whatever types of fish happen to be within the reach at a particular time of year and to accept that, at some seasons ...[1].

Despite this strategy, the traditional fishermen have not succeeded in maintaining their output to the previous levels. This is partly because of the technical constraints under which they are working - the limited catching potential of their craft - and the growing

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1. John Kurien and Rolf Willmann, <u>Economics of Artisanal and Mechanised Fisheries in Kerala</u>, (Small-Scale Fisheries Promotion in South Asia, FAO/UNDP, Working Paper 34, Madras, 1982), p. 3.

competition for resources in the inshore waters and the ensuing depletion of most prime varieties of fishes[1].

Let us now have a look at the economic significance of these species by ascertaining their value. As before, we are circumscribed by the paucity of data of prices and the sectoral output for several years. We, however, look at the limited data available and discern the economic importance of the various species and the total output. Table IV.9 gives the values of output of the traditional sector for two periods viz. 1969 to 1976 and 1979 to 1982.

Table IV.9. Value of Output of the Traditional Sector

(Value in Rs lakhs)

Year	Species				Total
	Oil sardines	Mackerels	Prawns	'Others'	
1969	390.20	226.46	332.70	406.68	1356.04
1970	744.50	414.71	238.32	555.77	1953.30
1971	706.09	824.35	187.08	669.93	2387.45
1972	411.99	307.60	344.13	697.57	1761.29
1973	521.23	182.17	853.46	1388.09	2944.95
1974	665.29	166.40	739.39	1682.84	3253.92
1975	826.50	357.62	216.31	1583.74	2984.17
1976	1011.33	404.36	658.08	1633.68	3707.45
Average of the period*	659.64 (25.93)	360.46 (14.17)	446.18 (17.54)	1077.29 (42.35)	2543.57 (100)
1979	1014.62	300.74	283.71	1428.08	3027.15
1980	527.27	224.57	647.66	1011.16	2410.66
1981	1044.17	209.41	674.67	788.38	2716.63
1982	775.54	127.84	618.32	1359.03	2880.73
Average of the period*	840.40 (30.46)	215.64 (7.82)	556.09 (20.16)	1146.66 (41.56)	2758.79 (100)
Percentage change over the former period	27.40	-40.17	24.63	6.43	8.46

* Figures in parentheses are percentages of the total.

Sources: 1. Table IV.8 for details of output.
2. Administration Reports of the Department of Fisheries for price estimates.

Note: The Administration Reports of the Department of

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It is quite evident from Table IV.9 that the 'other' species as a group contributed the largest share of the value of output of the sector. It contributed 42.35 per cent of the total value of output during the first period and 41.56 per cent in the second. This is despite its secondary position in terms of quantity of output during both these periods. Oil sardines, though forming the leading species in terms of quantity in both the periods, got only the second position in terms of value. Its share was about 26 per cent during the former period and 30.46 per cent in the latter. The share of mackerel came down from 14.17 per cent to 7.82 per cent, registering a fall of 40.17 per cent, in terms of actual value. Prawn's share in the total value of output was around 18 per cent in the first period, which increased to 20 per cent in the second. Table IV.9 further makes it clear that the value of output of the sector as a whole did not make much improvement over the years despite the manifold increases in the prices of every species[1]. The actual value of output of oil sardines increased by 27.40 per cent, prawns by 24.63 per cent, and 'others' by 6.43 per cent. The value of total output increased by only 8.46 per cent. This observed

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1. Between 1969 and 1984 the price of oil sardines increased by 265%, mackerel by 221%, prawns by 795% and 'others' by 218%. For prices of individual years, see Appendix Table IV.6.

Table IV.9. Sources Contd.

Fisheries give the quantity and value of output of almost all species caught in the state during the financial year. In order to arrive at the prices for the calendar year we first divided the value of output of the three major species and the remaining species by their respective quantities and then calculated the two year moving averages of the prices so obtained. The resulting figures are presumed to represent the prices of the calendar year for the relevant species.

pattern in the value of output of the traditional sector indicates that the sector has not been able to take advantage of the price rise of several high-priced varieties like prawn, pomfret, seer, etc. by redeploying its effort to catch these species. The sector has in fact failed to change its 'cropping pattern' or 'species-mix' by changing the input-mix. This lacunae on the part of the traditional sector, it must be pointed out, is largely due to the limited skill and capital possessed by the sector. The craft used by the traditional fishermen can hardly go beyond the 10 - 15 fathom limits and catch the more plentiful species in all seasons. Working under these constraints, the traditional fishermen are left with severe uncertainty of output[1]. In addition to this, the sector is also affected by price uncertainties. Fish prices are subject to heavy daily fluctuations - from morning to evening - depending on the hourly landings of fish. The traditional craft with no engine power can hardly compete with the mechanised boats in bringing the catch to the markets earlier to command a high price. The consequence is the deprivation of a fair price to the product.

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1. It is true that the traditional fishermen catch some of the high priced varieties like pomfrets and seerfish, but their absolute quantity is so small that they contribute only a small share to the total value of output of the sector.

It is now necessary to look at the real value of output of the traditional sector as much of the observed increase in the value of output was primarily due to the inflationary rise in the prices of most varieties of fish (as noted in Appendix Table IV.6). We, therefore, give below an index of real value of output of the traditional sector for the two periods from 1969 to 1976 and from 1979 to 1982.

Table IV.10. Index of Real Value of Output of the Traditional Sector

(Base Year: 1969 = 100)

Year	Money value of output (Rs lakhs)	Index of current value	Index of food prices*	Index of real value of output
1969	1356.04	100.00	100.00	100.00
1970	1953.30	144.04	105.48	136.56
1971	2387.45	176.06	111.39	158.06
1972	1761.29	129.88	122.57	105.96
1973	2944.95	217.17	147.36	147.37
1974	3253.92	239.96	184.49	130.07
1975	2984.17	220.07	182.48	120.60
1976	3707.45	273.40	186.28	146.77
Average of the period	2543.57	-	-	130.67
1979	3207.15	236.51	212.65	111.22
1980	2410.66	177.77	240.82	73.82
1981	2716.63	200.33	264.13	75.84
1982	2880.73	212.43	295.56	71.87
Average of the period	2803.79	-	-	83.18

Sources: 1. Value of output from Table IV.9.

2. Index of Food Prices from H.L. Chandhok, Wholesale Price Statistics - India - 1947-78, Vol.1 and Reserve Bank of India - Report on Currency and Finance 1984. Chandhok gave the index with base 1970-71. We have, however, converted this to 1969.

It is quite clear from Table IV.10 that the real value of output of the traditional sector has not shown any improvement but has on the other hand undergone a drastic decline. This is evident from the sharp decline in the average of the indices of the real value of output, which slipped from 130.67 during the former period (1969-76) to 83.18 during the latter (1979-82).

The economic implications of this sharp decline in the real value of output of the traditional sector must be briefly pointed out before we conclude this chapter. It is quite likely that the real income of the traditional fishermen will also decline with this fall in the real value of output of the sector unless their number has decreased. The population of fishermen in the state has in fact increased at a higher rate of 2.3 per cent per annum compared to the general average of 1.9 per cent per annum during the last decade[1]. Naturally, the number of the traditional fishermen will set this trend, being the major component of the fishermen population. We have, however, no direct estimate of the working fishermen in the traditional sector

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1. John Kurien, Technical Assistance Projects and Socio-Economic Change: CDS Working Paper No. 205, (Centre for Development Studies, Trivandrum, 1985), p. 67.

to study the trend in the real-value of output per fisherman. An indirect estimate of the working fishermen (active fishermen) in the traditional sector was given by Kurien[1] for the period from 1969 to 1976. This estimate, however, has the disadvantage of being an under estimate because of the higher weightage it had given to the mechanised sector by assuming a crew size of six when it actually was five. We have modified this assumption and a fresh estimate of the number of fishermen in the traditional sector was worked out for the same period and from 1979 to 1982[2]. Table IV.11 presents the index of real value of output per fisherman in the traditional sector for the period from 1969 to 1976 and for 1979 and 1980.

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1. John Kurien, op. cit., p. 68. The procedure followed by Kurien was to ascertain the total number of 'Ocean, sea and coastal fishermen' according to the 1971 Census and to add the numerical equivalent of 2.3 per cent growth rate which was the rates of growth of population assumed by him to each subsequent year and to deduct the same component for each earlier period. This gave the total number of working fishermen for each year. From this, the number of fishermen engaged in the mechanised sector (which is obtained by multiplying the number of mechanised vessels for each year by a crew size of six) was deducted to get the number of fishermen engaged the traditional sector.

2. We have changed the assumption of a six member crew to a five member crew. This changed assumption can be justified on the ground that most of the trawlers carry a crew of only five members. Gillnetters carry a crew of four men while purse-seiners carry nine. Considering the small number of these boats (gillnetters and purse-seiners), this assumption of a uniform crew size of five for all boats will not significantly affect our conclusions.

Table IV.11. Index of Real Value of Output per Fisherman in the Traditional Sector

(Base Year: 1969 = 100)

Year	No. of active fishermen	Current value of output (Rs lakhs)	Output per fisherman (Rs)	Index of current output per fisherman	Index of food prices	Index of real value of output per fisherman
1969	89162	1356.04	1521	100.00	100.00	100.00
1970	91257	1253.30	1373	90.26	105.48	85.57
1971	93016	2387.45	2567	168.77	111.39	151.51
1972	94132	1761.29	1871	123.01	122.57	100.35
1973	95665	2944.95	3078	202.36	147.36	137.32
1974	97310	3253.92	3344	219.85	184.49	185.66
1975	99358	2984.17	3003	197.43	182.48	108.19
1976	98770	3707.45	3754	246.81	186.28	132.49
Average of the period	94834	2543.57	2564	-	-	125.13
1979	103473	3207.15	3100	203.81	212.65	95.84
1980	105533	2410.66	2284	150.16	240.82	62.35
1981	107826	2716.63	2519	165.61	264.13	62.70
1982	110548	2880.73	2606	171.33	295.56	57.96
Average of the period	106845	2803.79	2627	-	-	69.71

Sources: 1. Value of output and index of food prices are from Table IV.10.

2. The number of active fishermen in the sector is estimated by substracting the number of fishermen in the mechanised sector (as per Table VI.4) from the total. The total number of fishermen in the state for each year is calculated by using a multiplier of 2.6 per cent growth rate for 1969-70 and 1.9 per cent growth rate for 1971-76 and 1979-82. The 1971 Census figure of active fishermen in the state is used as the base. The total number of fishermen (060 group)

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Table IV.11 makes it quite clear that the real value of output per fisherman has declined sharply over the period. The index (average) of real output per fisherman has declined from 125.13 during the former period to just 69.71 during the latter. It shows a decline of the order of 55.71 per cent within a short span of less than a decade.

Another important point that emerges from Table IV.11, which is contrary to the usual belief, is that the money value of output per fisherman has not shown any significant increase during the period. The average value of output per fisherman increased only marginally from Rs 2564/- during the former period to Rs 2627/- in the latter. The rationale of this meagre increase in the value of output of the traditional fishermen is not a fall in the price of the output produced by the fishermen but a sharp decline in the output per fisherman. This must be clear from the sharp decline in the total output of the sector as shown in Table IV.8 above (about 40 per cent), and the notable increase in the number of fisherman engaged in the sector in recent years (see Table IV.11 above). This,

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Table IV.11 Sources Contd.

in 1971 was 101916. 2.6 per cent and 1.9 per cent were the annual growth rates of population in the state during census decades of 1961-71 and 1971-81. From this the equivalent of 2.6 per cent was deducted for each previous year prior to 1971 and and the equivalent of 1.9 per cent added to each subsequent year after 1971.

in other words, means a decline in the productivity of the traditional sector. The genesis of the sharp fall in the output of the traditional sector has already been offered. It is the growing competition for the limited resources in the inshore fishing grounds and the inability of the traditional fishermen to pursue fish shoals in the outer seas.

It may be noted in conclusion of this chapter that the production conditions prevailing in the traditional sector as reflected in the craft and gear employed by this sector has not undergone any material change during the past three and a half decades. The technology of fishing has remained unaltered. The only remarkable change in the sector is the use of synthetic materials for the fabrication of nets. The organisational set up of the sector has been, however, undergoing certain changes leading to the growth individual (private) ownership of the means of production. This is found to be due to the poverty of the traditional fishermen and the unfavourable trade and credit systems prevailing in the industry. With limited capital equipment and poor technical adaptability, the output of the traditional sector has shown a steady decline since the seventies. The real output per fisherman has come down drastically during this period. The relative output of the sector which was almost 100 per cent as late as 1968-69 has come down to about 40 per cent in 1984.

The counterpart of this economic panorama is the growth of the mechanised sector which marked the introduction of new technology and the ensuing developments. In the next chapter we discuss the various technological changes that led to the development of the primary marine fishing industry of Kerala.

CHAPTER V

TECHNOLOGICAL CHANGE IN THE PRIMARY MARINE FISHING INDUSTRY OF KERALA - A VIEW OF THE 'PROCESS'

The 'process' of technological change in the primary marine fishing industry of Kerala as distinguished from its 'characteristics' and 'effects' is a complex phenomenon, which needs to be understood before we embark on a discussion of the last two aspects in the next two chapters. In this chapter we discuss the 'process' of technological change in the industry from 1951 to 1984[1]. The 'process', as pointed out earlier is most complex, pervading over a wide range of fields such as marine resource research, development of suitable craft and gear, evolution of new fishing techniques, harbour development, promotion of fisheries education, fishermen training, fisheries organisation, etc. It is practically difficult to compress the several changes that took place in these various fields during the last 30 or 35 years into the framework of a compact theory - the theory of technological change. However, in order to give some orderlines in the treatment of the various changes that took place in the

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1. Strictly speaking the first few years of this period witnessed no significant changes as no major schemes were taken up during this period. However, with the setting up of the Indo-Norwegian Project at Neendakara in 1953, the process of technological change was initiated in the industry. We will discuss this shortly.

industry during this period, we look at these changes in the usual framework of technological change, viz. 'Research and Development', 'Inventions', 'Innovations' and 'Diffusion of Innovations'. It may be prudent, however, here to point out that the fundamental changes in the industry may not have always followed this sequence of R and D, invention and innovation, but might have sometimes skipped or overlapped or over-run some of these processes or stages. Hence, it is our intention to combine some of these stages, depending upon their nature and process. We begin our analysis with a description of Research and Development (R and D) efforts for marine fishery resources.

1. Research and Development for Marine Fishery Resources

The role of R and D for resource location, identification and exploitation was recognised by the Government of India even prior to independence. It established two major research institutions early in 1947 (before independence) to conduct studies on marine fisheries resources of the country. The Central Marine Fisheries Research Station (later designated as Central Marine Fisheries Research Institute) with Headquarters at Mandapam Camp near Madras (shifted to Cochin in 1971) and the Deep Sea Fishing

Station (later made Exploratory Fisheries Project and now part of the Fisheries Survey of India) with headquarters at Bombay were set up to study and generate new 'knowledge' about the marine fishery resources of the country[1]. Since independence a number of other research, training and development organisations were set up by the central and state governments, all of which contributed to the 'furthering of the knowledge' of the Indian Ocean and Indian Fisheries. The International Indian Ocean Expedition (1959-65) also helped in understanding the migration, breeding, growth and mortality pattern of several species of fish in the region. The Pelagic Fisheries Project set up in 1971 with FAO/UNDP collaboration has further extended the knowledge of several surface water resources of the country. In this section we make a brief review of some of the major

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1. The chief objectives of the Central Marine Fisheries Research Institute are (1) to estimate the catches of the marine fishes and other animals from the seas around India throughout the year by different types of craft and gear, (2) to conduct research on marine fishery resources in order to step up their production to the maximum possible extent, (3) to locate new fishing grounds to conduct environmental studies in relation to fisheries, and to generate additional resources by mariculture, and (4) to recommend measures for the rational exploitation of the various resources. The major objectives of the Deep-Sea Fishing Station (Exploratory Fisheries Project) had been to conduct exploratory surveys and experimental fishing to assess the fishing potential and commercial viability of deep sea fishing in Indian waters.

findings of the leading research institutions concerning the fishery resources of the country with particular reference to Kerala[1]. The major findings relating to fishing grounds, fishing seasons, fishery biology, fish catches and fish culture (mariculture) are given as under.

a) Fishing Grounds

The continental shelf of Kerala is found to be relatively narrow with approximately 50 km length off Cochin. The profile of the shelf is with a uniform gradient upto about 80 m depth and thereafter the slope is observed to be more pronounced. The shelf area upto a depth of 60 m. is muddy from south of Alleppey towards the north, while it is sandy from South West of Alleppey to further south. The sea bottom is reported to be hard and slightly uneven from 60 - 90 m depth while it is uneven with rocky and coral formations between 90 - 120 m depth, the width of this uneven portion being about two nautical miles. The sea bottom between 120 - 200 m depth is stated to be hard and even, indicating the prospects for trawling, especially

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1. It may be noted that much of the 'knowledge' created on the fishery resources and their potential are discussed by the various institutions not exclusively with reference to Kerala but to the south-west coast of India, which includes the states of Kerala, Karnataka and Goa.

in the regions north of Cochin. Stray occurrence of rocky grounds were also reported in this depth range between Alleppey and Ponnani[1]. Exploratory trawling conducted by the vessels of the Deep Sea Fishing Station and the Indo-Norwegian Project during the late fiftees and the early sixtees and the operations of a few private companies during the same period had established the existence of suitable trawling grounds near Quilon, Cochin, Ponnani, Tanur and Cannanore. These grounds were reported to yield good catches of prawns, perches, lizard fishes, soles, flat fishes, etc. Table V.1 gives a picture of the comparative productivity of the trawl grounds of Kerala as observed by the vessels of the Deep Sea Fishing Organisation.

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1. K.M. Joseph, N. Radhakrishnan and K.P. Philip, Demersal Fisheries Resources of the South West Coast of India, Bulletin No.3 of the Exploratory Fisheries Project, (Government of India, Bombay, March 1976), p. 4.

Table V.1. Comparative Productivity of Trawling Grounds of Kerala

Region/ ground	Period of fishing	Method of trawling+ vessels/ H.P. of engine	Catch per hour in Kg. (Average)
Cannanore	1957-58	Bull-trawling/240 HP	591
	1960-61	Medium vessels	268
	1965-66	Small-shrimp trawlers 25-40 HP	83
Calicut*	1957-59	Bull-trawling	717-2033
	1960-61	Otter-trawling by bull-trawlers	136
	1962-66	NA	100-400
Cochin	1957-59	Bull-trawling	1015-1184
	1957-61	Medium vessels (less than 90 HP)	91-250
	1961-65	-do-	111-216
Alleppey/ Quilon*	1957-59	Bull-trawling	583-1025
	1957-61	Other-trawling (small vessels)	158-187
	1958-60	Medium vessels	105-220
	1962-66	NA	20-100
Trivandrum	1957-58	Bull-trawling	509

+ For a description of the method of trawling, See, John C. Sainsbury, Commercial Fishing Methods (Fishing News (Books) Ltd., London, 1971), pp. 17-57.

* The large difference in the range is due to the introduction of bull-trawling and the improvements effected after the location of the grounds.

Source: Ministry of Food and Agriculture as quoted by the Indian Institute of Foreign Trade in the Survey of India's Export Potential of Marine Products, Vol. III-A, (IIFT, New Delhi, 1970), p. 74.

Table V.1 while indicating the wide variations in the productivity of the different regions also establishes the potential for commercial trawling. A catch rate of 100 kgs/hr was reported to be good enough for small vessels for making the operation viable at that time[1]. It may be noted in perspective that the location of these grounds have led to the exploitation of these grounds by the small shrimp trawlers of the state since 1960[2].

We may now have a look at the extent of areas available for fishing/trawling in different columns of water and their resource potential. Table V.2 gives the extent of the continental shelf, standing stock and sustainable yield for different depths of water for demersal fishes in Kerala.

Table V.2. Extent of Continental Shelf, Standing Stock and Sustainable Yield of Demersal Resources at Different Depth Zones for Kerala

(Area in sq. km. and resources in tons)

Depth zones	Area	% of total	Standing stock	Sustainable yield at 60% of stock
0 - 10 fathoms (inshore)	5057	12.73	16064	22761
10-40 fathoms (offshore)	24442	61.53	85840	54259
40-100 fathoms (Deep-sea)	10224	25.74	NA	NA
Total (0-100 fathoms)	39723	100	NA	NA

Source: K.M. Joseph, et al., Bulletin of the Exploratory Fisheries Project (3), (Government of India, Bombay, March 1976), pp. 40-45.

1. We will discuss these developments at some length later.

Table V.1. Source Contd.: Indian Institute of Foreign Trade, Survey of India's Export Potential of Marine Products, Vol. III-A, (IIFT, New Delhi, 1970) p.78.

It is clear from Table V.2 that approximately 75 per cent of the continental shelf area of the state lies in the inshore and offshore regions upto 40 fathoms. The fishery potential of these regions (upto 40 fathoms) have been properly studied by the Exploratory Fisheries Project.

b) Fishing Seasons

The seasonality of the fisheries of the region is an important factor affecting the economy of the fishermen and the availability of fish in the state. The main fishing seasons for different species have been studied by the CMFRI. The pelagic fishery for sardines and mackerels usually start soon after the southwest monsoon and continue till about March with substantial landings taking place between October and December. The prawn fishery with indigenous craft commences by about June - July and lasts till about October. Bottom trawling for prawns begins in October and extends upto April - May of the succeeding year. Ribbon fish are plentiful during the monsoon months of June and July. The anchovy fishery move northwards and closer to the coast in September. Cuttlefishes, if they appear, will do so early in October. Fishing for 'Kalava' (rock cod) in deeper waters begins in November when the sea is calm.

Some of the unique features of the fishing grounds which lead to seasonal abundance of various species have also been studied by the Central Marine Fisheries Research Institute. A major characteristic of the region is that it is subjected to two monsoons viz. the south-west monsoon and north-east monsoon. The monsoons which affect the salinity of the coastal waters influence the fisheries of the region.

Another factor which affects the fishery of the region during this period is the intrusion of the oxygen minimum cool layer of water which drives and concentrates nearly all the demersal and pelagic resources towards the surface and towards the coast, rendering them readily available and easily accessible to the inshore fishermen along the south-west coast[1].

It may be noted further that the monsoons of the state besides affecting the distribution and availability of fish, produces heavy surf on the beaches, particularly in the southern parts of the state. Fishing operations have to be suspended during this period even if fish

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1. Expert Committee, Report of the Expert Committee on Marine Fisheries in Kerala, (CIFE, Bombay, 1985), p. 71.

are available. Based on the periodicity of the monsoons, three fishing seasons can be recognised for the state, viz. pre-monsoon (February - May), monsoon (June - September) and post-monsoon (October - January). From the point of view of the intensity of fishing operations, the first and the last periods are most important.

c) Fishery Biology

One of the major responsibilities of the Central Marine Fisheries Research Institute since its inception has been to study the biology of the major commercially exploited fish stocks of the country. The objective behind this responsibility was to study the parameters which affect the recruitment, individual growth and mortality of the species and to monitor these parameters with a view to regulate and manage the stocks as and when the need arises. The biology and breeding habits of some of the major pelagic species, viz. oil sardines, mackerels and anchovies and the major crustaceans like penaeid prawns have been studied in great detail. The migratory path of these species have also been studied by the Central Marine Fisheries Research Institute through its tagging experiments in the sixtees.

d) Fish Catches and Potential

A major objective of the Central Marine Fisheries Research Institute, as pointed out earlier is to estimate the marine fish catches of the country and to locate new fishing grounds for increasing fish production. The Institute has, since its inception, developed a system of stratified multi-stage sampling procedure to collect statistics of marine fish production in the whole of coastal India. It now collects and disseminates statistics of the various species of fish caught using different types of gear by mechanised and non-mechanised craft in the country. The Institute also makes seasonal and location specific forecasts for different species using accoustic and satellite imageries. Remote sensing in marine fisheries, using space technology has been successfully applied in the West coast. The Institute, based on a case study of Cochin zone using chlorophyll scanning technique, has recently shown that water columns having about 15 mg/m^2 chlorophyll can sustain a yield of over 250 kg/ha/year of fish inclusive of both demersal and pelagic resources[1].

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1. Central Marine Fisheries Research Institute, Research Highlights - 1984-85, (CMFRI, Cochin, 1986), p. 5.

The estimates of catch made by the Institute especially since 1956 have been published in its several bulletins and special publications. Bulletin 13 gave details of catch and effort for the period from 1956 to 1968. Details of catch for the period from 1969 to 1979 are published in the Marine Fisheries Information Service-22 and for the period from 1980 to 1982-83 in the Marine Fisheries Information Service-41 and 52.

Bulletin 27 of the Institute has given certain general details of the potential resources for exploitation in the country[1]. Here we outline some of the details of the potential resources as far as they relate to the Kerala coast, under seven categories of resources as discussed in the bulletin.

i) Resources Along the Continental Shelf-edge and the Upper Continental Slope

The bulletin notes from the combined findings of the various institutions that 'potentially good fishing grounds for demersal fishes and shellfish exist at different depths along the continental shelf edge and the upper continental slope'[2].

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1. E.G.Silas, S.K. Dharmaraja and K. Rengarajan, Exploited Marine Fishery Resources of India - A Synoptic Survey with Comments on Potential Resources, Bulletin 27, (CMFRI, Cochin, March 1976), pp.14-24.

2. Ibid., p. 14.

Table V.3 gives the estimated potential of these regions for the south-west coast of India.

Table V.3. Estimated Potential of the Demersal Fishery Resources of the Continental Shelf-edge and the Upper Continental Slope off the South-West Coast of India*

Depth-zones	Area (sq. km)	Estimated total demersal fishery resources based on average catch rates** (tons)	Estimated potential sustainable yield at 60% of the resource (tons)
75 - 100 m	11363	7542	4525
101 - 179 m	11916	32556	19539
180 - 450 m	20240	58891	35335
All	43519	98989	59339

* Resources from trawling grounds only.

** Estimated at average catch rates of 62.42, 256.87 and 273.65 kg/hr for trawling for the three depth-zones respectively.

Source: E.G. Silas, et al., op. cit., p. 15.

It is clear from Table V.3 that large concentrations of resources are available in the higher depth ranges.

The bulletin further noted that 'the good catches of deep-sea lobster Puerules sewelli and the deep-sea prawns Penaeopsis rectacutus, Aristeus semidentatus, etc. along the upper continental slope off Quilon are an indication of good potential resources'[1]. It also pointed out that 'commercial exploitation of these resources may be considered and if necessary, this may be combined alongwith Kalava fishing from the adjacent grounds or perhaps light fishing for squids or pelagic fishes such as anchovies'[2].

ii) Conventional Demersal Fishery Resources available for exploitation

Silas, et al. pointed out: 'In the shelf waters beyond 50 m there are considerable resources which remain virtually untapped . These resources included especially the threadfin bream in the depth zone of 75 - 100 m. In short there is every reason to be optimistic that with diversification of fishing to exploit all types of demersal fishery resources, the fish catch and production should go up considerably'[3].

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1. Ibid., p. 15.
2. Ibid., p. 16.
3. Ibid., p. 16.

iii) Conventional Pelagic Fishery Resources Available for Exploitation

The authors observed that 'it has been long suspected that both oil sardine and mackerel resources are available in abundance beyond the traditional fishing grounds. The recent investigations by aerial and accoustic surveys conducted along the west coast of India by UNDP/FAO Pelagic Fishery Project, Cochin, have confirmed that both oil sardine and mackerel shoals occur in neritic (nearshore) waters particularly between 19 and 40 fathoms'[1].

They further record that the FAO/UNDP Pelagic Fisheries Project (Report No.2) has confirmed the earlier findings that along the West Coast in depths upto 40 m there exists a diversity of species predominantly constituted by oil sardine, mackerel, Anchoviella spp. (anchovies), ribbon fishes, cat fishes, silver bellies and lesser sardines estimated to a total stock magnitude of several hundred thousand tons. The FAO/UNDP Report has also drawn attention to the possibilities of exploring for commercial utilization of these resources particularly the pelagic stock with relatively smaller vessels that are at present used for trawling in inshore waters for prawns[2].

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1. Ibid., p. 19. Words in parentheses is mine.
2. Ibid., p. 19.

The FAO/UNDP Report states that 'this resource is at present almost completely unexploited, and if the fish can find a market it could form the basis of a substantial small vessel fishery. It has the advantage that it is available through out the year although the total biomass appear to be the largest just prior to the South-West monsoon season. It is therefore proposed that experimental pelagic trawl fishing be started with types and sizes of vessels as the existing ones, and the pilot scale experiments of marketing and processing the fish be undertaken, including the trials of using the fish for production of fish meal intended for human consumption'[1].

It may be noted here that a small fleet of purse-seiners have been established in the state since 1979 to exploit some of these resources, especially the oil sardines and mackerel resources and many trawling vessels also have started pelagic trawling for a variety of species mentioned above

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1. FAO/UNDP, Pelagic Fishery Project (Ind. 93), Results of the First Year's Survey With 'Sardinella' Progress Report 2, Cochin, 1972, pp. 1-40.

iv) Non-conventional Pelagic and Demersal Fishery Resources of the Shelf Waters for Exploitation

These included resources which are at present either unemploited or under-exploited. The bulletin noted the possibilities for the development of a fishery for cuttlefishes and squids[1].

It has also drawn attention to the occurrence of large quantities of deep-sea gastropod Pirula investigatoris and deep-sea echinoid Elipneustes denudates and several other deep-sea fishes and crustaceans along the upper continental slope off the South-West coast of India. It stressed that 'there is an urgent need for evolving some methods for economically harvesting and utilising these and other such resources'[2]. No doubt, the industry of the state has taken heed of these findings, when it got the right incentive from the export market[3].

v) Pelagic Oceanic Fishery Resources for Exploitation

Pelagic oceanic fishery resources consist of fishes and other organisms which inhabit the oceanic realms outside

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1. E.G. Silas, et al., op. cit., p. 21
2. Ibid., p. 21.
3. We will discuss these developments in the next chapter.

the continental shelf. They include (1) fishes like tuna, bill fishes, pelagic sharks, sauries, flying fish, etc., (2) oceanic squids, (3) marine turtle (which needs conservation) and (4) whales like sperm whales, lesser toothed whales, dolphins and porpoises (some need urgent conservation). The potential yield of tunas and allied fishes from the South-west Coast of India, within 200 m is estimated to be 60,000 tons[1]. The authors observed: 'what is most significant is that hardly any effort is at present being expended to harvest the large pelagic resources of tuna-like fishes viz., the Skipjack *Katsuwonus pelamis* and the frigate mackerel *Auxis thazard* and *A. rochei* in the Indian Ocean. By using live bait and pole and line in the Lakshadweep and Maldive Archipelago a few thousand metric tons of skipjack are harvested at present. Development of suitable techniques for purse-seining for surface and sub-surface shoals of these species would yield good results'[2]. It may be noted here that following the oil crises of the middle seventies and the introduction of purse-seining in the state in the late seventies, a small

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1. E.G. Silas and P.P. Pillai, *Resources of Tunas and Related Species and Their Fisheries in the Indian Ocean, Bulletin 32*, (CMFRI, Cochin, April 1982), p. 134.

2. E.G. Silas, *et al.*, op. cit., p. 22.

fleet of small and medium vessels and country craft using out-board engines have started exploiting these resources beyond 40 m depth.

vi) Resources for Coastal Aquaculture (Mariculture)

Though different from capture fisheries, the importance of coastal aquaculture as a means to supplement the output of the capture fisheries has been well recognised. The potential for coastal aquaculture in the state is considerable if account is taken of the vast areas of inundated land, coastal lagoons, swamps, etc. which harbour a variety of marine and estuarine organisms that could be cultivated in such areas[1]. The fish and prawn culture experiments carried out by the CMFRI indicate that there is considerable scope for improving the production of prawns in the paddy fields (Pokkali fields) and backwater areas of central Kerala.

vii) Living Marine Resources for Industrial and Pharmaceutical Use

Apart from the possibility of manufacturing several edible industrial fishery products utilising 'thrash' fish or low value species, the technical possibility of producing

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1. The major species (organisms) for which culture techniques have been developed are pointed out in the next section on 'Fish Culture'.

other industrial fishery products have also been established. The technical possibility of producing cultured pearls of good quality has been demonstrated by the Central Marine Fisheries Research Institute. It should be clear from this extensive listing of the potential and the limited data furnished above that the industry has got considerable scope for expanding its output. It may be noted that the above observations, though not quantitative, are based on extensive fishing cruises conducted by the research vessels of the Institute and other organisations like the Integrated Fisheries Project and the Central Institute of Fisheries Nautical and Engineering Training (formerly known as the Central Institute of Fisheries Operatives).

We may, now have a look at the catch and the potential of the major commercially exploited pelagic and demersal fishery resources of the state. Table V.4 gives the details of current yield and estimated potential of the major pelagic and demersal fishery resources of Kerala.

Table V.4. Current Yield and Estimated Potential of the Major Pelagic and Demersal Fishery Resources of Kerala

(Yield and Potential in tons)

Group/species	Current yield (average of 1979-1983)	Potential stock			Gap in the potential
		Inshore (0-50 m)	Offshore (50-200 m)	Total	
1	2	3	4	5	6
I PELAGIC					
1. Oil sardine	127233	100800	-	100800	-26433
2. Anchoviella	7569	22400	67200	89600	82031
3. Ribbonfish	11351	16800	44800	61600	50249
4. Carangids	6737	16800	44800	61600	54863
5. Mackerel	14649	44800	-	44800	30151
6. Tunas and bill fishes	9019	5600	28000	33600	24581
7. Lesser sardines	8390	22400	-	22400	14010
8. Pelagic elasmobranchs	2497	4480	7840	12320	9323
9. Seer fish	3797	5600	-	5600	1803
10. Clupeoides other than anchovies	1085	5600	-	5600	4515
11. Miscellaneous	24984	18480	34720	53200	28216
Total	217311	263760	227360	491120	273809

Table V.4. Contd.

1	2	8	4	5	6
II DEMERSAL					
1. Perches	13712	11200	56000	67200	53488
2. Catfishes	8872	22400	44800	67200	58328
3. Penaeid prawns	32684	44800	8400	53200	20516
4. Cephalopods	2626	2800	16800	19600	16974
5. Sciaenids	4396	11200	-	11200	6804
6. Demersal elasomobranchs	2497	4480	7840	12270	9773
7. Silver bellies	3860	8400	-	8400	4540
8. Crabs, lobsters, non-penaeid prawns and other crustaceans	4912	2800	2800	5600	688
9. Pomfrets	2529	NA	NA	NA	NA
10. Bombay duck	-	NA	NA	NA	NA
11. Polynemids	40	NA	NA	NA	NA
12. Miscellaneous	12707	20720	38080	58800	46093
Total	88835	128750	174720	303470	214635
Grand Total	306146	392510	402080	794590	488444

Sources: 1. The potential stock of Kerala is estimated from P.C. George, B.T. Antony Raja and K.C. George, 'Fishery Resources of the Indian Economic Zone', Souvenir of the Integrated Fisheries Project, October 1977, pp. 79-116. The assumption made here is (vide George, et al.) that 56 per cent of the potential of the south west coast is due to Kerala.

2. Current yield (average of 1979-83 catch) is taken from the Report of the Expert Committee on Marine Fisheries in Kerala, pp. 230-38.

It is clear from Table V.4 that large potentials exist for anchoviella, carangids, ribbon fish, mackerel, etc. among pelagic species and for catfishes, perches, penaeid prawns, cephalopods, etc. among demersal species. The gap between the potential and the current level of exploitation is found to be more for pelagic species than for demersal species. This might be because of the comparative abundance (predominance) of the pelagic species in the waters of the state and the limited extent of the continental shelf and the related bottom-dwelling species. Among the pelagic species, however, the most predominant species viz. oil sardines is found to be over-exploited as indicated by a negative balance in the stock. This anomalous situation will, however, disappear, if we presume that there is the likelihood of some stock occurring in the offshore waters, for which no potential is given in the table as estimated by George and others.

A very important point which emerges from Table V.4 and which supports our earlier qualitative observations about the fishery potential of the state is that the bulk of the unexploited potential is in the regions beyond the 50 m depth contour. The implications of this resource endowment for future line of technical development in the industry is obvious - exploitation of these resources will require a new generation of vessels.

e) Fish Culture (Mariculture)

Promotion of fish culture (mariculture) by evolving suitable techniques for culture has been a major objective of the CMFRI. Accordingly, it has developed the techniques for culturing the major commercial species of prawns viz. *P. indicus*, *P. monodon*, *P. merquiensis*, *M. monoceros*, *M. dobsoni*, *M. affinis* and *P. stylifera*. The Institute is running a prawn culture centre at Njarakkal in Cochin. The Institute had also started a project for the culture of brown mussels at Vizhinjam in 1971. A project for culturing of green mussels in the open-sea was started at Calicut in 1975. The culture of pearl-oyster was taken up by the Institute at Tuticorin in 1972. A project for the culture of pearl oysters was started at Vizhinjam later. Edible oysters are also cultured by the Institute at Tuticorin. It has also developed techniques for the culture of seaweeds used in the production of agar-agar, alginic acid and other by-products.

2. Research and Development for Fishing Craft, Gear and Techniques

Development of suitable craft, gear and techniques were considered crucial for the development of the primary marine fishing industry of Kerala. The constraints on production prevailing in the traditional sector for want of suitable craft, gear and techniques for operation in the different columns of water have been pointed out in the last chapter. In this section, the Research and Development efforts for the evolution of suitable craft, gear and techniques are considered. The activities in these directions may be said to fall broadly in three periods: a) 1953 to 1963[1], b) 1963 to 1979[2] and c) 1979 onwards[3]. We will discuss the activities of these periods separately.

a) Research and Development from 1953 to 1963

i) Research and Development by the Indo-Norwegian Project (INP)

A major part of the R and D during this period was undertaken by the Indo-Norwegian Project, which started functioning from the Neendakara-Sakthikulangara region near Quilon in 1953[4]. The work primarily related to the mechanisation of fishing craft[5]. As a first step in the

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1. This period marks the period of small boat mechanisation.
2. This period marked the growth of medium and large vessels.
3. This period witnessed the growth of diversified fishing.
4. The Indo-Norwegian Project was set up in 1953 following a tripartite agreement signed by the Governments of Norway and India and the United Nations in October, 1952.
5. The Project had in fact attended to the community's overall needs of health, sanitation, housing, education, etc. Here, we confine to the Research and Development relating to fishing undertaken by the Project.

mechanisation of the craft the Project explored the possibility of utilizing the existing craft by fitting suitable engines. It shipped two local vallorns (canoes) to Norway in late 1952 and fitted 4 HP one-cylinder semi-diesel engines to the craft with some alterations. The two craft were returned to the Project site in 1953 and used on an experimental basis for fishing as well as training young fishermen in engine handling and manoeuvering of mechanised boats. The Project offered to rebuild and install engines to the local craft at a total cost of Rs 600/- to the fishermen. But the fishermen are reported to have shown no interest in this offer and instead preferred to wait for the specially built motor boats to become available. Further experiments to mechanise the country craft was continued for sometime by supplying outboard engines to these craft. But none of these experiments proved a success and the idea of mechanising the existing local craft was abandoned. Sandven, a former Director of the Project noted 'although it proved possible to mechanise the valloms, it soon became evident that this type of craft was not suited for conversion into an efficient motorised fishing boat'[1].

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1. Per Sandven, The Indo-Norwegian Project in Kerala, (Norwegian Foundation for Assistance to Underdeveloped Countries, Oslo, 1959), p. 34.

With little success in the mechanisation[1] of existing craft, the Project began to concentrate on the development of suitable new designs. As a temporary measure, it made arrangements to import twelve 22 ft. boats with 4 HP semi-diesel engines from Norway in 1954. Simultaneously, it began construction of a number of boats of the same type from its boat building yard at Neendakara, which was established in the same year. The building material used was anjili. The nets used were the traditional gillnets for sardine and mackerel. In March 1955, the first four mechanised boats of this type were issued to four fishermen who had completed the first training course given by the Project[2]. By August 1957, 63 such boats were issued to the local fishermen. The Project, however, stopped construction

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1. Here, the word mechanisation is used in a general sense. In the context of fishing it involves the application of machine power for both the propulsion of the craft and for the handling (operation) of the gear (net). The initial effort of the project was mainly to give power for propulsion, which is often called 'motorisation'. Mechanisation in its full content involves mechanical handlin of the gear too.

2. Training of manpower was integral to the process of technological change and in tune with this the Project had established a training centre for imparting training to young fishermen in mechanised fishing, engine handling, boat repair, etc. at the Project site. 'Education and Training' are discussed separately elsewhere.

of this type of boat after 1957. This decision was perhaps due to the poor response of the fishermen, particularly the Araya fishermen of the Neendakara region to mechanised fishing. It was found that most of the 22 ft. boats issued to the fishermen there were either disposed off or had gone out of service due to indifference and poor maintenance[1]. The indifference of the fishermen was based on sound reasons. The 22 ft. boats issued to the fishermen from 1956 to 1958 had hardly any out-right superiority over traditional canoes[2]. It may be noted from Appendix Table V.1, that the average net income from this craft was much less than that of the canoes. The fishermen were actually not impressed by the early performance of the 22 ft. boats[3]. Another factor that could have contributed to the reluctance on the part of the fishermen, particularly those of the Neendakara region, was

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1. T.R. Thankappan Achari and M. Devidas Menon, A Report on the Assessment of the Impact of the Indo-Norwegian Project on the Socio-Economic Conditions of the Fishermen of the Indo-Norwegian Project Area, (NORAD, Oslo, 1963), p. 34.

2. Ibid., p. 83.

3. Ibid., p. 36. It was further noted that these boats were quite heavy with limited HP (4 HP) and could carry only a small quantity of gear for fishing.

the absence of a landing jetty near their coast and the need to go to the Ashtamudi lake for mooring the boats[1]. It was found in the Neendakara village that only 50 per cent (17 boats) of the 22 ft. boats issued to the fishermen of the region were in operation in 1963[2]. It was further observed that many of the fishermen owning those boats were using them for ferry service instead of fishing as it was more lucrative to do so[3].

Knowing the limited success of the 22 ft. boats, the Project began to construct during the end of 1957 a 25 ft. boat with 8-10 HP full diesel engine. By the end of 1958 it introduced 19 such vessels in the Project area. These boats were capable of using a larger quantity of traditional nets as well as of fishing at greater distances. But the results were not upto the expectation, and a new design of 23 1/2 ft. with an 8-10 HP diesel engine was

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1. Arne Martin Klausen, Kerala Fishermen and the Indo-Norwegian Project, (George Allen and Unwin, London, 1968), p. 136. Kalusen reported this as one of the arguments put forward by former owners of mechanised boats at Neendakara for their operation becoming uneconomic and for their eventual discarding of mechanised fishing.

2. T.R.Thankappan Achari and M. Devidas Menon, op. cit., p. 34.

3. Bharat Bhushan, 'Technological Change in Fishing in Kerala 1953-1977', (Unpublished M.Phil Dissertation, Centre for Development Studies, Trivandrum, 1978), p. 48.

introduced in 1961. This design yielded better results than the 25 ft. boat. In 1962, the Project introduced a 25 ft. boat fitted with a 16 HP diesel engine capable of using a small shrimp trawl[1]. With the introduction of this craft (and trawlnets), there was some real appreciation of mechanised fishing over non-mechanised fishing[2]. This appreciation was not only because of the comparative 'efficiency' of these craft over the traditional craft in terms of the reduction in time taken to reach the fishing grounds, greater depth range of operation and the reduction in crew requirements, but also because their introduction coincided with the location of rich shrimp grounds along the Kerala coast and the development of an export industry for shrimp[3].

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1. Shrimp trawl is a dragnet used for catching shrimps. It is a bag-shaped net drawn along the sea-bed to scoop up fish/prawn on or near the bottom. The net has a wide mouth end and it tapers to a sock-like end which is referred to as the 'cod-end'. For more details, see 1) John C. Sainsbury, Commercial Fishing Methods - An Introduction to Vessels and Gear, (Fishing News (Books), Ltd., London, 1971), p. 19 and (2) D.L. Alverson, 'Fishing Gear and Methods' in Maurice E. Stansby (Ed.), Industrial Fishery Technology, (Reinold Publishing Corporation, New York, 1963), p. 51.

2. T.R.Thankappan Achari and M. Devidas Menon, op. cit., p. 83. The trawlnets, unlike other existing nets showed the possibility of catching shrimp/fish which are bottom dwelling and mostly high priced species.

3. D.A.S. Gnanadoss, 'Whither Mechanisation', Souvenir, IFP, Cochin, October 1977), p. 8.

The 25 ft. (16 HP) trawl boats brought considerable catches (see Appendix Table V.1) and the result was a complete shift in favour of mechanisation and trawl fishing. Even the 8-10 HP boats turned to trawling. The Project had to design very small trawlnets to meet the new demand from the fishermen. By the end of March 1963, all the 23 1/2 ft. boats and nearly two-thirds of the 25 ft. (8-10 HP) boats were engaged in trawling operations. The trawlnets generated double the income that were got through gillnet operations. Between October 1962 and March 1963, the 25 ft. (16 HP) boats yielded on an average 300 kg of catch per day valued at Rs 166/-, the 23 1/2 ft. boats yielded 131 kg/day valued at Rs 78/- and the 25 ft. (8-10 HP) boats, 112 kg/day valued at Rs 62/-.

Till March 1963, the Project issued 143 mechanised boats, of which 67 were 22 ft. (4.5 HP) boats, 23 of 23 1/2 ft. (8-10 HP), 39 of 25 ft. (8-10 HP), 9 of 25 ft (16 HP), one of 30 ft. (36 HP) and 4 of 36 ft. (48 HP).

The discovery of shrimp grounds and their export potential led the Project to design more types of mechanised vessels exclusively for shrimp trawling. One such design was the 32 ft. trawler fitted with a 40-50 HP engine. This design turned out to be the most economic one for shrimp trawling within the inshore waters[2]. Another design made by the Project was the 36 ft. (10.8 m) stern trawler powered by a 48 HP engine.

The nets and other fishing gear required were initially imported from Norway. After sometime, the Project organised net making through cooperatives and all types of nets, including trawlnets, were made locally.

It may be noted here that the project, while developing trawling vessels, had also tried to introduce diversified methods of fishing at Neendakara and Cochin as early as 1957. One of the four medium type of boats (called the M. Boats) brought from Norway following the Second Supplementary Agreement between the Government of India and Norway was engaged in purse-seining[3] and for sometime in

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1. T.R. Thankappan Achari, op. cit., p. 89.
2. Ibid., p. 93.
3. Purse-seining is a kind of fishing which involves the setting out of a long net to form a well of webbing around the school of fish being taken, the top of the net usually being on the surface. When the net has encircled the fish, its bottom is pulled togetner so that an artificial pond of webbing holds the catch. This pond is then gradually made smaller until the fish are gathered alongside the vessel and may be taken aboard. For details of the technique see John C. Sainsbury, Commercial Fishing Methods, (Fishing News (Books) Ltd., London, 1971), p. 69.

pole and line fishing. The operational aspect of the purse-seine trials was reported to be quite satisfactory although the poor prices obtained for the catches made the operation, non-viable[1]. The average price realised for oil-sardines and mackerels in 1958 were Rs 0.03 and Rs 0.08 respectively, while the price received for shrimp was Rs 0.25 per lb[2]. However, to improve the performance of these vessels, the Project introduced a system of paying a fixed monthly salary plus of 30 per cent of the value of the catch to the crew.

In November 1961, the Governments of India and Norway signed a third supplementary agreement by which the Project's activities were shifted to Cochin, which became its Headquarters in 1963. The facilities of the Project at Neendakara and Sakthikulangara were handed over to the State Government and the Administration of the Project brought under the direct control of the Government of India. Since 1963, the Project's activities from Cochin were more directed to exploratory and experimental fishing than towards the evolution of any further craft types. This work was more or less taken up by the Central Institute of Fisheries Technology (CIFT) which was established by the Central Government in 1957. We will discuss the R and D work of the CIFT in this direction in due course.

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1. Per Sandven, op. cit., p. 56.
2. Ibid., p. 56.

ii) Research and Development under the FAO/EPTA[1] Programme

On the basis of an agreement signed between the Government of India and the Food and Agricultural Organisation of the United Nations in 1953 the Government of India sought the service of a naval architect to advise and assist the Government on problems of boat design arising out of related technical assistance in small craft mechanisation and gear technology[2]. In the same year the FAO appointed Mr. Paul B. Ziener, a naval architect, with the following terms of reference:

1) to advise on improvements to available boats with regard to design, construction, safety rules and engineering.

2) to advise on mechanisation of available boat and

3) to design new, improved types of fishing boats.

Ziener began his work in September 1953 by surveying the different types of craft and gear operating in the country.

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1. This is the Expanded Programme of Technical Assistance (EPTA) which FAO gave to India under resolution 222 (IX) A of the Economic and Social Council of the United Nations.

2. FAO, First Report to the Government of India on Fishing Boats, based on the works of Paul B. Ziener and Kjeld Rasmussen, Naval Architects, Report 945, (FAO, Rome, 1958), p. 6.

Finding the work as more than what 'one man could possibly handle', the Government of India requested the FAO to send a second naval architect in 1955. The FAO sent Mr. K. Rasmussen, another naval architect in January 1956 with the same terms of reference as that of Ziener. The two naval architects continued their survey of the traditional craft with efforts to mechanise them till the middle of 1957. They found that the two boat types of the Gujarat - Maharashtra region, viz. the Machwas and the Lodhias, the Tuticorin boats, the Navas of Andhra Pradesh and the Batchari, Chot and Diamond Harbour boats of West Bengal are amenable for mechanisation. Fishing vessel types of other regions were found to be either too small or narrower lacking in stability and unsuitable for mechanisation. With regard to the two primary craft types of Kerala it was observed that it is most difficult if not practically impossible to mechanise catamarans and canoes[1]. Moreover, studying the condition of these coasts, the FAO experts came to the conclusion that the 'only possibility of carrying out mechanised fishing from the long surf-beaten coasts seems to be the development of a surf-boat[2]. This was also stated to be the 'logical step to take' in the prevailing conditions[3]. During the same

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1. Ibid., p. 92. 2. Ibid., pp. 56-57. 3. Ibid., p. 92.

period, the FAO had been searching for a suitable surf-boat design in Europe, North America and elsewhere for introduction in India. It was, however, found that the type of boats observed in other parts of the world were not really surf-boats, but beach-boats which operate from protected coasts without much surf. Hence the need for developing a special type of surf-boat was felt[1].

Between 1954 and 1958, the FAO experts in India tried to develop three proto-types of mechanised surf-boats for India. These efforts, however, failed and the FAO reported to the Government of India stating that at present it is impossible to release any final design of a surf-boat for Indian conditions as much work remains to be done before an economical and practical size of boat is developed[2]. The idea of a surf-boat was still toyed by the organisation and in 1959 it persuaded the Central Fishery Technology Station (now CIFT) to take up the work with the help of the Indo-Norwegian Project and its naval architects. It also made an agreement with the Central Government and the Indo-Norwegian Project to this effect. Between 1959 and 1963 the FAO designed and guided the construction of four surf-boats. The following table (Table V.5) gives details of those boats.

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1. Ibid., pp. 92-93. 2. Ibid., p. 96.

Table V.5. Details of Surf-boats Constructed Between 1959 and 1963

Boat	Length	Material	Engine specification			Remarks
			HP	Fuel	Cooling mechanism	
INP - 1	25 ft.	Wood	10	Petrol	Fresh water cooled	INP design
Surf - 2	24 ft.	Wood	10	Diesel	Air-cooled	FAO design, built by INP, direct drive
Madras boat	24 ft.	Wood	10	Diesel	Air-cooled	Government of India design 2:1 rev./ reduction gear
Fish tech. - 3	24 ft.	Plywood and fibre glass	10	Diesel	Air-cooled	FAO design, built in Bombay, direct drive.

Source: FAO, _Third Report to the Government of India on Fishing Boats, Based on the Work of Peter Gurtner, Report No. 1535_, (FAO, Rome, 1963), p. 8.

Among the four types, Fish Tech. - 3 was found to give the best performance during test operations and it was decided to use this type for pilot project whenever possible[1]. However, no further work seems to have been carried out in this direction for more than a decade[2]. The reasons for this are not far to seek. They are partly technical and partly economic. The final Report of the FAO (Report 3) to the Government of India notes 'trials have not shown (and were not intended to show) whether such beach boat operations could be an economical way of increasing catch and returns[3]. It may be noted here that the entire test operations at most places had met with difficulties and failures. Economically also the operations were found non-viable[4]. The initial cost of the best

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1. FAO, Third Report to the Government of India in Fishing Boats, based on the work of Peter Gurtner, Report No. 1535, (FAO, Rome, 1963), p. 8.

2. It may be noted that by the turn of the eightees, a new beginning in this direction was made under the auspices of the Bay of Bengal Programme of the FAO/UNDP on the East Coast of India. Since 1980, a new programme for the modernisation of the traditional craft of Kerala was launched with assistance from the FAO/UNDP Project for 'Small-Scale Fisheries Promotion in South East Asia' and the FAO/SIDA Project 'Development of Small-Scale Fisheries in the Bay of Bengal'. Details of this programme are discussed under the period since 1979.

3. FAO, op. cit., (1963), p. 8. Parentheses as in the original.

4. FAO, op. cit., (1958), p. 94.

surf-boat (Fish Tech. 24 ft.) in 1963 was Rs 10000/- compared to Rs 8500/- for the 25 ft. open mechanised fishing boat which was also designed by the FAO[1]. It may be further noted that the open mechanised boat could be used for both gillnetting and trawling/long lining. The surf-boats on the other hand could operate only the gillnets. It should be remembered that it is at a time when the export market for shrimp was developing - the quantity and value of shrimps exported increased by about 31 per cent and 45 per cent respectively between 1962 and 1963[2]. The obvious choice of the fishermen in these circumstances would be the open mechanised boat meant for trawling. The success of the INP vessels might have particularly promoted this choice.

The FAO, besides attempting to develop the mechanised surf-boats had also tried to develop a number of new designs of mechanised boats from 1953 to 1963. In 1953, it brought two Danish-built 22 ft. (6.6 m) fishing boats equipped with 10 HP semi-diesel engines for experimental and exploratory fishing. These boats were called Dan Boats and were fitted with power-driven winches for handling the gear.

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1. Ibid., p. 14.
2. Marine Products Export Promotion Council, Statistics of Marine Products Exports 1970, (Marine Products Export Promotion Council, Cochin, 1971).

A similar design by Paul Ziener, with a slightly higher length (24 ft. 2 inch) was constructed at the boatyard of the Madras Fisheries Department. It was named 'pablo', and this design became quite popular on both the West Coast and the East Coast[1]. The price of this boat with a 10 HP engine (without the line hauler) was Rs 15000/- in June 1958[2].

Between 1956 and 1958 attempts were made to develop a 22 ft. (6.6 m) open fishing boat with a 8-10 HP engine. These attempts, however, seem to have failed at the testing stage itself, and nothing more was heard of this design[3].

A 25 ft (7.5 m) fishing boat which was cheaper than the 'pablo' boats was designed by the FAO naval architect Peter Gurtner in 1958. This boat, essentially of similar dimensions as the well-known 'pablo' type boats, but with somewhat bigger capacity found favour in Mysore and Kerala where it was felt that the 'pablo' did not allow sufficient fishing activities for its size[4].

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1. This boat was, however, not suitable for trawling.
2. FAO, op. cit. (1958), p. 85.
3. The FAO Report makes no further mention of this boat or its operation. Ibid., p. 89.
4. FAO, Second Report to the Government of India on Fishing Boats based on the Work of Peter Gurtner, FAO|EPTA Report 1906, (FAO, Rome, 1959), p. 6.

The FAO considered that 'where the 24 ft. 7 inch 'pablo' boat can work economically, a somewhat larger boat might give still better results. Accordingly, a 30 ft. boat was constructed which used a 20-25 HP diesel engine. This boat had a transom stern differing from the cruiser stern of the 'pablo' type. The transom stern gives more deck space aft, and is more efficient with regard to speed and sea-keeping. The boat was intended for multipurpose fishing viz. long lining, gillnetting and trawling'[1]. By June 1958, 12 such boats were built and the price including a 20 HP diesel engine and line hauler was Rs 23000/-.

A 31 ft. 9 inch fully decked fishing vessel was constructed in 1956 for use at the Fishermen Training Centres at Cochin and Tuticorin. The 30 HP engine fitted in this vessel turned out to be too heavy and the design had to be enlarged in size[2]. The work on the development of a 32 ft. shrimp trawler was started around 1958. However, it was only in 1962 that a finalised design of the craft was put out. It had a 40 HP diesel engine, a crew requirement of five persons, could fish at a depth of 20 fathoms (120 ft.) and could stay at sea for about 65 hours at full power.

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1. FAO, op. cit. (1958), p. 89.
2. Ibid., p. 90.

It may be noted here that the designs of craft described above are only some of the pioneering types designed by the FAO during the period from 1953 to 1963, and a number of other types were also designed/developed under the direct or indirect influence of the FAO naval architects in India. Appendix Table V.2 gives details of the prototypes of craft developed and constructed during the period from 1954 to 1961. Despite the large number of designs shown in the table, only eight types were standardised. The following table (Table V.6) presents details of designs that were standardised. It also includes the details of a 38 ft. (11.4 m), (50-60 HP) general purpose vessel which was not included in Appendix Table V.2.

Among the various craft designs standardised, the four most important designs that became very popular in the state are (1) the 25 ft. gillnetter, (2) 32 ft. trawler, (3) 32 ft. gillnetter and (4) the 36 ft. trawlers.

It is apparent from the above review of Research and Development for fishing craft, gear and techniques in Kerala during the period from 1953 to 1963 that four main craft-gear combinations were developed for substantial application in the later years. The four major craft-gear types developed are (1) 25 ft. gillnetters, (2) 30 ft. gillnetters, (3) 32 ft. trawlers and (4) 36 ft. trawlers.

at ze	Type of boat	Type of fishing possible	Life span (years)	Displacement (tons)	Power (HP)	Crew size	Unit cost* (Rs)	Remarks
ft.	Surf-boat	Gillnetting	15	1.30	10-12	3-4	10000/-	Cost redu expected mass prod
ft.	Fishing boat	Gillnetting, long lining and shrimp trawling	15	2.30	10-15	4	8500/-	Open boat
ft.	Trawler	Shrimp trawling	15	7.28	40	5	32000/-	Fully dec boat. Quo cost.
ft.	Fishing boat	Drift netting, long lining and small boat purse-seining	15	7.50	30	5-6	30000/-	Estimated
ft.	Trawler	Shrimp trawling	15	12.20	60-60	5-6	45000/-	Quoted co
ft.	General purpose boat	All types	15	14.40	50-60	6-8	50000/-	Estimated
ft.	Fishing boat	Drift-netting and shrimp trawling	15	22.30	80-90	6	65000/-	Estimated
ft.	Drifter/trawler	Drift-netting and shrimp trawling	15	30.00	80-100	6	90000/-	Estimated

at 1963 prices.

urce: FAO, Third Report to the Government of India on Fishing Boats, Based on the Work of Peter Gurtner, Report No. 1535, (FAO, Rome, 1963), pp. 14, 60-90.

b) Research and Development from 1963 to 1979

The Research and Development efforts during this period were primarily indigenous. This period marked the development of medium and large fishing vessels, indigenous engines for fishing vessels, research on alternative materials for boat-building, new and efficient designs of fishing gear and new methods of fishing. After 1963, most of this research was carried out by the Central Institute of Fisheries Technology (CIFT), Cochin, which was established in 1957, on the recommendations of the Fisheries Research Committee appointed by the Ministry of Food and Agriculture, Government of India in 1954[1]. A Craft and Gear Division was organised in the CIFT in 1963[2] on the recommendation of the FAO expert. Most of the Research and Development during this period was carried out by this division. The Research and Development in this period focussed mainly on i) new designs of mechanised boats, ii) indigenous engines, iii) alternative materials for boat building, iv) new materials and designs of nets and, v) new methods of fishing.

i) New Designs of Mechanised Craft

Between 1963 and 1979, twelve standard designs of mechanised fishing boats were prepared by the CIFT[3]. Table V.7 gives details of the major craft-types standardised by the Institute.

ble V.7. Details of Major Craft-Types Standardised by the CIFT[a]

rticulars of the craft	Size of the craft									
	25 ft.	30 ft.	32 ft.[b]	36 ft.	38 ft.	40 ft.	42 ft.	45 ft.[c]	49 ft.[d]	50 f
Breadth (m)	2.19	2.75	2.90	NA	2.51	3.81	3.96	4.26	NA	4.4
Tonnage	3.90	6.20	8.30	12.20	14.85	17.40	22.30	NA	25.00	30.0
Fish hold capacity (cu. ft.)	No fish hold	150	175	NA	240	260	NA	NA	520	600
Free-running speed (knots)	5-6	6.5-7	7-7.5	NA	7-7.8	NA	NA	NA	7-8	8
Horse power of engine	10-15	30-35	40-45	50-60	60-70	80-90	80-90	90-100	90-100	150-1
Fuel capacity (Ltrs.)	75	90	620	NA	990	NA	NA	NA	2000	2700
Fuel consumption (Litres/hour)	NA	5	7.5	NA	15	NA	NA	NA	NA	30
Crew size	5	6	6	5-6	6	5	6	6	7	8
Endurance at sea	10-12 hrs	20-22 hrs	1 day	NA	3 days	3 days	NA	4 days	5 days	5 da
.Depth range of operation (fathoms)	0-10	0-15	0-20	NA	0-25	0-25	NA	0-30	NA	0-3
.Freshwater storage capacity (litres)	20	40	130	NA	270	NA	NA	NA	675	NA
.Accommodation (No. of persons)	Nil	Nil	Nil	NA	6	5	6	6	7	8

All these designs were developed prior to 1967. b) The particulars are common to both the fishing boat and the trawler of this size. c) A slightly different version of this craft wa developed by the INP. d) This design was originally developed by the FAO naval architects.
: Information not available.

It is apparent from the above that the CIFT's focus was on medium-vessels capable of trawling as well as doing other kinds of fishing, such as hand-lining, gillnetting and purse-seining. The 57.4 ft. (17.5 m) 'Jheenga' type of vessel, with a 200 HP engine developed at the Mazagon Docks at Bombay, was found suitable for trawl as well as purse-seining and long-lining[1].

An idea of the comparative costs of some of these designs can be obtained from Table V.8

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1. By having a suitable deck lay-out it is possible for the vessel to engage in trawling as well as other kinds of fishing. A purse-seiner-cum-trawler would require additionally a collapsible purse-gallow, a ring needle and a net stacking platform. For more details, see Jan-Olof Traung (Ed.), Fishing Boats of the World: 3, (Fishing News (Books) Ltd., London, 1967), pp. 535-47.

Size of the craft	Type of craft	Cost of parts (Rs) Hull*	Engine	Gear	Navigational and life saving equipment	Total cost (Rs)
25 ft.	Open fishing	12000	20000	5000	400	37400
30 ft.	Fishing boat	29000	22000-30000	15000	2700	68700-7670
32 ft.	Trawler	45000	22000-40000	16000	3200	86000-1042
32 ft.	Fishing boat	45000	22000-50000	16000	3200	86000-1042
36 ft.	Trawler	59000	62000-70000	20000	4000	145000-1530
40 ft.	Trawler	60000	75000	25000	4500	164500
45 ft.	Drifter/trawler	71500	90000	30000	4500	196000
50 ft.	Combination vessel	150000	140000	35000	15000	340000

* includes the cost of sheathing the hull. The wood used for hull is teak.

Sources: 1) CIFT

2) Bharat Bhushan, op. cit., p. 54.

It is apparent from Table V.8 that the medium boats cost more than double the price of the small boat (25 ft.) and the price of larger types are far greater. It may be noted that the high cost of these vessels are partly due to the high cost of the material used (teak) in the construction of these vessels and partly due to the high cost of engines and other accessories which were still imported. It is worth noting here that the Institute's activities during this period were partly directed to solve this problem by developing suitable boat-building materials including cheap wood and by identifying suitable engine designs for better performance. The activities of the Institute in these directions will be discussed shortly.

A notable feature of the craft types developed by the Institute during this period is that they could be used simultaneously for trawling as well as for other kinds of fishing with suitable modifications in the deck layout. This was especially the case with the larger vessels of 50 ft. and 57.4 ft. It may be interesting to note here that this widening of the 'horizon' of fishing from trawlin to 'diversified' fishing is not because of any decline in t importance of trawling for shrimp but because of the growin recognition of the importance of fishing/trawling in deeper waters. As a matter of fact, the export market for shrimp had grown steadily during this period. Appendix Table V.3 shows the trend in the export of shrimp and other marine products from India during the period from 1964 to 1979. It is evident from this table that the quantity and value of shrimp exported from the country (the bulk of which is from Kerala) increased from 8007 tons to 53669 tons and Rs 38.10 million to Rs 2237.92 million respectively during this period. It amounted to an increase of 6.7 times in terms of quantity and 58.7 times in terms of value[1]. It should, however, be noted that the landings of shrimp in the country has been showing an unsteady trend. Table V.9 shows the trend in the landings of shrimp in Kerala and India as a whole for the period from 1970 to 1979.

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1. The average wholesale price realised for Indian shrimp during this period had shown a significant increase. See Appendix Table V.4 for prices realised for different grades of shrimp in the U.S. and the Japanese markets.

Table V.9. Landings of Shrimp in Kerala and All-India during 1970-79.

(Quantity in tons)

Year	Kerala	All India	Index (1970:100)	
			Kerala	All India
1970	36954	121646	100.00	100.00
1971	32813	148843	88.79	122.35
1972	36577	163849	98.97	134.69
1973	85751	203469	232.04	167.26
1974	69829	170178	188.96	139.89
1975	77962	220751	210.97	181.47
1976	34533	191427	93.44	157.36
1977	40324	170464	109.11	140.13
1978	45428	179856	122.93	147.85
1979	29597	177582	80.09	145.98

Source: MPEDA, <u>Statistics of Marine Products Exports, 1981</u>, (MPEDA, Cochin, 1983), p. 252.

It is apparent from Table V.9 that the fluctuations in the landings of shrimp are more pronounced in the case of Kerala. It also shows a notable decline. It is worth recalling that the trawlers that were built during earlier period i.e. prior to 1963, were mostly small boats (30 ft, 32 ft. and 36 ft.) capable of operating only in the inshore waters upto 20 fathoms (40 m). The need for larger vessels suitable for operation in the offshore waters and adequate to catch shrimp and other varieties of fish, both in the pelagic and demersal waters was felt during this period. The need was reinforced by the growing export demand for fish in the international markets. The export demand (ex-post) for fish and other marine products have increased by nearly four times during this period (1963-79)[1]. The value of exports rose by eighteen fold[2]. The domestic demand also should have shown an unsurpassed increase. That was quite natural with the growth in population and the urbanisation that followed in the sixtees and seventies.

Another factor which might have led the planners to decide upon a course of action favouring the introduction of larger combination vessels was the emerging 'law of the sea' which made it obligatory for the coastal states to make full use of the living resources of the seas around their coasts (EEZ)[3]. It is apparent that this legal

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1. See Appendix Table V.3.

2. See Appendix Table V.3.

3. United Nations, <u>Documents on Law of the Sea</u>, U.N. Document, A/Conf.62/WP 10-15th July 1977, pp. 297-98

responsibility has significantly influenced the government policy to promote deep-sea fishing by introducing joint-ventures and chartering of foreign fishing vessels during this period. By 1979, 57 large vessels (23.4 m) were operating in the country[1]. Most of these vessels were imported as part of the joint venture/ chartering programme. It may be noted that these vessels are capable of exploiting the potential resources of prawns and resources of tuna, mackerel, perches, pomfrets, seer, etc. of the regions beyond 50 meters depth.

The need for 'diversified' fishing and the necessity of introducing combination vessels were really pressing. The marine products export industry of the country and Kerala in particular was under severe crisis in the late seventies. The raw material problem (scarcity of shrimp) was quite acute[2]. The shrimp landings in Kerala

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1. Department of Agriculture, Hand Book on Fisheries Statistics 1981, (Government of India, New Delhi, 1981), p.12

2. Calling attention to this problem at the eighth Annual General Body Meeting of the Seafood Exporters' Association of India in 1978, the President of the Association stated: 'The atmosphere under which we meet today is charged with gloom for the Indian seafood industry. Since about three months the industry is faced with a severe shortage of raw material supplies. And therefore quite a number of processing plants, particularly in Kerala region, are virtually idling'. This, he added is 'the result of the industry concentrating on one particular item, viz. shrimp as its raw material. This aspect has to change soon if the marine products export industry of the country is to survive. The alternative is nothing but diversification.

had shown a severe slump since 1976 (see Table V.9 above). The importance of large combination vessels for deep-sea fishing was obvious[1].

Another important factor which may be noted here is that the economic viability of diversified fishing has been established by the Integrated Fisheries Project which operated a few large combination vessels during this period[2]. Despite this, few large vessels found entry into the fishing fleet of Kerala. The very few big trawlers introduced by the Kerala Fisheries Corporation during this period were found to operate along the East Coast of India and not from the Kerala Coast. What led to this curious development is worth probing.

ii) Indigenous Manufacturing of Engines

Until 1966 marine diesel engines were imported. By the end of the fiftees a domestic company, The Kirloskar Oil Engines Ltd., Poona, began to experiment on the use adapted marine diesel engines by fitting them in fishing boats built at their own cost and using them in trial operat

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1. It is surprising that the primary marine fishing industr of Kerala did not take any perceptible step for exploiti the deep-sea resources of its continental shelf during t period or even after. The consequences of this policy w be discussed later.

2. C.P. Varghese and N. Radhakrishnan Nair, 'Diversified Fishing Methods', Souvenir, (IFP, Cochin, 1977) pp. 60-73.

3. FAO, op. cit. (1959), The CIFT also assisted in the evaluation of the quality and suitability of engines wit different HP for different sizesof vessels. See also Twe

With considerable modifications the company was able to supply acceptable engines to the industry. In the next one and a half decades when the pace of mechanisation was so fast, a number of other companies also started manufacturing marine diesel engines indigenously. By 1977, there were about nine manufacturers of marine diesel engines in the country, with a capacity to produce engines of even 10000 HP.

Table V.10 gives details of the marine diesel engine manufacturers in India in 1977.

Table V.10. Details of Marine Diesel Engine Manufacturers in India in 1977.

Name of Manufacturer	Name of engine	Horse power	Annual licensed capacity
1. Veegal Engineers Ltd. Calcutta.	Veegal - outboard	5	NA
2. Lynx Machinery Ltd. Calcutta	NA	9-18	900
3. Lakshmi Narathan Engg. Works Ltd.	Lister	18-42	142
4. Ruston and Hornsby (India) Ltd., Poona	Ruston	25-75	720
5. Premier Automobiles	Meadows	44-70	3000
6. Ashok Leyland	Leyland	70-130	NA
7. Kirloskar Cummins Ltd. Poona	Kirloskar Cummins	120-372	NA
8. Kirloskar Oil engines Ltd., Poona	Kirloskar	300-600	600
9. Garden Reach Workshop (Marine Engine Division), Ranchi	NA	800-10000	NA

Source: CMFRI, Indian Fisheries 1947-77, p. 72

It is apparent that the country could make a break-through in the provision of marine diesel engines to the fishing industry during this period.

iii) Alternative Materials for Boat Building

Teak (tectona grandis) and Aini (Artocarpus hirsuta) were the most common timbers used in the construction of fishing vessels through out the country even by the end of the sixtees. The price of these timbers have been, however, rising very sharply over the years. The price of teak per cubic meter has increased from Rs 565/- in 1961 to Rs 1060/- in 1970 and that of Aini from Rs 353/- to Rs 530/- during the same period. This necessitated studies on alternative materials for the construction of vessels. The CIFT conducted studies on the suitability of more than forty varieties of timber, and about thirty of them were identified as suitable substitutes. It found the possibility of using Venteak (Lagerstroemia lanceolata), a cheaper wood, in the place of Teak and Aini. This substitution was supposed to result in a reduction of about 75 per cent of the cost of timber. Table V.11 shows the comparative cost of hulls for different sizes of boats using Teak, Aini and Venteak as the building material.

Different Size of Boats

of t	Quantity of timber required in log form[1]			Cost of timber at 1970 prices[2]			Cost of timber at 1978 prices[3]		
	Teak cu.ft.	Aini cu.ft.	Venteak[+] cu.ft.	Teak Rs 27/- per cu.ft.	Aini Rs 15/- per cu.ft.	Venteak Rs 7/- per cu.ft.	Teak Rs 80-150/- per cu.ft.	Aini Rs 50-70/- per cu.ft.	Vente Rs 40/ per cu.
t.	380	380	480	10260	5700	2800	30400-57000	19000-26600	16000
t.	700	700	750	18900	10500	5250	5600-105000	35000-49000	30000
t.	1050	1050	1120	28350	15750	7840	84000-157500	52500-73500	44800
t.	1400	1400	1470	37800	21000	10290	112000-210000	70000-98000	59800
t.	1800	1800	1880	48600	27000	13160	144000-270000	90000-126000	75200

cludes wastages as well.

ces: 1 and 2: Balasubrahmanyam, 'On the Characteristics of Some of the Indian Timbers for Boat Building (Part-1)', Indian Seafoods, Vol. VII, No.4, March 1970.

3. CIFT, Cochin.

Table V.11 suggests the possibility of considerable saving in cost for all sizes of vessels. Moreover, this substitution will not hamper the programme of construction of fishing boats since Venteak is available in sufficient quantities in different parts of the country[1].

The use of fibreglass, ferro-cement, aluminium alloy and steel as alternative materials for boat building was considered by the CIFT. It, however, found that these materials have only limited substitution possibility since they are either too light, too heavy and expensive or suitable only for small craft. Fibreglass could be used only for small boats and steel being heavy and costly only for large vessels. Aluminium-alloy was light and ferrocement a little heavy for small and medium boats. Efforts were also made by the CIFT to find out the possibility of using other cheaper timbers particularly for structures above water line. The Institute found that Mango (*Mangifera indica*) and Haldu (*Adina Cordifolia*) timbers when treated with arsenic copper compound with a loading of 0.5 to 1.0 lb/cu.ft. can be used for structures above water line. Likewise, the same timbers treated with creosote (a coaltar derivative) can

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1. CIFT, *Twelve Years of Fisheries Technological Research*, (CIFT, Cochin, n.d), p. 20.

be used for deck planks, hatch covers and bulk-heads. Further investigations by the Institute has shown the possibility of using aluminium alloy sheet in place of costly copper sheets for sheathing the hull. This was expected to reduce the cost of hull significantly and save foreign exchange. The Institute has also developed a number of anti-fouling, anti-corrosive and zinc-rich paints which are greatly demanded by the industry. A protective coating for cast-iron propellers developed by the Institute is expected to save the cost by 50 per cent compared to the common bronze propellers[1]. Two other materials developed by the Institute, viz. a toxic wood plastic composite for boat scantling and the indigenous resin preservative for wooden craft are valuable contributions for protecting the boats from degenerating organisms as well as for extending the life of the capital investment.

iv) New Methods of Fishing

Mechanisation of the craft demanded the use of new methods of fishing. New methods like bottom trawling, pelagic trawling, purse-seining and long-lining were introduced in Kerala during this period.

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1. CIFT, Techniques Developed at CIFT, Special Bulletin No.11 (CIFT, Cochin, 1985), p. 8.

Bottom Trawling

Bottom trawling was first introduced by the Indo-Norwegian Project at Neendakara in the fifties and later at Cochin in the sixties. The technique consists in drawing the trawlnet along the sea bed with the mouth open[1]. Mouth opening is obtained with a number of floats attached to the head rope and the weighted ground line at the bottom. Horizontal spread of the mouth is attained by the 'otter-boards' or 'doors' which are set at the angle of attack in front of the net in the towing direction. The predominant form of bottom trawling introduced in the state in the beginning was 'stern' trawling[2] which can be conducted even from small boats. By using a net-drum it was possible to handle a larger gear and in effect make a 'big' trawler out of a small boat. This improvement has helped in increasing the catches from trawling very much.

Another bottom trawling method introduced in the state was out-rigger trawling or side-trawling which saved considerable space for handling the catch and for storing

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1. For details of the net's operation see John C. Sainsbury, op. cit., pp. 17-62.

2. In stern trawling, the operations of setting the net and hauling it are conducted over the stern. See J.C. Sainsbury, op. cit., p. 29.

the materials on board[1]. A notable improvement in this method was the introduction of multi-rigs. In this case two trawls are used. The principal reason for using two trawls instead of one large otter trawl is the sedentary characteristics of the species which needs wider horizontal spread and scraping on the bottom rather than the higher vertical coverage[2]. This is of special importance in shrimp fishing.

Bull-trawling or pair-trawling was also attempted in the state but without much success. The method consisted of the use of two boats, each towing one warp and the mouth of the net being opened by the outward pull provided by the correct lateral spacing of the vessels, without using any starboards.

The bottom trawling techniques in the country were further improved by the CIFT through several modificatior in the existing designs. Some of the new designs developed by it have been discussed in the section on 'New Material and Designs of Nets'.

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1. For details of the technique see J.C. Sainsbury, op. cit., pp. 21-29.

2. Ibid., p. 50.

Mid-Water Trawling

With the growing shortage of prawn resources in the inshore waters (0-40 m) of the state, pelagic or mid-water trawling became quite important and efforts were made by the Integrated Fisheries Project (formerly Indo-Norwegian Project) and the CIFT to modify the fishing gear for tapping the pelagic and mid-water resources of the state.

The mid-water trawl is used to capture the semi-pelagi species that school at various levels between the sea-bed and the surface. While bottom trawls are often towed for several hours at a time and fish a large area, capturing mainly loosely distributed fish, the mid-water trawl is usually towed for about 10 to 20 minutes in order to pass through and catch a particular shoal of fish. Much of the boat's time is spent hunting for fish in schools large enough to justify shooting of the net[1]. Successful mid-wate trawling also requires the effective use of various electronic aids, both to find the fish and to manoeuvre the vessel while catching them. Moreover, the net must be set at the correct depth, and the vessel proceed on a course tha will ensure the net passes through the school.

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1. Ibid., p. 57.

Mid-water trawling has been successfully tested and recommended by the CIFT since the middle of the 'seventies'. The medium vessels of the Integrated Fisheries Project have also been using this techniques for quite sometime. The method has been now widely accepted by the industry, since the viability of bottom trawling for shrimp has become quite poor due to the shortage of shrimp resources[1].

Purse-seining

Purse-seining by mechanised vessels was first introduced in Kerala by the Indo-Norwegian Project during 1957-58[2]. The 25 ft. boats initially developed by the Project used purse-seine nets for their operation from Neendakara. The operations were, however, discontinued because of the difficulties in marketing the catch and the resulting non-viability of operations. One of the M-Boats of the Project at Cochin was also engaged in purse-seining. These operations, however, did not attract the attention of the industry as trawling was the preoccupat

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1. Introduction of this technique has been severely opposed the traditional fishermen as this technique is quite efficient in catching the pelagic shoaling fishes like sardines, mackerels, anchovies, etc. enmass and is expecte to result in a serious depletion of the stock in a very short time. This is quite possible when the mesh-regulat are not strictly followed. This issue is further discuss in Chapter VII where the effects of technological change outlined.

of the time and it was continued only by two of the Project's medium boats - Kalava and Norind II. However, with the decline in the shrimp catches of the state (see Table V.9) since 1976, there has been a revival of interest in this technique. The success of this technique in the Mangalore-Malpe region in Karnataka State and the growing demand for fish in the domestic and export market further led to the introduction of this technique in Kerala on a commercial basis in 1979. The technology was perfected by the CIFT and the Integrated Fisheries Project much earlier. The basic technique involved the setting out of a long net to form a wall of webbing around the school of fish being taken. Usually when a school of fish is located the vessel manoeuvres depending on the wind and the tide, so that it can pay out the net and complete a circle around the fish. While setting the net, the bunt of the net is usually attached to a seine skiff, a heavily constructed open power boat, which is dropped into the water to assist in pulling out the net. An alternative is to drop a buoy attached to the bunt, and for the vessel to steam in a complete circle around the shoal, paying out the net. When the net is paid out in this manner, its bottom is pulled together to form an artificial pond of webbing which holds the catch. This pond is then gradually made smaller until the fish inside are gathered alongside the vessel which are then taken aboard[1].

Purse-seining is a very efficient method for catching pelagic fish, especially sardines, mackerel, anchovies, tuna, etc. The mesh size of this net is crucial in determining the efficiency of the net as well as in the conservation of the fish stock. It may be noted here that the introduction of purse-seines in Kerala in the late seventies has caused serious conservation problems as well as objection from the traditional fishermen in the state[2].

<u>Gillnetting</u>[3]

With the rising cost of fuel and the growing scarcity of prawns in the inshore waters of the state, the

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1. John C. Sainsbury, op. cit., p. 67.
2. The economic effects of the introduction of this technique will be discussed in Chapter VII where the effects of technological change are outlined.
3. Strictly speaking gillnetting was not a new development in the primary marine fishing industry of Kerala. Traditional fishermen were using this technique much earlier. What is described above is only the modification made to the technique. For a description of the technique See J.C. Sainsbury, op. cit., p. 94.

small mechanised vessels (25 ft. to 30 ft.) have found it more advantageous to go for gillnet operations. The traditional gillnet designs for sardines and mackerels were modified and improved by the CIFT during the sixties for adoption by the small mechanised boats. The CIFT had also designed and fabricated a gillnet for catching silver pomfrets in the NorthWest Coast of India. New gillnet designs for lobsters and seer fish in the SouthWest Coast (particularly in Kerala), was also developed and supplied by the Institute. A special gillnet for lobster fishing was developed by the Institute (see the discussion on 'new materials and designs of nets').

Long Lining and Trolling

Long lining was undertaken by the traditional fishermen in Kerala using the traditional craft like catamaran and canoe. The lines used by them were, however short, breakable and visible in water. They also needed considerable quantity of bait and repairs. The new lines developed by the CIFT dispensed with live baits and used artificial baits made of buffalo horns and other materials.

Trolling is a new method of fishing adapted by the CIFT to capture large pelagic species such as shark, seer, etc which have high individual value. The method involves the use of a number of baited hooks or lures which are towed astern of a slowly moving vessel. The fishes hooked after snapping the lures or baits are held by the mouth till they are brought aboard. The lines are arranged to tow at different depths by varying the length run out and the weight used, thus providing a wide coverage of the depth fished[1]. Trolling can be undertaken in small boats by one or two persons[2].

Trap Fishing

The importance of trap fishing in Kerala is due to the export demand for lobster tails. Lobsters which were caught earlier as stray catches of the shrimp fishery has now become a major foreign exchange earning item[3]. The new lobster trap developed by the CIFT is a significant improvement upon the existing technology (See the discussion on 'new materials and designs of nets').

Other Improvements

Several improvements were made during this period in the designing and use of mechanical fishing accessories,

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1. J.C. Sainsbury, op. cit., p. 114.
2. Ibid., p. 114.
3. The value of foreign exchange earned by the export of lobster tails has increased from Rs 12.79 million in 1972 to Rs 53.46 million in 1979.

ancillary fishing equipment and electronic testing devices. Some of the major achievements included the design of a winch for a 7.67 m boat, a power-isolation clutch for power transmission from engine to winches, designs of gallows, jockey pulleys and mechanical spraying arrangement for chumming of fish. Among the electronic devices, mention may be made of designing of impulse generat for carrying out electrical fishing and the development of a telemetry type electro-mechanical net-depth meter for continuous measurement of the depth of operation of the trawl net.

v) New Materials and Designs of Nets

Mechanisation of the craft has entailed the development of suitable net-making materials that would be stronger than treated cotton and also the evolution of suitable designs of nets for various types/sizes of boats. Initially, the mechanised boats were using the indigenous gear[1]. But it soon became apparent that the returns by way of catch was not commensurate with the investment on mechanised boats. Following this, the Indo-Norwegian Projec

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1. CMFRI, Indian Fisheries 1947-77, (CMFRI, Cochin, 1977), p. 43.

began to import gear materials from Norway and fabricate nets from the Project site at Neendakara. The manufacture of multifilament nylon yarn (polyamide group of fibres) in India was started only in 1962. It was still later that manufacturing of polyethylene and nylon mono-filaments for making fishing nets was started in India[1]. By 1977 four net-making plants had been set up in the public sector with a capacity to manufacture over 400 tons of twine from nylon yarn per year. Besides, there were four small units in the private sector and four licenced firms (large units) manufacturing nylon nets[2].

The advent of synthetic fibres was a land-mark in fishing gear development in the country as well as in Kerala. The non-rotting characteristic of the synethetic fibres resulted in an increase in the life-span of the nets to about three years, compared to one or two years for the traditional cotton nets. It also helped the fishermen in dispensing with the laborious and expensive process of rot-proofing. The synthetic twines also possessed some of the essential properties required for nets such as the

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1. K. Radhalakshmy and S. Gopalan Nair, 'Synthetic Fibres for Fishing Gear', Fishery Technology, Vol. X(2).
2. CMFRI, Indian Fisheries 1947-77, (CMFRI, Cochin, 1977), p. 73.

fineness, pliability, elasticity, durability and invisibility for gillnets and fineness for trawlnets to minimise hydraulic resistance.

With the growing pace of mechanisation the CIFT has made significant contributions in the field of gear design by making suitable modifications to the existing gear types.

Trawl Designs

Since most of the mechanised boats go for shrimp trawling, a large part of the research had gone in for improvement of the trawl designs. Prior to 1977, the CIFT had prepared over thirty designs of trawl nets for operation from different sizes of vessels from different centres. The catching efficiency of these gears was improved by making subtle changes in the rigging pattern, or by the addition of false-head-rope, gussets and kites and a tickler chain to the foot rope. These and similar modifications by the Institute has further facilitated the evolution of new concepts in trawl net design like the long wing trawl, bulged belly trawl, six seam trawl, double rig shrimp trawl, large mesh fish trawl, high opening trawl, etc. The comparative cost and efficiency gain of some of these new designs are given in Table V.12.

Table V.12. Comparative Cost and Efficiency Gain of New Trawl Designs

Name of the new design	Cost of the net (Rs)	Efficiency gain over conventional design (in %)	Remarks
1. Longwing trawl	2750-4000	45	Wider coverage of area
2. Bulged belly trawl	3500-5000	35	Better vertical opening
3. Six seam trawl	2750-4000	NA	Better vertical opening with lesser resistance
4. Double-rig shrimp trawl	3500-5000	100	Wider coverage and efficient sweeping
5. Large-mesh fish trawl	3000-4500	NA	Better flow of water enabling the use of bigger nets
6. High opening trawl	3000-4500	NA	Easy lifting and spreading of head-rope possible

Source: CIFT, 'Technologies Developed at CIFT, (CIFT, Cochin, 1985), pp. 9-10.

In addition to the above, the Institute has also made a number of improvements in the design and use of otter boards for operation with different sizes of trawls from different size groups of vessels[1].

Modified Gillnets

By the second half of the seventies the Institute began to pay attention to other kinds of nets too. The growing demand for lobsters for processing, particularly for export, necessitated the development of effective means for the exploitation of the lobster resources of the country. The CIFT made an all out effort to design a suitable non-injurious gear for the exploitation of lobsters along the South West Coast of India. This led to the development of a suitable gillnet for lobster fishing. Gillnets with optimum mesh size for sardines and with optimum twine/mesh size for seer fishing from Cochin were also developed by the Institute.

Purse-seines

The CIFT developed a purse-seine design for operation from small classes of boats hitherto engaged in trawling, as an alternative when shrimping fails and during the sardine and mackerel seasons[1]. Recently the Institute has fabricatec a mini-purse-seine for operation from motorised country craft The net can be operated by a group of 20 persons from two mechanised boats or non-mechanised thangu valloms. The

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1. The cost of this net (with a length of 260.5 m) was workec out to be around Rs 1.5 lakh compared to Rs 2.5 - 3.0 lakh for nets with length ranging from 325 m - 400 m.

gear has a length of 225 m and costs Rs 100000/-. It has a capacity to catch 5 tons per haul.

Long Lines and Troll Lines

A new long line for sharks and troll lines for predatory species like seer, tuna, barracuda, etc. are developed by the CIFT during this period. The techniques are intended for use in the event of failure of the prawn fishery[1]. Several artificial lures or jigs using indigenous materials were also designed and developed. Similarly, a method for stunning the hooked fish to prevent escaping by the application of electrical impulses was developed by the Institute during this period[2].

Lobster Traps

A new lobster trap was developed by the Institute to replace the crude and easily breakable traditional traps made of coconut or palmyra leaf stalk fibres. The new trap fabricated out of M.S. rod frame mounted with 2.5 m square welded mesh is provided with a complete coating of plastic to make it completely impervious to seawater. The trap

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1. CIFT, op. cit., p. 12.
2. CIFT, Twelve Years of Fisheries Technological Research, (CIFT, Cochin, n.d), p. 15.

which costs Rs 400/-, has an expected life of 3 years and a catching efficiency which is two-fold of the traditional type. This was reported to have found great favour with the traditional fishermen.

c) Research and Development Since 1979

The Research and Development efforts during this period were found to concentrate primarily on those issues/problems which were not properly attended to in the past or had defied finding any solution in the past. The major achievements of this period are discussed below.

i) Motorisation and Improvement of the Traditional Craft

The initial efforts to motorise the traditional craft of Kerala by the Indo-Norwegian Project at Neendakara in the early fifties were a failure. This has been pointed out earlier. Renewed effort in this direction was made by the Kerala Fishermen's Welfare Corporation in 1980, when it started trials for introducing three different types of engines to the traditional canoes (thangu valloms) at Purakkad in Alleppey district[1]. The three different types of engines that were tested are (1) inboard diesel engine of 9 HP with Z-drive through the starboard side of the hull, (2) out-board diesel engine of 5 HP fitted to a bracket on the star board side and (3) out-board kerosene engine of 7 HP fitted to a bracket on the star board side.

The first two engines were indigenous and the third, imported from Japan. It was reported that the diesel engines (indigenous), despite their fuel economy and availability of spare parts, suffered from various defects including transmission difficulties and the fishermen eventually preferred the imported kerosene out-board engines[1]. It was also noted that the increase in catches with motorisation was so great that the fishermen considered fuel economy of lesser importance and within a period of three years, the importer of the Japanese-made outboard engine was able to sell nearly 2000 engines; about 80 per cent of them being of 7 HP engines and the remaining of 12 HP[2]. The cost of the 7 HP engine was Rs 11200/- and the 12 HP, Rs 15600/-.

Another attempt to improve the traditional craft of the state during this period was made by the FAO under its Bay of Bengal Programme (BOBP). The BOBP began to work on three different projects in 1981. The first project related to the development of an improved sailing craft for small-mesh gillnetting from Tangassery near Quilon. The project tested two new sailing beach landing craft of the

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1. Ibid., p. 2.
2. Ibid., p. 2.

IND-17 type named FAO-3 and FAO-4. The craft built of marine plywood had an overall length (LOA) of 7.8 m, breadth of 1.95 m and depth of 0.69 m. It used a main sail of 17.6 sq.m. and a jib of 6 sq.m. The crew size was five. The testing operations were carried out for one full year but it was found that the improved sails did not help in reducing the cost. The catch during the first four months was reported to be higher by 24 per cent and that was attributed to higher quantity of gear carried by the craft.

The second project undertaken by the BOBP in the state during this period was for the motorisation of the craft for small-mesh gillnetting. The project after concluding the sailing trials at Tangassery fitted the two canoes with two 7 HP kerosene out-board engines of the type utilised by the Thangulvala units at Purakkad. The engine was mounted in a well-like construction in the fore part of the keel. The sailing jig was kept intact for use in favourable wind to save fuel. The trials were started in April 1982 and continued upto the end of March 1983. The catches were reported to be higher by 40 per cent, but this gain was lost because of the added cost of fuel, repair, maintenance and depreciation. The crew incomes did not rise substantially[1]. The main advantage noted was the elimination

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1. Ibid., p. 15.

of the strenuous work of rowing the craft for two to three hours per day.

A third project undertaken by the BOBP in this regard was the introduction of two motorised beach-landing craft for large-mesh gillnet fishing from Cheriazheekal near (north of) Quilon. Under this scheme, the BOBP introduced two IND-18 type of boats (designated as FAO-1 and FAO-2) for operation from Cheriazheekal in November 1981. These boats also, built of marine plywood had a length of 8.40 m, breadth of 2.24 m and depth of 0.76 m. They are powered by small 5 HP aircooled diesel engines. In addition, they have a main sail of 17.6 sq.m. and a jib of 9.1 sq.m. The crew strength was four. The engine was mounted in a pivotable water tight box which permits retracting the propeller and rudder when landing on the beach. Finding the crew from Cheriazheekal unfamiliar with the operation of large-mesh gillnets further offshore from their village, the boats were transferred to Sakthikulangara in March 1982. The boats continued their operation at Sakthikulangara till December, when they were shifted to Pulluvila, south of Trivandrum. Meanwhile, the 5 HP engines were found to be unreliable and had to be replaced by 8 HP engines. The boats' operation during the first seven months from Cheriazheekal an Sakthikulangara had shown that their performance in terms of catch and total revenue was as good as the local 22 ft. (24 HP) boats and the investment and fuel cost involved on the other hand were much less than the local craft[1].

ii) <u>Alternative Materials for Boat Building</u>

The Research and Development work carried out in this direction earlier was quite inconclusive about the possibility of introducing substitutes for wood for boat building. The work in this direction was continued by the CIFT and the BOBP. The BOBP studied the comparative costs of different boat building materials and came to the conclusion that wood is still the cheapest material for building the small craft. Table V.13 shows the comparative cost per square meter of alternative materials used in the construction of an 8.5 m beach-landing boat.

Table V.13. Comparative Cost+ Per Square Meter of Alternative Materials Used in the Construction of an 8.5 m Boa

Material	Basic material cost	Thick-ness (mm)	Weight Kg/sq.m.	Cost Rs/sq.m
<u>Aini</u>	Rs 3000.00/cu.m. in log form (40% loss from log to planks)	19	11.5	112
Marine Plywood	Rs 120.00/sq.m.	12	9.0	120
Fibreglass	Rs 55.00/Kg.	6	9.0	500
Aluminium	Rs 40.00/Kg.	3	8.4	340

+ The costs given seems to be for the year 1983.

The observed difference in the cost of wood is, however, said to disappear, when the total cost of boat is taken. This is because of the added cost of labour, fastenings, paints, etc. which the wooden boat needs for its construction. It is also felt that the cost of the fibreglass (FRP) boats is unlikely to come down even if their production is undertaken on a mass scale. The BOBP further considered the possibility of using pressure impregnated marine plywood as an alternative material especially in view of the difficulty in getting suitable timber for construction. But looking at the additional cost of sheathing the plywood hull, it emphasised the need for development work on FRP and aluminium boats[1].

iii) Fuel Saving Devices

In the wake of the mounting cost of fuel, there was an alround demand for fuel saving devices. From the FAO/UNDP/CIFNET experiments on 'fuel saving devices' conducted during this period, it has been found that fitting a Kort nozzle in combination with the existing propeller could save the fuel consumption by 24.4 per cent in a 9.75 m (32 ft.) stern trawler. It was also shown that a boat with the new slotted blade propeller together with Kort nozzle of

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1. Ibid., p. 15.

angle of attack 12.5°, fin and air divertor can save fuel upto 32.6 per cent. The experiments have further shown that adequate aperture would help to improve the propeller efficiency and obtain added fuel efficiency[1].

iv) Improvements in Deck Lay-out

Many improvements in the deck lay-out which improved the performance of the vessels have been achieved during this period. The introduction of 'gantry' on the deck of a trawler by the BOBP was found to obviate the need for a mast and the boom, the stay of the mast and the boom, and the trawl gallows. Similarly the introduction of a 'netdrum' was found to be extremely useful in handling the net and the otter board. The 'tiltable drum winch' introduced by the BOBP was found to eliminate the possibility of the wire getting sharp bends and damaging itself. It is also self winding and saves manual and mechanical work[2].

v) New/Diversified Fishing Methods

A major technological break-through in fishing techniques achieved during this period was the introduction

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1. M. Swaminath, 'Is There Need for a New Generation of Mechanised Boats', Annual of the Industrial Fisheries Association (1983), p. 28.

2. Ibid., p. 27.

of the high opening bottom trawling method for demersal fishery resources with the help of the BOBP. The technique was first introduced at Tuticorin in Tamil Nadu by the BOBP in 1982 and at Porbander in Gujarat by the CIFNET in 1983[1]. The technique has captured the attention of the mechanised boat operators, particularly the trawler owners because of the high yields reported in these regions.

Another notable improvement in fishing technique achieved during this period was in the field of tuna fishing. A Special Intensive Tuna Drive Programme was launched by the CIFNET in 1983 with technical assistance from the Japan International Cooperation Agency. Under this programme the CIFNET and the Fishery Survey of India organised an intensive training programme for tuna long lining and survey of tuna resources with technical guidance from Captain E. Haruta of the Japan International Cooperation Agency during 1983-84[2] The programme, apart from identifying the tuna resources of tl country, has helped in transferring the technology of fishing for tuna to Indian skippers. The catching efficiency of the technique was reported to be satisfactory with an average hooking rate of 0.76 per cent for the whole period of the programme. The hooking rates were reported to be higher during October 1983 (1.25 per cent), February 1984 (1.4 per c

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1. M.Swaminath and P.K. Vethabothagam, <u>Transfer of Technology Diversified Fishing - A Successful Gujarat Story</u> CIFNET/BUL/04/DFT, (CIFNET, Cochin, 1987), pp. 1·

and March 1984 (1.84 per cent). Still higher rates were obtained in the Tamil Nadu Coast, particularly in the regions of 12°N, 80°E (2.15 per cent) and 13°N, 80°E (2.20 per cent)[1].

3. Research and Development for Fishing Harbours

The Research and Development for fishing harbour projects in India was started in 1954, when the Government of India sought the services of two FAO harbour specialists to survey and study the possible locations for the development of fishing harbours in the country. In 1955, the FAO deputed two Swedish harbour engineers, Messrs Carl G. Bjuke and C. Ragnar Bjuke to assist the Government of India in investigating and planning for fishing harbour projects in the country. The two engineers carried out investigations till the end of 1958 and prepared plans for the development of six fishing harbours at Veraval, Bombay and Karwar on the West Coast and Royapuram, Cuddalore and Nagapattnam on the East Coast[2]. The lay outs for a harbour at Vizhinjam and another at Beypore were also prepared by Messrs C.G. Bjuke and C.R. Bjuke in 1962[3].

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1. Ibid., p. 14.
2. P.K. Dewer, 'Development of fishing harbours in India', Proceedings of the symposium on Development of Deep Sea Fishing, (Central Institute of Fisheries Operatives, Cochin, 1970), p. 322.
3. Annonymous, Deep Sea Fishing Project off the Kerala Coast Based at Kovalam - Vizhinjam, (Government of Kerala, Trivandrum, 1977), p. 14. See also, Directorate of Fisheries, The Master Plan for

The need for providing landing and berthing facilities for small mechanised boats in the country had become quite pressing by the turn of the sixties. Initially the small boats were using the shallow waters of the coast or the river mouths or lakes as their anchorage. This had, however, proved to be disasterous because the boats were subjected to the onslaughts of bad weather and monsoon. With the growing pace of mechanisation, fishing boats had begun to congregate at or near the commercial ports of the country, where facilities for landing, berthing, fuel, water, ice and other accessories are available. This, however, created problems of navigational hazards and hygiene The need for providing separate full-fledged fishing harbours with all essential facilities like landing jetties, auction halls, berthing quays, slipways, dredging machines, fuel bunks, water supply, ice and cold-storage, processing halls, transport, repair and maintenance, etc. were felt very important. This was also thought to be the 'logical step' for the industrial concentration of fishing to major ports with modern amenities for commercial fishing, processing and

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1. Planning Commission, Evaluation Report on the Fishing Harbour Projects, (Government of India, New Delh 1977), p. 1.

marketing[1]. It was also the considered opinion of the Government that the proper exploitation of the distant water fishery resources of the country needed a net work of major and minor fishing harbours in the country[2]. It was legitimately held that development of fishing harbours is an essential pre-requisite for the modernisation and expansion of the fishing industry of the country[3].

Considering the urgency of the problem, the Government of India in 1965-66 decided to entrust the work of investigation, formulation and execution of major fishing harbour projects in the country to the Port Trust Authorities of the respective regions[4]. As regards the development of minor fishing harbours, it realised the paucity of funds and expertise with the state governments and decided to set up a central agency to study the technical feasibility and economic viability of developing a number of minor fishing harbour projects at the major fish landing centres of the country. Accordingly it set up the Pre-Investment Survey of Fishing Harbour Projects (PISFHP at Bangalore in 1968 with technical assistance from FAO/UNDP[5]

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1. Ministry of Agriculture, Report of the National Commission on Agriculture - Part VIII Fisheries, (Governmen of India, New Delhi, 1976), p. 235.

2. Ibid., p. 234.

3. P.K. Dewer, op. cit., p. 327.

4. Planning Commission, op. cit., p. 2.

The PISFHP since its inception has prepared a number of feasibility reports for small and medium harbour projects in the country. Some of the projects prepared by the PISFHP have been accepted and implemented by the Government[1].

During the second and third five year plans, the State Governments were responsible for the development of minor fishing harbour projects. This was, however, made a centrally sponsored scheme in 1966-67 with a pattern of assistance of 50 per cent subsidy and 50 per cent loan. This pattern of assistance was raised to 100 per cent grant in 1967-68 and continued till the end of the fourth five year plan. The pattern of assistance was again reverted to the old formula of 50 per cent grant and 50 per cent loan during the subsequent plans following a decision of the National Development Council. The Central grants-in-aid is now limite to 50 per cent of the cost of the project. Upto March 1979, the Government of India had sanctioned 81 minor fishing harbours and five major fishing harbour project in the country[2].

The only major fishing harbour project sanctioned in Kerala is the Cochin Fishing Harbour Project at Mattancher

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1. Ministry of Agriculture, op. cit., p. 299.
2. Planning Commission, op. cit., p. 62.

The project proposal for the harbour was prepared by the Cochin Port Trust in 1969. The project aimed to provide (1) adequate berthing accommodation for fishing vessels, (2) good discharge conditions in the harbour, (3) adequate auction hall, (4) easy and quick access from the sea, (5) sufficient land for development of shore-based industries, (6) repair facilities and, (7) other services such as supply of ice, water, bunker, etc.[1]. The harbour was expected to accommodate 1500 small and medium vessels and 250 trawlers. The lay-out of the harbour proposed included a 1200 ft. long straight quay with a width of 15 ft. and an open pier at the south end of the quay in the first stage of development. The project also included one auction-cum-packing hall, auction offices, telephone booths, toilets, ice-plant and ice-storage, freezing plant, cold-stor fishing gear sheds, net drying and repair sheds, parking spac for vehicles, bunker facilities, repair workshops, administrative office building, restaurant, etc.. Among other facilities, water supply, electricity, roads and drainage were also taken care of in the project proposal. Work on the project was started in 1971. Bulk of the work was completed by the end of 1979. The harbour was commissioned in December 1979.

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1. Ibid., p. 6.

As pointed out earlier, development of minor fishing harbour projects was the responsibility of the state governments and accordingly the Government of Kerala have been trying to develop a number of small fishing harbours in the state since 1956. During the Second Five Year Plan, the Government of Kerala obtained the services of Mr. Carl G. Bjuke, the FAO harbour engineer who was on special duty in India, to study the possibilities of developing the Kovalam-Vizhingam fish landing centre into a leading fishing harbour of the State. Bjuke suggested the development of the harbour in three stages. The first stage envisaged the construction of a sea-ward break-water and the second and third stages, the development of infrastructure for landing, docking, repair, maintenance, etc.[1] Construction of the harbour was started in December 1967[2].

With the commencement of the Fourth Five Year Plan, the Government of Kerala had taken up a number of schemes for the development of small fishing harbours and landing centres in the state. The technical and economic viability of these schemes were studied by the State Port Department, the State Planning Board and the PISFHP. The major schemes taken up for implementation during the successive five year plans are given in Table V.14.

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1. Anonymous, Deep-Sea Fishing Project off the Kerala Coast Based at Kovalam-Vizhinjam, (Government of Kerala, Trivandrum, 1977), p. 14.

2. Ibid., p. 14.

Kerala During the Successive Five Year Plans

ear	Period	Name of Harbour	Landing Centres	Remarks
n	1969-74	Azheekal (Baliapattam) Mopla Bay, Beypore, Azheekode, Cochin*, Kayamkulam, Neendakara, Vizhinjam		
	1974-79+	Chandragiri, Azheekal, Mopla Bay, Thalayil, Beypore, Ponnani, Azheekode, Thottapally, Neendakara, Vizhinjam	-	Work on Azheekal, Mopla Beypore, Azheekode, Neendakara and Vizhinja was continued during th plan.
n	1980-85	Neendakara, Vizhinjam	Manjeswar, Kasargode, Bekal, Nileswar, Cheruvathur, Palacode, Dharmadom, New Mahe, Iringal, Puthiyappa, Keettingal, Ponnani, Munakkakadavu, Chettuvai, Munambam, Andakara Azhi, Purakad, Thottapally, Kayamkulam, Muthalapozhi	Work on Neendakara and Vizhinjam was continued about 21 landing centre identified for providin better landing faciliti Progress achieved only the case of Kasargode, Neeleswar and Munakkakadavu
an	1985-90	Mopla Bay, Chombal, Puthiappa, Ponnani, Munambam, Kayamkulam, Neendakara, Thankassery, Vizhinjam stage II and III, Muthalapozhi	Bekal, Kanhangad, Neeleswaram, Cheruvathur, Palacode, Dharmadom, Chombal, Quilandy, Parappanangadi, Chowara, Munakkakadavu, Andhakara Azhi, Thottapally	Work on Mopla Bay which was suspended during th VI Plan due to heavy siltation is resumed. proposal includes four mini-harbours at Chomba Kayamkulam, Thankassery and Muthalapozhi. In addition, 59 landing centres are proposed to get sheltered landing b

It may be noted that the progress in respect of the state sector projects was quite tardy. Some of the leading harbour development schemes taken up during the fourth, fifth and sixth five year plan periods are still incomplete. The second and third stage of the Vizhinjam harbour project are yet to be completed[1]. The projects at Neendakara and Beypore are yet to take off on an even keel. Another scheme, the Mopla Bay Project, which was started during the third five year plan (1963) with Norwegian assistance was suspended during the fifth five year plan because of technical faults in the designs[2].

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1. It is pointed out that this harbour, because of its strategic location and its proximity to the Wadge Bank (a potential fishing ground located off Trivandrum and Kanyakumari district of Tamil Nadu is known for prawns, perches and other demersal resources, the Indian Ocean tuna resources and the deep-sea prawns off Quilon) is of paramount importance in the development of the marine fishing industry of Kerala.

2. This project is again taken up with the Central Government's approval during the seventh plan.

Contd. from Table V.14.

* This was a major harbour development scheme wholly financed by the Central Government.

\+ The last year of the Vth Plan was dropped by the Janatha Government in 1978.

Sources: 1. Directorate of Fisheries, Master Plan for Fisheries Development - Kerala State, (Government of Kerala, Trivandrum, 1969), p. 22.

2. State Planning Board, Fifth Five Year Plan - A Draf Outline, (Government of Kerala, Trivandrum, 1973), p. 168.

3. State Planning Board, Draft Sixth Five Year Plan, 1980-85 and Annual Plan 1981-82, Vol. I, (Governmen of Kerala, Trivandrum, 1980), p. 59.

The main reasons pointed out for the slow progress of the harbour development schemes are (1) the delay in finalising the designs of the projects, (2) dearth of qualified engineers, (3) paucity of funds, and (4) unforeseen natural hazards[1] (for example, the severe siltation of the quay at Mopla Bay in Cannanore). In view of this and in order to give a strong technical support to the harbour development scheme, the Government of Kerala constituted a Harbour Engineering Wing during the Fifth Five Year Plan. Since 1980, it has also begun to give special attention to develop the traditional fish landing centres of the state. About 59 fish landing centres were identified for development during this period and 21 centres included for development in the sixth plan (see Table V.14 above). It is, however, observed that progress was achieved only in the case of three centres, viz. Kasaragode, Neeleswar and Munakkakadavu[2]. It is apparent that the Research and Development efforts in this direction were not satisfactory despite the long attention and interest given by the government to this factor. This naturally would

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1. S. Krishna Kumar, Strategy and Action Programme for a Massive Thrust in Fisheries Development and Fishermen Welfare in Kerala State 1980-83, (Government of Kerala, Trivandrum, 1980), p. 67.

2. State Planning Board, Seventh Five Year Plan 1985-90, Report of the Working Group on Fisheries, (Government of Kerala, Trivandrum, 1984), p. 10.

have had its impact on the development of commercial fishing by small, medium and large vessels, both in the inshore and offshore waters of the state..

4. Fisheries Education and Training[1]

The role of learning, education and training in technological change was recognised earlier. It was identified as a crucial factor in improving the productivity of the workers and in enhancing the National Divident (see Chapter III). The role of education and training in the development of the primary marine fishing industry of Kerala cannot be overlooked. It has been accorded a major role in the government's programmes for the development of fisheries in the state. Fisheries education and training was given top priority by the central government too.

Fisheries education and training in Kerala has its beginning with the introduction of the programme of mechanisati of fishing boats in the early fifties. The Indo-Norwegian Project which began its operation from Neendakara established the first fishermen training centre at Neendakara in 1954. The Project offered training in the handling of boat-engines, in the monoeuvring of motor boats, and in the use of modern

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1. Here our discussion is confined to the education and trainir prevailing in the primary (catching) sector of the marine fishing industry of Kerala.

fishing gear[1]. Mechanisation demanded that the fishermen should acquire new skills to operate the vessel, to handle the engine and the new gear. The traditional skills were of not much use and the need for acquiring new skills were compelling. In view of this skill requirement, the government of Kerala organised two fishermen training centres in 1956 - one at Ernakulam and another at Beypore. Two more fishermen training centres were established in the subsequent years; one at Vizhinjam in 1961 and another at Cannanore in 1963. Table V.15 shows the details of fishermen trained from these centres prior to 31.12.1980.

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1. Per Sandven, op. cit., p. 37.

as on 31.12.1980.

Location of the fishermen training centres	Year of establishment	Maximum intake capacity	Duration of training (months)	No. of trainees admitted till the end of 1980*	No of trainees who have completed the course till the end of 1980
Vizhinjam	1961	40	9	919	855
Neendakara	1954	40	9	560	517
Ernakulam	1956	40	9	1110	1047
Beypore	1956	40	9	1020	961
Cannanore	1963	40	9	742	694
All		200	-	4351	4074

* Includes trainees who are undergoing training during the last year under reference (198

Sources: 1. Department of Fisheries, Kerala Fisheries - Facts and Figures, 1980, (Government of Kerala, Trivandrum, 1983), p. 93.

2. CMFRI, Indian Fisheries - 1947-77, (CMFRI, Cochin, 1977), p. 49.

In addition to the above centres, the Government of Kerala had sanctioned six more fishermen training centres in the state during the sixth plan period[1]. It may be noted that the training offered from these centres are brief covering the operation and maintenance of small fishing boats. The specific subjects taught include fishing methods, fishing gear technology, elementary principles of navigation and running and maintenance of internal cumbustion engines. The trainees are offered three months practical training in fishing. The minimum qualification required for entry to this training programme was a basic education upto the 5th standard and at least five years fishing experience. Initially, the Government of Kerala had encouraged the trainees by issuing them small mechanised boats after the completion of the training and by organising them into groups of four or five fishermen under a local producers cooperative society. During the training period the trainees were also offered a stipend.

Another sources of vocational training for fishermen in Kerala is the Fishermen Technical High Schools, where fishermen boys are given specialised coaching on fisheries science and technology along with general academic

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1. State Planning Board, Seventh Five Year Plan 1985-90 - Report of the Working Group on Fisheries, (Government of Kerala, Trivandrum, 1984), p. 8.

subjects. Before 1980, the state had three Regional Fishermen Technical High Schools located at Vizhinjam, Ernakulam and Cannanore (Azheekal). The sixth plan proposed to start fishermen technical high schools in all the coastal districts and made provision for starting six additional schools at Cannanore, Beypore, Tanur, Chowghat, Alleppey and Quilon[1]. In addition to these, a Central Training Institute is also proposed by merging the Fishermen Training Centres at Vizhinjam, Neendakara, Ernakulam, Beypore and Cannanore with the Staff Training Centre at Ernakulam[2].

It may be noted that the Fishermen Training Centres and the Fishermen Technical High Schools in the state give only basic training to the fishermen at the artisanal level, i.e. for fishing with small mechanised boats. Training at higher levels, for operating larger vessels and for other shore-based operations, are given by the Central Institute of Fisheries and Nautical Engineering Training (CIFNET), Cochin, established by the Central Government in 1963[3].

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1. Ibid., pp. 8-9.

2. Ibid., p. 8.

3. This institute was established in 1963 as the Central Institute of Fisheries Operatives (CIFO), following the recommendations of the Committee on Fisheries Education appointed by the Government of India in 1959 under the Chairmanship of late Dr.N.K.Panikkar.

The CIFNET offers training for seven categories of personnel; mates of fishing vessels, engine drivers, radio-telephone operators, gear technicians, boat-building foremen, shore mechanics and trained teachers for fishermen training centres. The duration of these courses varies from six months to eighteen months. Table V.16 gives the duration and intake of students by the CIFNET for various courses conducted by it at Cochin, Madras and Visakhapatnam.

Table V. 16. Name, Duration and Intake of Students for Various Courses Offered by the CIFNET

Sl. No.	Name of Course	Duration (months)	Intake capacity			To
			Cochin	Madras	Visakha-patnam	
1.	Mate, Fishing Vessel	18	40	40	20	1
2.	Engine Driver/Fishing Vessel	18	40	40	20	1
3.	Boat Building Foremen	15	20	-	-	
4.	Shore Mechanics	12	20	20	-	
5.	Gear Technicians	9	20	20	-	
6.	Radio Telephone Operators	9	15	15	-	
7.	Teacher's Training	6	10	-	-	

Source: Annual Report 1983-84, (CIFNET, Cochin, 1984), p. 4.

In addition to the above courses, the Institute also conducts refresher courses to candidates appearing for the lower and higher competency certificates examinations of the Mercantile Marine Department for Skippers, Engine Drivers and Fishing Second Hands. On completion of institutional training, the trainees are further given placements on board fishing vessels of appropriate tonnage/HP and in recognised marine workshops to enable them to obtain the necessary sea/engine room/workshop experience to appear for the respective competency certificate examinations[1]. In addition to the above programme of training, the Institute also offers occasional training to fishermen and officers of the Department of Fisheries of the various coastal states as required by them. In 1983 it had organised a 'Special Intensive Tuna Drive' which, apart from locating the tuna resources of the country, also gave training to the crew of the tuna longliner 'Prashikshani' under the guidance of Captain Haruta of Japan (see the earlier description of Research and Development for Fishing Techniques).

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1. The Indian Merchant Shipping Act 1958, Rule 76(4) requires that all fishing vessels of 25 GRT and above should be manned and operated by duly qualified officers (skippers and engineers). The rules further stipulates that an officer to become eligible for appearing for the certificate of competency examination for skipper or engine driver should have the requisite sea/engine room experience.

A third major source of training for fishermen in Kerala is the Integrated Fisheries Project (IFP), Cochin, which departs regular training to the candidates to become engine drivers, fishing second hands and master fishermen in purse-seine boats. The first two courses extend for a period of more than a year and the last for about 10 months[1]. Short-term (two weeks) special training in diversified fishing is also conducted by the Project on a more or less regular basis for the benefit of the industry and the administration.

A refresher training course for fishermen and other workers involved in the fishing industry was started by the CIFT in 1973[2]. Between 1973 and 1982, it imparted training on various aspects of marine fishing vessels, gear, their operation, maintenance, etc. The major areas covered included (a) maintenance of mechanised fishing boats, (b) technology of aluminium sheathing of wooden hulls of fishing boats, (c) technology of FRP sheathing of wooden hulls of fishing boats, (d) cathodic protection of fishing boats, (e) preparation of marine paints and their applicatio

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1. Integrated Fisheries Project, Annual Report 1980-81, (IFP, Cochin), p. 23.

2. CIFT, Twenty Five Years of CIFT - 1957-82, (CIFT, Cochin, 1982), p. 47.

(f) maintenance of marine engines, (g) uses of instruments developed at CIFT for fisheries investigations, (h) design, construction and rigging of modern fishing gear like trawls, purse-seines, gillnets and lines, (i) design and construction of improved types of otter boards, (j) design, construction and rigging of artisanal fishing gear like traps, thanguvala and mini-purse-seines for operation from country craft and, (k) testing of gear materials like twines, floats, etc..

A notable point here is that the type of training discussed so far is primarily meant for active fishermen and ancillary workers. Training at the higher levels of functionaries for the management and development of the industry is equally important and in tune with this requirement new courses were designed at the graduate and post-graduate levels in two of the universities of the state. The Kerala Agricultural University offers a B.F.Sc Course in Fisheries Science with special emphasis on Culture Fisheries. The Cochin University of Science and Technology offers one of the most integrated courses at the post-graduate level in Fisheries Science and Technology. The M.Sc. Industrial Fisheries Course of the University is an inter-disciplinary programme for two years, which combines the latest knowledge about fishery resources, fishing craft, gear and methods of fishing, methods of utilisation, economics of production, processing, marketing and management of the industry. It may be noted that the University since the inception of this course in 1976 has been supplying the large number of personnel required for the management and development of the industry at the production, processing, marketing, financing and administrati levels within and outside Kerala. Over and above these training programmes available in the state, it is likely that the state has benefitted from the institutional training available at the Central Institute of Fisheries Education, Bombay, and some of the Agricultural Universities outside the state (for e.g. from the University of Agricultu Sciences, Bangalore and its College of Fisheries at Mangalore

It is our presumption that the system of organised education and training which was made available to the primar marine fishing industry of Kerala should have contributed to large increase in the productivity (output per fishermen) as well as the total product of the industry.

5. Organisational Changes

One of the crucial factors in economic development is the availability of suitable organisational (institutional set up to carry out the process of technological change. The primary marine fishing industry of Kerala prior to the introduction of new technology was managed by a group of small producers, who are heavily indebted to the fish merchants and the money lenders, with practically no urge for development of new skills, enterprise or technology. The production system was deeply tied to the local feudal caste-based organisations in which the majority of fishermen had no dominant role but only that of craftsmen (oarsmen) and the minority of owners of the means of production controlled the entire production system with their strong linkages with the trade and credit system. This organisational set up was quite unconducive to improvements in the industry. In these circumstances it is natural that a large part of the fishing population actuall prefers to be indebt as in any other country and thinks 'the more heavily a man is in debt, the more certainly will his creditor support him through hard times in order to exploit him in the future'[1]. The fishermen generally thought that any increase (improvement) in their effort will be immediate appropriated by the middle-men, either in the form of repaym of debt or through lowering the prices[2].

The introduction of new technology - new craft, new gear, new techniques, etc. - demanded new organisations

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1. United Nations, Special Study on Economic Conditions and Development in Non-Self Governing Territories, (UN, 1952), p. 135.
2. E.S. Kirby and E.F. Szczepanik, 'Special Problems of Fisheries in Poor Countries', in Ralph Turvey and Jack Wiseman (Eds.), Economics of Fisheries

and institutions. The Administration which provided the resources - capital, know-how, etc. - also thought it advisable to establish a new form of organisation which will effect the requisite technological changes in the industry. It considered that the cooperative form of organisation would be the ideal form of organisation to effect such changes in production, processing and marketing. The cooperative forms of organisation, it was thought, will liberate the fishermen from the clutches of the money lenders, promote thrift, enhance production and encourage better marketing. It was also thought necessary to bring self-reliance and improvement in the socio-economic condition of the fishermen. Anticipating these improvements the Government of Kerala organised fishermen cooperatives at the primary, central and apex levels. At the primary level, societies were organised for production (Matsya Utpataka Cooperative Societies) and credit. At the central (district/regional) level, societies were established for marketing of fish. At the apex level, the Kerala State Fish Marketing Federation was established in 1968. These societies were given managerial assistance and financial support by the state government and other central institutions like the National Cooperative Development Corporation and the Agricultural Refinance and Development

Corporation (now NABARD). Initially, the Government's programme of mechanisation of fishing boats were implemented through the cooperatives which were made the channel for distributing mechanised boats and other accessories to the fishermen. Credit and marketing services were also extended through the cooperatives. The number of different type of cooperatives had increased remarkably fast during the first two decades since 1956-57 when the movement was launched on a vigorous scale. From a survey of fishery cooperative in the state in 1975 conducted by the Resuscitative Committee for fishery cooperatives it has been found that there were 1057 fishery cooperatives in the state and that the state government had been able to bring the majority of the primary producers (fishermen) within the fold of copperatives[1]. Table V.17 shows the break-up of these cooperatives by their type as on 30.6.1975.

Table V.17. Details of Fishery Cooperatives in Kerala as on 30.6.1975.

Sl.No.	Type of Cooperatives	Number
1.	Credit Societies	189
2.	Production Societies	849
3.	Marketing Societies	18
4.	Federation	1
Total		1057

Source: Resuscitative Committee, Report of the Resuscitative Committee on Fishery Cooperatives, (Government of Kera Trivandrum, 1976). p. 13.

1. Resuscitative Committee. Report of the Resuscitative Commit

Despite the large number of Cooperatives in the state, the performance of these Cooperatives was found to be quite unsatisfactory and the Resuscitative Committee was in fact forced to recommend the liquidation of all these societies and to suggest their replacement by a kind of multi-purpose societies which could render a package of services running from supply of credit, inputs and infrastru to processing, marketing and management of fishermen's interests. Following the recommendations of the committee and finding the irredeemable state of the societies, the Government of Kerala initiated measures for the liquidation of the fishermen Cooperatives in 1981 and constituted a new set of Cooperatives called Fishermen Welfare Societies in all the 222 fishing villages of the state. At the apex of these societies is the Kerala State Cooperative Federation for Fisheries Development (Matsyafed) which now spearheads the fisheries development activities in the state.

A major organisation outside the fold of Cooperatives established to promote technological change and development in the marine fishing industry of Kerala was the Kerala Fisheries Corporation which was set up by the Government of Kerala in 1966, with a view to promote mechanised fishing, processing and modern marketing[1]. It ma

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1. This organisation is now part of the Kerala State Cooperative Federation for Fisheries Development (Matsyaf

be noted that this organisation has succeeded in introducing a few medium and large boats using modern gear and to operate in deeper waters off the coast of Kerala for sometime. Its fishing activities are now confined to the East Coast.

Another organisation which had played a crucial role in modernising the traditional sector of fishing in the state was the Kerala Fishermen Welfare Corporation which was established in 1978. This Corporation had played a crucial role in testing and introducing new outboard engines to the traditional craft since 1980 and in providing better housing and sanitary facilities to the traditional fishermen in the state since 1979.

In addition to the above mentioned organisations, it is important to note that the creation of a separate Department of Fisheries for the state since the state's reorganisation in 1956 with a Director of Fisheries at the Headquarters and a large number of subordinate officers at the district and village levels had been a notable supporting factor facilitating technological change and development in the industry[1].

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1. A quantitative assessment of the contribution of these institutional agencies will be practically difficult but their role cannot be ignored.

6. Investment, Innovation and Diffusion of Innovations

a) Investment

The major technological changes in the primary marine fishing industry of Kerala have been 'embodied' in physical capital and human resources. This was made possible through a planned programme of investment in the industry by the state (government) and autonomous investments by the private sector. Investment by the state constituted the largest share in the industry in the form of mechanised boats, fishing harbours, landing centres, fishermen training centres, fishermen technical schools, ice plants, cold storages, processing plants, roads, transport vehicles, market infra-structure, etc.. Investments in human capital — in fishermen's training, education, health, sanitation, housing, etc.—were also made by the state. The details of investments made by the state are discussed in Chapter VI, where the indicators of technological change are discussed.

b) Innovation and Diffusion of Innovations

The various technological changes introduced by the Government and the Research and Development Organisations in the industry have been quickly followed or imitated by the fishermen once it was proved to be economically superior to the existing technology. The first major innovation introduced in the industry was bottom trawling for shrimp with mechanised boats at Neendakara by the Indo-Norwegian Project. This was quickly adopted by the fishermen and it soon became the most popular method of mechanised fishing in the state. The most common design of the craft employed was the 32 ft. CIFT design. Even the small mechanised boats which were using traditional gillnets for catching sardines, mackerels, etc. began to use trawlnets when the market for shrimp was expanding. This trawler boom had, however, led to an over-expansion of the fleet and over-fishing by the turn of the 'eighties'[1].

A second major innovation in the industry was the introduction of purse-seining for small pelagic fishes like sardines, mackerels and anchovies since 1979. This innovation also had spread very fast. The number of purse-seiners increased from about 10 units in the second half of 1979 to 40 in 1980, 60 in 1981 and over 90 in 1982[2].

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1. This issue will be discussed in Chapter VII where the effects of technological changes are presented. The fleet size has increased from less than 100 in 1957 to 2476 by 1982.

2. Expert Committee, Report of the Expert Committee on Marine Fisheries in Kerala, (Expert Committee, C/o. Central Institute of Fisheries Education, Bombay, 1985), p. 383.

The predominant craft type used is the CIFT designed 36 ft. boat. The sharp increase in the number of purse-seiners in the state has in fact led to severe protests from the traditional fishermen who feared a further decline in their catches and depletion of resources[1].

A third major innovation which is yet to spread itself in the industry is the introduction of pelagic/ mid-water trawling for tuna, mackerel and other widely distributed resources of the inshore and offshore waters of the state. It may be noted that this innovation is also being stiffly resisted by the traditional fishermen who anticipate a further fall in their catches with the introduction of these techniques.

A fourth innovation, which is in fact a counter move by the traditional fishermen to protect their interests, is the introduction of out-board engines to the traditional craft, particularly the Thanguvalloms. About 2,200 'or so' traditional units are reported to have gone for this innovation by the end of 1984[2]. The majority of these units belong to the southern districts of the state where

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1. The output of the traditional sector had started declining much earlier, particularly since 1969. (See Chapter IV for the trend in the output of the traditional sector). The basis of this fear and its after-maths are discussed in Chapter VII.

2. Expert Committee, op. cit., p. 401.

concentration of mechanised boats is more pronounced and competition for resources more acute. Of late, these units are also reported to have introduced small trawlnets locally called as 'disco-nets', 'mayuri-nets', etc.

It may be noted before concluding this section that the various innovations in craft/gear and fishing techniques introduced in the state have only helped in intensifying the fishing effort in the inshore waters of the state and to some extent in depleting certain resources. Conversely, the larger craft designs (combination vessels) made by the CIFT and other institutions have not yet become popular with the fishing companies or public sector corporations in the state. What is most annoying is that the resources of the off-shore waters of the state are now exploited by foreign vessels without legal sanctions[1]. Development of an off-shore fishing fleet or what is generally called a 'new generation' of fishing vessels is the next line of innovation, which is wanting in the primary marine fishing industry of Kerala[2].

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1. Poaching by foreign vessels in Indian waters is reported on several occasions. This is despite the presence of the Indian Coast Guard Authority.

2. M. Swaminath, 'Is There Need for a New Generation of Mechanised Boats', Industrial Fisheries Association Annual - 1983, pp. 21-31.

CHAPTER VI

TECHNOLOGICAL CHANGE AND THE DEVELOPMENT OF THE PRIMARY MARINE FISHING INDUSTRY OF KERALA - A STUDY OF INDICATORS

The 'process' of technological change in the primary marine fishing industry of Kerala has been outlined in the last chapter. This chapter presents some of the major indicators of technological change which have not been fully elaborated in the last chapter. The chief indicators discussed in this chapter are (1) increase in the number of medhanised boats and new gear, (2) increase in the number of skilled and educated manpower employed in the industry, (3) progressive increase in the infrastructure for fishing, ice, storage, processing, transport, distribution, boat building, etc., (4) progressive increase in the outlay and expenditure for fisheries development, (5) export promotion, and (6) import substitution. A brief discussion of these indicators is made below.

1. Increase in the Number of Mechanised Boats and New Gear

It has already been pointed out in the last chapter that the Research and Development efforts of the

INP, FAO and CIFT had led to the design and construction of several new types and sizes of mechanised boats and nets in the state. Some of the major innovations made in the field of fishing were also pointed out in that chapter. In this section we measure the extent of these changes by looking at the growth in the number of mechanised boats and (new) nets introduced in the state during the last three and a half decades. It is important to caution here that the data which are being presented here are from different sources. These data are quite incomparable and sometimes even conflicting. They are, however, presented here for getting a broad idea of the process of technological change in the primary marine fishing industry of Kerala. Table VI.1 gives different estimates regarding the number of mechanised boats and gear in Kerala for different years.

Table VI.1. Estimates of Mechanised Boats and Gear in Kerala for Different Years by Different Sources

Number of boats				Number of gear (trawlnets)[a]
Calendar year	No.	Financial year	No.	
1	2	3	4	5
1955	NA	1954-55	23[13]	NA
1956	NA	1955-56	45[13]	NA
1957	NA	1956-57	80[13]	NA
1958	NA	1957-58	91[13]	NA
1959	NA	1958-59	115[13]	NA
1960	16[1]	1959-60	139[13]	NA
1961	24[1]	1960-61	160[13]	NA
1962	111[1]	1961-62	262[13]	NA
1963	206[1]	1962-63	297[13]	NA
1964	305[1]	1963-64	380[13]	NA
1965	501[1]	1964-65	451[13]	NA
1966	788[1], 715[2], 943[3]	1965-66	533[13]	7555[2]
1967	972[1]	1966-67	943[13]	NA

Table VI.1. Contd.

1	2	3	4	5
1968	1304[1]	1967-68	1055[13],1055[14]	NA
1969	1505[1],1207[4]	1968-69	1250[13],	NA
1970	1602[1]	1969-70	1465[13],2007[15]	NA
1971	1780[1]	1970-71	1487[13]	NA
1972	1944[1],2641[5]	1971-72	NA	16500[5]
1973	2032[1]	1972-73	NA	NA
1974	2105[1]	1973-74	2014[16]	NA
1975	2105[6]	1974-75	NA	NA
1976	2640[7]	1975-76	NA	NA
1977	2322[8],2641[6],2988[9]	1976-77*	1026[17]	9771[9]
1978	NA	1977-78	2390[18]	NA
1980	3019[6],3038[10]	1979-80	NA	NA
1981	NA	1980-81	NA	NA
1982	2961[11],5613[12]	1981-82	NA	NA

a The data are for calendar year.

* The actual period covered is 1973-77. The data seem to include only craft owned

Sources:

1. Bureau of Economics and Statistics, Employment Potential of Fisheries Development Programmes in Kerala, (Government of Kerala, Trivandrum, 1977), p. 26.
2. Directorate of Economics and Statistics, Indian Livestock Census - 1966, (Government of India, New Delhi, 1972).
3. Directorate of Fisheries, Master Plan for Fisheries Development - Kerala State, (Government of Kerala, Trivandrum, 1969), p. 177.
4. Central Marine Fisheries Research Institute, Marine Fish Production in India 1950-68, Bulletin 13, (CMFRI, Cochin, 1969), p. 142.
5. Department of Animal Husbandry, Livestock Census 1972, Annexure III, Schedule III, (Government of Kerala, Trivandrum, 1972), pp. 5-11.
6. Government of Kerala, Report of the Committee to Study the Need for Conser Marine Fishery Resources During Certain Seasons of the Year and Allied Mat (Government of Kerala, Trivandrum, 1982), p. 28.
7. State Planning Board, Economic Review of Kerala 1977, Quoted by Bharat Bhu (op. cit., p. 78).
8. Central Marine Fisheries Research Institute, Indian Fisheries 1947-77, (CMFRI, Cochin, n.d), p. 86.
9. Department of Animal Husbandry, Livestock Census - 1977, Annexure VI, Schedule III, (Government of Kerala, Trivandrum, 1979), pp. 39-51.
10. CMFRI, All India Census of Fishermen, Craft and Gear: 1980, MFIS-30, (CMFRI, Cochin, 1981), p. 30.
11. Directorate of Fisheries, Census of Mechanised Fishing Boats in Kerala 198 (Government of Kerala, Trivandrum, n.d), p. 2.

Table VI.1. Contd.

Sources:

12. Directorate of Economics and Statistics, Livestock Census 1982, Part III, Fisheries, (Government of Kerala, Trivandrum, 1984), pp. 30-32.

13. Committee on Science and Technology, Recommendations of the Committee on Fisheries and Other Living Aquatic Resources of Kerala, (Government of Kerala, Trivandrum, 1973), p. 40.

14. Directorate of Fisheries, Kerala Fisheries - Facts and Figures 1967-68, Government of Kerala, Trivandrum, 1970), p. 5.

15. Planning Commission, Evaluation of the Programme of Mechanisation of Fishing Boats, (Government of India, New Delhi, 1971), p. 90.

16. Department of Agriculture, Report of the National Commission on Agriculture - Part VIII - Fisheries, (Ministry of Agriculture, Government of India, New Delhi, 1976), p. 196.

17. CMFRI, Marine Fisheries Information Service-3, (CMFRI, Cochin, 1978).

18. Department of Agriculture and Cooperation, Statistical Supplement for the Eleventh Meeting of the Central Board of Fisheries at New Delhi, (Ministry of Agriculture and Irrigation, Government of India, New Delhi, 1979), p. 45.

The above estimates (notwithstanding certain inconsistencies in the estimates for certain periods like 1966,1969,1972,1977 and 1982 and the discrepancies in the estimates for financial years) reveal a steadily increasing trend in the number of mechanised boats in the state. This indicates the technological progress and the development of the industry.

As regards the gear, Table VI.1 does not give much details. The gear shown relate to only trawlnets and their number seems to be an over estimate when viewed in relation to the number of boats against the respective periods. It may be noted that details of the other major gear, viz. gillnets, purse-seine nets, etc. used by the mechanised boats are not available separately and hence they are not included in Table VI.1. (They are included in Table IV.3 in Chapter IV).

We may now have a look at the number of major (mechanised) craft types of Kerala as revealed by the Census of Mechanised Boats of Kerala in 1982. Table VI.2 shows the major craft types of Kerala by their size and number.

Table VI.2. Details of Major Craft Types, Their Size and Number in Kerala, in 1982

Size group	Craft type				Total
	Gill netters	Trawlers	Purse-seiners	Others	
Below 32 ft*	364 (95.08)	1271 (51.33)	-	39 (78.00)	1674 (56.53)
32 ft to 47 ft*	18 (4.71)	1205 (48.66)	53 (100)	11 (22.00)	1287 (43.46)
All*	382 (100)	2476 (100)	53 (100)	50 (100)	2961 (100)
Percentage of all to total	12.90	83.62	10.78	1.68	100

* Figures in parentheses are percentages of the group total.

Source: Department of Fisheries, Census of Mechanised Fishing Boats in Kerala, 1982, (Government of Kerala, Trivandrum, n.d.), pp. 8-11.

It is apparent from Table VI.2 that the major craft type was trawlers, which constituted 83.62 per cent of the total number of craft in the state during the reference period. This is followed by gillnetters which constituted approximately 13 per cent of the total. Purse-seiners and 'other' craft types formed less than 2 per cent each, of the total number.

Another feature of the craft which is revealed by the table is that the majority of these craft are small sized boats of less than 32 ft. length. They constituted 56.53 per cent of the total. The rest of the boats comprised of medium types of boats ranging from 32 ft. to 47 ft.. They formed 43.46 per cent of the total. It may be further noted that 95 per cent of the gillnetters belonged to the category of small boats and 4.71 per cent, medium boats. Among trawlers 51.33 per cent were small boats, mainly of 30 ft. and 31.5 ft. length (see Appendix Table VI.1). About 49 per cent of the trawlers were in the range of 32 ft. to 47 ft., the majority of them being of 32 ft. and 36 ft. (see Appendix Table VI.1). The purse-seiners were all of medium size. Among the other boats, 78 per cent were small boats and 22 per cent, medium type. It is significant to note here that few of the above boats have the potential to fish in the offshore waters of the state at a depth beyond 50 m or to stay in the sea for more than 36 hours. The fishing potential of the majority of these crafts is also limited by the horse power of these boats[1].

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1. The horse power of the craft is an important factor particularly in trawling for bottom fishes. It assumes greater significance when the deck machinery is also operated by machine power from the main engine.

An idea of the horse power of these boats can be gained from Table VI.3.

Table VI.3. Horse Power of Boats Operating from Kerala in 1982

Horse power range (HP)	Gill netters	Trawlers	Purse-seiners	Others	Total
Below 15	30 (7.25)	3 (0.12)	-	-	33 (1.11)
15 - 25	131 (34.29)	27 (1.09)	-	-	158 (5.33)
26 - 50	203 (53.14)	998 (40.30)	-	-	1201 (40.56)
51 - 100	18 (4.71)	1427 (57.63)	19 (35.84)	50 (100)	1514 (51.13)
Above 100	-	21 (0.84)	34 (64.15)	-	55 (1.85)
All*	382 (100)	2476 (100)	53 (100)	50 (100)	2961 (100)

* Figures in parentheses indicate percentages of the vertical total of each column

Source: Same as for Table VI.2.

It is evident from Table VI.3 that majority of the boats were in the horse power range of 26-50 (40.56%) and 51-100 (51.13%). About 40 per cent of the trawlers and

53 per cent of the gillnetters were having 26-50 horse power. Nearly 58 per cent of the trawlers were having higher horse power ranging from 51 to 100. Among purse-seiners, approximately 36 per cent had horse power ranging from 51 to 100 and 64 per cent, above 100. All 'other' craft types belonged to the 51-100 HP group. What is apparent from the above is that the horse power of these boats are just sufficient for operation in the inshore waters upto 50 m depth. It is evident that the technological possibilities of introducing the 57 ft. combination vessels and larger trawlers for deep-sea fishing have not so far been exploited by the mechanised sector of the primary marine fishing industry of Kerala. The economic effects of this failure to innovate and introduce a 'new generation' of large vessels have been the virtual stagnation of the output of the industry since 1975 and a decline in the output per fisherman[1].

2. Increase in the Number of Skilled and Educated Man-Power Employed in the Industry

The role of education and training in the development of the primary marine fishing industry of Kerala was discussed

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1. These issues are discussed in Chapter VII where the effects of technological change are pointed out.

in the last chapter. With technological improvements, the number of educated and trained manpower employed in the industry is bound to increase. Unfortunately, however, we have no direct estimate of such personnel employed in the industry. In the last chapter, we have presented the number of fishermen trained in the fishermen training centres of Kerala upto 1980. That do not, however, reflect the number of fishermen actually employed in the mechanised sector of the industry. In the absence of any direct estimate of the skilled manpower employed in the industry, we may look at some of the secondary or indirect indicators of the likely increase in the manpower employed in the industry.

First of all, we may look at the number of fishermen engaged in mechanised sector as an indicator of the progress in know-how. It may be noted that the programme of mechanisation of fishing craft was introduced in the state as a phased programme, by giving the fishermen training in mechanised fishing and organising them under cooperatives before they were issued mechanised boats. In view of the wide state patronage given to the programme, it is likely that a large number of the mechanised boat operators are specially trained in mechanised fishing[1]. Given below is an estimate of the number of fishermen engaged in the mechanised sector.

Table VI.4. Estimated Number of Fishermen Engaged in the Mechanised Sector in Kerala

Year	Number of Fishermen*	Year	Number of Fishermen*
1954-55	115	1969	7525
1955-56	225	1970	8010
1956-57	400	1971	8900
1957-58	455	1972	9720
1958-59	575	1973	10160
1959-60	695	1974	10525
1960-61	800	1975	10525
1961-62	1310	1976	13200
1962-63	1485	1977	14940
1963-64	1900	1978	NA
1964-65	2255	1979	15000
1965	2505	1980	15190
1966	3940	1981	NA
1967	4860	1982	14805
1968	6520		

* The number of fishermen is estimated by multiplying the number of mechanised boats (given in Table VI.1 above), by a crew size of five per boat. The number of boats taken are from the financial year column for the period upto 1965 (i.e. from 1954-55 to 1964-55) and from the calendar year column for the rest of the period. Moreover, for 1977 and 1980 the relevant number of boats taken are as per the last

It is apparent from Table VI.4 that there is a progressive increase in the number of fishermen engaged in the mechanised sector of the industry upto 1980. A large number of them can be presumed to have acquired specialised training in mechanised fishing. What is disturbing, however, is the tendency for a notable decrease in the number of fishermen engaged in this sector since 1980. The table indicates a perceptible fall in the number of fishermen engaged in the sector between 1980 and 1982[1]. This fall in the number of fishermen engaged in the sector can be attributed to the post-1980 convulsions in the industry following the resource crises and the enactment of the Kerala Marine Fishing Regulation Act which sought to restrict mechanised fishing in the state to offshore waters beyond 22 km^2.

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1. This picture would, however, change if the fishermen operating the traditional craft with outboard engines are included in this group. We, nevertheless, have no data on this account.

2. The economic consequences of this development will be discussed in Chapter VII where the effects of technologica change are presented.

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1. It may be noted here that the Government, while issuing mechanised boats to groups of fishermen, had made the stipulation that at least one fisherman should have undergone training in mechanised fishing in the Fishermen Training Centres or other Institutions.

As an indirect indicator of the technological potential of the industry, we may look at the number of fishermen who are literate and having higher levels of education. Table VI.5 presents details of the fishermen according to the level of education for two points of time, viz. 1970 and 1979.

Table VI.5. Percentage of Fishermen According to Level of Education in 1971 and 1979

Year	Level of education							
	Illiterate	Literate and primary	Middle	Matriculation of higher secondary	Non-technical diploma/certificates	Technical diploma/certificates	Graduates	[illegible]
1971*	43.69	51.41	4.42	0.41	0.00	0.01	0.03	[illegible]
1979+	34.87	43.04	19.53	2.29	NA	NA	0.21	[illegible]

* Relate to active fishermen (male workers only)

\+ Relate to male fishermen population

Sources: 1. Directorate of Census Operations, Census of India - 1971, B VI, Part A (11) and Part B (11) (Manuscript (Government of India, New Delhi, 1974).

2. Directorate of Fisheries, Census of Fisherfolk in Kerala, 1979, (Government of Kerala, Trivandrum, 1982), pp. 27-28.

Table VI.5 indicates the low level of education of both the working fishermen and the total male population. It is apparent from this table that the technological/skill potential of the industry is very low at present. A noteworthy point here is that the industry at present seems to be not making full use of the knowledge-potential created by the Fishermen Training Centres and the Fishermen Technical High Schools in the state. Table VI.6 presents the number of fishermen-children who have passed the S.S.L.C. examination from the Fishermen Technical High Schools of the State during the period from 1971-72 to 1979-80.

Table VI.6. Number of Fishermen-Children who have passed the S.S.L.C. Examination from the Fishermen Technical High Schools of Kerala from 1971-72 to 1979-80

Year	Number
1971-72	45
1972-73	56
1973-74	52
1974-75	69
1975-76	67
1976-77	77
1977-78	59
1978-79	61
1979-80	69

Source: Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), p. 93.

Table VI.6 indicates the possibility of getting young recruits for further training in fishing at the fishermen training centres of the central and state governments. But it is quite doubtful whether a significant percentage of these educated manpower (potential) is drawn to the industry. It is quite likely that the 'service sector' of the state and the 'Gulf-boom' in the Middle-East have attracted a large number of the educated fishermen for better-paid jobs in these alternative fields of employment. Moreover, it was also pointed out that the fishermen-boys 'who were able to complete S.S.L.C. are without job and refuse to go for fishing which they consider below their dignity'[1]. One probable reason for this unwillingness on the part of educated fishermen-boys to shy away from fishing is the heavy physical exertion required for working in the fishing craft, particularly in the traditional craft and the lack of opportunities to work. It is well known that the capital endowment of the industry is unenviably poor, particularly in the northern districts of the state[2]. The low productivity, high risk and technological backwardness are all likely to contribute

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1. Directorate of Census Operations, <u>Village Survey Monographs of Kerala, Trivandrum District, Census of India (1961)</u>, (Government of India, Trivandrum, 1961), p. 181.

2. We will come to this aspect while studying the characterist and effects of technological changes in the indust in Chapter VII.

to the low percentage of literate and qualified workers participating in the primary marine fishing industry of Kerala.

It may be noted before concluding this section that a large number of scientific and technical personnel are employed in the Department of Fisheries of the State and other central and state government institutions which conduct research, training and education on fisheries science and technology. However, we have no estimate of such personnel and their precise contribution to the development of the primary marine fishing industry of Kerala. It is likely that a large part of the research work done by these personnel are of a routine and fundamental nature which do not yield any direct benefit to the industry. This has been pointed out by the Government which stated that the standard of research done by the officers of the Department has been very poor and the various research institutions have not been able to produce any significant impact on the growth and development of fisheries in Kerala[1].

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1. S. Krishnakumar, Strategy and Action Programme for a Massiv Thrust in Fisheries Development and Fishermen Welfare in Kerala State (1980-83), (Government o Kerala, Trivandrum, 1980), pp. 236-40.

3. Increase in the Infrastructure for Fishing, Ice, Storage, Processing, Transportation, Distribution, Boat Building, etc

The importance of shore-based facilities like fishing harbours, fish processing plants, distribution facilities, etc. were well recognised by the Government. The fishing harbour was considered to be the focal point which provides all these facilities and acts as the central/ nodal point for the development of the fishing industry. The Research and Development efforts for fishing harbours have been discussed in the last Chapter. Here, we may point out the major achievements in the shore-based facilities (including harbour facilities) to indicate the development of the industry concomitant to the technological changes in the primary marine fishing industry of Kerala.

a) Harbour Facilities

The successive five year plans in the state have succeeded in providing one major fishing harbour and five minor fishing harbours in the state. Table VI.7 presents details of the major and minor fishing harbours constructed in the state as on 31.3.1981.

Table [illegible] Details of Fishing Harbours Constructed/Progress of work, their
Sanctioned Cost, Capacity, etc. as on 31st March 1981

Sl. No.	Name of Harbour	Sanctioned Cost (Rs in lakhs)	Designed Capacity		Progress of work
			Deep-sea vessels (Nos.)	Mechanised boats (Nos.)	(% of work completed)
1.	Cochin*	409	57	450	95
2.	Vizhinjam - Stage I+	173	85	210	100
3.	Baliapattam+	13	-	54	100
4.	Mopla Bay+	30	-	166	100
5.	Kasargode+	13	-	100	100
6.	Ponnani+	7.5	-	NA	NA

* Major Harbour

+ Minor Harbour

Source: Department of Agriculture and Cooperation, Handbook on Fisheries Statistics, 1981, (Ministry of Agriculture, Government of India, New Delhi, 1981), pp. 38-41.

In addition to the above, a number of small/ mini-harbour projects and landing centres with central assistance have been taken up for construction in the state during the sixth five year plan and the current plan. Details of their location were given in Chapter V. It is, nevertheless, important to note here that the development of fishing harbours in the state has been quite slow and the progress achieved quite tardy. It may be recalled that the work of the fishing harbour at Mopla Bay had to be suspended for quite sometime due to natural (silting) and technical reasons. The work of two important fishing harbours at Neendakara and Beypore had to be protracted due to delay in getting central clearance and other reasons. The second and third stage of the Vizhinjam and Cochin Harbour are yet to be completed. One major reason cited for the delay in completing the harbour construction work was the shortage of qualified engineers and another the dearth of funds. It now seems that the policy of the government regarding the development of full-fledged fishing harbours have undergone some change. The emphasis in the sixth plan and the current plan is for providing minimum facilities at all landing centres in the state. This policy is expected to help the government in minimising the financial burden on it. The implications of this changed emphasis on the prospects for development of deep-sea fishing and the exploitation of the off-shore resources of the state have to be explored. We may just recall here that a predominant factor impeding the development of deep-sea fishing industry in India is lack of suitable harbour facilities for the operation of large vessels. It may be noted that none of the existing harbours in Kerala is capable of accommodating large vessels of 24 m and above. This is apparently one reason for the drifting away of larger trawlers introduced in the state to the East Coast of India[1]. The role of major harbours for the development of off-shore fisheries of the state is undeniable.

b) Facilities for ice, cold storage and processing

Strictly speaking, these are facilities which are created in the secondary or processing sector of the industry and therefore not part of the technological change in the primary sector of the fishing industry. Nevertheless, these developments in the processing sector has been as much a part of the process of development in the primary sector, that their existence cannot be overlooked in a study of the development of the primary marine fishing industry of Kerala.

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1. The four trawlers owned by the Kerala Fisheries Corporation are all using Visakhapatnam as their base for operation. This, apart from the resource plenitude in the East Coast, must be due to the conjestion at the Cochin Fishing Harbour and the absence of alternative landing facilities in the state.

After all, our division of the marine fishing industry of Kerala as primary, secondary and tertiary is only for analytical convenience. The processes of production (fishing), processing and marketing are continuous operations which are inter-linked and inter-dependent. Hence, the technological developments in the processing sector are bound to have its impact on development in the catching branch or the primary sector of the industry. Here, we only point out some of the technological facilities provided by the secondary and tertiary sectors to the primary sector in the form of ice plants, cold storages, processing plants, etc. all of which helped the primary sector in enhancing its output, both in terms of quantity and value. It may be noted that the provision of ice, both on board the vessel and onshore after landing, have helped the fishermen in maintainin the quality of their produce till they are disposed of to the consumers or traders. Preservation on board with ice has further helped the fishermen in extending their fishing time to maximise their output and thereby to enhance their productivity and earnings. It may also be noted that the provision of storage facilities on shore with processing establishments have helped the fishermen in the proper utilisation of the resources caught and for the realisation of their full value. It is interesting to note here that a large part of these facilities were provided by the private sector. Table VI.8 shows details of the capacity for ice production, ice storage, cold storage, freezing, frozen storage, etc. in the state under the private sector and the public/cooperative sector separately in 1980.

Table VI.8. Details of the Capacity for Ice Production, Ice Storage, Fresh Fish Storage, Freezing and Frozen Storage in the Private and Public/ Cooperative Sectors in Kerala in 1980

(Capacity: Tons per day)

Sector	Ice production	Ice storage	Fresh fish storage	Freezing	Frozen fish storage
Private*	2103.00 (91.89)	3166.00 (81.41)	92.75 (13.78)	450.00 (88.93)	9244.00 (85.80)
Government/ Cooperative*	186.00 (8.13)	723.00 (18.59)	584.00 (86.28)	56.00 (11.07)	1530.00 (14.20)
Total*	2289.00 (100)	3889.10 (100)	676.75 (100)	506.00 (100)	10744.00 (100)

* Figures in parentheses are percentage of total.

Source: Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983 pp. 51-59.

The apparent domination of the private sector in the production of ice, ice storage, freezing and frozen storage is the inevitable consequence of the monopoly that the private sector has gained over the processing and export of marine products from the state. The growing export demand for prawns and other marine products have necessitated bulk purchase of the raw material by the processors, and their preservation for long periods caused the need for setting up of large ice, cold storage and freezing plants in the state[1]. The ice and cold-storage plants have helped the domestic market too in making fish available in fresh form. This is evident from the utilisation pattern of fish in the state. Table VI.9 shows the pattern of utilisation of fish in Kerala in 1978.

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1. In fact, a significant amount of excess capacity in the processing sector was reported on more than one occasion The Indian Institute of Foreign Trade made a study of the extent of excess capacity in the industry in 1970. Valsala John made a similar effort in 1976. The CIFT a: monitored the extent of excess capacity prevailing in the industry from 1979 to 1981. It observed excess capacity ranging from 70 to 75 per cent with some sign of decline during the last year. For details see H. Krishna Iyer, 'Is There Any Excess Capacity in Our Fish Processing (Freezing) Plants?' Seafood Export Journal, Vol. 15, No February 1983.

Table VI.9. Pattern of Utilisation of Marine Fish in Keral in 1978

Form	Quantity (Tons)	Percentage of Total
Fresh	208938	55.96
Dry	92726	24.83
Frozen	58210	15.59
Fish meal	13460	3.60
Total	373334	100.00

Source: Indian Institute of Management, Marine Fish Market in India, Vol. V, Supply-Infrastructure and Projec Requirements (Mimeo), (Indian Institute of Managem Ahmedabad, 1981), p. 248.

It is evident that the availability of ice and cold storage facilities has helped in increasing the percentage of fish utilised in fresh form and extended the market for fish to wider areas. This extension of the market for fisl has been a major factor in the development of the primary marine fishing industry of Kerala. It is nevertheless, th export market which provided the major 'big-push' to the development of the industry. The further impetus was prov by the facilities for storage, transportation and distribu of fish within the state.

c) Facilities for Transportation and Distribution

The role transport to connect the fish landing centres with the nearby markets, railway stations, and bus terminals were recognised by the government and a programme for the construction of coastal roads and link roads was chalked out by the Government in the middle sixties. Between 1966 and 1980, about 59 link roads were constructed by the Government to facilitate the quick transportation of fish from landing centres to the hinterland markets and for despatch to the processing centres for export. It is well known that the shrimp catches of the northern districts of the state are brought by railways and the private carriers (insulated cold-vans) owned by the processing companies located at Cochin and elsewhere for processing for export.

The facilities for the distribution of fish in the domestic markets were also improved by the Government by establishing ice factories, cold-storages, water supply schemes auction halls, etc. These facilities were provided in the municipal and semi-urban markets, where such facilities were meagre or non-existing. The state has at present 58 regular markets for fresh fish and five major markets for dry/salted fish[1]. It may be, however, noted that none of these markets

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1. Directorate of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 117-18.

is regulated by the Government, but are controlled by the private merchants who exercise a baneful influence on the producers in the primary sector. It is important to note here that the private trade had seldom provided any linkage for the development of the primary marine fishing industry of Kerala by extending the market. This was in fact one of the crucial factors which acted as a constraint for the develooment of the primary marine fishin industry of Kerala.

d) Facilities for Boat-Building and Boat-Repair

The state was renowned for its boat-building industry and has been a major supplier of small craft to the fishing industry and for cargo trade in the Middle East and nearby regions. This was partly due to the availabilit of timber in abundance and the low cost of construction. With technological improvements in the fishing industry, the traditional boat-building industry had to give way to the modern boat-building units with mechanised workshops and other facilities. The first modern boat-building yard in the state was set up by the INP at Neendakara in 1953. To cope with the growing demand for mechanised boats, the Government of Kerala also set up four boat-building yards in the state in the early sixties. Three of these yards - one at Vizhinjam, another at Cannanore and the third at

Azhikode - were closed down in 1974[1]. The yards at Neendakara (which was handed over to the Government by the INP in 1963) and Beypore are capable of building 38-40 boats (of 32 ft.) per annum[2]. In addition to these, there are about 36 boat building yards in the private sector in the state[3]. The majority of these units are located in Ernakulam and Quilon districts. The building capacity of these yards is believed to be more than sufficient for meeting the state's demand for small and medium boats. The state at present has no yard capable of building large trawlers/combination vessels. The boat-building yards of the IFP and CIFNET build only medium boats for training or research purposes. It is worth noting here that the future development of the industry demands modernisation of the boat-building yards in the state with facilities for construction of large vessels of steel and other materials.

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1. S. Krishnakumar, op. cit., p. 137.

2. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), p. 48.

3. Ibid., p. 48.

4. Increase in the Plan Outlays/Expenditure for Marine Fisheries Development

It is well known that the major programmes for fisheries development in the state - viz. mechanisation of the fishing craft, modernisation of the gear, training of fishermen, harbour development, provision of infrastructure for storage, transport and distribution of fish, housing and colonisation of fishermen, fishermen cooperatives, etc. were all financed by the state government with its own resources and with central assistance. In addition to these, a number of pilot projects, were started with financial assistance from institutional sources like Agricultural Refinance and Development Corporation (ARDC, now NABARD), National Cooperative Development Corporation, etc.[1]. Over the years, the outlay and expenditure for fisheries development in the state have increased manifold. Table VI.10 presents the summary of outlay and expenditure for fisheries development in Kerala during the successive five year plans.

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1. Details of institutional funds invested in Fisheries Development Projects in Kerala through ARDC support is given in Appendix Table VI.2.

Table VI.10. Summary of Outlay and Expenditure for Fisheries Development in Kerala during the Successive Five Year Plans

(Rs in lakhs)

Sl. No.	Name of plan	Plan period	Outlay/ provision	Expenditure	Expenditure as percentage of outlay/ provision
1.	I Five year plan	1951-56	11.11	2.74	24.66
2.	II Five year plan	1956-61	88.17	60.52	68.64
3.	III Five year plan	1961-66	367.67	343.24	93.35
4.	Annual plans	1966-67 to 1968-69	877.29	749.33	85.41
5.	IV Five year plan	1969-74	1100.00	563.37	51.21
6.	V Five year plan*	1974-78	1009.79	791.03	78.33
7.	Annual plans	1978-79 to 1979-80	774.85	734.48	94.78
8.	VI Five year plan	1980-85	2000.00	2105.42	105.27
9.	VII Five year plan	1985-90	6500.00	-	-

* It was actually a four year plan as the Janatha Government at the Centre terminated the final year of the original V Plan and started a fresh plan in 1978. The Janatha plan, however, continued only upto 1980 and is entered here as the annual plans for 1978-80.

Sources: 1. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 102-11.

2. State Planning Board, Draft VII Five Year Plan 1985-90 and Annual Plan 1985-86, Vol. II,

It is evident from Table VI.10 that there has been a progressive increase in the outlay and expenditure for fisheries development in the state. The outlay increased from Rs 11.11 lakhs during the First Five Year Plan to Rs 2000.00 lakhs during the Sixth Plan. The expenditure also showed commensurate increase from Rs 2.74 lakhs in the former period to Rs 2105.42 lakhs during the latter period. This is equivalent to a 764.40 fold increase. What is, however, quite disturbing is the notable fluctuations in the percentage of outlay actually spent during the various plan periods. The percentage of outlay actually spent varied from 24.66 per cent during the First Five Year Plan to 94.78 per cent during the 1978-80 annual plans. The more than 100 per cent expenditure seen during the Sixth Five Year Plan seems to be the result of some budgetary adjustments rather than the effect of any real improvement in plan implementation. It is important to note here that the table does not give any idea of the major programmes for technological change and development of the primary marine fishing industry of Kerala. Table VI.11 gives details of outlay and expenditure for major programmes for fisheries development in Kerala since 1951 to 1985.

Table VI.11. Details of Outlay and Expenditure for Major Programmes for Fisheries Development in Kerala since 1951 to 1985

(Rs in lakhs)

Sl. No.	Major Programmes	Outlay/ Provision	Expenditure[@]	Expenditure as percentage of outlay
1	2	3	4	5
1.	Mechanisation and improvement of fishing craft	1475.692	1235.483* (23.09)	83.72
2.	Commercial trawler fishing	79.000	98.230 (1.83)	124.34
3.	Assistance to traditional fisheries including supply of fishery requisites	101.263	72.291 (1.35)	71.39
4.	Training of fishermen/personnel	192.868	143.968 (2.69)	74.64
5.	Research	70.654	40.464 (0.76)	57.27
6.	Harbour Development	1070.362	700.933 (13.10)	65.48
7.	Organisation and support to fishermen cooperatives	243.875	167.452 (3.13)	68.66
8.	Housing and colonisation of fishermen+	179.972	174.103 (3.25)	96.73

1	2	3	4	5
9.	Introduction of ice plants, cold storages, transport vehicles, etc.	484.220	387.813 (7.25)	80.09
10.	Coastal link-roads	218.254	162.006 (3.03)	74.22
11.	Repair and Refitting facilities	28.550	6.146 (1.11)	21.52
12.	Other schemes α	1720.628	2047.539 (38.27)	119.00
	Sub-total (1-12) - predominantly marine fisheries	5865.338	5236.428 (97.87)	89.27
13.	Inland fisheries	363.549	113.715 (2.13)	31.28
	Grand Total	6228.887	5350.143 (100)	85.89

η Figures in parentheses are percentage of the total expenditure

* Includes the entire expenditure of Rs 2.74 lakhs during the First Five Year Plan, which was almost exclusively spent on mechanisation.

\+ Includes expenditure only upto 1980. Details for later period are clubbed in other schemes

α The predominant item is assistance to K.F.C. and many welfare schemes since 1980. For details of these schemes, see Appendix Table VI.3.

Source: Appendix Table VI.3.

It is quite evident from Table VI.11 that among individual programmes for the development of the primary marine fishing industry of Kerala, the most important one was mechanisation and improvement of fishing craft. The total expenditure during the entire plan period was Rs 1235.48 lakhs which constituted 23.09 per cent of the total plan expenditure for fisheries development in the state. The next major scheme was Harbour Development which got 13.10 per cent of the total expenditure. Another major programme which though not part of the primary sector but integral for the development of the primary marine fishing industry of Kerala was introduction of ice plants, cold storages, transport vehicles, etc. which took 7.25 per cent of the total expenditure. Other important schemes included training of fishermen, assistance to traditional fisheries, organisation of fishermen cooperatives, housing and colonisation of fishermen, construction of coastal link-roads, etc. which got 2.69 per cent, 1.35 per cent, 3.13 per cent, 3.25 per cent and 3.03 per cent of the expenditure respectively. The percentage of expenditure on research, repair and refitting facilities, etc. are considerably low. A large percentage of the expenditure (38.27%) is seen devoted to 'other' schemes which included assistance to Kerala Fisheries

Corporation, subscription to Kerala Fishermen Welfare Corporation and several other welfare schemes. This was particularly so after the Fifth Five Year Plan (see Appendix Table VI.3 for plan-wise details of outlay and expenditure on individual programmes).

It is apparent from Table VI.11 and Appendix Table VI. that among all programmes for fisheries development in Keral pride of place was given to mechanisation of fishing craft, fishermen training, harbour development, organisation of fishermen cooperatives, etc. All these are in confirmity with the concept and process of technological change and development described in the last chapter. There are, however, some disturbing aspects in the outlay and expenditure as shown in Table VI.11 and Appendix Table VI.3. One such element in the table is the large disparity between outlay and expenditure on schemes like research, training of fishermen, harbour development, repair and refitting facilities, etc. The large gap between outlay and expenditure was due to the non-implementation of the schemes on time. This certainly has hampered the developmen of the industry. This would become apparent if account is taken of the delay in implementation of schemes like harbour development, research, repair and refitting facilities,etc., all of which have affected the growth of the primary marine fishing industry of Kerala. It is well known that lack of harbour facilities in the state has adversely affected development of offshore fisherie of the state. Similarly, the dearth of repair and maintenanc facilities was also reckoned to be a major factor adversely affecting the performance of mechanised boats in the state[1].

Another major factor emerging from Table VI.11 and Appendix Table VI.3 is the shifting of emphasis/ importance from developmental measures to welfare measures since 1980. This was probably in response to the sharp decline in the output of the traditional sector (which was discussed in Chapter IV) and the growing protest from the traditional fishermen to curb the growth of the mechanised sector whose relative importance has grown over the years[2]. There seems to be also a shifting of emphasis in favour of inland fisheries since the Fifth Five Year Plan. In fact, it seems from Appendix Table VI.3 and the recent plan documents that the strategy for fisheries development in the state has suffered some 'crisis of confidence' in planning ar

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1. Planning Commission, Evaluation of the Programme of Mechanisation of Fishing Boats, (Government of India, New Delhi, 1971), p. 107.

2. For details of this importance, see Chapter VII.

a diffusion of emphasis to programmes with no enduring basis for development. It is suspected whether this attitude on the part of the planners and the administration is due to the continuing stagnation in the traditional sector or the bewildering opposition from the traditional fishermen and other groups to a more dynamic course of development[1]. Whatever be the rationale or reason for this thinking, the impact of this policy, has been the growing technological obsolescence in the industry and the retardation and even negation of growth in the industry.

5. Export Promotion

Export promotion has been a major objective of fisheries development in Kerala. This was in tune with the national objective of earning more foreign exchange by exporting selected high priced varieties of fish[2]. The

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1. It may be noted that the traditional fishermen had always objected to all initiatives at technological changes in the primary marine fishing industry of Kerala and of late they have been organised with strong political and religiou social backing to fight any technological change which will modify the existing socio-economic system. It may be notec that these organisations have now got a strong scientific argument to resist technological changes with the emerging ecological imbalance in the biological 'niche' of fishes and the economic argument of high social costs of developme

2. Ministry of Agriculture, Report of the Working Group on Fifth Five Year Plan (1974-79), Fisheries, (Government of India, New Delhi, 1973), p. 33.

It is important to note here that foreign exchang was quite crucial for importing essential components like boat engines, wire-ropes, nets, freezing machinery, etc. in the initial years when domestic production of these items ajor technological changes in the catching, processing nd marketing branches seem to have been tailor-made to uit this objective. Introduction of trawling by mechanised oats was primarily to catch shrimp intended for export. heir processing was made easier with the setting up of a arge number of freezing plants with imported technology[1]. xport of shrimp was exclusively taken up by the private ector with organisational support from the Government and he industry. The Marine Products Export Development uthority (MPEDA) was constituted by the Central Government n 1972 with headquarters at Cochin, by reorganising the then xisting Marine Products Export Promotion Council. The MPEDA as the objective of furthering the export of marine products rom the country to meet the national needs of earning more oreign exchange. The Seafood Exporters Association of India with headquarters at Cochin) also helps the industry, in arning more foreign exchange by working as a liaisoning gency between the Government and the industry.

It may be noted that export promotion was not an nd in itself but only a means to achieve the goal of conomic development of the country. Export of selected

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. Import of technology, know-how and capital equipment was permitted by the Central Government under the Open General Licencing System for 100 per cent export industries.

high-priced varieties of fish was a convenient method for earning more foreign exchange for the country. Accordingly, the quantity and value of marine products exported from the state increased several fold during the last 20 to 25 years. Table VI.12 gives the trend in the quantity and value of marine products exported from Kerala during the period from 1960 to 1985.

Table VI.12. Trend in the Export of Marine Products from Kerala During the Period From 1960 to 1985

(Quantity in M.T. and value in Rs lakhs)

Period/* year	Quantity	Index of quantity (base 1960 = 100)	Value	Index of value (base 1960 = 100)
1	2	3	4	5
1960	6113.00	100.00	179.00	100.00
1961	7080.00	115.81	240.71	134.47
1962	6943.00	113.57	330.06	184.39
1963	8238.00	134.76	383.62	214.31
1964	9742.50	159.37	504.36	281.76
1965	9556.90	156.33	601.02	335.76
1966	13175.30	215.52	1464.01	817.88
1967	15245.70	249.39	1674.95	935.72
1968	18481.80	302.33	2024.52	1131.01
1969	22272.50	364.34	2722.91	1521.17
1970	24077.00	393.86	2752.10	1537.48
1971	21569.00	352.83	3015.98	1684.90

Table VI.12 Contd.

1	2	3	4	5
1972	25519.00	417.45	4226.92	2361.40
1973	30826.00	504.26	5408.39	3021.44
1974	24529.00	401.25	4336.05	2422.37
1975	32478.00	531.29	6029.63	3368.50
1976	31155.00	509.65	8794.84	4913.31
1977	27802.00	454.80	7467.54	4171.81
1978	31855.00	521.10	6501.84	4749.63
1979	31988.00	523.27	10987.03	6138.00
1980+	28472.00	465.76	8845.72	4941.74
1981+	32260.00	527.72	12444.96	6952.49
1982+	33255.00	544.00	13846.01	7735.20
1983+	32555.00	532.55	14027.94	7836.83
1984+	30597.00	500.52	14090.97	7844.11
1985+	30155.00	493.29	13837.80	7730.61

* The date for the period from 1960 to 1969 are for financial years.

\+ The figures for this period relate to exports (quantity and value) from Cochin and Calicut Ports. These covered almost 99 per cent of the quantity and not less than 99 per cent of the value of marine products exported from the state. A small percentage of these exports might have originated from other states like Tamil Nadu and Karnataka.

Sources: 1. Bureau of Economics and Statistics, Statistics for Planning - Series 9 - Rates and Ratios, (Government of Kerala, Trivandrum, 1974), p. 61.

2. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala,

Table VI.12 indicates a more than five-fold increase in the quantity of marine products exported from the state during the period from 1960 to 1985. The value of these exports increased by more than 78 times. The sharp increase in value was primarily the result of a steady increase in the unit value realised for the predominant item of export, viz. shrimp (see Appendix Table V.4). It is apparent from the above that export promotion as an objective of fisheries development in Kerala has been achieved through the various technological changes in the catching, processing and (export) marketing sectors of the industry. The public policy has been tuned to this objective[1].

6. Import substitution

Export promotion and import substitution are only corollaries of a common policy aiming at national economic development and self-sufficiency. Export promotion, as pointed out earlier, was to procure the essential foreign exchange for import of capital equipment and know-how for development. Import substitution was visualised as a long-term objective of economic development in the country to phase out all imports of capital items and consumer goods

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1. The economic and biological implications of this policy will be pointed out in the next chapter.

and to manufacture them domestically using indigenous know-how and resources. Import of capital goods was considered as essential and inevitable in the initial stages of development. But it was recognised that this import will become redundant when domestic supplies are available.

It may be noted that several of the technological changes in the primary marine fishing industry of Kerala have helped in substituting imports by domestic production. For example, it may be pointed out that import of boat-engines trawl-winches, gurdies, synthetic material for gear, and several other accessories have been dispensed with domestic production of these items. Development of the ancillary industries like boat-building, boat repair, engine manufacturing, net making, etc. have helped in saving foreign exchanges for the country by reducing the import bills. It is, however, worth noting that the state/country has not been able to reduce the dependence on foreign technology for design and construction of larger fishing vessels, other items like out-board engines (now in great demand in the traditional sector), electronic equipment, and several other components for the processing sector. It is apparent that import substitution as an objective of fisheries development or technological change has not been fully realise in this state. The failure to realise this objective is partl attributed to the misuse of the provisions of the O.G.L. by exporters of marine products to import non-essential items or luxury goods for domestic or personal uses. It may be noted that this misuse of the licence and the diversion (leakage) of resources from the industry had its impact on the development on the primary marine fishing industry of Kerala.

CHAPTER VII

TECHNOLOGICAL CHANGE AND THE DEVELOPMENT OF THE PRIMARY MARINE FISHING INDUSTRY OF KERALA - A STUDY OF EFFECTS AND CHARACTERISTICS

This chapter examines the major effects and characteristics of technological change in the Primary Marine Fishing Industry of Kerala. The following effects are identified for discussion in this chapter: effects on (1) production, (2) productivity, (3) employment, (4) earnings, (5) profitability, (6) housing, (7) health and sanitation, (8) fish consumption, and (9) fish conservation. The characteristics of the various effects are pin-pointed in the course of the discussion.

1. Effects on Production

One of the major objectives of technological change in the primary marine fishing industry of Kerala was to enhance production by providing the fishermen with better tools and organisation. It was also presumed to minimise the fluctuations in the output of the industry. An attempt is made in this section to study the effects of technological changes on the volume and value of output of the mechanised sector of the industry. It may be noted that although the 'process' of mechanisation was initiated as early as 1953 with the setting up of the Indo-Norwegian Project at Neendakara, the impact of mechanisation on production began to manifest only after 1969. This is evident from the low level of output during the whole period from 1956 to 1968. The average output of the sector during this period was only 2900 tons per annum. This output, however, increased to 82537 tons during 1969-78 and 123137 tons during 1979-84. The average annual compound growth rate during the whole period (1956-84) was 55.09 per cent. Table VII.1 gives details of the average annual output and the annual compound growth rate of the sector during the period 1956-68, 1969-78 and 1979-84.

Table VII.1. Average Output and Annual Compound Growth Rates of Output of the Mechanised Sector During 1956-68, 1969-78 and 1979-84

Period	Average annual output (tons)	Annual compound growth rate (%)
1956-68	2900	30.01
1969-78	82537	108.20
1979-84	123137	9.07
1956-84	52812	55.09

Source: Appendix Table VII.1

It is obvious from Table VII.1 that the output of the sector grew at a relatively lower rate during the first period when mechanisation was moving at a slower pace but grew sharply during the second period when mechanisation proceeded in full swing. The third period, however, marked a slowing down of the rate of growth owing perhaps to the limitations of the small/medium boats to fish in the offshore waters and their concentration in the inshore areas where the traditional craft are also operating. The rate of growth during this period was only 9.07 per cent. The average output of the sector, however, reached the maximum during this period. It was about 123137 tons. The notable increase in the output of the sector during this period was largely due to the introduction of purse-seine fishing in the state. The purse-seine catches of the state had increased sharply during this period[1]. This is evident from Table VII.2.

Table VII.2. Trend in the Output of Purse-seiners in Kerala from 1979 to 1984

Year	Output (Tons)
1979	1841
1980	14858
1981	17673
1982-83	9558
1983	NA

The purse-seine catch, barring a fall in 1982-83, has shown a significant increase during this period - it increased by more than nine fold during a short span of five years.

A notable feature of the increase in the output of the mechanised sector, which is contrary to expectations is that the increase is not steady but subjected to severe biennial/triennial fluctuations. This is evident from Appendix Table VII.1 and Figure VII.1. They clearly indicate that the technological changes introduced in the industry have not helped the industry in stabilising the output of the mechanised sector or in promoting steady rate of growth.

Another aspect of the technological change and its impact on production which needs to be pointed out here is the changing composition of output of the mechanise sector. This is illustrated with the help of Table VII.3.

Table VII.2. Contd.

Sources: 1. CMFRI, 'Impact of Purse-seine Operations on Traditional Fishery with Special Reference to Oil Sardine in Kerala during 1980 and 1981', MFIS, No.40, (CMFRI, Cochin, 1982), p. 9.

2. CMFRI, 'Trends in Marine Fish Production India 1982-83', MFIS, No. 52, (CMFRI, Cochin, 1983), p. 12.

3. Department of Fisheries, Survey on Marine Fish Landings, Nos 2,3,4 and 5, (Government of Keral Trivandrum, 1984).

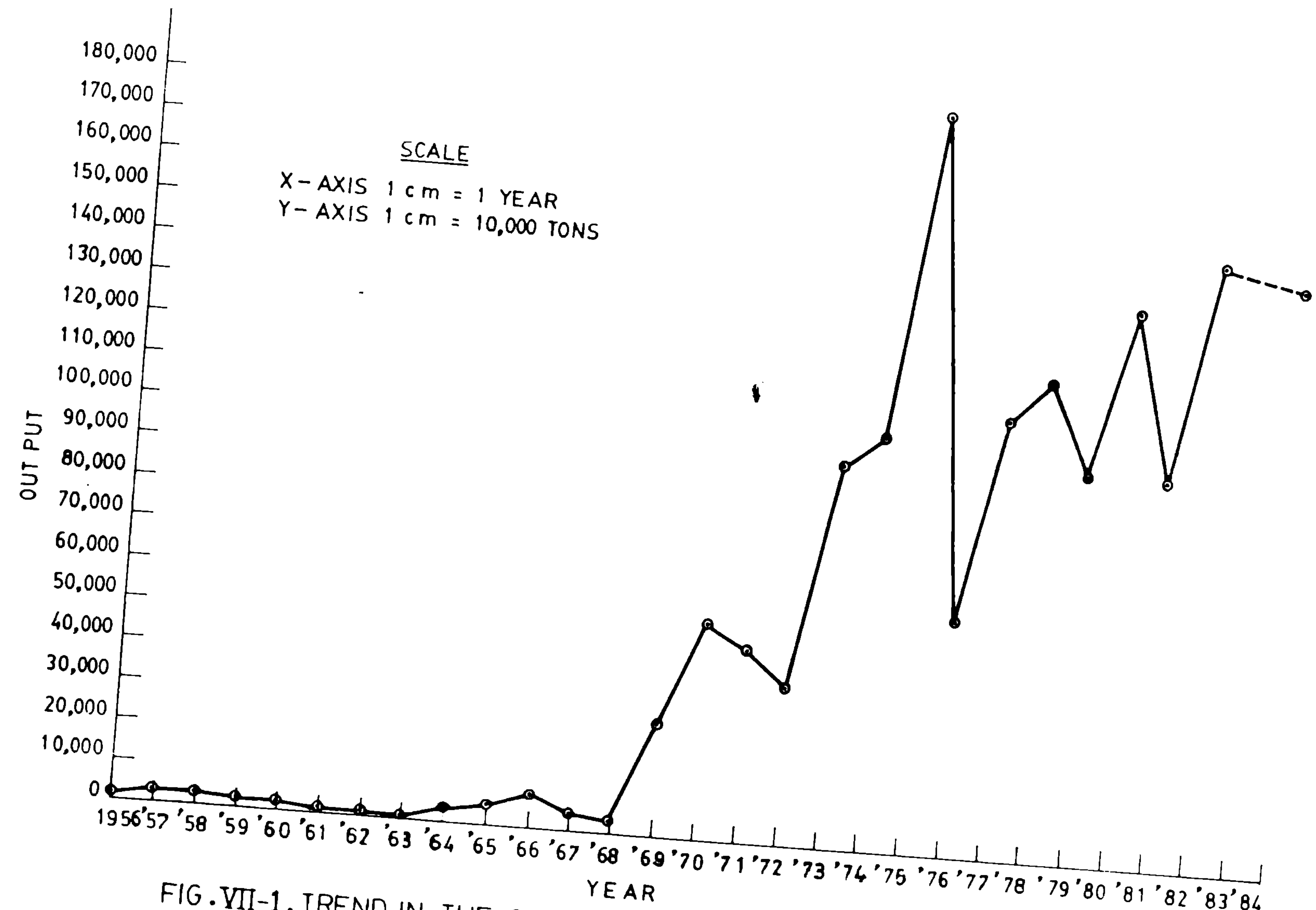

FIG. VII-1. TREND IN THE OUT-PUT OF THE MECHANISED SECTOR (1956-1984).

Table VII.3. Species-wise Catch of the Mechanised Sector for the Period from 1969 to 1976 and from 1979 to 1982

(Quantity in Tons)

Year	Species				Total
	Oil-sardine	Mackerel	Prawns	'Others'	
1969	2889	451	12267	12570	28177
1970	5576	842	22881	23272	52571
1971	5091	773	20924	20503	47291
1972	101	16	17923	20608	38648
1973	157	20	56308	37174	93659
1974	373	141	40164	60734	101412
1975	79	55	72035	107942	180111
1976	104	117	23820	34676	58717
Average of the period*	1796 (2.39)	302 (0.40)	33290 (44.34)	39685 (52.86)	75073 (100)
1979	3469	457	26567	64286	94779
1980	12042	5067	46170	71504	134783
1981	35972	4122	16325	38912	95331
1982	58907	3862	21821	63650	148240
Average of the period*	27597 (23.33)	3377 (2.85)	27721 (23.44)	59588 (50.38)	118283 (100)
Percentage change over the first period	1436.58	1018.21	-16.72	50.15	57.55

* Figures in Parentheses are percentage oftotal.

Sources: 1. John Kurien, Towards an Understanding of the Fish Economy of Kerala, (Centre for Development Studies, Trivandrum, 1976), p. 63.

2. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), p. 8.

Table VII.3 clearly shows that during the period from 1969 to 1976 prawns and the 'other' species group together contributed the lion's share of the catch of the mechanised sector[1]. These two groups together accounted for approximately 97 per cent of the catch of the sector. Prawns alone contributed 44.34 per cent of the total catch of the sector and its by-catch, 52.86 per cent. Oil-sardines and mackerels, which were identified as the major catch of the traditional sector (in Chapter IV), were of minor importance to the mechanised sector during this period. It must be due to the overwhelming importance attached to the prawn fishery and the export boom which the mechanised sector enjoyed during this period (see export promotion in Chapter VI).

The composition of output of the mechanised sector has, however, undergone drastic changes during the second period (i.e. from 1979 to 1982). Prawns and the 'other' species, which accounted for nearly 97 per cent of the output earlier, contributed only about 74 per cent of

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1. See Chapter IV for a definition of 'other' species group. In the case of the mechanised sector it essentially denotes the 'by-catch of the prawn fishery'. The main species included are sciaenids, soles, silverbellies, lactarius, anchovies, elasmobranchs, catfish, ribbon fish, etc.

of the output during 1979-82 . The relative share of prawns came down to 23.44 per cent from 44.34 per cent. The actual quantity of prawns caught by the sector also came down from an average of 33290 tons during the first period to 27721 tons during the second period marking a 16.72 per cent decline. The relative share of the 'other' species group, however, registered only a marginal decrease, i.e. from 52.86 per cent to 50.38 per cent. The actual volume of output of these species in fact had registered an increase; it increased from 39695 tons in the former period to 59588 tons in the latter period. The output of oil-sardines and mackerels also registered significant increases during the second period. The average output of the former species increased from 1796 tons in the first period to 27597 tons in the second period. The output of the latter species increased from 302 tons to 3377 tons over the same period. These two species together accounted for 26.18 per cent of the total output of the sector during the second period. The significant increase in the catch of oil-sardines and mackerels was due to the introduction of purse-seining, a major technological change in the primary marine fishing industry of Kerala in the recent period. The welfare aspect of this innovations is, however, open to question as it has led to some displacement of the traditional fishermen[1]. What is not quite apparent from Table VII.3, but implicit in the changing pattern of output of the mechanised sector, is the growing need of the mechanised sector to diversify its output to optimise its operations.

The growing shortage of prawns and the resource crisis facing the mechanised sector was reflected in the declining quantity of marine products (particularly shrimp) exported from Kerala (see Chapter VI). The resource crisis in the mechanised sector can be further understood from the declining share of prawns in the total landings of the mechanised vessels operating from Neendakara - Sakthikulangara, the leading mechanised fishing port of Kerala. Table VII.4 gives details of the total catch and prawn catch of the mechanised boats operating from Neendakara-Sakthikulangara during 1970-1981.

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1. A study by T. Jacob et al. observed that about 10 per cent of the traditional fishermen have left their occupation in 1980. Some of them were reported to have turned to backwater fishing and others to road repairing, rubble-work, metalling, head load work, etc. Even those continuing in the field are reported to be under-employed. For further details see, T. Jacob et al., 'Impact of Purse-seine Operations on Traditional Fishery with Special Reference to Oil-Sardine in Kerala during 1980 and 1981', MFIS, No.40, (CMFRI, Cochin, July 1982), p. 11.

Table VII.4. Details of Total Catch and Prawn Catch of Mechanised Boats Operating from Neendakara-Sakthikulangara during 1970-81

Year	Total catch	Prawn catch	Prawns as per percentage of total catch
1970	26704	11845	44.35
1971	51493	11004	21.36
1972	23622	11267	47.69
1973	66064	45477	68.83
1974	77748	27764	35.71
1975	151095	56750	37.55
1976	29836	14993	50.25
1977	45828	24197	52.79
1978	89892	33143	36.86
1979	56016	14582	26.03
1980	84556	36559	43.23
1981	32427	9540	29.41

Sources: 1. Department of Fisheries, Kerala Fisheries, Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), p. 19.

2. Directorate of Economics and Statistics, Statistics for Planning 1983, (Government of Kerala, Trivandrum, 1984), p. 191.

Table VII.4 clearly shows the decline in the relative share of prawns in the total catch of the mechanised boats. The implication of this fall in the share of the most high-priced variety of fish caught by the mechanised boats is the likelihood of a net reduction in their profitability. The viability of mechanised fishing in Kerala was under severe stress by the turn of the eightees. Adoption of purse-seining and other diversified fishing methods like pelagic and mid-water trawling were only some of the measures taken by the mechanised sector to improve their performance. Measured by the trend in the output of the mechanised sector, these innovations seem to have failed in bringing about any tangible solution to the resource problem in the primary marine fishing industry of Kerala.

It is however interesting to note that the mechanised sector of the industry has benefitted significantly from the rising prices of its products. This is evident from the remarkable increase in the value of the output of the sector. Table VII.5 gives the value of output of the sector during 1969-1976 and 1979-1982 periods.

Table VII.5. Value of Output of the Mechanised Sector for the period 1969 - 1976 and 1979 - 1982

(Value in Rs lakhs)

Year	Species				Total
	Oil Sardine	Mackerel	Prawn	'Others'	
1969	8.23	3.46	185.23	65.36	262.28
1970	22.30	6.48	388.97	149.87	567.62
1971	18.93	6.74	377.25	133.88	536.80
1972	0.39	0.14	345.01	143.01	488.55
1973	0.66	0.18	1692.61	279.54	1972.99
1974	2.43	2.31	1439.07	560.57	2004.38
1975	0.67	1.32	3016.82	1390.29	4409.10
1976	0.87	2.39	1481.60	470.20	1955.06
Average for the period*	6.81 (0.44)	2.87 (0.18)	1115.82 (73.21)	399.09 (26.17)	1524.59 (100)
1979	31.04	7.58	6172.09	906.43	7117.14
1980	110.18	84.87	7165.41	1083.28	8443.74
1981	336.33	70.89	4404.83	617.53	5429.58
1982	541.94	72.02	8054.90	1066.77	9735.63
Average for the period*	254.87 (3.32)	58.84 (0.76)	6449.30 (83.96)	918.50 (11.96)	7681.51 (100)
Percentage change over the former period	3642.58	1950.17	477.98	130.14	403.84

* Figures in parentheses indicate percentage of total.

Sources: 1. Table VII.3 for quantity of output.

It is apparent from Table VII.5 that the average total value of output of the sector has increased from Rs 1524.59 lakhs during 1969-76 to Rs 7681.51 lakhs during 1979-82. This marked an increase of 403.84 per cent. The bulk of this increase was made by prawns whose actual value increased from Rs 1115.82 lakhs in the former period to Rs 6449.30 lakhs in the latter. The relative share of prawns also increased from 73.21 per cent to 83.96 per cent. The values of other species like Sardines and mackerels also registered significant increases though their relative and absolute shares were much less.

Another aspect of the effect of technological change on the output of the primary marine fishing industry of Kerala which needs to be highlighted in this study is the changing spatial distribution of this output. The limited data available on this aspect indicate a notable reduction in the relative share of output of some of the northern and central districts of the state and a perceptible increase in the output of the other districts. Table VII.6 gives a rough indication of this process.

(Catches in Tons)

d	Cannanore	Kozhikode	Malappuram	Trichur	Sub-Total	Ernakulam	Alleppey	Quilon	Trivandrum	Sub-Total
67[1]	32332	102215	16559	19901	171007	13038	15593	19039	11126	58796
total	14.07	44.48	7.21	8.66	74.42	5.67	6.79	8.28	4.84	25.58
79[2]	46620	33578	13083	17664	110945	42890	42398	87120	67718	240126
total	13.28	9.56	3.73	5.03	31.60	12.22	12.08	24.82	19.29	68.41
81[3]	38982	28085	10821	16042	93930	36448	31216	75908	39419	182991
total	14.08	10.14	3.91	5.79	33.92	13.16	11.27	27.41	14.23	66.07
	43429	51510	40116	18506	153561	74894	76642	83014	36607	271157
total	10.22	12.13	9.44	4.36	36.15	17.63	18.05	19.55	8.62	63.85

ludes the catches of both mechanised and non-mechanised sector.

ta for financial years 1965-66 and 1967-68.

ta for calendar years 1978 and 1979.

ta for calendar years 1980 and 1981.

ta for calendar year 1984.

es: 1. Directorate of Fisheries, Kerala Fisheries,- Facts and Figures 1965-66, (Government of Kerala, Trivandrum, 1966), p. 3.

2. Directorate of Fisheries, Kerala Fisheries - Facts and Figures 1967-68, (Government of Kerala, Trivandrum, 1970), p. 3.

3. Directorate of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 10-13.

4. Directorate of Economic and Statistics, Statistics for Planning 1983, (Government of Kerala. Trivandrum. 1984). p. 188.

It is apparent from Table VII.6 that the relative share of output of districts like Cannanore, Kozhikode, Malappuram and Trichur (combined) have come down from 74.42 per cent during 1965-67 to 31.60 per cent during 1978-79. This share has improved only marginally during 1980-81 and 1984. The combined share of the other districts, viz. Ernakulam, Alleppey, Quilon and Trivandrum on the other hand has increased from 25.58 per cent during 1965-67 to 68.41 per cent during 1978-79. Their share showed a marginal fall during the following years to reach 63.85 per cent in 1984. The decline in the relative share of the northern districts may be attributed to the failure of these districts to take full advantage of mechanisation and the market potential for many of the high-priced varieties of fish caught by the mechanised boats. This is evident from the meagre share of prawns and 'other' species caught by the fishermen of these districts. Table VII.7 illustrates this situation.

Table VII.7. Relative Share of the Coastal Districts in the Total Catch of Oil-sardines, Mackerels, Prawns and 'Other' species during 1978-84*

(In percentages)

Districts	Oil-sardines	Mackerels	Prawn	'Other' species
Cannanore	22.50	14.95	10.30	6.63
Kozhikode	18.77	16.80	5.79	5.12
Malappuram	8.43	6.73	2.65	3.50
Trichur	9.52	6.92	2.03	2.66
Ernakulam	13.75	22.52	13.48	13.04
Alleppey	18.93	9.71	8.04	11.22
Quilon	5.69	7.53	57.46	31.46
Trivandrum	2.41	14.84	0.25	26.37
Total	100	100	100	100

* Does not include the details for 1982 and 1983 as no data for the period were available at the district level.

Sources: 1. Directorate of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 10-13.

2. Directorate of Economics and Statistics, Statistics for Planning 1983, (Government of Kerala, Trivandrum, 1984), pp. 187-88.

3. Department of Fisheries, Survey on Marine Fish Landings, Nos 2,3,4 and 5, (Government of Kerala, Trivandrum, 1984).

It is quite evident from the Table VII.7 that the northern districts like Cannanore, Kozhikode, Malappuram and Trichur together contributed only 20.77 per cent of the prawn catches of the state during 1978-84 whereas the remaining four districts alone produced 79.23 per cent of the prawn output. The relative share of the former districts in the production of 'other' species was also considerably low. They together produced only 17.91 per cent of the 'other' species while the other districts caught about 82.09 per cent of this output. The northern districts seem to have concentrated more on oil-sardines and mackerels which are bulk species caught by the traditional sector and marketed locally. The limited contribution of improved technology to greater output in these districts is obvious.

2. Effects on Productivity

A leading objective of technological change in the primary marine fishing industry of Kerala was to improve the productivity of fishermen and thereby to improve their economic condition. An attempt is made here to verify whether this objective has been realised and if so to what extent.

Productivity in the primary marine fishing industry is generally defined as the catch per man-hour of effort[1]. It appears from the available data that technological changes in the primary marine fishing industry of Kerala has helped in improving the productivity of the fishermen. Table VII.8 below gives the comparative productivity (catch per man-hour of effort) of the traditional sector and the mechanised sector of the primary marine fishing industry of Kerala for the period from 1970 to 1980.

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1. The catch per man-hour of effort is only a rough indicator of productivity. It does not distinguish between different grades (quality) of inputs and outputs. On the input side, it takes only one factor i.e. labour, when capital is known to be an important factor influencing the productivity. Here it is presumed that labour is equipped with some amount of 'capital' inputs (craft and gear).

Table VII.8. Comparative Productivity (catch per man-hour of effort) of the Traditional and Mechanised Sector of the Primary Marine Fishing Industry of Kerala (1970-1980)

Year	Catch per man-hour of effort (Kg./Hr.)	
	Traditional sector	Mechanised sector*
1970	12.16	36.53
1971	11.08	37.25
1972	5.12	12.32
1973	5.61	24.00
1974	4.16	18.87
1975	4.78	22.69
1976	6.61	11.11
1977	9.18	6.85
1978	4.04	7.45
1979	4.35	15.48
1980	NA	3.49

*Relates to Mechanised boats operating from Neendakara-Sakthikulangara region. These boats represent the largest chunk of mechanised boats in Kerala. It may be noted here that the original data give the catch per boat-hour. This has been converted to catch per man-hour by dividing the figures by five (which is the crew size per boat).

Sources: 1. Expert Committee, *Report of the Expert Committee on Marine Fisheries in Kerala*, (Expert Committee, C/o. Central Institute of Fisheries Education, Bombay, 1985), pp. 207-8, for effort of the traditional sector.

2. Appendix Table IV.3 for output (catch) of the traditional sector.

3. R. Satyadas and G. Venkataraman, 'Impact of Mechanised Fishing on the Socio-Economic Conditions of the Fishermen of Sakthikulangara-Neendakara, Kerala', MFIS No. 29, (CMFRI, Cochin, 1981), p. 12, for catch per man-hour of effort of the mechanised sector.

It is quite evident from Table VII.8 that technological change (mechanisation, training, etc.) has helped in improving the productivity (of the mechanised sector) of the primary marine fishing industry of Kerala. The table, however, indicates a dismal trend in the productivity of the industry. There seems to be a sharp decline in the productivity of the mechanised sector especially since 1975. The decline in the catch per man-hour of effort must be attributed to the marked increase in the fishing effort made by the mechanised boats (see Appendix Table VII.2). The number of mechanised boats operating from the Neendakara-Sakthikulangara base had increased remarkably over the years. During 1978-80 it was reported to vary between 288 in December (lean season) and 1578 in July (peak monsoon-trawling season). The operational range of these vessels are, however, limited to the inshore waters upto forty fathoms or twenty to twenty five nautical kms from the shore. The majority of these boats, as pointed out in the last chapter, are small/medium boats of 30-32 ft. which cannot go beyond 20-25 nautical kms. The horse-power range of these vessels are also within 100 HP. It appears then that the technological advancements in the industry has only a 'limited' impact on enhancing the productivity of the primary marine fishing industry of Kerala.

Another aspect of the productivity trend in the primary marine fishing industry of Kerala which needs to be highlighted here is the converging/diverging trend in the productivity of the industry in the different coastal districts of the state. It is observed that the productivity of the industry has in fact shown a declining trend in six of the northern and central districts of Kerala and a rising trend in two of the southern districts. Table VII.9 presents the catch per man-hour of effort (index of productivity) in the three fishing zones of Kerala for the period 1965-67, 1969-71 and 1974-76.

Table VII.9. Catch per Man-hour of Effort[1] in the three Fishing Zones of Kerala[2]

Period	Catch per man-hour of effort (Kg./Hr)		
	Northern zone*	Central zone+	Southern zone$^{\alpha}$
1965-67	11.77	10.58	3.45
1969-71	11.62	9.32	4.71
1974-76	9.37	3.38	5.49

* Cover approximately the districts of Cannanore (now Kasargode too), Kozhikode, Malappuram.

\+ Cover approximately the districts of Trichur, Ernakulam and Alleppey.

α Cover approximately the districts of Quilon and Trivandrum.

Sources: 1. Ramakrishnan Korakandy, 'Some Aspects of Employment, Organisation and Productivity in the Fishing Industry of Kerala - A Spatial Analysis', (unpublished M.Phil Dissertation, Jawaharlal Nehru University, New Delhi, 1976), p. 103.

2. John Kurien, Towards an Understanding of the Fish Economy of Kerala State (Centre for Development Studies, Trivandrum, 1978), p. 78.

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1. The catch per man-hour of effort shown here is for the whole of the primary sector i.e.for the mechanised and the traditional sectors as a whole.
2. The clubbing of the various districts into the three zones is not very scientific. This is especially so if account is taken of the continuing differences in the level of technological changes in the various districts. It may be noted, for example, that technological changes were minimum in Trivandrum district and the maximum in Quilon district, and to compare the productivity of these districts with that of other districts (zones) would be misleading. The justification for grouping these districts (Trivandrum and Quilon) into a single zone is their initial low level of productivity and the lack of comparable data for later periods. It may be noted that the CMFRI had divided the entire coast of Kerala into nine fishing zones. The above zones in fact combines the nine zones of the CMFRI from

Table VII.9 clearly illustrates the decline in the productivity of the industry in the northern and central districts (zones) and the rise in the southern districts (zone). The sharp fall in the productivity of the central districts (zone) is in marked contrast to a steady improvement in the productivity of the southern districts (zone). This diverging trend in the productivity of the industry must be attributed to a large extent to the various technological changes that took place in the industry in the Quilon region. It may be noted that the programme of mechanisation of fishing boats which had its first innings at Neendakara had in fact helped the district of Quilon to become the focal point for mechanised fishing in the state. This is further supported by the setting up of several shrimp processing plants in the district.

Cochin too has become a central point for mechanised fishing in the state. It may be noted that this industrial concentration or 'localisation' of fishing had both positive and negative effects on productivity. On the positive side it could provide many of the services and facilities required for regular fishing, thereby raising the level of productivity and production. On the negative side, it resulted in severe congestion at the port and the fishing grounds leading to external diseconomies and diminishing returns to the fisherman's effort. The declining catch per man-hour of effort shown in Table VII.9 is indicative of this tendency.

Another point which needs to be recognised from Table VII.9 is the declining trend in the productivity of the northern zone. This declining trend in the productivity of the northern zone is largely due to the decline in the average catch of the zone during the period. The average catch of the zone had decreased from 184061 tons during 1969-71 to 109741 tons during 1974-76[1].

It may be noted in summary that the technological changes in the industry has not helped in improving the productivity of the industry uniformly in all the districts. The major beneficiaries of technological change and improvement in productivity are the fishermen of Quilon and Ernakulam districts.

3. Effects on Employment

It is well known that a large part of the literature on technological change and economic development has concentrated on this aspect of technological change, but the views expressed are as divergent as the economic

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1. John Kurien, op. cit., p. 78.

and social conditions in which they originated, notwithstanding the paucity of data. An attempt is made here to measure or spell out the effects of technological change on the employment in the primary marine fishing industry of Kerala. It has been observed in the last chapter that the number of mechanised boats in the state has increased from less than 100 in the early fifties to more than 3000 in the beginning of eighties. The number of fishermen in the mechanised sector has increased correspondingly during this period. It rose from 115 in 1954-55 to 14805 in 1982 (see Chapter VI, Table VI.4). This increase has taken place without any corresponding reduction in the number of traditional craft or the fishermen engaged in them. The number of traditional craft on the other hand had actually increased from 20227 in 1957-58 to 25100 in 1973 and to 26719 in 1982 (see Chapter IV, Table IV.2). This would imply that the number of fishermen engaged in the traditional sector also has increased correspondingly. It would appear then that technological changes in the primary marine fishing industry of Kerala has not led to any reduction in employment or to any displacement of workers from the industry. This seems to be in sharp contrast with the findings of some of the studies on farm mechanisation (tractorisation) in

Indian Agriculture[1]. In addition to the above, it may be noted that technological changes in the primary marine fishing industry of Kerala has led to an expansion in the employment opportunities in the secondary and tertiary sectors of the industry as well as in allied industries like boat-building, boat-repair, net-making, net-repair, manufacture of wire ropes, winches, floats, sinkers,etc.. Trawling, as a new method of fishing, has led to both direct and indirect increases in employment. Directly, it provided employment to a large number of fishermen in the mechanised boats and indirectly in the storage, processing, transportation and distribution (marketing) of fish[2]. Table VII.10 gives details of

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1. A net reduction in employment as a direct result of technological change in Agriculture in Punjab was reported by Professor Raj Krishna. See Raj Krishna, 'Measurement of the Direct and Indirect Employment Effects of Agricultural Growth with Technical Change' in Earl O. Heady and L.R. Whiting (Eds.), Externalities in Transformation of Agriculture, (IOWA State University Press, Ames, IOWA, 1975), pp. 305-27.

   An opposite view, supporting the above is also found in the literature. For instance, see C.H.Hanumantha Rao, 'Factor Endowments, Technology and Farm Employment', Economic and Political Weekly, Vol. XI, No. 39, pp. A-117-A-123, September 25, 1976.

2. Marketing of the by-catch of the trawlers was particularly a problem in the initial years, when a large part of such catches were reportedly thrown back to the sea or allowed to go waste.

fishermen employed in fishing and allied activities in Kerala during 1972 and 1982.

Table VII.10. Details of Fishermen Employed in Fishing and Allied Activities in Kerala During 1972 and 1980.

Year	Fishing*	Processing of fish+	Marketing of fish+	Making and repair of nets+	Total
1972	110492	11144	19490	15694	156810
1982α	125008 (13.13)	7386 (-33.72)	23070 (18.36)	12418 (-20.82)	167882 (7.06)

* Includes full-time and part-time workers.

\+ Includes only workers from the fishermen households.

α Figures in parentheses show the decennial increase in percentage.

Sources: 1. Livestock Census 1972, Annexure VI, Schedule III, (Government of Kerala, Trivandrum, 1973), p. 3.

2. Livestock Census 1972, Annexure VI, Part III, (Government of Kerala, Trivandrum, 1984), p. 29.

The table shows two distinct trends in employment: the first is an over all increase in the level of employment, with the total number of fishermen engaged in the industry increasing from 156810 in 1972 to 167882 in 1982, registering a total increase of about 7.06 per cent during the whole period. The number of fishermen engaged in the actual operation of fishing increased from 110492 in 1972 to 125008 in 1982. The increase amounted to 1.31 per cent per annum or 13.13 per cent during the whole period. A large part of this increase may be attributed to mechanisation, as the number of mechanised boats introduced in the state increased sharply during this period (see Table VI.1). A slightly higher rate of increase was noted in the case of fishermen engaged in the marketing of fish. The availability of ice, storage and better transportation facilities in the coastal villages, all might have led to this development.

A quite disturbing trend in the employment pattern in the fishing industry of Kerala, which is perhaps an adverse consequence of technological changes in the industry, is the decline in the number of fishermen engaged in the processing of fish and in the making and repairing of nets. Table VII.10 shows a decline of 33.72 per cent in the number of fishermen engaged in the processing of fish and 20.82 per cent in the case of fishermen engaged in the making and repairing of nets. Both these developments are indicative of the technological developments in the industry which have transformed the traditional house-hold operations of curing and making/repairing of nets into factory based operations, in which workers from outside the fishermen households are also engaged. (The available data, however, do not give details of such 'outside' workers). Looking at the general employment potential and opportunities created in the industry one can confidently say that the various technological changes in the industry has contributed to more employment opportunities in the industry, though some of these opportunities are shared by non-fishermen workers as well.

Another disturbing aspect of the effects of technological changes on employment in the industry is that it is not uniformly distributed in all (coastal) districts of the state. It can be seen from Appendix Table VII.3 that while districts like Malappuram, Quilon and Ernakulam registered significant increases in employment between 1972 and 1982, all other districts registered a net decline in the number of workers engaged from fishermen households in the industry. This decline is more pronounced in the districts of Kozhikode, Trichur and Alleppey. Kozhikode registered a net decline in the number of fishermen engaged in all activities (see Appendix Table VII.3). Trichur also registered a similar decline in the number engaged in all activities except marketing. In the case of

Alleppey the decline was found only in the case of fishermen engaged in processing and making and repairing of nets. The table in fact indicates a shift in employment opportunities towards Quilon, Ernakulam and Malappuram districts. The technological lead provided by the Indo-Norwegian Project at Neendakara in Quilon district in the fifties and the sixties and the discovery of good trawling grounds off Quilon coasts might have led to such an expansion and concentration of fishing activities at Neendakara-Sakthikulangara. The development of a major fishing harbour at Cochin and the setting up of several processing establishments in and around Cochin also have led to an increase in employment in Ernakulam district. The unprecedented increase in employment noted in Malappuram district, however, cannot be explained easily. Maximum increases were noted in the number of fishermen engaged in fishing and in marketing of fish (see Appendix Table VII.3). It is likely that the leading fishing centres of the district like Tanur, Ponnani, etc. might have absorbed a large percentage of fishermen in the activities of fishing and marketing of fish. It can also be argued that a large percentage of the fishermen in the district might have also been drawn to their traditional occupation in the absence of alternative employment opportunities in the district. It is apparent from the above (and Appendix Table VII.3) that technological changes in the primary marine fishing industry of Kerala had both positive and negative effects on employment of the fishermen in the different coastal districts of the state.

4. Effects on Earnings

One of the major objectives of technological change and development in the primary marine fishing industry of Kerala was to enhance the earnings of the fishermen by providing them with better tools for greater production and better organisation for efficient marketing. It would be interesting in this section to see how the earnings of the fishermen have increased over the years as a result of technological changes. Regretably the statistical material on this aspect of the change is also quite meagre to draw any definite conclusion. An attempt is, however, made in this section to draw the scattered pieces of information and to arrive at some meaningful conclusions.

A preliminary idea of the impact of technological change on the earnings of the fishermen is obtained from the findings of a study by Thankappan Achari and Devidas Menon[1]. The study observed a phenomenal increase in the earnings of the fishermen in the Indo-Norwegian Project area as a result of mechanisation and other improvements. It recorded that the average annual income of the fishermen households in the Project area as having increased from Rs 624/- in 1954 (before technological change) to Rs 1251/- in 1963[2] (after the introduction of technological changes). The per capita income is reported to have increased from Rs 118/- to Rs 192/- during the same period[3]. The Programme Evaluatic Organisation (PEO) of the Planning Commission noted that the average family income of the fishermen households in the mechanised sector increased from Rs 1200/- during 1958-59 to Rs 2200 during 1968-69[4]. The average family

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1. T.R. Thankappan Achari and M. Devidas Menon, A Report on the Assessment of the Indo-Norwegian Projec on the Socio-Economic Conditions of the Fishermen of the Indo-Norwegian Project Area, (NORAD, Oslo, 1963).

2. Ibid., pp. 67-70.

3. T.R. Thankappan Achari, The Impact of the Indo-Norwegia Project on the Growth and Development of India Fisheries, (Government of Kerala, Trivandrum, 1969), p. 10.

4. Planning Commission, Evaluation of the Programme of Mechanisation of Fishing Boats, (Government of India, New Delhi, 1971), p. 106.

income of the fishermen in the non-mechanised sector was also reported to have increased from Rs 1300/- to Rs 2500/- during the same period. In percentage terms, these increases amounted to 83 per cent and 92 per cent respectively. The apparently higher increase in the average family income of fishermen in the traditional (non-mechanised) sector must be the result of the introduction of improved gear made of synthetic materials and better prices realised for their catches. The relatively poor increase in the earnings of the fishermen in the mechanised sector must be due to the less than optimum performance of the mechanised boats. The mechanised boats for instance had operated for only 148 days in 1968-69, whereas the non-mechanised units operated for 183 days during the same period[1].

An estimate of the average per capita crew income for the mechanised and non-mechanised boats as derived from a study by the Indian Institute of Management, Ahmedabad, is given below.

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1. Ibid., p. 102.

Table VII.11. Average Crew Earnings for Different Types of Craft in Kerala During 1978-79

Sl. No.	Type of craft	Crew earnings* (Rs.)
1.	Mechanised	
	a) Trawler	6384
	b) Gillnetter	5100
2.	Non-Mechanised	
	i) Plank-built boat	
	a) upto 30 ft.	4246
	b) 31 ft. and above	4015
	ii) Dug-out canoe	
	a) upto 25 ft.	4738
	b) 26 ft. and above	4778
	iii) Catamaran	
	a) upto 25 ft.	3238
	b) 26 ft. and above	3103

*Crew earnings are estimated by dividing the total crew remuneration (crew wages plus food allowance) by the crew size. The crew size rpported by the IIM was six for trawlers; four for gillnetters; five for plank-built boats upto 30 ft; eight for plank-built boats of 31 ft. and above; four for canoes upto 25 ft.; five for canoes of 26 ft. and above; two for catamarans upto 25 ft. and three for catamarans of 26 ft. and above length.

Source: Centre for Management in Agriculture, Marine Fish Marketing in India, Vol. V, Supply Infrastructure and Projected Requirements, (Indian Institute of Management, Ahmedabad, 1981), pp. 163-79.

Table VII.11, though based on a micro-economic study of comparative profitability of fishing operations by different categories of boats during a single point of time, clearly indicates the relative income differences which are primarily due to the variations in the level of technology employed in fishing.

A similar estimate of crew earnings for different traditional craft-gear combinations and for trawlnets and gillnets operated by mechanised boats was given by John Kurien and Rolf Willmann for 1980-81. Table VII.12 presents the details of crew remuneration for different craft-gear combinations in Kerala during the 1980-81 fishing season.

Table VII.12. Per Capita Crew Remuneration for Different Craft-gear Combinations in Kerala During 1980-81.

Sl. No.	Craft-gear combinations*	Per capita crew remuneration+
1	2	3
		Rs.
1.	Encircling nets with plank-built boat	1690.00
2.	Encircling nets with Dug-out canoe	910.00
3.	Boat seines with Dug-out canoe	1029.00
4.	Boat seines with Catamaran	427.00
5.	Shore seines (cotton) with plank-built boats	544.00

Table VII.12 Contd.

1	2	3
		Rs
6.	Shore seines (cotton) with Dug-out canoe	256.00
7.	Shore seine (nylon)$^{\alpha}$	251.00
8.	Small mesh drift nets with plank-built boat	1161.00
9.	Large mesh drift nets with Dug-out canoe	1491.00
10.	Large mesh drift nets with catamaran	959.00
11.	Specialised gillnet for Anchovy with catamaran	384.00
12.	Specialised gillnet for sardine with catamaran	791.00
13.	Specialised gillnet for sardine with Dug-out canoe	1188.00
14.	Specialised gillnet for prawn with catamaran	422.00
15.	Specialised gillnet for prawn with Dug-out canoe	797.00
16.	Specialised gillnet (bottom set) for lobster with Dug-out canoe	1000.00
17.	Castnet with Dug-out canoe	1202.00
18.	Hooks and lines with plank-built boat	481.00
19.	Hooks and lines with Dug-out canoe	1502.00
20.	Hooks and lines with catamaran	1547.00
21.	Trawlnets with mechanised boats	3406.00
22.	Large mesh gillnets with mechanised boats	2004.00

* It may be noted that none of these gear is operated through out the year. On the contrary, they are operated at different seasons of the year depending upon their

It is apparent from Table VII.12 that the trawlnets and the gillnets used in conjunction with mechanised boats had given better per capita incomes to the crew. The per capita earnings noted above for all craft-gear combinations in general are said to be on the lower side as the 1980-81 fishing season was an 'exceptionally bad fishing year'[1]. What is apparent from the available cursory data shown above is that technological changes (crudely measured in terms of mechanisation of the craft, modernisation of the gear, better education, etc.) have contributed to an increase in the earnings of the fishermen. It is significant to note that the available data are insufficient to draw any specific conclusion as to the extent of improvement in the earnings of the fishermen as a result of technological changes. An attempt is, however, made in the remaining part of this section to give an estimate of the per capita earnings of the fishermen working in the mechanised sector[2].

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1. John Kurien and Rolf Willmann, op. cit., p. 20.
2. An estimate of the earnings of the fishermen in the traditional sector is given in Chapter IV.

Table VII.12 Contd.: α The craft used in combination is not given.

Source: John Kurien and Rolf Willmann, Economics of Artisanal and Mechanised Fisheries in Kerala - A Study of Costs and Earnings of Fishing Units, (Small-Scale Fisheries Promotion in South Asia, FAO/UNDP, Madras, 1982), p. 102-A.

An indirect estimate of the earnings of the fishermen working in the mechanised sector is obtained by dividing the value of output of the mechanised sector by the number of fishermen engaged in the sector. Here, no distinction is made between owner fishermen and worker fishermen. The estimated values would strictly speaking show the value productivity of the sector. For want of any alternative data the gross value of output per fisherman is presented below.

Table VII.13. Gross-Value of Output per Fisherman in the Mechanised Sector During 1969-76 and 1979-82

Year	Number of fishermen	Total value of output (Rs lakhs)	Gross value of output per fisherman (Rs.)
1969	7525	262.28	3485.44
1970	8010	567.62	7086.39
1971	8900	536.80	6031.46
1972	9720	488.55	5026.23
1973	10160	1972.99	19419.19
1974	10525	2004.38	19043.99
1975	10525	4409.10	41891.68
1976	13200	1955.06	14811.06
Average of the period	9821	1524.59	15523.77
1979	15000	7117.14	47447.60
1980	15190	8443.74	55587.49
1981	NA	5429.58	NA
1982	14805	9735.63	65759.06
Average of the period*	14998 (52.71)	8432.17+ (453.07)	56221.96 (262.16)

Table VII.13 clearly shows a phenomenal increase in the value of output of the fishermen in the mechanised sector during the period since 1979. The average value of output per fisherman increased from Rs 15523.77 during 1969-76 to Rs 56221.96 during 1979-82. This marked an increase of 262.16 per cent. It is apparent that the various technological changes introduced in the industry, including better marketing facilities have helped the mechanised sector in improving the value product of the fishermen.

5. Effects on Profitability

It has been noted in Chapter V that economic viability is the hall-mark for adoption of any new technolog The economic viability of most innovations in fishing techniques in Kerala were, however, not subjected to much scrutiny prior to their introduction as those innovations were carried out simultaneously with Research and Developmer efforts by Government support. Notwithstanding this, a few follow-up studies were conducted to assess the economic viability of the innovations made in the industry. The results of an early study which assessed the economic

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Table VII.13. Contd.

* Figures in parentheses show the percentage increase durin 1979-82 over the 1969-76 values.

Sources: 1. Table VI.4 above for number of fishermen.
2. Table VII.5 above for value of output of the se

viability of mechanised boats operating from Neendakara are presented in Table VII.14.

Table VII.14. Comparative Profitability of Small Mechanised Boats and Traditional Craft Operating from Neendakara during 1959-62 (average)

Items	22 ft. boat (4-5 HP)	23.5 ft. boat[1] (8-10 HP)	25 ft. boat[2] (8-10 HP)	Small canoe	Big cano
1. Investment	3736	6748	7270[3]	NA	NA
2. Gross operating expenses[4]	1760	2912	2689	357	519
3. Gross earnings	3643	8156	7248	2389	3667
4. Net earnings (3-2)	1883	5244	4559	2032	3148

1. Data relate to 1962.
2. Data relate to 1960-62.
3. Does not include the cost of gear.
4. Includes payment of depreciation.

Source: T.R.Thankappan Achari, The Impact of the Indo-Norwegia Project on the Growth and Development of Indian Fisheries, (State Planning Board, Government of Kerala Trivandrum, 1969), pp. 6-7.

Table VII.14 shows that the net earnings of two of the mechanised boats were higher compared to the net earnings of the traditional craft. The net earnings of the small mechanis boats of 22 ft. length was, however, found to be lower than tha of the country craft.

A more detailed study of the profitability of mechanised fishing at Neendakara and Calicut was made by the State Planning Board in 1966. The major findings of this study are presented in Table VII.15 below.

5. **Comparative Profitability of Mechanised and Non-Mechanised Boats Operating from Neendakara and Calicut during 1966–67**

	Neendakara							Calicut						
	Mechanised boats					Non-mechanised boats		Mechanised boats					Non-mechanised boa	
	25 ft (16 HP)	28 ft (24 HP)	30 ft (36 HP)	32 ft (51 HP)	36 ft (60 HP)	Small	Big	25 ft (16HP)	30 ft (30 HP)	32 ft (40 HP)	32 ft (60 HP)	36 ft (75 HP)	Small	Big
ents														
	8000	14000	14200	32500	60000	1050	2000	8000	14000	32500	32500	60000	750	15C
ne	5440	9600	13600	17000	26000	–	–	5440	8280	21860	18600	49280	–	–
osts														
eciation														
ull	800	1410	1420	3250	6000	100	200	800	1400	3250	3250	6000	75	15
ngine	544	960	1360	1700	2600	–	–	544	828	2186	1860	4928	–	–
rest	806	1422	1668	2970	5160	60	120	806	1337	3262	3066	6567	45	9
rance	–	–	417	743	1290	–	–	–	334	815	767	1639	–	–
ir and tenance	670	1080	1390	2475	4300	50	100	670	1114	2718	2555	5464	38	7
l	2820	4872	6225	11138	19350	210	420	2820	5013	12231	11498	24588	158	31
onal costs														
and icants	1068	2239	5483	4255	4813	–	–	1523	2864	4689	5276	5102	–	–
of gear including ir charges ear	405	710	1580	910	1073	165	165	750	860	980	990	1030	165	16
s	630	1106	2709	1554	1624	3402	1617	1162	1470	1680	1701	2016	4074	27
rs	50	130	370	150	1210	20	15	30	390	30	350	200	25	4
l	2153	4185	10142	6869	8720	3587	1797	3465	5584	7379	8317	8348	4264	29
osts II)	4973	9057	16397	18007	28070	3797	2217	6285	10597	19610	19815	32932	4422	331
arnings	5154	13701	30581	18948	22945	6054	16500	9285	7684	10599	9178	8410	8200	38
(+)/)	181	4644	14184	941	-5125	2257	14283	3000	-2913	-9011	-10642	-24522	3778	57

te Planning Board, Comparative Efficiency of Fishing Crafts in Kerala, (Government of Kerala, vandrum, 1969), p. 18 and Appendix Tables III.1, III.2 and

Table VII.15 shows a highly regressive picture of profitability of mechanised fishing particularly from the Calicut region. Almost all classes of mechanised boats except the 25 ft. class were incurring loss during the year under observation. At Neendakara, however, all categories of boats, except the 36 ft. were earning some profits, the profit margin being the highest in the case of 30 ft. boats. Among non-mechanised boats, the bigger ones were earning maximum profit in the region. The major reason pointed out for the significant losses of the mechanised boats in the Calicut region was the shortfall in the daily catches of the boats and the high operating expenses.

The findings of a comparative study of profitability of selected 32 ft. and 36 ft. vessels by the CIFT is presented in Table VII.16.

Table VII.16. Comparative Profitability of Selected 32 ft. and 36 ft. Boats Operating from Kerala during 1966-67.

(Amount in Rs.)

Sl. No.	Item	32 ft. (43.5 HP)	36 ft. (62 HP)
1.	Investment	56000	85000
2.	Operating costs		
	i) Fuel and oil	8592	12927
	ii) Salaries and shares	8590	19714
	Total	17542	32641
3.	Fixed expenses including depreciation	10500	17000
4.	Total expenses (2+3)	28042	49641
5.	Total earnings	34151	65713
6.	Profit (+)/Loss (-)	6109	16072

Source: H. Krishna Iyer, et al., 'Comparative Fishing Ability and Economic Efficiency of Mechanised Trawlers Operating Along the Kerala Coast', *Fishery Technology*, Vol. V, No.2, pp. 75-81, Cochin, 1968.

This study shows the comparative superiority of the 36 ft. boats over the 32 ft. boats. The findings of this study is in sharp contrast to the findings of the previous study by the State Planning Board. The notable difference in the fact profitability of the 36 ft. boats studied must be due to the that the samples in the former case was from Calicut and in the latter case from Cochin.

An evaluation of the programme of mechanisation of fishing boats by the Programme Evaluation Organisation of the Planning Commission gave the following results.

Table VII.17. Comparative Profitability of Mechanised Boa and Country Craft in Kerala during 1968-69

Sl. No.	Item	Unit	Mechanised boats		Cou cr
			10 m and above	Below 10 m	
1.	Investment	Rs '000	64.88	33.43	[illegible]
2.	Operational costs*	-do-	23.55	15.70	[illegible]
3.	Gross earnings	-do-	26.55	19.99	[illegible]
4.	Net earnings	-do-	3.00	4.29	[illegible]
5.	Return on investment (Per Rs 100/-)	Rs	43.50	60.00	11[illegible]
6.	Return on operational cost (Per Rs 100/-)	-do-	106.00	125.50	12[illegible]

* Includes payment of fixed charges.

Source: Planning Commission, Evaluation of the Programme of Mechanisation of Fishing Boats, (Government of In New Delhi, 1971), pp. 101-4.

Table VII.17 illustrates the superiority of mechanised fishing over traditional fishing in terms of gross earnings and net profits. The profitability in terr of the return on unit investment was, however, found to be lower in the case of mechanised boats.

A study by the Indian Institute of Management, Ahmedabad in 1978-79 gave the following picture of profitability of mechanised and non-mechanised fishing in Kerala.

Table VII.18. Comparative Profitability of Mechanised and Non-Mechanised Craft in Kerala during 1978-79

(Amount in Rs.)

Sl. No.	Type of craft	Gross earnings	Total expenditure*	Net earnings
<u>Mechanised Craft</u>				
1.	Trawlers	158428	128836	29592
2.	Gillnetters	102096	84084	18012
<u>Non-Mechanised Craft</u>				
1.	Plank-built boats			
	a) upto 30 ft.	29900	27606	2294
	b) 31 ft. and above	44980	40241	4739
2.	Dug-out canoes			
	a) upto 25 ft.	26386	23996	2390
	b) 26 ft. and above	32998	40440	2558
3.	Catamarans			
	a) upto 25 ft.	11310	9141	2169
	b) 26 ft. and above	16700	12978	3722
4.	Boat-seine (<u>Thangu vallom</u>)	112380	94638	17742

* Including overheads

Source: Centre for Management in Agriculture, <u>Marine Fish Marketing in India, Vol. V, Supply Infrastructure and Projected Requirements</u>, (Indian Institute of Management, Ahmedabad, 1981), pp. 161-81.

Table VII.18 shows the superiority of trawling over gillnetting and the general superiority of mechanised fishing over non-mechanised fishing. Among the non-mechanised craft, the profit margin earned by the boat-seine (Thangu vala) unit was found to be significantly higher than all other units.

A somewhat different picture of profitability was, however, given by Kurien and Willmann for 1980-81. Kurien and Willmann gave the following estimates of profitability for different craft-gear combinations.

Table VII.19. Comparative Profitability of Selected Craft-Gear Combinations in Kerala during 1980-81

(Amount in Rs.)

Sl. No.	Craft-Gear Combinations	Gross profit per annum to the owner	Net returns on investments (%)
1	2	3	4
1.	Encircling net with plank-built boat	15160	61.3
2.	Encircling net with Dug-out canoe	4221	4.7
3.	Boat-seine with Dug-out canoe	4794	20.8
4.	Boat-seine with Catamaran	604	-2.0
5.	Shore seine (cotton) with plank-built boat	4193	39.0

Table VII.19 Contd.

1	2	3	4
6.	Shore seine (cotton) with Dug-out canoe	2290	8.81
7.	Shore seine (nylon)*	384	-5.4
8.	Small mesh drift net with plank-built boat	3557	28.4
9.	Large mesh drift net with Dug-out canoe	2054	10.0
10.	Large mesh drift net with Catamaran	954	2.6
11.	Specialised gillnets for Anchovy with Catamaran	496	14.1
12.	Specialised gillnets for Sardine with Catamaran	776	27.3
13.	Specialised gillnets for Sardine with Dug-out canoe	1300	16.3
14.	Specialised gillnets for Prawn with Dug-out canoe	740	16.9
15.	Specialised gillnets for Prawn with Catamaran	373	6.4
16.	Specialised gillnet (bottom set) for Lobster with Dug-out canoe	973	21.0
17.	Castnet with Dug-out canoe	713	15.8
18.	Hooks and lines with plank-built boat	1014	-1.8
19.	Hooks and lines with Dug-out canoe	1774	15.2
20.	Hooks and lines with Catamaran	826	32.2
21.	Trawl net with mechanised boat	3562	-9.8
22.	Large mesh gillnet with mechanised boat	1795	-8.7

Table VII.19 indicates the uneconomic nature of mechanised fishing in the state and the negative returns to capital. The negative returns to capital was attributed to high operating costs, particularly the cost of oil, maintenance, etc. and the poor catches of the year which was reported to be an 'exceptionally bad year' for the state's fishery[1].

A study of costs and earnings of purse-seine fishing at Cochin in 1980 by Kalavathi gave the following results.

Table VII.20. Costs and Earnings of Purse-seine Fishing at Cochin in 1980

(Amount in Rs.)

Sl. No.	Items	Vessel - I*	Vessel - II+
1.	Investment	391000.00	422000.00
2.	Operational costs	311421.50	338027.45
3.	Overheads	132624.75	138504.00
4.	Total costs (2+3)	443046.25	476531.45
5.	Gross earnings	703800.00	728437.50
6.	Net earnings (5-4)	260753.75	251906.05
7.	Return on operational cost	58.85%	52.86%

* Projections based on 180 days of fishing.

+ Projections based on 185 days of fishing.

Source: S. Kalavathi, 'Evaluation of the Costs and Earnings of Fishing Vessels in Cochin Area', Term Paper (Manuscrip copy), (Department of Industrial Fisheries, 1980), pp. 9-10.

Kalavathi's study gave a satisfactory picture of profitability of the new method of fishing which was introduced in the state in 1979. The return on operational cost was satisfactorily high at above 50 per cent after meeting the full expenses of production (see Table VII.20 above).

The Expert Committee on Marine Fisheries in Kerala gave the following estimates of profitability of mechanised fishing in the state by a 32 ft. trawler operating for 215 days a year for the period from 1971 to 1982.

Table VII.21. Estimates of Profitability of Mechanised Fishing by one 32 ft. Trawler in Kerala during 1971-82

(Amount in Rs.)

Year	Total revenue per day	Total cost per day*	Net profit	
			Per day	Per year+
1971	1073.14	322.00	751.14	161495
1972	1768.36	341.73	1426.63	306725
1973	3499.14	385.11	3114.03	669516
1974	1987.28	443.77	1543.51	331855
1975	3332.41	517.72	2814.69	605158
1976	3355.80	587.00	2768.80	595292
1977	2807.62	711.49	2096.13	450668
1978	1989.85	831.31	1158.54	249086
1979	3990.63	991.00	2999.63	644920
1980	1364.94	1116.81	248.13	53348
1981	2019.82	1283.00	736.82	158416
1982	2171.84	1450.00	721.84	155196

* Including overheads.
\+ The boat is expected to operate for 215 days.

Table VII.21 shows a declining trend in the profitability of mechanised fishing in the state. The unduly low level of profit of 1980 seems to be due to the lower earnings of the year (Rs 1364.94 per day). This estimates seems to support the findings of the earlier study by Kurien and Willmann for 1980-81.

It may be noted in summary of this section that the scattered evidences cited above indicate the general superiority of mechanised fishing over non-mechanised fishing, though individual classes of boats have shown losses during certain years. Among mechanised vessels the purse-seiners were found showing the maximum returns (profits) followed by trawlers and gillnetters in that order. The performance of some of the traditional craft like the Boat-seine (Thanguvala) was also found to be superior in certain years. It is, however, significant to note that the limited information on the trend in profitability of the major class (32 ft.) of mechanised boats in Kerala indicates the fall in profit margins. This can be attributed to the fall in the productivity (catch per man-hour of effort) of the mechanised sector, which is primarily due to the sharp increase in fishing effort by the mechanised boats (See Appendix Table VII.4 and Table VII.8 above).

6. Effects on Housing

A major objective of technological change in the primary marine fishing industry of Kerala was to improve the socio-economic condition of the fishermen who are economically and socially backward. Housing and colonisation of fishermen was a major programme in the Government's policies for the development of the industry. The outlay and expenditure for housing and colonisation of fishermen had increased considerably over the years. (See Chapter VI and Appendix Table VI.3 for details of outlay and expenditure on the scheme during the successive Five Year Plans). Between 1961-62 and 1977-78 the Government constructed 4472 houses for the fishermen under the various housing schemes for the fishermen[1]. Of these, 1611 were constructed under the 'general housing and colonisation scheme', 452 under the 'victims of sea erosion, not fire accidents' and another 2409 under 'grant scheme for fishermen owning house plots'. Table VII.22 below gives details of houses constructed by the Government under the grant scheme in the various coastal districts of Kerala till the end of 1980.

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1. Directorate of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), p. 95.

Table VII.22. Details of Houses Constructed under the Grant Scheme for Fishermen till the end of 1980

Name of district	No. of houses constructed	Percentage of total
Cannanore	448	12.83
Kozhikode	404	11.57
Malappuram	580	16.60
Trichur	455	13.03
Ernakulam	411	11.76
Alleppey	433	12.40
Quilon	407	11.65
Trivandrum	355	10.16
Total	3493	100

Source: Directorate of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), p. 98.

Table VII.22 shows a more or less equitable distribution of housing development under the grant scheme. The problem of housing is, however, found to be serious among the fishermen as a large section of fishermen households do not own their houses. Table VII.23 shows the number of fishermen households in the various coastal districts of Kerala according to the ownership of houses.

Table VII.23. Distribution of Fishermen Households in the Coastal Districts of Kerala by Ownership of Houses in 1979

Sl. No.	Name of district	No. of households			Not owning as percentage of total
		Owning houses	Not owning	Total	
1.	Cannanore	8375	1791	10166	17.62
2.	Kozhikode	10713	931	11644	8.00
3.	Malappuram	6573	979	7572	12.93
4.	Trichur	9298	368	9666	3.80
5.	Ernakulam	13802	2372	16174	14.66
6.	Alleppey	16654	5729	22383	25.59
7.	Quilon	12501	3116	15617	19.95
8.	Trivandrum	14718	7636	22354	34.16
Total		92634	22923	115576	19.83

Source: Directorate of Fisheries, Census of Fisherfolk in Kerala, (Government of Kerala, Trivandrum, 1982), p. 38.

The Table reveals that the problem of housing was most acute in the districts of Trivandrum and Alleppey where more than 25 per cent of the households were not own houses. The percentages of households not owning houses were comparatively higher in the districts of Quilon, Cannanore, Ernakulam and Malappuram as well. For the state as a whole (taking only the coastal districts) this stood at 19.83 per cent.

Despite the shortage of housing facilities among the fishermen, there seems to be some improvement in the quality of houses owned by the fishermen. This improvement may be attributed to the general economic development of the fishermen community which is engineered by the technological changes in the industry. A glimpse of the general improveme in housing can be obtained from Table VII.24 which shows the changing housing condition in Neendakara-Sakthikulangara-Puthenthura region during 1953 and 1978.

Table VII.24. Distribution of Fishermen Households by Type of Dwellings at Neendakara, Sakthikulangara and Puthenthura during 1953 and 1978

(Figures in percentage)

Type of dwelling	Neendakara		Sakthikulangara		Puthenthura	
	1953	1978	1953	1978	1953	1978
Huts	82	66	57	37	70	48
Kutcha	11	23	28	36	21	46*
Pucca	7	11	15	27	9	6*
All	100	100	100	100	100	100

* It is pointed out that if the houses built by the Govt. w bricks and tiles were grouped as 'pucca', the percentage of kutcha houses would fall to twenty three and that of pucca houses would rise to twenty nine.

Source: Leela Gulati, Fishing Technology and Women - Part I Centre for Development Studies, Working Paper No. 1!

Table VII.24 shows that there was a notable reduction in the percentage of houses which were mere huts, between 1953 and 1978. There is, however, a corresponding rise in the percentage of kutcha houses in al the three villages. The percentage of pucca houses had increased only at Neendakara and Sakthikulangara; Sakthikulangara having a higher percentage of pucca houses. The table further indicates an apparent fall in the percentage of pucca houses in Puthenthura. It may be noted here that the perceptible improvement in the housing condition at Neendakara and Sakthikulangara was largely due to the improvement in the economic condition of the fishermen of these regions which happened to be the seat of major technological changes in the primary marine fishing industry of Kerala under the aegis of the Indo-Norwegian Project.

Looking at the state as a whole and at the district level, the condition of housing of the fishermen seems to be not very different. Table VII.25 shows the distribution of fishermen households by type of houses at the district level in 1979.

Table VII.25. Distribution of Fishermen Households by Type of Houses in the Coastal Districts of Kerala during 1979

Name of district	Huts		Kutcha houses		Pucca houses		Total	
	No.	% of total	No.	% of total	No.	% of total	No.	%
Cannanore	3203	31.51	4757	46.79	2206	21.70	10166	100
Kozhikode	4793	41.16	5012	43.04	1839	15.79	11644	100
Malappuram	4861	64.37	2096	27.75	595	7.88	7552	100
Trichur	5130	53.07	3172	32.82	1364	14.11	9666	100
Ernakulam	6253	38.66	5837	36.09	4084	25.25	16174	100
Alleppey	13739	61.38	5521	24.67	3123	13.95	22383	100
Quilon	7165	45.88	6179	39.57	2273	14.55	15617	100
Trivandrum	10054	44.97	9570	42.81	2731	12.22	22355	100
Total	55198	47.77	42144	36.47	18215	15.76	115557	100

Source: Directorate of Fisheries, Census of Fisherfolk in Kerala, (Government of Kerala, Trivandrum, 1982), p. 37.

Table VII.25 shows that approximately 16 per cent of the households at the state level (including only coastal districts were having pucca houses in 1979. Compared to the 1953 situation at Neendakara-Sakthikulangara-Puthenthura region, this shows a marked improvement in the housing condition of the fishermen in the state. The housing condition seems to be somewhat improved in districts like Ernakulam and Cannanore, but far below the state average in Malappuram district. Housing condition seems to be most appalling in Malappuram and Alleppey districts, where more than 60 per cent of the households stay in hutments. For the state as a whole this percentage is about 48. What is apparent from the table is that there was some marked improvement in the housing condition of the fishermen; but viewed from the sheer size (percentage) of the hutment dwelling households of the fishermen, the impact of technological changes on the housing condition of the fishermen seems to be quite insufficient and disproportionate.

7. Effects on Health and Sanitation

Improvement in the health and sanitation of the fishermen was a corollary to the technological changes initiated by the Indo-Norwegian Project at Neendakara in

1953. The Project had in fact recognised the importance of investment in human capital-in better health and hygiene - for improving the economy of the fishermen. The project hence set up a health centre and a pipe factory at Neendakara for producing pipe lines for bringing protected water to the village. The village was also provided with public toilet facilities.

The Government of Kerala too had recognised the importance of health and sanitation in improving the socio-economic condition of the fishermen. The Government established a number of coastal dispensaries exclusively to cater to the needs of the fishermen. Before the end of 1980, about 31 fisheries dispensaries were sanctioned by the Government. Of these, twenty were reported as functionin

A rough indicator of the improvement in health is provided by the decline in the crude birth and death rates. Table VII.26 shows the crude birth and death rates at Neendakara and Sakthikulangara during the period from 1950 to 1979.

Table VII.26. Crude Birth and Death Rates at Neendakara and Sakthikulangara Villages during 1950-7

Period	Neendakara		Sakthikulangara	
	Birth rate	Death rate	Birth rate	Death rate
1950-54	55.0	9.2	46.5	8.6
1955-59	48.1	5.1	45.4	8.1
1960-64	51.7	8.5	39.0	5.8
1965-69	46.2	4.7	42.6	5.7
1970-74	49.8	8.2	40.7	5.8
1975-79*	36.1 (38.0)	8.1 (10.0)	31.2 (34.7)	4.9 (8.4)

*Figures in brackets are corrected figures for under reporting during the period as given in the source.

Source: Leela Gulati, op. cit., pp. 74 and 85.

Table VII.26 indicates a notable fall in the crude birth rates in both Neendakara and Sakthikulangara; the death rates also showed some decline although it was not quite pronounced.

An alternative index of improvement in health facilities in the villages is provided by the number/percentage of births taking place in the hospitals. Table VII.27 gives details of births taking place at home and hospitals in the two villages of Neendakara and Sakthikulangara during the period from 1950 to 1979.

Table VII.27. Percentage of Births taking place at Home and Hospitals at Neendakara and Sakthikulangara during 1950-79

Period	Neendakara		Sakthikulangara	
	at home	at hospitals	at home	at hospitals
1950-54	96.3	3.7	92.2	1.8
1955-59	99.3	0.7	87.7	12.3
1960-64	99.7	0.3	68.1	31.9
1965-69	97.4	2.6	46.5	53.5
1970-74	61.5	38.5	13.1	86.9
1975-79	50.7	49.3	3.7	96.3

Source: Leela Gulati, op. cit., pp. 75-87.

The table indicates a real improvement in the health and family welfare facilities in the two villages. It should, however, be noted that this improvement became evident in Neendakara only after 1970. Another point worth noting here is that this general improvement in health in t two villages cannot be attributed exclusively to the technological changes in the fishing industry, but must be viewed partly as the result of the general improvements in the public health facilities in the state as a whole.

An assessment of the effect of technological changes on the sanitary conditions in the fishing villages is made difficult for want of comparable data for different points of time. The available data for 1979 gives the following picture.

Table VII.28. Distribution of Fishermen Households with Facilities for Electricity, Drinking Water and Toilet within the Household/Ward in the Coastal Districts of Kerala during 1979

(in percentages)

District	Electrified houses	Houses getting drinking water within the ward	Houses with toilet facilities
Cannanore	18.97	37.32	8.23
Kozhikode	7.06	27.73	4.54
Malappuram	6.05	28.04	2.11
Trichur	4.38	17.97	3.68
Ernakulam	7.53	40.98	4.13
Alleppey	4.78	16.45	1.12
Quilon	14.04	42.44	10.30
Trivandrum	14.49	50.84	7.13
Total	9.82	33.91	5.19

Source: Directorate of Fisheries, Census of Fisherfolk in Kerala, (Government of Kerala, Trivandrum, 1982), p.4(

The percentage of electrified houses was less than 10 per cent for the districts as a whole and it was much below the state (only coastal districts) average for the fishermen households in all districts except Cannanore, Quilon and Trivandrum. The percentage of households getting drinking water within the ward was about 34 per cent for the state as a whole, but much below this in districts like Alleppey, Trichur and Malappuram.

The percentage of households with toilet facilities attached to them was also quite low in all the districts.

It is apparent from the above that the impact of technological change and economic improvements on the social infra-structure of the fishermen community is quite meagre in all the coastal districts of Kerala. It indicates of the poor social development planning which the state had undertaken during the past 30-35 years.

8. Effects on Fish Consumption

A significant objective of technological change in the primary marine fishing industry of Kerala was to enhance production and consumption of fish in the state. Table VII.29 gives the trend in the consumption of fish in Kerala during the period from 1960-61 to 1984-85.

Table VII.29. Trend in the Consumption of Fish in Kerala during the period from 1961-62 to 1984-85

(Per capita consumption in kg.)

Year	Consumption*	Year	Consumption*
1961-62[1]	14.81	1970-71[1]	17.85
1962-63[1]	12.18	1973[2]	17.27
1963-64[1]	9.22	1975[3]	15.00
1964-65[1]	19.37	1978-79[4]	11.60
1965-66[1]	11.35	1979-80[4]	10.10
1966-67[1]	11.71	1980-81[5]	9.10
1967-68[1]	12.28	1981-82[6]	8.90
1968-69[1]	17.52	1983-84[7]	11.50
1969-70[1]	17.90	1984[8]	14.50

* It is the landed weight available per head of the population after adjusting for import and export. The figures include the limited quantity available from fresh-water sources too. Figures for certain intervening years were not available.

Sources: 1. Bureau of Economics and Statistics, Statistics for Planning - Series 9, (Government of Kerala, Trivandrum, 1974), p. 58.

2. State Planning Board, Economic Review of Kerala 1975, (Government of Kerala, Trivandrum, 1976), p. 110.

3. Ministry of Agriculture and Irrigation, Report of the National Commission on Agriculture - Part VII Fisheries, (Government of India, New Delhi, 1976) p. 417.

4. State Planning Board, Economic Review - 1980, (Government of Kerala, Trivandrum, 1981), p. 54.

5. ____________________, Economic Review - 1981, (Government of Kerala, Trivandrum, 1982), p. 57.

6. ____________________, Economic Review - 1982, (Government of Kerala, Trivandrum, 1983), p. 51.

Table VII.29 shows a generally declining trend in the consumption of fish in the state, particularly after 1973[1]. This trend in the consumption (availability) of fish in Kerala, especially after the introduction of major technological changes in the industry is quite unwarranted. The figures indicate of the dismal failure of planning in the state in increasing the domestic supply of fish for improving the nutritional standards of the population. It is significant to note here that this deteriorating trend in the domestic availability of fish was to a large extent due to the overwhelming importance attached to the prawn fishery for export and the consequent neglect of the domestic market and domestic supply.

9. Effects on Fish Conservation

A major consequence of technological change in the primary marine fishing of Kerala has been the quick expansion of fishing effort in the mechanised sector and the fast

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1. It may be noted that the quantity (per capita) available for consumption in the state is much higher than the national average and is well above the nutritional minimum (10 kg per annum) prescribed by the Indian Council of Medical Research.

Table VII.29. Sources Contd.

7. State Planning Board, Economic Review - 1984, (Government of Kerala, Trivandrum, 1985), p. 25.
8. ______________________, Economic Review - 1985, (Government of Kerala, Trivandrum, 1986), p. 28.

depletion of the catches of prime varieties of fish like prawns and oil-sardines. This development has been pointed out in the earlier discussions on output of the traditional sector in Chapter IV and the sections on the effects on 'production' and 'productivity' in this chapter. The declining catches of the traditional sector, particularly after 1975, had prompted the traditional fishermen to demand conservation of the fishery resources of the state. The fall in the output of the traditional sector was attributed by the traditional fishermen to the introduction of bottom trawling in the state which, they felt, had also resulted in the distruction of juvenile fishes and larvae of many of the species which they were catching. The introduction of purse-seining in the state in 1979 also led to a further fall in their catches (see Chapter IV). Since 1979 the traditional fishermen have been following an agitational path for the conservation of the fishery resources of the state and to safeguard their interests.

The need for conservation of the fishery resources of the Neendakara coast was studied by the scientists of the CMFRI in 1980[1]. The study after observing the trend in the catch, effort and catch per man-hour of

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1. M.J.George, et al., 'A Case of Over Fishing: Depletion of Shrimp Resources Along Neendakara Coast, Kerala', MFIS No.18, (CMFRI, Cochin, 1980), pp. 1-8.

effort of the region came to the conclusion that there was the possibility of economic over-fishing in the region but no biological over-fishing. The continuing decline in the catches of the traditional fishermen, on the other hand, forced the traditional fishermen to agitate for effective regulatory measures to restrict trawling to the offshore waters beyond the reach of the traditional craft. Witnessing the strife in the primary marine fishing industry of Kerala, the Government of Kerala enacted the Kerala Marine Fishing Regulation Act in 1980 which sought to regulate, restrict and prohibit fishing in specific waters by specific categories of vessels and gear for specific periods of time and for specific species. Based on the provisions of this Act, the Government of Kerala stratified the whole coastal length of Kerala into two contiguous regions with four depth zones for fishing by different categories of vessels. Table VII.30 gives the demarcation of fishing regions with depth zones and categories of boats allowed to operate in these regions.

Table VII.30. Demarcation of Fishing Regions with Depth-Wise Allocation of Boats for Operation

Sl. No.	Region	Length of coastal line (km)	Depth zone	Class of vessels allowed for fishing in the zone
1.	Kollengode to South Edava	78	a) upto 16 fathoms	Non-mechanised boats
			b) between 16 and 20 fathoms	Non-mechanised boats fitted with engines
			c) between 20 and 35 fathoms	Mechanised boats below 25 GRT
			d) beyond 35 fathoms	Mechanised boats of 25 GRT and above
2.	Paravoor south to Manjeswar	512	a) upto 8 fathoms	Non-mechanised boats
			b) between 8 and 10 fathoms	Non-mechanised boats fitted with engines
			c) between 10 and 20 fathoms	Mechanised boats below 25 GRT
			d) beyond 20 fathoms	Mechanised boats of 25 GRT and above

Source: MPEDA, Seafood Newsletter, Vol. LVII, No.1, (MPEDA, August 1982), pp. 3-4.

Following the passage of this Act, the Government of Kerala issued a series of notifications prohibiting the use of purse-seines, ring-seines, pelagic trawls and mid-water trawls in the territorial waters of the state. This led the mechanised boat operators in the state to challenge the ban on pelagic trawling and purse-seining in the Kerala High Court, which issued interim stay in April 1983. This led to unabated fishing by mechanised boats and further deterioration in the catch of the traditional sector. The deteriorating economic condition of the traditional fishermen led many of them to assault the mechanised boats in the sea and to organise themselves for creating a strong public opinion in defence of the cause of the traditional sector[1].

Meanwhile in 1981, the Government of Kerala appointed a Committee to study the need for conservation of the marine fishery resources of the state during certai seasons of the year and allied matters under the chairmansl of Shri D. Babu Paul, Special Secretary, Department of Transport, Fisheries and Ports. The Committee, which

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1. It may be noted that the Kerala Swathanthra Matsya Thozhilali Union and the All India Catamaran and Countr Craft Operators Association are Organisations with considerable working class support in the primary marine fishing industry of Kerala.

went into the question of conservation of the marine fishery resources of the state, particularly the need for a ban on monsoon trawling, was divided in its opinion, with one section advocating the ban and the other finding no justification for its introduction. The section that was against the ban felt that it will have adverse consequences on the prawn fishery of the state, as the bulk of the catches are landed during the monsoon months. The scientific opinion of the Committee was also not in favour of a ban on monsoon trawling as it felt that the prawns are year round breeders and will not be affected by monsoon trawling[1]. As regards the fall in the catches of oil sardine and mackerel a section of the Committee held that such fall in production was experienced even prior to the introduction of purse-seining in 1979 and therefore the fall in their production was only a cyclical phenomenon[2]. The Committee, however, suggested the introduction of larger mechanised vessels for increasing marine fish production in the state. It also offered several other recommendations including strict enforcements of the minimum mesh size for trawlnets and

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1. Government of Kerala, Report of the Committee to Study the Need for Conservation of Marine Fishery Resources During Certain Seasons of the Year and Allied Matters, (Government of Kerala, Trivandrum, 1984), p. 70.

2. Ibid., p. 69.

stakenets (35 mm), licensing of all fishing vessels, limiting the number of trawlers in the inshore waters, prevention and control of water pollution in the coastal areas, establishment of fish sanctuaries, etc..

The recommendations of the committee did not find much favour with the traditional fishermen as their major demand for ban on monsoon trawling was rejected by the scientific panel of the Committee. The agitation by the traditional fishermen continued uninterrupted. The growing menace of the traditional fishermen's agitation prompted the Government of Kerala in 1984 to appoint another Committee with the specific task of finding out the reasons for the fall in the catches of the traditional sector and to suggest ways and means for improving the productivity of the traditional sector, as well as to improve the working of the mechanised sector. The Committee found that the fall in the catches of the traditional sector was primarily due to the fall in the fishing effort of the sector, which was due to the competition for resource, space and price with the mechanised sector in the inshore waters. To enhance the productivity of the traditional sector, the Committee suggested an exclusive fishing zone of 0-20 m depth for the traditional sector and a total ban on trawling in those

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Expert Committee, The Report of the Expert Committee on Marine Fisheries in Kerala, (Central Institute of Fisheries Education, Bombay, 1985). pp.427-36 waters by the mechanised boats. The Committee further recommended the introduction of 513 trawlnets for operation by the traditional fishermen for tapping the inshore prawn resources of the state. The Committee also favoured the idea of 'dory' fishing[1] in the offshore regions by traditional craft for extending their operational range.

To improve the performance of the mechanised sector which is over-capitalised, the Committee suggested a reduction in the trawl fleet size from the existing 2000 and odd to 1145 and a redeployment of the remaining vessels to the offshore regions (beyond 20 m) for fishing for white bait, rock cod, shark, etc.. The Committee further recommended a total ban on night-trawling in all waters. It also suggested a ban on mid-water trawling upto 20 m depths and on purse-seining and pelagic trawling in territorial waters.

The Government of Kerala, following the recommendations of the Committee, sought to implement the provisions of the Kerala Marine Fishing Regulation Act more vigorously by restricting all mechanised fishing in

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1. The method involved the use of a 'mother' boat for dragging a fleet of country boats to and from the fishing grounds and collecting the catches of the smaller boats. In this method, the actual operations of fishing are carried out by the country-boats.

the territorial waters upto 22 nautical km. This action of the Government was, however, again challenged in the Kerala High Court by the mechanised boat operators in December 1986. The court observed that an absolute ban on mechanised fishing in the territorial waters was unconstitutional and ordered to limit the restriction upto a distance of 10 nautical km. It further observed that the Expert Committee Report had given no indication of a depletion of the fish stock in the territorial waters of the state so as to deny the traditional fishermen of their due share[1].

Entrenched as it is, one finds the crisis in the primary marine fishing industry of Kerala continuing with conflicting claims for sharing the limited resources of the inshore waters by the traditional fishermen and the mechanised boat operators. The net effect of the stalmate has been, as observed in the earlier sections, a virtual stagnation in the output of the industry with no signs of real improvement.

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1. Staff Reporter, High Court Reduces Banned Area for Purse-seines, (Indian Express, Cochin, 14.12.1986).

CHAPTER VIII

FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

1. Summary of findings

The introductory chapter of this study pointed out the declining trend in the output of the primary marine fishing industry of Kerala and established the need for a fresh probe into the process of growth in the industry to induct growth in the industry.

The review of economic literature made in Chapter Two offered no compact theory capable of explaining the process of development in the industry. The need for evolving a fresh theory was recognised.

The production function approach to the study of technological change and development discussed in Chapter Three was found to have many drawbacks and a model of technological change taking several indicators and characteristics was considered more appropriate for studying the development of the industry.

A preview of the traditional sector of the primary marine fishing industry of Kerala revealed the technological backwardness of the sector, the lack of specialised training for fishermen and the organisational constraints for production and marketing. An analysis of the output of the sector between 1951 and 1984 showed a declining trend, with the output of the sector reaching the maximum in the fourth quinquennium ending in 1970 and falling thereafter. The average (annual) output of the sector declined from 3.29 lakh tons during 1966-70 to 2.13 lakh tons during 1981-84. A species-wise analysis of the output of the sector showed a notable fall in the output of all species during the period 1979-82, the decline being the maximum in the case of prawns and mackerels. The relative share of output of these species also fell during this period.

In value terms, the total (average) value of output of the sector showed only marginal improvements from Rs 2543.57 lakhs during 1969-76 to Rs 2758.79 lakhs during 1979-82. This amounted to an increase of 8.46 per cent.

The real value of output of the sector showed a decline of 47 per cent. The relative share of output of the sector fell from near 100 per cent during the period prior to 1969 to between 52 per cent and 71 per cent during 1979-84. The significant fall in the output of the sector was attributed to a reduction in the fishing effort of the sector particularly after 1975 (see Appendix Table : and the limited operational range of the traditional craft. The limited capital equipment possessed by the traditional fishermen, particularly in the northern districts, and the marketing constraints prevailing in the sector are found to restrict the output of the sector.

The 'process' of technological change in the industry consisted predominantly the activities of Researc and Development for fisheries resources, fishing craft, fishing gear, fishing techniques, fishing harbour, fishermen training, fisheries organisation, etc.. The Research and Development efforts for fishery resources were carried out primarily by the CMFRI, Pelagic Fisheries Project and the Indo-Norwegian Project. The surveys carrie out by these institutions established the vast potential fc exploiting prawns and other pelagic/demersal resources in the state (see Table V.1). A significant point about the Research and Development efforts for fisheries resources is that a precise quantitative estimate of these resources has not yet been made possible.

The Research and Development efforts for new fishing craft types were initiated by the Indo-Norwegian Project from Neendakara-Sakthikulangara in 1953. The

Project, after initial experimentation, introduced a number of new designs of small and medium mechanised boats for trawling for shrimp/prawn on the inshore waters of the state. The FAO also helped in designing a number of new craft designs by sending its naval architects during 1956-61. These developments coincided with the growing demand for prawns in the export market in the U.S. and Japan.

The Research and Development activities for new craft, gear and other accessories and suitable materials for their production were carried out by the CIFT since its establishment in 1957. It standardised a number of new craft and net designs (see Table V.7) and popularised the use of modified gillnets for seer and pomfret and lobster-tra for lobster fishing by traditional fishermen. It also developed a variety of new trawl designs for bottom, pelagic and mid-water trawling. Simultaneously the Integrated Fisheries Project (former INP) perfected the use of purse-seine nets in the state for catching pelagic species like oil-sardines, mackerels, anchovies, etc.. The Institute's other activities led to the possibility of using venteak and mango wood as alternative materials for boat building. Many indigenous materials for preserving the hull of traditional craft were also developed by the

Institute. The Institute's work on alternative materials for boat building found it difficult to use aluminium alloy, fibre glass, steel, etc. because of technical and economic constraints. The work on design of new fishing craft was taken up by the Bay of Bengal Programme of the FAO/UNDP since 1980.

The BOBP's efforts to introduce new designs of beach-landing craft did not create much enthusiasm among the traditional fishermen as it meant a total abandonment of their existing means of production. A programme which found wide acceptance among the traditional fishermen in recent years was the scheme for the introduction of out-board engines to the traditional craft. The scheme which was started by the Kerala Fishermen Welfare Corporation during late 1980 became quite popular, with about 2009 units going for out-board engines within three years. This programme was accepted by the traditional fishermen in the wake of the declining catches of the traditional sector. The output of the sector, however, did not show much improvement during this period. (See Appendix Table IV.3). A significant finding in this regard is that the Research and Development efforts in the state have succeeded in building only the small and the medium boats for operations in the inshore waters. The larger combination vessels of the Mazagon Dock design have not yet become popular in the state.

The Research and Development effort for fishing harbours in the state was started early in the sixties. The effort was to develop a number of minor and major fishing harbours in the state with central assistance. The programme was, however, delayed till the beginning of the fourth five year plan (1969) due to technical and other constraints. At present the state has only one major fishing harbour at Cochin and five other fishing harbours at Vizhinjam, Azhikode, Ponnani, Beypore and Baliapattam. The work on a number of landing centres was started during the sixth five year plan. The policy of the Government for providing harbour facilities seems to have undergone some change in the recent period with the emphasis turning for providing minimum facilities at all landing centres instead of providing full-fledged fishing harbours at major landing centres. This policy, though sound in promoting regional development and less burdensome for the state exchequer, is expected to thwart the development of the deep-sea fishing industry of the state. Lack of major harbour facilities for landing, berthing and repair of large vessels have already led to the movement of larger vessels from the state's coast to other coasts.

A notable finding here is that the Research and Development efforts and the public policy for fishing harbour development in the state have not succeeded in providing the minimum facilities at the major fish landing centres of the state. This is observed to be a significant factor, which restricted the productivity and growth in the primary marine fishing industry of Kerala.

The Research and Development activities in the state had also extended to fishermen training for providing skilled man-power for the mechanised sector. The man-power trained in the state was, however, not fully utilised for want of fishing equipment and other reasons. The main beneficiaries of the training programmes were the fishermen engaged in the mechanised sector.

Technological changes in the primary marine fishing industry of Kerala had envisaged organisational changes at all levels of production, processing and marketing. Fishermen Cooperatives were organised at the village, district and state levels for production, credit and marketing. These cooperatives, however, did not do much good for the development of the industry. Since 1981, the Government established integrated village societies of fishermen in all coastal villages for promoting integrated development of fishing, processing and marketing. The organisational set up is being reviewed by the government for improving its performance. Another major organisational set-up by the Government for promoting technological change in the industry was the Kerala Fisheries Corporation which also had only limited success. The emerging conclusion in this regard is that the organisational changes effected by the Government had not helped in the modernisation and the development of the primary marine fishing industry of Kerala.

The 'process' of technological change described in Chapter Five came to the broad conclusion that the various innovations introduced in fishing craft/gear and techniques have helped only in intensifying the fishing effort in the inshore waters of the state and to some extent in depleting the resources. Conversely, it was found that the larger craft designs of the CIFT and other institutions have not yet been put for commercial use by the industry. The need for introducing a 'new generation' of larger fishing vessels was recognised.

A study of the indicators of technological change in the primary marine fishing industry of Kerala in Chapter Six indicated the following results.

1) A progressive increase in the number of mechanised boats. These boats are, however, of small and medium types, suitable for inshore fishing only.

2) An increase in the number of educated/trained man-power (fishermen) employed in the industry. The level of education was, however, found to be low.

3) A progressive increase in the infra-structure for fishing, ice, storage, processing, transportation, marketing, boat-building, etc. A large part of this infra-structure, especially for ice, storage, transportation, boat-building, etc. was provided by the private sector.

4) An increase in the outlay and expenditure for fisheries development. The bulk of this outlay and expenditure have gone for mechanisation of fishing craft, development of fishing harbour, other infra-structure, etc.. A large part of the expenditure is seen to have gone as assistance to Kerala Fisheries Corporation and as welfare schemes in the recent period (see Table VI.11). One significant point emerging here is the large gap between outlay and expenditure for fishing harbour development, research, repair and refitting facilities, etc., all of which might have contributed to a slackening of the process of growth in the primary marine fishing industry of Kerala.

5) An increase in the quantity and value of marine products exported from the state. This is obviously because of the high priority accorded to this objective by the state and the initiative taken by the private sector.

6) Import substitution as an objective of technological change in the primary marine fishing industry of Kerala has only partly been achieved. This is because of the low priority given to self-reliance and also due to the misuse of import licence by the exporters of marine products.

A study of the various effects and characteristics of technological change and development in the primary marine fishing industry of Kerala in Chapter Seven reached the following conclusions.

1) The average output of the mechanised sector increased from 2900 tons during 1956-68 to 82537 tons during 1968-78 and 123137 tons during 1979-84. The rate of growth (compound) for the whole period was 55.09 per cent per annum (See Table VII.1). Much of this increase was due to the increase in the catch of oil-sardines, mackerels and 'other' species (See Table VII.3).

2) A significant fall in the relative share of the output of the northern districts of the state has been observed during this period.

3) The bulk of the output of oil-sardines and a large part of the output of mackerels in recent periods were contributed by the northern districts (See Table VII.6). The lion's share of output of prawns and 'other' species was contributed by the southern districts (See Table VII.6). This relative distribution of output of the low value species in the northern districts and the high-value species in the southern districts is characteristic of the technological changes that took place in the industry since 1953.

4) The technological changes in the primary marine fishing industry of Kerala have led to significant increases in the productivity (catch per manhour of effort) of the fishermen in the mechanised sector (See Table VII.7). The productivity of the sector, however, showed a steady decline since 1976. The catch per manhour of effort was found to be the lowest in 1980 (3.49 kg). Another aspect of the productivity trend in the primary marine fishing industry of Kerala (traditional and mechanised sector combined) is the declining trend in the northern and the

central districts and the improving trend in the southern districts (See Table VII.8). This diverging movement in the productivity is attributed to the technological obsolescence in the northern and central districts (excluding Ernakulam) and the technological advancement made in the southern districts, particularly Quilon. It is further noted that the technological lead provided by the Indo-Norwegian Project and the trade and credit linkages in the industry had contributed to the concentration (localisation) of mechanised fishing at Cochin and Neendakara. This was found to have both positive and negative effects. On the positive side, it has led to continuous fishing raising productivity, and on the negative side to external dis-economies resulting in diminishing returns and declining productivity (See Table VII.

5) The net effect of technological changes on employment was found to be positive (See Table VII.9). There was, however, a significant decrease in the number of fishermen engaged in the processing of fish as well as in the making and repairing of nets. At the district level, net decreases in employment were noticed in Cannanore, Kozhikode, Trichur, Alleppey and Trivandrum districts (See Appendix Table VII.3).

6) Technological changes in the industry have contributed to a general increase in the earnings of the

fishermen in the mechanised sector (See Table VII.10).

7) The profitability of boats operating in the mechanised sector was found to be superior for both the small and the medium boats (See Table VII.12 through Table VII.18). Among the traditional craft, the Thangu valla unit was found to show a relatively higher level of profit (See Table VII.16). The estimated profits of the trawlers, however, showed a perceptible fall since 1979 (See Table VII.18).

8) The housing condition of the fishermen seems to have shown some improvement, though a large percentage of fishermen households, particularly in the southern districts, were seen not owning houses (See Table VII.20 and VII.21).

9) The health and sanitary condition of the fishermen households in general was found to be far from satisfactory.

10) The level of consumption of fish in the state showed a declining trend since 1979 (See Table VII.26).

11) Conservation of the fishery resources of the state, particularly in the inshore areas, has become a pressing problem for the government.

2. Conclusions

The major conclusion arrived at from this study is that the various technological changes introduced in the industry has helped in achieving only 'limited growth' in terms of increases in output, employment, earnings, regional development, self-reliance (import-substitution), etc.. This is largely due to the limited growth strategy, followed by the administration (which is reflected in the poor implementation of the plan programmes, wide gap between outlay and expenditure for fishery development, etc.) and the poor (domestic) market development.

3. Recommendations

1) The declining trend in the output of the primary marine fishing industry of Kerala calls forth continuous technological changes in the industry to enhance productivity of both the mechanised and the non-mechanised sectors.

2) The technology of the mechanised sector should be improved by introducing larger vessels for operation in the offshore waters of the state which are now exploited by foreign fishing vessels.

3) The catching potential of the traditional sector should be enhanced through motorisation, 'dory' fishing and improved gear.

4) The declining trend in the output of the northern districts of the state should be reversed through a redeployment of the fishing fleet of the state, particularly the mechanised boats now concentrating at Neendakara and Cochin.

5) The work of construction of harbour facilities at major landing centres should be expedited for exploiting the deep-sea (offshore) resources of the state. The state government should develop the Baliapattam fishing harbour into a major fishing harbour. This is necessary to attract larger fishing vessels to the region and to promote greater exploitation of the demersal fishery resources of the region.

6) The provisions of the Kerala Marine Fishing Regulation Act, 1980 and the rules formulated thereafter should be implemented rigorously to conserve the fishery resources of the state, both in the inshore and in the backwater regions.

7) Prevention and control of water pollution in the coastal zones should be given top priority in the fish conservation programmes of the state.

8) Exploitation of the fishery resources of the state beyond 40 fathoms should be organised by the Kerala State Cooperative Federation for Fisheries Development (Matsyafed) on a priority basis. Private investment in the field should be encouraged by making use of the funds available under the Shipping Development Fund Scheme of the Central Government.

9) The market-linkages for fisheries development (through technological change) in the state should be provided by the Matsyafed by organising regulated markets in the state and by providing price support schemes.

10) The Matsyafed should also take up the processing/ export of larger varieties of fish which are not in great demand in the domestic market at present.

11) The Department of Fisheries should provide the requisite organisational support for introducing technological changes in the industry by strengthening the management of the Matsyafed with proven management talents.

12) The Project Cell of the Department of Fisheries of the State should evolve a regular programme for technology assessment by collecting and analysing statistics of catch and effort, costs and earnings and other operational parameters of different classes of mechanised and non-mechanised boats at district levels separately.

Appendix Table I.1

Contribution of Fisheries to the State's Net Domestic Product at 1970-71 Prices

(Rs in lakhs)

Year	Fisheries	Total	% of Fisheries in the total
1960-61	475	43222	1.10
1969-70	582	59965	0.97
1970-71	2569	125843	2.04
1974-75	2989	130803	2.28
1975-76	2994	132514	2.26
1976-77	2031	129868	1.56
1977-78	2431	135757	1.79
1979-80	2096	152209	1.38
1980-81	2191	156327	1.40
1981-82	1922	163340	1.17

Sources: 1. The Directorate of Economics and Statistics, Statistics for Planning 1980, (Government of Kerala, Trivandrum, 1980), p. 70.

2. The Directorate of Economics and Statistics, Statistics for Planning 1983, (Government of Kerala, Trivandrum, 1984), p. 97.

Appendix Table I.2

Trend in the Output of the Primary Marine Fishing Industry of Kerala during 1950-1984

(Output in tons)

Year	Output	% increase (+)/ decrease (-) over the previous year
1	2	3
1950	202047	
1951	191032	-5.45
1952	129345	-32.29
1953	111999	-13.41
1954	117034	4.49
1955	105457	-9.89
1956	152213	44.33
1957	309926	103.61
1958	294655	-4.92
1959	191375	-35.05
1960	346684	81.15
1961	268624	-22.51
1962	192470	-28.34
1963	203242	5.59
1964	317973	56.45
1965	339173	6.66
1966	346744	2.23
1967	364129	5.01
1968	345301	-5.17

Appendix Table I.2 Contd.

1	2	3
1969	294787	-14.62
1970	392880	33.27
1971	445347	13.35
1972	295618	-33.62
1973	448269	51.63
1974	420257	-6.24
1975	420836	0.13
1976	331047	-21.33
1977	345037	4.22
1978	373339	8.20
1979	330509	-11.47
1980	279021	-15.57
1981	274820	-1.50
1982	325367	18.39
1983	418085	28.49
1984	424718	1.58
1985	295339	-30.46

Sources: 1. Expert Committee, Report of the Expert Committee on Marine Fisheries in Kerala, (Expert Committee, C/o. Central Institute of Fisheries Education, Bombay, 1985), pp. 203-5.

2. CMFRI, Marine Fish Production in India 1950-68, Bulletin No. 13, (CMFRI, Cochin, July 1969), pp 33-127.

3. CMFRI, Exploited Marine Fishery Resources of India, Bulletin No.27, (CMFRI, Cochin, March 1976 p. 12.

Appendix Table I.2 Contd.

Sources: 4. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 8-9.

5. Directorate of Economics and Statistics, Statistics for Planning 1983, (Government of Kerala, Trivandrum, 1984), pp. 189-90.

6. Department of Fisheries, Survey on Marine Fish Landings, Nos 2,3,4,5,(Government of Kerala, Trivandrum, 1984-85),

7. M.P.E.D.A., Seafood News Letter, Vol. 77, No.1, August 3, 1987.

Appendix Table I.3

Quinquennial (average) output of the Primary Marine Fishing Industry of Kerala

(Output in tons)

Quinquennium (period)	Output	Annual compound growth rate (%)
1951-55	130973	-11.31
1955-60	258971	37.82
1960-65	264296	3.57
1966-70	348768	4.14
1971-75	406065	5.05
1976-80	331791	-3.77
1981-85	347666	3.30

Source: Appendix Table I.2.

Appendix Table I.4

Comparative Output of the Primary Marine Fishing Industry of Different Coastal States/Union Territories of India in 1985

(Output in tons)

States/Union Territories	Output	Rank
1. Andhra Pradesh	126848	6
2. Gujarat	288500	3
3. Goa	39927	8
4. Karnataka	200828	5
5. Kerala	295339	2
6. Maharashtra	388088	1
7. Orissa	49205	7
8. Tamil Nadu	257000	4
9. West Bengal	39350	9
10. Andamans	6304	11
11. Lakshadweep	4676	12
12. Pondicherry	19913	10

Source: MPEDA, Seafood News Letter, Vol. 77, No.1, p. 3, August 3, 1987.

Appendix Table IV.1

Distribution of Two Major Traditional Fishing Gear of Kerala by Their Material in 1977

Material	Gear			
	Gillnet	%	Boat-seine	%
Cotton	5797	27.91	12628	48.34
Hemp	2580	12.44	2450	9.38
Nylon	12355	59.54	11041	42.27
Total	20732	100.00	26119	100.00

Source: Department of Animal Husbandry, Livestock Census 1977, (Government of Kerala, Trivandrum, 1979).

Appendix Table IV.2

The Comparative Costs of Different Types of Traditional Craft and Gear of Kerala in 1976, 1977 and 1985.

Type of craft/gear		Year		
		1976+	1977*	1985σ
		Rs	Rs	Rs
Craft				
Catamaram:	Small	750	NA	2000
	Large	1000	NA	3000
Dug-out Canoe:	Small	NA	1200-1500	10000-15000
	Large	5000-7000	5000-10000	30000-35000
Plank built boat:	Small	NA	2750-3000	10000-12000
	Large	NA	3500-5000	15000-20000
Gear				
Hook and line (per set)		150	NA	500-800
Gillnets				
Anchovy net (Cotton)		350		
Sardine net (Cotton)		1000	700	7000-10000 (Nylon net)
Mackerel net (Nylon)		NA	2500-3200	
Boat-seines				
Silver bellynet (Cotton)		NA	500	
Mackerel net	(Cotton)	NA	700	3000-5000 (Nylon net)
	(Nylon)	NA	1000-1200	
Sole net	(Cotton)	NA	750	

Sources: + John Kurien, op. cit., p. 106.
* P.R.G. Mathur, op. cit., pp. 139-170.
σ Own estimates.

Appendix Table IV.3

Trend in the output of the Traditional Sector During 1950-1984

(Output in tons)

Year	Output	% increase (+)/ decrease (-) over the previous year	% of total output of the fishing industry
1	2	3	4
1950	202047	-	100.00
1951	191032	-5.45	100.00
1952	129345	-32.29	100.00
1953	111999	-13.41	100.00
1954	117034	4.49	100.00
1955	105457	-9.89	100.00
1956	150913	43.10	99.15
1957	307126	103.51	99.10
1958	292055	-4.90	99.12
1959	189675	-35.05	99.12
1960	346605	82.73	99.40
1961	267493	-22.82	99.58
1962	191421	-28.43	99.46
1963	202380	5.72	99.58
1964	314582	55.44	99.94
1965	334218	6.24	98.54
1966	338402	1.25	97.60
1967	359872	6.34	98.84
1968	342065	-4.94	99.07

Appendix Table IV.3 Contd.

1	2	3	4
1969	266610	-22.05	90.44
1970	340309	21.65	86.62
1971	398056	16.96	89.39
1972	256970	-35.44	86.93
1973	354610	37.99	79.11
1974	318845	-10.08	75.87
1975	240725	-24.50	57.21
1976	272330	13.12	82.27
1977	237613	-12.74	68.87
1978	255983	7.73	68.57
1979	235730	7.91	71.33
1980	144238	38.81	51.70
1981	179489	24.43	65.32
1982	177127	-1.31	54.44
1983	NA	NA	NA
1984	282167	59.30*	66.44

*. Increase over 1982.

Sources: 1. Expert Committee, Report of the Expert Committee on Marine Fisheries in Kerala, (Expert Committee, C/o. Central Institute of Fisheries Education, Bombay, 1985), pp. 203-5.

2. CMFRI, Marine Fish Production in India 1950-1968, Bulletin No. 13, (CMFRI, Cochin, July 1969), pp. 33-127.

3. CMFRI, Exploited Marine Fishery Resources of India, Bulletin No. 27, (CMFRI, Cochin, March 1976), p.12.

4. Department of Fisheries, Kerala Fisheries - Facts and Figures, 1980, (Government of Kerala, Trivandru 1983), pp. 8-9.

Contd...

Appendix Table IV.3 Contd.

Sources: 5. Directorate of Economics and Statistics, Statistics for Planning 1983, (Government of Kerala, Trivandrum, 1984), pp. 189-90.

6. Department of Fisheries, Survey on Marine Fish Landings, Nos 2,3,4 and 5, (Government of Kerala, Trivandrum 1984-85).

Appendix Table IV.4

Fishing Effort by the Traditional Sector in Kerala During 1956-1984

(in '000 man-hours)

Year	Effort
1	2
1956	81687
1957	93851
1958	95391
1959	63328
1960	39972
1961	37869
1962	32279
1963	37139
1964	39224
1965	46303
1966	48130
1967	41756
1968	39612
1969	27708
1970	27978
1971	35911
1972	50170
1973	63138
1974	76500

Appendix Table IV.4 Contd.

1	2
1975	50363
1976	41174
1977	25880
1978	63273
1979	54137
1980	NA
1981	28740
1982-83	35122
1983	NA
1984	NA

Sources: 1. CMFRI, Marine Fish Production in India 1950-1968, Bulletin No.13, (CMFRI, Cochin, 1969), p. 137.

2. CMFRI, MFIS Series Nos. 41 and 52, (CMFRI, Cochin, 1982-83).

3. Expert Committee, op. cit., pp. 207-8.

Appendix Table IV.5

Trend in the Qutput of Major Species of Fish Caught by the Traditional and Modern Sector of the Fishing Industry of Kerala during 1951-1984.

(Quantity in tons)

Year	Oil sardine	Mackerel	Prawn	'Other'	Total
1	2	3	4	5	6
1951	15160	59314	NA	116558	191032
1952	6617	24748	NA	97980	129345
1953	42012	13875	NA	56112	111999
1954	29276	7492	NA	80266	117034
1955	20388	5345	NA	79724	105457
Average of 1951-55	22691 (17.32)	22155 (16.91)	NA	86128 (65.76)	130973 (100)
1956	5065	8986	NA	138162	152213
1957	175851	26187	NA	107888	309926
1958	118971	55476	NA	120208	294655
1959	62036	29332	NA	100007*	191375
1960	185929	35485	NA	123191**	*344605
Average of 1956-60	109570 (42.37)	31093 (12.02)	NA	117891 (45.60)	258555 (100)

Appendix Table IV.5 Contd.

1	2	3	4	5	6
1961	166005	20044	20436	61009	267494
1962	91203	11938	29218	59062	191421
1963	59950	48917	21954	72559	202380
1964	190401	9657	35220	82696	317974
1965	219170	18048	14411	87544	339173
Average of 1961-65	145146 (55.04)	21721 (8.24)	24248 (9.20)	72574 (27.52)	263688 (100)
1966	202800	10747	28379	104818	346744
1967	235410	4500	27252	96967	364129
1968	247048	3600	25391	69262	345301
1969	139983	29981	34368	90455	294787
1970	191683	54659	36954	109584	392880
Average of 1966-70	203385 (58.32)	20697 (5.93)	30469 (8.74)	94217 (27.01)	348768 (100)
1971	194977	95164	32813	122393	445347
1972	104426	34516	36577	120099	295618
1973	122783	19780	85751	219955	448269
1974	102135	10335	60829	246958	420257
1975	97183	14930	77962	230761	420836
Average of 1971-75	124301 (30.61)	34945 (8.61)	58786 (14.48)	188033 (46.30)	406065 (100)

Appendix Table IV.5 Contd.

1976	123937	19978	34533	152599	331047
1977	117356	19968	40324	167389	345037
1978	119937	25917	45428	182057	373339
1979	116834	18585	29597	165493	330509
1980	69667	18474	54375	137027	279543
Average of 1976-80	109546 (33.00)	20584 (6.20)	40851 (12.31)	160913 (48.48)	331895 (100)
1981	146986	16199	22268	88942	274395
1982-83	159488	9270	32288	147397	348443
1983	-	-	-	-	-
1984	101844	20894	31139	270841	424718
Average of 1981-84	136106 (38.98)	15454 (4.42)	28565 (8.18)	169060 (48.42)	349185 (100)

* includes 288 tons of prawns.

** includes 417 tons of prawns.

Sources: 1. Babu Paul, Report of the Committee to Study the Need for Conservation of Marine Fishery Resources During Certain Seasons of the Year and Allied Matters, (Government of Kerala, Trivandrum, 1982), pp. 154-56.

2. CMFRI, MFIS Series No. 41 and 52, (CMFRI, Coch 1982-83).

3. Department of Fisheries, Survey of Marine Fish Landings, Quarterly Reports, (Government of

Appendix Table IV.6

Average Wholesale (Shore) Price of Major Species of Fish in Kerala during 1961-1984

(Price: Rs/ton)

Year	Oil sardine	Mackerel	Prawn	Other
1961	83	264	254	194
1962	105	312	273	180
1963	161	283	348	194
1964	160	294	409	247
1965	133	366	695	260
1966	167	451	887	273
1967	185	539	979	318
1968	162	729	1287	368
1969	285	769	1510	520
1970	400	770	1700	644
1971	372	873	1803	653
1972	395	892	1925	694
1973	425	921	3006	752
1974	654	1638	3583	923
1975	851	2409	4188	1288
1976	840	2044	6220	1356
1977	905	1607	7815	1261
1978	925	1639	8790	1305
1979	895	1659	9601	1410
1980	915	1675	10021	1515
1981	935	1720	11320	1587
1982	920	1865	12655	1676
1983	950	2065	12825	1672
1984	1040	2470	13525	1655
% increase in 1984 over the 1969 level	265%	221%	795%	218%

Appendix Table V.1

Comparative Performance of Country Craft and Small Mechanised Boats Issued by the Indo-Norwegian Project

(Average of 1959-1962)

Items	Traditional craft		Mechanised boats		
	Small canoes	Big canoes	22 ft. 4 - 5 HP	23.5 ft.* 8 - 10 HP	25 ft.+ 8 - 10 HP
1. Capital cost	NA	NA	2883-3736	6748*	7220*
2. Annual catch per boat (Kg.)	8603	8010	8841	11652	14563
3. Annual gross fishing income per boat (Rs.)	2389	3667	3643	8156	7428
4. Annual net income per boat (Rs.)∞	2032	3148	1883	5244	4559
5. Size of crew per boat	5	10	3-4	4	4
6. Annual net income per crew member (Rs.)	406	315	538	1311	1140

* Data relate to 1962 only

\+ Data relate to 1960-62. Cost of gear not included.

∞ In working out the net income, the actual capital cost of the boats were also taken into account.

Source: T.R. Thankappan Achari, 'Indo-Norwegian Project: An Assessment of Its Impact on the Growth and Development of Indian Fisheries', Souvenir, (INP, Cochin, 1972), p. 91

Appendix Table V.2

Details of Prototypes of Craft Developed and Constructed Under the Supervision of FAO Naval Architects During 1954-61

Type of Boat Design	Designer	No. of Boats					
		1954-57	1958	1959	1960	1961	Total
1	2	3	4	5	6	7	8
New Designs							
18-20 ft. surf-boat	Ziener	6	-	-	-	-	6
22 ft.	Rasmussen	2	-	1	-	-	3
24 ft. surf-boat	Gurtner	-	1	2	-	-	3
24 ft. 7 in.	Ziener	3	12	5	14	1	35
25 ft.	Gurtner	-	3	14	30	40	87
30 ft.	Ziener/Gurtner	11	15	30	65	65	186
31 ft. 9 in.	Ziener	2	2	2	-	-	6
32 ft.	Rasmussen	1	-	-	-	-	1
32 ft.	Gurtner	-	-	-	6	-	6
36 ft.	Gurtner	-	-	-	2	-	2
42 ft.	Gurtner	-	-	-	1	-	1
44 ft.	Ziener	-	-	1	-	-	1
49 ft.	Gurtner	-	-	-	7	-	7
69 ft.	Gurtner	-	-	-	1	-	1

Appendix Table V.2. Contd.

1	2	3	4	5	6	7	8
Local Types Adapted and Mechanised							
Machwas	Ziener	NA	NA	NA	NA	NA	NA
Satpati boats	Ziener	1	-	1	-	1	3
Tuticorin boats	Ziener/ Gurtner	-	-	-	-	2	2
Navas	Rasmussen	-	44	-	-	-	44
Others	NA	1	3	-	1	16	21
All	-	79	56	68	110	142	455

Source: FAO, Third Report to the Government of India on Fishing Boats, based on the Work of Peter Gurtner, FAO Report No. 1535, (FAO, Rome, 1963), p. 40.

Appendix Table V.3

Trend in the Export of Shrimp and Other Marine Products from India from 1963 to 1979

(Quantity in Tons; Value in Rs. Millions)

Year	Shrimp		Other products		Total	
	Quantity	Value	Quantity	Value	Quantity	Value
1963	8007	38.10	9901	20.55	17908	58.65
1964	9953	47.50	11505	20.99	21458	68.49
1965	9878	56.38	5580	12.86	15458	69.24
1966	11470	112.72	7683	22.53	19153	135.25
1967	14913	170.01	6851	29.28	21764	199.29
1968	18046	189.76	6764	31.09	24810	220.85
1969	23937	289.89	6647	40.84	30584	330.73
1970	26199	290.42	10976	64.94	37175	355.36
1971	25729	346.86	8303	44.87	34032	391.73
1972	31747	531.25	6524	50.07	38271	581.32
1973	38378	713.72	10407	82.04	48785	795.76
1974	35993	686.59	10636	76.54	46629	763.13
1975	47191	950.52	6221	98.54	53412	1049.06
1976	48090	1610.82	14061	187.80	62151	1798.62
1977	47602	1569.14	17362	228.23	64964	1797.37
1978	51431	1799.87	26515	321.70	77946	2121.57
1979	53669	2237.92	38515	382.37	92184	2620.29
% increase in 1979 over 1963	570.27	5873.80	389.00	1860.68	514.76	4467.67

Sources: 1. MPEDA, Statistics of Marine Products Exports - 1976, (MPEDA, Cochin, 1977), pp. 12-13.

2. MPEDA, Statistics of Marine Products Exports - 1985, (MPEDA, Cochin, 1987), p. 13.

Appendix Table V.4

Average Wholesale Price[a] of Indian Shrimp[b] in U.S. and Japanese[c] Markets

Grade of shrimps	U.S. Market (Cents/Kg.)			Japanese Market (Cents/Kg[d])		
	1972	1979	% change between 1972 and 1979	1972	1979	% change between 1972 and 1979
Un/15	509	1128	221.61	575	1400	243.47
16/20	496	1102	22.17	520	1388	266.92
21/25	472	1051	222.66	450	1100	244.44
26/30	441	959	217.46	390	900	230.76
31/35	385	859	223.11	305	800	262.29
36/40	352	826	234.65	305	708	232.13
41/50	315	694	220.31	245	630	257.14
51/60	293	606	206.82	205	571	278.53
61/70	273	584	213.91	175	500	285.71
71/90	244	548	224.59	140	427	305.00
91/110	231	489	211.68	-	-	-
110/130	224	473	211.16	-	-	-
130/200	216	372	172.22	-	-	-
200/300	145[e]	337	232.14	-	-	-

a Prices prevailing in January only.

b Price of peeled and deveined shrimp in U.S.

c Price of Headless white/tiger/flower variety of prawn in Japan

d C.I.F. price offered to indian shippers for packets of 2 Kg blocks

e Price of December 1972

Appendix Table VI.1

Major Craft Types, Their Size and Number in Kerala in 1982

Craft size (in ft.)	Craft Types				Total
	Gill netters	Trawlers	Purse-seiners	Others	
1	2	3	4	5	6
18	1	-	-	-	1
20	3	-	-	-	3
21	1	-	-	-	1
21.5	1	-	-	-	1
22	2	-	-	-	2
22.5	1	-	-	-	1
23	10	-	-	-	10
23.5	5	-	-	-	5
24	2	1	-	-	3
25	194	52	-	-	246
26	17	-	-	-	17
27	4	-	-	-	4
28	60	39	-	-	99
29	2	-	-	-	2
30	61	633	-	-	694
30.5	-	3	-	-	3
31	-	58	-	-	58
31.5	-	485	-	39	524

Appendix Table VI.1 Contd.

1	2	3	4	5	6
32	16	1108	-	9	1133
32.5	-	1	-	-	1
33	-	1	-	-	1
34	-	1	-	-	1
36	-	85	-	2	87
38	-	4	-	-	4
39	2	-	2	-	4
40	-	-	1	-	1
41.5	-	1	1	-	2
42	-	4	5	-	9
43	-	-	4	-	4
43.5	-	-	9	-	9
44	-	-	5	-	5
45	-	-	9	-	9
46	-	-	9	-	9
47	-	-	8	-	8
All % of total	382 (12.90)	2476 (83.62)	53 (1.78)	50 (1.68)	2961 (100)

Source: Department of Fisheries, Census of Mechanised Fishing Boats in Kerala, (Government of Kerala, Trivandrum), pp. 8-11.

Appendix Table VI.2

Details of Cumulative Investments in Fisheries Development Projects in Kerala by ARDC from June 1974 to June 1982

(Rs in lakhs)

Period	Funding Agency			Total
	State Land Development Bank	Scheduled Commercial Banks	State Co-operative Bank	
Upto 30th June 1974	-	-	48	48
1975	-	-	-	-
1976	-	-	-	-
1977	-	-	-	-
1978	-	112	56	168
1979	-	249	56	305
1980	-	316	56	372
1981	4	369	56	429
1982	10	397	56	463

Source: Agricultural Refinance and Development Corporation, Annual Reports, 1973-74, 1977-78, 1978-79, 1979-80, 1980-91 and 1981-82.

Appendix Table VI.3

Details of Outlay and Expenditure for Fisheries Development in Kerala During the Successive Five Year Plans

(Amount in Rs lakhs)

Name of plan	Sl. No.	Name of scheme	Outlay	Expenditure	Expenditure as percentage of outlay
1	2	3	4	5	6
I Plan 1951-56	1.	Marine Fisheries	3.270	NA	NA
	2.	Inland Fisheries	2.660	NA	NA
	3.	Research Station at Cape and Ernakulam	2.000	NA	NA
	4.	Other Schemes	3.180	NA	NA
	Total		11.110	2.740	24.66
II Plan 1956-61	1.	Mechanisation and improvement of fishing craft	8.360	8.560	102.39
	2.	Supply of fishery requisites	5.590	3.320	59.39
	3.	Training of personnel	1.830	1.790	97.81
	4.	Construction of break water and development of fishing harbour	21.950	0.150	0.68

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	5.	Issue of loans to Fishermen Cooperatives and Organisation of Fishermen Cooperative Societies	10.200	6.850	67.15
	6.	Research Schemes	2.190	1.690	77.16
	7.	Salt subsidy scheme	9.360	15.360	164.10
	8.	Introduction of ice plants and cold-storages	21.550	18.480	85.75
	9.	Identification and guide lights	1.150	0.250	21.74
	10.	Expansion of Fisheries Technological Station	0.750	0.990	132.00
	11.	Stocking of Ponds and Intensive Seed Collection	3.110	1.300	41.80
	12.	Development and exploitation of major reservoirs	0.500	0.620	124.00
	13.	Estuarine fish farms	1.000	0.550	55.00
	14.	Rural fishery demonstration	0.630	0.610	96.82
	Total		88.170	60.520	68.64

Appendix Table VI.3 Contd.

1	2	3	4	5	6
III Plan 1961-66	1.	Mechanisation of fishing craft	92.450	108.530	117.39
	2.	Commercial trawler fishing	4.000	3.710	92.75
	3.	Supply of fishery requisites	16.360	10.970	65.06
	4.	Training of fishermen	13.450	11.630	86.46
	5.	Education and staff training	2.400	2.410	100.41
	6.	Fishing harbours and landing centres	98.980	81.810	82.65
	7.	Organisation of fishermen cooperatives	11.080	11.050	99.73
	8.	Research and statistics	5.440	3.520	64.70
	9.	Ice plants, cold storages, and transport vehicles	63.000	65.190	103.47
	10.	Freezing plants	1.500	1.130	75.33
	11.	Fish curing	14.470	14.940	103.24
	12.	Housing and colonisation	6.000	5.220	87.00
	13.	Provision of community amenities	7.520	3.970	52.79
	14.	Subsidiary industries	0.750	0.010	1.33
	15.	Fish farming and river fisheries	17.770	6.670	37.53
	16.	Development of major reservoirs	4.540	4.830	106.38

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	17.	Administration	5.990	6.370	106.34
	18.	ICAR scheme	1.470	1.280	87.07
	Total		367.670	343.240	93.35
Three Annual Plans (1966-67 to 1968-69)	1.	Mechanisation of fishing craft	327.463	427.966	130.69
	2.	Supply of fishery requisites	33.812	18.951	56.04
	3.	Training of fishermen	4.502	3.732	82.89
	4.	Technical School for fishermen children	2.620	1.972	75.26
	5.	Education and staff training	5.600	4.120	73.57
	6.	Fisheries Schools and Training Centres	11.276	11.521	102.17
	7.	Investigations for the fishing harbours at Kayamkulam and Koottayi	0.700	0.020	2.85
	8.	Fishing harbours	181.641	87.747	48.30
	9.	Boat-building yards, service stations and slip way	12.800	1.218	9.51
	10.	Fishermen Cooperative Societies	26.657	24.055	90.23

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	11.	Kerala Fisheries Corporation	93.000	65.000	69.89
	12.	Central Fisheries Corporation	10.500	0.000	0.00
	13.	Research and Statistics	8.721	4.758	54.55
	14.	Housing and Colonisation	24.500	7.912	32.29
	15.	F.C.S. Contribution to Agricultural Refinance Corporation	5.000	1.320	26.40
	16.	Development of roads	12.254	6.225	50.80
	17.	Ice Plants and Cold Storages	71.547	53.600	74.91
	18.	Community Amenities	12.764	3.302	25.86
	19.	Ameleoration Measures to Fishermen	3.000	7.186	239.53
	20.	Applied Nutrition Programme	5.070	5.341	105.34
	21.	Development of Major Reservoirs	10.617	7.069	66.58
	22.	Estuarine Fish Farms and River Fisheries	6.909	1.658	24.00
	23.	Administration (Headquarters Staff)	3.718	3.020	81.22
	24.	Statistical Unit and Sample Survey on Marine Fisheries	0.250	-	-
	25.	I.C.A.R. Schemes	2.372	1.643	69.26
	Total		877.293	749.336	85.41

Appendix Table VI.3 Contd.

1	2	3	4	5	6
IV Five Year Plan	1.	Mechanised Fishing and Trawler Fishing	654.000	295.852	45.23
	2.	Supply of Fishery Requisites	16.000	11.996	74.97
	3.	Manpower Training and Expertise	6.000	2.126	35.43
	4.	Training Centres and Schools	35.000	20.032	57.23
	5.	Fishing Harbours	-	21.450	-
	6.	Boat yards and service Stations	3.000	2.127	70.90
	7.	Cooperation	100.000	17.824	17.82
	8.	Housing Colonisation and Welfare Measures	50.000	50.348	100.69
	9.	Roads	100.000	53.300	53.30
	10.	Ice Plants and Cold Storages	40.000	20.590	98.97
	11.	Distribution of Fish	36.000	-	-
	12.	Assistance to Kerala Fisheries Corporation	-	22.000	-
	13.	Research	20.000	1.217	6.08
	14.	A.R.C. Scheme	-	36.517	-
	15.	Inland Fisheries and Reservoirs	15.000	6.282	41.88
	16.	Other Fisheries	10.000	1.680	16.80

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	17.	Sample Survey on Marine Fish Landings	-	0.030	-
	18.	Administration and Extension	15.000	-	-
	Total		1100.00	563.371	51.21
V Plan (1974-78)	1.	Small Boat Mechanisation	257.149	217.345	84.52
	2.	Assistance to Traditional Fisheries	9.001	6.689	74.31
	3.	Deep Sea Fishing	25.000	25.000	100.00
	4.	Training in Marine Fisheries	9.800	4.490	45.81
	5.	Research and Training in Marine Fisheries	31.684	21.496	67.84
	6.	Fishing Harbour and Landing Facilities (Centrally Sponsored Scheme)	147.091	44.279	30.10
	7.	Establishment of Harbour Engineering Wind	3.000	0.212	7.06
	8.	Repair and Refitting Facilities	2.750	-	-
	9.	Roads	61.000	64.432	105.62
	10.	Research in Marine Fisheries	14.803	9.037	61.04
	11.	A.R.C. Scheme	52.400	31.740	60.57
	12.	Development of Vizhinjam and Neendakara Fishing Harbours with World Bank Assistance	1.719	-	-

Appendix Table [illegible] Contd.

1	2	3	4	5	6
	13.	Infrastructure for Fishing Villages	7.001	0.050	0.71
	14.	Land Acquisition for Cochin Fishing Harbour	0.001	-	-
	15.	Assistance to Fishermen Cooperative Societies	69.538	57.703	82.98
	16.	Assistance to K.F.C.	118.000	143.100	121.27
	17.	Housing and Colonisation	74.100	85.690	115.64
	18.	Community Amenities and Dispensaries	0.350	1.177	336.28
	19.	Kerala Fishermen Welfare Corporation and Fishermen Relief Fund	35.000	35.000	100.00
	20.	Guide Lights	5.500	1.692	30.76
	21.	Storage, Processing and Marketing	37.623	17.073	45.38
	22.	Curing and Drying	1.500	-	-
	23.	Extension	2.510	3.210	127.88
	24.	Development of Reservoir Fisheries	7.600	4.541	59.75
	25.	Fish Farming in Brackish Water	3.300	0.669	20.27
	26.	Fish Seed Farm	11.309	2.714	23.99
	27.	Fish Seed Production	12.791	7.565	59.14

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	28.	Training of Pisciculturists	1.100	0.469	42.63
	29.	Fresh Water Research	2.000	1.239	61.95
	30.	Development of Small Water Areas	0.019	-	-
	31.	Subsidy to Pisciculturists	1.000	-	-
	32.	Fish Farmers Development Agency (Central Scheme)	0.001	3.700	-
	33.	Other Minor Works	0.150	-	-
	34.	Planning and Statistical Cell	4.000	0.718	17.95
	Total		1009.790	791.030	78.33
Two Annual Plans (1978-79 to 1979-80)	1.	Small Boat Mechanisation	33.000	32.655	98.95
	2.	Assistance to Traditional Fisheries	20.000	20.365	101.82
	3.	Development of Fishermen Training Centres	13.706	20.774	151.56
	4.	Inservice Course to Technical Personnel	3.000	0.013	00.43
	5.	Development of Vizhinjam, Kovalam and Neendakara Fishing Harbours	68.000	70.933	104.31
	6.	Harbour Engineering Wing	2.000	0.872	43.60

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	7.	Roads	45.000	38.049	84.59
	8.	Infrastructure in Selected Fishing Villages	55.000	16.713	30.38
	9.	Land Acquisition Charges for Rehabilation of Displaced Person	0.001	0.640	-
	10.	Assistance to Fishermen Cooperative Societies	26.400	49.970	189.28
	11.	Assistance to Kerala Fishermen's Welfare Corporation	85.000	92.000	108.23
	12.	Assistance to Kerala Fisheries Corporation	80.001	189.142	236.42
	13.	Assistance to Fishermen Welfare Corporation for Subsidised Housing	-	83.000	-
	14.	Community Amenities and Dispensaries	13.000	2.345	18.03
	15.	Fishermen Welfare Fund	35.000	30.000	85.71
	16.	Housing and Colonisation	25.372	24.933	98.27
	17.	Guide Lights	7.000	0.277	3.95
	18.	Repair and Refitting Facilities	10.000	2.801	28.01
	19.	Development of Tuna Fishing	32.000	-	-
	20.	Off-shore Fishing by Purse-seiners	15.000	0.010	0.06

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	21.	A.R.C. Scheme	7.000	4.704	67.20
	22.	Diversification of Fishing Accessories and Gear	45.000	-	-
	23.	Market Survey and Research	1.000	0.600	60.00
	24.	Storage, Processing and Marketing	3.500	3.020	86.28
	25.	Fish Boxes and Insulated Cabinets	3.250	-	-
	26.	Organisation of Regulated Markets and Large Markets	10.600	-	-
	27.	Financial Assistance for Marketing of Fish	5.000	-	-
	28.	Canning and Curing	6.000	-	-
	29.	Extension	5.000	5.501	110.02
	30.	Planning and Statistical Cell	6.000	3.322	55.36
	31.	Research in Marine Fisheries	9.500	4.192	44.12
	32.	Development of Small Water Areas	3.000	0.296	9.86
	33.	Brackish Water Fish Farming	25.620	4.649	18.14
	34.	Fish Seed Farms	27.388	12.339	45.05
	35.	Training of Pisciculturists	3.000	0.046	1.53
	36.	Fish Seed Production	14.094	1.513	10.73

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	37.	Reservoir Fisheries	7.249	6.263	86.39
	38.	Mariculture in Shallow Protected Areas	5.000	3.284	65.68
	39.	Fishing Harbours and Landing Centres (Centrally Sponsored Schemes - States Share Included)	3.488	0.029	0.83
	40.	Strengthening of Organisation for Fisheries Extension	0.001	-	-
	41.	Fish Farmer's Development Agency (Central Scheme)	11.002	7.523	68.37
	42.	Brackish Water Fish Farming at Thevara	4.682	1.713	36.58
	Total		774.854	734.486	94.78
VI Plan (1980-85)	1.	Mechanisation and Improvement of Fishing Craft	100.000	141.840	141.84
	2.	Off-shore Fisheries and Deep-Sea Fisheries	50.000	69.520	139.04
	3.	Education and Training	52.000	60.020	115.42
	4.	Fishing Harbours and Landing Centres	547.000	393.460	71.93
	5.	Research	10.000	16.050	160.50
	6.	Processing, Preservation and Marketing	247.000	209.860	84.96

Appendix Table VI.3 Contd.

1	2	3	4	5	6
	7.	Inland Fisheries	41.500	28.920	69.68
	8.	Fish Farming and Hatcheries	121.500	152.490	125.50
	9.	Extension	10.000	11.790	117.90
	10.	Direction and Administration	22.500	36.120	160.53
	11.	Other Schemes (Mainly Welfare Schemes)	798.500	985.410	123.40
	Total		2000.000	2105.420	105.27
VII Plan (1986-90)	1.	Mechanisation and Improvement of Fishing Craft	605.000		
	2.	Off-shore Fisheries and Deep-sea Fisheries	200.000		
	3.	Education and Training	250.000		
	4.	Fishing Harbour and Landing Centres	1328.000		
	5.	Research	75.000		
	6.	Processing, Preservation and Marketing	720.000		
	7.	Inland Fisheries	192.000		
	8.	Fish Farming and Hatcheries	480.000		

Appendix Table VI.6 Contd.

1	2	3	4	5	6
	9.	Direction and Administration	-		
	10.	Extension	-		
	11.	Other Schemes (Mainly Welfare Schemes)	1760.000		
	12.	New Schemes (Social Amenities, Adult-Education, etc.)	900.000		
	Total		6500.000		

Sources: 1. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 102-11.

2. State Planning Board, Draft Seventh Fifth Five Year Plan 1985-90 and Annual Pla 1985-86, Vol. II, (Government of Kerala, Trivandrum, 1984), pp. 12-13.

Appendix Table VII.1

Trend in the Output of the Mechanised Sector During 1956-1984

(Output in tons)

Year	Output	% increase (+)/ decrease (-) over the previous year	% of total output of the industry
1	2	3	4
1956	1300	-	0.85
1957	2800	115.38	0.90
1958	2600	-7.14	0.88
1959	1700	-34.61	0.88
1960	2079	22.29	0.60
1961	1131	-45.59	0.42
1962	1049	-7.25	0.54
1963	862	-17.82	0.42
1964	3391	293.38	1.06
1965	4955	46.12	1.46
1966	8342	68.35	2.40
1967	4257	-48.96	1.16
1968	3236	-23.98	0.93
1969	28177	770.73	9.56
1970	52571	86.57	13.38
1971	47291	-10.04	10.61
1972	38648	-18.27	13.07
1973	93659	142.33	20.89
1974	101412	8.27	24.13

Appendix Table VII.1 Contd.

1	2	3	4
1975	180111	77.60	42.79
1976	58717	-67.39	17.73
1977	107424	82.95	31.13
1978	117356	9.24	31.43
1979	94779	-19.23	28.67
1980	134783	42.20	48.30
1981	95331	-29.27	34.68
1982	148240	55.50	45.56
1983	NA	NA	NA
1984	142551	-3.83*	33.56

* Decrease over 1982.

Sources: 1. CMFRI, Marine Fish Production in India 1950-19 Bulletin No.13, (CMFRI, Cochin, July 1969), pp. 129-30.

2. CMFRI, Exploited Marine Fishery Resources of India, Bulletin No.27, (CMFRI, Cochin, March 1976), p. 12.

3. Department of Fisheries, Kerala Fisheries - Facts and Figures 1980, (Government of Kerala, Trivandrum, 1983), pp. 8-9.

4. Directorate of Economics and Statistics, Statistics for Planning 1983, (Government of Kerala, Trivandrum, 1984), pp. 189-90.

5. Department of Fisheries, Survey on Marine Fish Landings, Nos 2,3,4 and 5, (Government of Kera Trivandrum, 1984-85).

Appendix Table VII.2

Catch, Effort and Catch per Man-Hour of Effort for Mechanised Boats Operating From Neendakara During 1970-80

Year	Catch (tons)	Effort (boat-hour)	Catch per boat-hour of effort (Kg)	Catch per man-hour* (Kg)
1970	26704	146185	182.67	33.53
1971	51493	276476	186.25	37.25
1972	23622	383227	6164	12.32
1973	66064	550370	120.04	24.00
1974	77748	823719	94.39	18.87
1975	151095	1331728	113.46	22.69
1976	29836	536897	55.57	11.11
1977	45828	1336732	34.28	6.85
1978	89892	2413475	37.25	7.45
1979	56016	723730	77.40	15.48
1980	84556	4843440	17.46	3.49

* Obtained by dividing the catch per boat-hour by a crew size of five.

Source: R. Satyadas and G. Venkataraman, 'Impact of Mechanised Fishing on the Socio-Economic Conditions of the Fishermen of Sakthikulangara-Neendakara, Kerala', MFIS, No.30, (CMFRI, Cochin, 1981), p. 12.

Appendix Table VII.3

Details of Fishermen Employed in Fishing and Allied Activities in the Coastal Districts of Kerala during 1972 and 1982

Districts	Year and % change over 1972 *	Fishing	Processing	Marketing	Making repairing of nets	Total
Cannanore	1972	10858	1501	2432	617	15408
	1982	11654	331	2733	291	15009
	% change	7.33	-77.94	12.37	-52.83	-2.59
Kozhikode	1972	14736	315	697	618	16366
	1982	10711	163	499	590	11963
	% change	-27.31	-48.25	-28.40	-4.53	-26.90
Malappuram	1972	4169	504	183	374	5230
	1982	13508	789	970	766	16033
	% change	224.01	56.54	430.05	104.81	206.55
Trichur	1972	7038	953	725	733	9449
	1982	6647	156	1068	314	8185
	% change	-5.55	-83.63	47.31	-57.16	-13.37
Ernakulam	1972	14528	1934	2203	1357	20022
	1982	16525	1933	2618	1311	22387
	% change	13.74	-0.05	18.83	-3.38	11.81
Alleppey	1972	24586	2458	3265	5234	35543
	1982	25227	1779	3543	1379	31928
	% change	2.60	-27.62	8.51	-73.65	-10.17
Quilon	1972	11287	769	1507	1918	15481
	1982	17984	1133	2962	3677	25756
	% change	59.33	47.33	96.54	89.83	66.37
Trivandrum	1972	20832	2468	7231	4637	35168
	1982	20282	1066	7460	3960	32768
	% change	-2.64	-56.80	3.16	-14.59	-6.82

* Percentage change as increase (+) or decrease (-).
Source: Same as for Table VII.9

Appendix Table VII.4

Total Catch, Effort and Catch per Unit Effort for Mechanised Boats in Kerala During 1971-82

Year	Total catch (tons)	Effort (Boat hours)	Catch per boat hour (Kg.)
1971	47291	1821372	25.96
1972	38648	1387252	27.86
1973	93659	1321972	70.85
1974	101412	2042130	49.66
1975	180111	1867494	96.45
1976	58707	1522566	38.56
1977	107424	2138632	50.23
1978	117355	3389548	34.62
1979	94777	1669683	56.76
1980	135305	6020342	22.47
1981	96321	2764282	34.84
1982	148240	4186038	35.41

Source: Expert Commitee, op. cit., p. 15.

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