TECHNOLOGY TRANSFER IN THE FISH CURING INDUSTRY IN INDIA

THESIS SUBMITTED TO
THE UNIVERSITY OF COCHIN
IN PARTIAL FULFILMENT OF THE REQUIREMENTS
FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY

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MARCH 1986

DECLARATION

I hereby certify that this thesis is a record of bonafide research carried out by me under the supervision of Dr. C.T.Samuel, Professor of Industrial Fisheries and Dean, Faculty of Marine Sciences, University of Cochin and that it has not formed the basis for award of any degree, diploma, associateship, fellowship or other similar titles of this or any other University or Society.

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CERTIFICATE

This is to certify that this thesis is an authentic record of the research carried out by Shri M.K.Kandoran, Scientist, Central Institute of Fisheries Technology, Cochin under my supervision and guidance, in partial fulfilment of the requirements for the award of Ph.D. degree of the University of Cochin. I further certify that no part of this thesis has previously formed the basis of the award of any degree, diploma, associateship, fellowship or other similar titles of this or any other University or Society.

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ACKNOWLEDGEMENTS

It is with profound gratitude that I express my indebtedness to Dr. C.T.Samuel, Professor of Industrial Fisheries and Dean, Faculty of Marine Sciences, University of Cochin for his enlightened guidance and criticism of this investigation.

I express my deep sense of gratitude to Shri M.R.Nair, Director, Central Institute of Fisheries Technology, Cochin for providing all necessary facilities to carry out this investigation.

I wish to place on record my sincere thanks to S/Shri H.Krishna Iyer and G.R.Unnithan, Scientists of Central Institute of Fisheries Technology, Cochin for the co-operation and assistance in the statistical treatment of the data.

I am extremely thankful to Dr. Devesh Kishore, Professor and Head, Agricultural Extension and Communication, National Academy of Agricultural Research Management, Hyderabad, Dr. A.M.Thampi, Professor of Agricultural Extension, College of Agriculture, Trivandrum, Dr. Byra Reddy, Director of Extension, Andhra Pradesh Agricultural University, Hyderabad and Dr. S.V.Reddy, Professor of Extension, Extension Education Institute, Hyderabad for their helpful discussion during this investigation.

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INTRODUCTION

CHAPTER ONE

INTRODUCTION

1.1. Historical account

There are two distinct phases in the fish processing industry in India. One is the saturated growth in the age old traditional curing upto 1953 and the second phase is the application of modern preservation methods and the export of frozen and canned fishery products to other countries (Govindan, 1969).

During the first phase, the sea food industry in India was mainly confined to the production and export of cured fish. Dried fish and salted fish have been conventional items in India from even the prehistoric times (Devidas Menon, 1976). For more than hundred years, India exported cured fishery products to the neighbouring countries. This item occupied an important place in the world market till the early fiftees. Ceylon, Burma, Singapore, Mauritius, Hong Kong etc. had been the traditional markets for cured fish from India. Later, India lost some of the markets owing to the political and administrative changes in these countries. Restrictions were imposed by importing countries like Ceylon, Burma stopped off-take of dry fish from India on the basis of a bilateral trade agreement with Pakistan involving exchange of rice for fishery prorducts on account of foreign exchange difficulties. An internal market for the local products for providing impetus to the development of local fisheries was made in Singapore and Hong Kong.

On the basis of a trade agreement between India and Ceylon, 95% of the total export of dried fish from India was taken by Ceylon. The products were shipped from Tuticorin. The import of dried fish by individual importers in Ceylon was banned after the formation of a Co-operative Whole sale Establishment in 1961. The Indian shippers supplied the materials in accordance with the terms and conditions set forth in the price list issued by C.W.E. from time to time. The price list was common for several countries such as India, Pakistan and Aden supplying dried fish to Ceylon. The primary financier in this trade was the Indian Overseas Bank Ltd. which gave 50% advance against the shipping documents with out any inspection of the goods. This provision led to the export of goods of inferior quality and C.W.E. imposed arbitrary cut in the value of goods. The inordinate delay in receiving remittance caused hardships to the exporters. To solve these problems and to help the exporters of cured fish from India, the State Trading Corporation came into the picture. STC gave 65% of the f.o.b. value as advance against the shipping documents after conducting inspection of the products through the approved agency. The final accounts were settled after STC received remittance from CWE.

C.W.E. published a list of 10 exporters who alone were permitted to export dried fish to Ceylon. This was done to maintain quality and to avoid clerical labour involved in dealing with too many small parties. As the result of this, a large number of traditional exporters were thrown out of the business. As requested by them, Government of India issued in 1967 a notification canalizing the export of dried fish (excluding prawns, fish maws, shark fins, beach-de-mer and Bombay duck) from India to Ceylon. The exports were then subjected to vigorous inspection and quality control by the Export Inspection Agency.

In the past, the surplus fish that could not be marketed in fresh condition were cured. The State Governments provided curing yards and salt at subsidised rates to encourage fish curing. Later, in many states subsidy of salt was abolished and the Government curing yards were closed down as the emphasis became more and more for alternate methods of fish preservation (George, 1969).

The decline in fish curing was mainly due to the tremendous increase in the consumption of fresh fish. This is attributed to the fast development of our fishing centres which are connected directly with major consumer markets with motorable roads. Also there has been substantial increase in facilities for icing fresh fish. Mechanised fishing and scientific methods of handling and preservation of fish were practically unknown to our country before the second world war (Govindan, 1975). Decline of fish curing was partly due to lack of demand of cured fish products in foreign markets and also, to some extent, due to the establishment of the freezing and canning industry. The Table 1 shows the trend of disposition of fish catch and the position of fish curing industry in India.

Table 1. Percentage disposition of fish catch in India

Year	Marketing as fresh	Curing	Freezing	Canning	Reduction	Miscellaneous
1953	42.73	50.74			6.60	
1954	42.70	50.70			6.30	
1955	42.70	50.70			6.50	
1956	42.70	50.70			6.60	
1957	42.70	50.70			6.60	
1958	42.76	50.71			6.58	
1959	42.66	50.70			6.60	
1960	47.90	43.80			8.40	
1961	47.96	43.69			8.40	
1962	47.90	46.77			8.41	
1963	67.40	27.10	0.40	0.10	5.00	
1964	70.00	21.70	1.20	0.20	5.90	0.90
1965	68.30	25.60	1.30	0.40	4.10	0.20
1966	70.40	21.90	1.90	0.60	3.90	0.80
1967	68.80	19.70	3.40	0.80	5.50	1.80
1968	69.10	19.30	4.10	0.70	5.20	1.60
1969	67.90	21.50	3.50	0.60	4.40	2.10
1970	67.00	20.30	4.60	0.70	5.50	2.80
1971	66.00	19.30	5.30	0.70	5.60	2.90
1972	68.20	17.50	5.00	0.70	4.90	3.20
1973	65.30	19.40	5.40	0.80	5.33	3.78
1974	63.70	23.20	4.50	0.40	4.94	3.18
1975	69.64	18.96	2.80	0.21	6.01	2.38
1976	69.30	17.88	5.02	0.30	5.00	2.50

Source: FAO year books for different periods

Till 1959, about 50% of the total catch was processed by curing alone. This figure was lowered to about 25% in 1965 and from 1966 onwards, it was retained in the range 18-22% (FAO year book from 1953-76).

To some extent, the decline could be attributed to the low quality of cured fish products produced in the country. Very little attempt has been made to improve the quality of dried and salted fish. Processing of cured fish was in the hands of the illiterate people belonging to a poor sector of the community. Industrial principles and concept had never been applied to this traditional industry. As a result of all these, the fish curing industry in India remained as quite primitive.

In spite of the development of the sophisticated methods like freezing and canning, fish curing is still the largest single method of preservation of fish in India. Salting and drying remain to be the largest single method of fish preservation in the world because of its cheapness and easiness (Govindan, 1971). Fish curing is a labour intensive industry and it does not require much skill and technical expertise. Due to the low cost and easy availability, cured fish has become an ideal protein food to the people of the low income group.

Naturally the fish curing industry could not be taken to modern lines.

The low priced fish is normally taken for curing. Bombay duck, sardines, mackerels, catfish, anchovies, scianids, ribbon fish, silver belly, red mullet and other miscellaneous varieties are used for curing. There is a vast scope for modernising this industry which may even capture foreign markets for such products besides combating the protein deficiency in our country to a large extent. Transformation of traditional curing of fish into modern lines would benefit the fishermen, trade and the consumer.

1.2. Marine fish catch in India

India has a coast line of 6100 km. 1800 marine fishing villages are situated along this coast line with a fishermen population of about 3 million. One third of this population is actively engaged in small scale fisheries. About 2.19 lakhs of indigenous non mechanised craft and 16,000 mechanised fishing boats of various sizes are operated in this country. An annual marine catch of 14 lakhs tonnes is produced in India by using about 25 lakhs of different types of fishing gear (Govindan, 1982).

1.3. Marine products export from India

Till 1953 the handling and processing of fish were carried out by traditional methods in India. During this period, the market for Indian marine products were largely confined to under-developed or developing countries like Srilanka, Burma, Singapore etc. (Chidambaram, 1975). Dry prawn pulp, salted and cured fish, pickled or Colombo cured fish, dried shark fins, fish maws and fish body oil constituted the list of exported fishery products from India. Export figures from 1953-54 to 1982 are given in Table 2. Foreign exchange on account of marine products export increased from Rs.44.033 million in 1953-54 to Rs.3422.429 million in 1982. This increase in export was probably due to the introduction of freezing and canning, world wide scarcity of food and the inflation after the second world war.

The export figures show that our fish processing industry depends mainly on a single item namely prawns which constitutes only 10 to 12% of our total marine landings. All our fisheries activities are centered round this commodity. In the course of this race for specialisation, our traditional fishery products, namely, dried fish, dry prawn pulp, shark fins and fish maws

Table 2. Growth in export of marine products from India

Year	Quantity (Tonnes)	Value (Rs.'000)
1953-54	30,851	44,033
1954-55	28,641	46,675
1955-56	23,972	39,219
1956 (April to December)	18,140	37,201
1957	22,778	45,861
1958	30,683	58,647
1959	33,716	62,342
1960	16,337	40,216
1961	17,297	41,318
1962	11,619	37,475
1963	17,908	58,646
1964	21,458	68,489
1965	15,457	69,237
1966	19,153	1,35,246
1967	21,764	1,99,286
1968	24,810	2,20,846
1969	30,584	3,30,731
1970	37,175	3,55,359
1971	34,032	3,91,725
1972	38,271	5,81,317
1973	48,785	7,95,763
1974	46,629	7,63,127
1975	53,412	10,49,063
1976	62,151	17,98,620
1977	64,964	17,97,374
1978	77,946	21,21,574
1979	92,184	26,20,292
1980	74,542	21,88,756
1981	75,374	28,67,128
1982	75,136	34,22,429

Source: Statistics of marine products, MPEDA.

which once constituted the back bone of our fishery industry were neglected.

1.4. General methods of fish curing

Fish curing comprises of the traditional methods of preserving fish by drying, salting and smoking.

1.4.1. Sun drying:

Small and lean species of fish are usually sun dried without salting. Fishes like white bait, silver belly, small ribbon fish, Bombay duck etc. are sun dried. The fish is just washed and dried in the sun by spreading the material either on a mat, hard ground or even on a sandy beach. Bombay duck is usually dried on scaffolds. The material is usually dried for 3 days. The advantage of drying fish is that no nutrient is lost during processing. However, commercial sun dried fish will have a high content of sand.

The natural method of drying by solar evaporation is usually adopted for drying fish all over India. As solar energy is available in plenty in tropical countries like India, solar drying has got great economic advantage. Artificial drying of fish is tried only in some isolated cases in India. Due to the high cost involved in the artificial drying, this method is not widely used in commerce at present.

1.4.2. Dry curing:

In this method, the fish is split open, gutted, washed and salted in a specific proportion depending on the size and species of fish. Salting is done in cement tanks or in any other suitable containers. When the salt penetrates into the fish muscle by osmotic pressure, water is pressed out from the muscle thus forming the self-brine. During the salting process, the fish muscle changes from a translucent to an opaque stage and becomes more fibrous in texture. The salted fish is kept without disturbance for one day or more to get the fish properly ripened or matured. The salted fish is then taken out and rinsed in self brine, sea water or fresh water and dried in sun for 2 or 3 days. If there is rain, the salted fish is allowed to remain in the salting tank for some more days till sun drying is possible. Drying is done on mat, concreted ground, on ropes or directly on the sandy beach. Dried fish is packed in different indigenous containers like bamboo basket, palmirah mat, coconut leaf mat, gunny bag etc. and despatched to markets.

1.4.3. Mona cure:

Mackerels, lactarius etc. are cured by this method in Maharashtra region. The fish is not split open. Instead, the viscera is pulled out through the buccal cavity of the fish. After washing, the salt is stuffed into the belly cavity through the mouth in a specific proportion and stacked in the salting tank. After salting, the fish is dried as in the case of dry curing.

1.4.4. Wet curing:

This method is also known as the Ratnagiri method and it is almost similar to the "Kench cure" of Western countries. Split and gutted fish is salted and stacked in cement tanks and some weight is applied on the top. The self-brine formed is allowed to drain out continuously. After 3 days, the salted fish is packed as such and sent to the market. Fish is not dried in this method. In some areas, the salted fish is directly packed in bamboo baskets with salt and the self-brine flows out freely. After the curing is completed, the same baskets with fish are sent to markets.

1.4.5. Pit curing:

Pit curing is generally done in Tamil Nadu. The split and gutted fish is salted and stacked in a 60 cm deep pit in the sand with a lining of palmirah leaf mat. The top of the fish is also covered with a similar mat and then with sand. Salting and maturation take place under anaerobic conditions for about 36 to 48 hours. The fish is then taken out of the pit, packed and sent to markets without drying.

1.4.6. Colombo curing:

Fish cured in this way is solely intended for the Colombo market. Mackerel is usually taken for this type of curing. The gutted and split fish is mixed with salt in the required proportion along with small pieces of the Malabar tamarind (Garcinea cambogea) in the ratio 1:10 and tightly packed in wooden drums. Self-brine is retained in the container along with the fish. The drum should be filled with extra brine to replace air from the top layer. The top lid is fixed and made water tight. As the fish is in the medium of concentrated brine fortified with tamarind, the fish attains a characteristic flavour and also gets an added protection. The fish is out of contact with air. The salted fish is not dried.

1.4.7. Smoke curing:

Smoke curing is not usually practised in India. The fish is split, gutted and scored, washed and immersed in brine for a specified period. The brined fish is taken out, drained and surface dried. The fish is then taken to a smoke-kiln. Fish is hung inside the smoke chamber and smoke is generated by burning saw dust, wood shavings, coconut husks etc. Smoking period depends on the species and size of fish. Smoked fish may or may not be dried for some more time to reduce the moisture content and then packed.

At present, fish curing in India consists mainly of salt curing and sun drying. Smoking is rarely practised. Pickling is restricted to South Kanara and Malabar region and the method called "Colombo curing" is almost non-existent now. Pit curing is also almost discontinued (Durairaj, 1981).

1.5. Spoilage in cured fish

Rust is a common type of spoilage seen in salted fish. Fish affected by rust will have colour of rusted iron, unpleasant taste and rancid fat odour. Rust is caused by the oxidation of fat by atmospheric oxygen. Salt present in the fish accelerates the process of oxidation. The best method of controlling oxidation is by preventing contact with air. Fish should be kept covered with brine during salting and dried fish should be properly packed.

'Pink' or 'red' is a serious type of spoilage seen in salt cured fish. Large quantities of cured fish get spoiled and become unfit for human consumption due to the 'red' attack. This defect is caused by the microorganisms present in the salt used for salting fish. Preventive measures consist of keeping the fish out of contact with air and storing at lower temperature. Chemical preservatives can also be used for arresting the 'red' attack in cured fish.

Salted and dried fish are usually attacked by moulds. Mould attack is not seen at moisture levels below 15%. Chemical treatment can arrest mould growth.

Maggots also attack salted fish. Cheese fly (<u>Drosophila casei</u>) deposits its eggs on the salted fish or on the sides of the container. The maggots hatch in two to four days and infest the whole salted fish. The maggot metamorphoses into a red pupa from which a fully grown cheese fly emerges a week later. Keeping the premises clean, use of concrete floors and covering the salted fish to avoid flies laying eggs are the normal preventive measures.

1.6. Approach to fisheries extension in India

Even though extension is a well organised net work all over the country in agriculture and animal husbandry, fisheries field lacks such an infrastructure for its development. Barring a few Central and State Fisheries Departments, many fisheries institutions do not have a separate extension wing. Fisheries extension work is carried out by the Central and State Fisheries Departments and Agricultural Universities. The Fisheries Departments under the Ministry of Agriculture and Irrigation, Government of India is the planning and policy making body for fisheries development in India. The extension Directorate of the above Ministry has the responsibility of organising extension programmes in the agriculture sector. The Fisheries Faculties of Agricultural Universities have, in the recent years, taken up fisheries education at the graduate and postgraduate levels. The four ICAR Institutes, namely, Central Institute of Fisheries Technology, Central Marine Fisheries Research Institute, Central Inland Fisheries Research Institute and Central Institute of Fisheries Education are the premier organisations responsible for fisheries research and extension activities in India.

Community Development Project and National Extension Services were started in India immediately after independence. Unfortunately these Project and Services did not include fisheries. Very often the Extension Officer for Agriculture or Animal Husbandry was considered to be responsible for giving extension advice to fishermen and fish farmers. In 1957, the Balwant Rai Mehta Commission focussed the attention on the need for separate Extension Officers in fisheries to train the village level workers in this field.

The working group of the Fifth Plan on Research, Training and Extension pointed out that extension is the weakest link in the development of fisheries (Mammen, 1980). The group recommended the following.

1. the establishment of extension training centres, one for inland fisheries and one for marine fisheries.
2. provision of equipment and extension literature support to the state level extension units.
3. starting of Fish Farmers Development Agencies.
4. starting of fishery data and information service and starting a Fishery Information Forecasting Bureau for marine fisheries.

1.7. Extension Units for fish culture

The Central Inland Fisheries Research Institue started the first organised extension service in fisheries in the early fiftees for organising fish fry trade. The success of this unit led to the establishment of nine more extension units on a regional basis during the second Five Year Plan. The activities of these units included survey of cultivable water areas, correction and improvement of ponds, collection of fish seeds from riverine sources, demonstration of induced breeding, nursery practices, weed control etc. These extension units functioned for about 10 years and later most of them were transferred to the States. Two units were converted into Extension Training Centres. These two centres at Hyderabad and Agra are now functioning under the Indian Council of Agricultural Research (Mammen, 1980).

1.8. Extension work in fresh water fisheries

The formation of Fish Farmers Development Agency was an important step for extension work in fresh water fisheries. FFDA provides a package assistance under the direct control of the District Collector. The functions of FFDA include long lease of water areas, training, extension services, credit and incentives by way of subsidy.

1.9. Extension work in brackish water fisheries

This fishery is almost similar to inland fisheries. Many maritime states having water areas like paddy fields, bheels etc. have already practised shrimp culture. However, all these states have run into serious difficulties in the construction of brackish water farms. To solve this problem, Government has proposed to survey, design and prepare project reports for large brackish water fish farms adopting an area development approach. Such large farms will work as 'Collective farms' with the extension support in the matter of fry collection, rearing, harvesting etc. The Central Inland Fisheries Research Institute, Central Marine Fisheries Research Institute, Central Institute of Fisheries Education, Marine Products Export Development Authority and State Fisheries Departments provide technical assistance to interested parties for brackish water fisheries (Mammen, 1980).

1.10. Extension work in marine fisheries

Technical expertise and extension support are now available in the country for the culture of mussels, oysters, pearl oysters, sea weeds etc. It is reported that the lagoons or coral islands, the Gulf of Manner, Palk way, Gulf of Cambay, Gulf of Kutch, certain areas in the Andaman and Nicobar Islands etc. are suitable places for mariculture. Extension support is necessary for fishery information and fishery forecasting. Immediate extension work is also required for conservation, particularly in respect of shrimp resources and protecting juveniles in the back waters.(Mammen, 1980).

1.11. Extension work on fishing craft and gear

The Fifth Five Year Plan gave emphasis on the introduction of mechanised fishing boats mainly for trawling and gill netting. Other fishing methods such as purse seining, pole and line fishing and long lining were also introduced. However, very little work has been done for the improvement of traditional fishing craft like catamaram, canoes and plank built boats.

Substantial improvement has been made on fishing gear materials. The vegetable yarn has been replaced by synthetic yarn, particularly for marine fishing. However, the design aspects of fishing gear have to be further improved which requires more research and extension.

1.12. Extension work on handling and processing of fish

Since the introduction of freezing and canning of fish in India, considerable amount of extension work has been carried out to maintain the hygienic condition of fish processing plantsand the quality of processed fish products. However, similar achievements could not be made in other aspects of fish processing. Processing techniques have been developed in handling, preservation and production of new fishery products from low priced fish and fish wastes. Many of these techniques are not yet adopted by the trade.

1.13. Organisation of fisheries extension by various fisheries establishments

Extension activities in fisheries are carried out by various Central and State agencies. A brief account of the work done by these organisations is given below.

1.13.1. Central Inland Fisheries Research Institute:

CIFRI has been disseminating technologies on modern aquaculture practices by training courses, demonstrations, Operational Research Projects and Lab to Land Programmes. The Institute is regularly organising Fish Farmers Days, exhibitions, film shows etc. for transfering the improved practices of fish farming. Communication is also conveyed to fish farmers through radio, TV, newspapers and extension publications. Representatives of the Institute participate in farmer's meetings, discussions, demonstrations etc. organised by the village organisations and other departments. The Institute organises ad-hoc training programmes for the extension, scientific and technical personnel from State Fisheries Departments, fish farmers and bank officials. Training courses are also conducted for fish farmers at Krishi Vigyan Kendras.

An advisory service is maintained for people who visit the Institute for technical advice. Technical queries are replied regularly on various aspects of fish culture. CIFRI has taken up Lab to Land Programmes for transfering the improved aquaculture technology to the fields.

1.13.2. Central Marine Fisheries Research Institute:

Transfer of technology through training, demonstration and other extension programmes has been given priority in the programmes of CMFRI. The Institute has taken up Operational Research Projects on 'blending sea farming with traditional capture fisheries' to train the fishermen in the methodsof mariculture of fishes, prawns and molluscs so that these could be undertaken along with traditional capture fisheries. The integrated approach to blend culture fisheries with capture fisheries for rural development is a new concept in the marine fisheries sector in India. The appropriate technologies in the culture of various species of fish are demonstrated to the interested fish farmers and entrepreneurs. The Institute is giving technical assistance to State Government Departments on fish culture. The Institute participated in the Co-operative Intensive Prawn Farming Project jointly sponsored by Kerala Government, MPEDA and CMFRI. This project was intended to demonstrate the economic viability of intensive prawn culture to the industry and fish farmers.

Under the Lab to Land Programme of the Institute, CMFRI gives training in scientific farming methods and respective technologies in a phased manner. The Institute also conducts training courses in marine prawn culture, pearl culture, oyster culture, under water diving by SCUBA, fishery resource assessment, population dynamics etc. A Krishi Vigyan Kendra is also run by CMFRI to impart need based and skill-oriented vocational training to fish farmers who intend to go for self employment. Consultancy service and publication of extension literature are other methods followed by CMFRI for technology transfer.

1.13.3. Central Institute of Fisheries Technology:

This Institute has been in constant contact with the fishing and fish processing industry and maintaining proper feed back on technological problems of the industry. The Institute conducts frequent training courses on various aspects of fishing, fish processing and allied subjects for the benefit of the personnel from the industry, Government Departments and new entrepreneurs. In addition to this, ad-hoc training courses are conducted on improved methods of fishing and fish processing in response to specific requests from the parties. CIFT has got a consultancy service to provide technical information and guidance for entrepreneurs directly and through various other Departments. The Institute organises exhibitions, film shows, fishermen mela and open house discussions to project various technologies developed at the Institute. Demonstrations are organised in different states to show various methods, formulae and recipes developed. The Institute is having provision for replying technical queries pertaining to fishing and fish processing received from different parties. Design drawings of various equipments and machinery developed at the Institute are supplied on specific requests from the parties. CIFT is having facilities to test and give certificate on the equipments, materials and products related to fishery industry. Remedial measures for technical problems or defects of such items, if any, are also suggested by the Institute. Scientists of CIFT are regularly visiting fish processing factories to give technical guidance on the maintenance of hygiene of fish processing plants and the quality of processed fishery products.

Publication is another major item helping the technology transfer by this Institute. Extension publications on various technologies developed by the Institute are brought out and distributed to the interested parties.

Lab to Land Programme is still another notable item of technology transfer. Various technologies are transferred under this programme by adopting fishermen families of coastal areas.

The Institute conducts follow up action and studies the impact of various extension programmes conducted so as to identify and solve the problems in technology transfer. The feed back information from the field is used to formulate problem oriented research programmes of the Institute.

1.13.4. Central Institute of Fisheries Education:

This Institute has been organising short term training programmes in various aspects of fresh water and brackish water fish farming for the nominees of State Fisheries Departments and Corporations, private entrepreneurs, the educated unemployed, fish farmers, fishermen, rural youth and candidates sent by fish farmers, industry and social organisations.

1.13.5. Marine Products Export Development Authority:

MPEDA is contributing significantly to the development of fisheries in India through several developmental programmes. Training programmes on improved methods of fish culture, fishing and fish processing are organised by MPEDA in collaboration with other Fisheries Departments or agencies. Subsidies are provided by MPEDA to different individuals and agencies who take up improved methods of fish culture, fishing and fish processing. Extension literature is published extensively by this Department. Consultancy service on fisheries is also provided by MPEDA.

1.13.6. Directorate of Extension:

The Directorate of Extension under the Ministry of Agriculture and Rural Development, Government of India is sponsoring training programmes through the Extension Education Institutes and other Departments on various aspects of agriculture including fisheries.

1.13.7. Central Food Technological Research Institute:

CFTRI, under the Council of Scientific and Industrial Research, conducts training programmes on preservation and processing of fish and fish products through its Meat and Fish Section.

1.13.8. Other organisations:

Central Institute of Fisheries Nautical and Engineering Training (CIFNET) is engaged in educational activities. Regular academic courses on various disciplines of fisheries are conducted by this Institute for the State Fisheries Officials and educated fisheryouth.

Integrated Fisheries Project (IFP) is also conducting different courses on fisheries for Departmental and private candidates.

Fisheries Survey of India (FSI), though not conducting any academic courses or training programmes, propagates the new information on fish resources through various mass media.

1.14. <u>Present status of fisheries extension</u>

As the general approach to fisheries extension in India has already been explained in the previous pages, the status of fisheries extension in the three states covered under the present investigation is described here.

1.14.1. Kerala:

The Extension wing of the Fisheries Department was started only in 1976 (Vasavan,1980). It was organised as a small unit with limited resources. The extension personnel were exclusively drawn from the cadres of the State Department and they were very few in number.

The Department has started various programmes on mechanisation of small boats, pilot projects on pearl culture, mussel culture and fish culture, Fingerlings are produced and distributed to the fish culturists. Fisheries Technical Schools and Fishermen Training Centres are run by the Fisheries Department. A comprehensive programme for imparting specialised re-orientation course for the benefit of the technical personnel has been drawn up. It has been proposed to issue catamarams, dug-out canoes and plank built canoes to the traditional fishermen on subsidised basis availing institutional finance. Provision of necessary infra-structure facilities like roads, water supply, community halls, ice plants and workshops in selected villages has also been proposed.

Better housing facilities are provided to the fishermen. A fishermen Welfare fund for the payment of old age benefits and expenses connected with death and marriage ceremony has been included in the budget provision of the state. Several houses are constructed and handed over to fishermen under the housing and colonisation scheme. There is arrangement with All India Radio to broadcast special weather bulletin and cyclonic forecasts extensively for sea going fishermen.

1.14.1.1. Kerala Agricultural University:

The University, through its Fisheries College, is conducting training programmes on scientific methods of fish farming for officials from different departments. Technical advice and guidance are also given to the fish farmers on fish farming. Technology on aqua-culture is transferred to fish farmers through Lab to Land Programme. Extension pamphlets are prepared on fresh water fish farming, brackish water fish farming etc. and distributed to the interested parties. Demonstration of fish processing methods is arranged in collaboration with other Fisheries Departments.

1.14.2. Tamilnadu:

The Fisheries Department of the erstwhile Madras

Presidency, started in 1907, was not only a pioneer in fisheries research and development but also a forerunner in fisheries extension work (Chellappan, 1980). The fish curing yards with the salt subsidy scheme, the fisheries schools and the fishermen co-operatives in the coastal fishing villages are only a few examples of the past fisheries extension activities of the department.

The fish seeds of quality fish are stocked, cultured and harvested by the Department and demonstrated to the public on the profitability of fish culture in the inland water spreads. The major reservoirs are stocked with quality fish seeds. In order to encourage private fish farming and composite fish culture practices and to step up per hectare production in inland ponds and tanks, Fish Farmers Development Agencies have been established. To find out new fishing grounds in inshore areas and to popularise new and diversified fishing methods among fishermen, Inshore Fishing Stations have been established. To facilitate the fishermen to transport their catches from the landing centres to the nearby marketing centres, the Department has provided them with vans on nominal hire charges through the fishermen co-operative societies, marketing unions and federations. Fisheries training centres are in operation to impart training to the fishermen boys in maintenance of mechanised vessels, fabrication and operation of nets etc. Primary Fishermen Co-operative Societies have been organised in fishing villages and District Co-operative Federations have been formed for improving the fishing industry and welfare of the fishermen through co-operative enterprises. All types of loans are given to the fishermen through the co-operative societies for purchasing fishing equipments and to clear the debts and free them from the clutches of the middlemen. To replace cotton nets, to popularise nylon nets and to increase the fish catches, the advantages of using nylon nets are explained and nylon yarn is distributed to fishermen through the Fishermen Co-operative Societies on subsidy basis. The Department is constructing houses and allotting to fishermen. Suitable guide lights are being installed in needy fishing villages along the coast as an important socio-economic measure. Mechanised fishing craft are introduced by the Department to make the traditional fishermen adopt modern fishing methods. The integrated rural development and adult education are implemented in the state. Fisheries schools are run by the Fisheries Department in the coastal fishing villages.

The extension units of the Department are conducting demonstrations of technologies of fish seed production, composite fish culture, prawn and juvenile collection, prawn culture, fish curing, drying of fish, icing of fish, transport of iced fish etc. Films are screened in fishing villages and educational institutions. Various leaflets, hand outs, brochures, pamphlets etc. on fisheries development are distributed among fishermen. Radio and Doordharshan talks and group discussion on various schemes and achievements are given by the fisheries officials. Fishery development projects and fishermen welfare programmes are telecast in TV. Frequently, articles of fisheries interests are also published in Tamil and English dailies.

1.14.2.1. Tamilnadu Agricultural University:

The fisheries college functioning under the Tamilnadu Agricultural University is undertaking various extension activities for the development of fisheries in the state. The Directorate of extension education is co-ordinating the extension work of all the agricultural fields including fisheries. The communication centre disseminates the new knowledge to fish farmers, fishermen and processors through AIR, television, news papers, journals, film shows etc. Technical assistance is given to the fishery industry by experienced extension workers. The farmers training centre imparts training to interested parties on fresh water fish culture. The Krishi Vigyan Kendra is actively involved in extension education activities for rural uplift. The staff of Fisheries College assist the Farmers Training Centre to conduct monthly meeting at the Block level to enlighten villagers on modern methods of fisheries. Fish seeds are distributed to interested parties through seed sales depots. Technical queries received from different parties on fisheries are replied. Farmers' Day is celebrated to disseminate the information on all aspects of fisheries development. Exhibitions are conducted to display the findings of the Fisheries College.Lab to Land Programme is also organised by adopting fish farm families and supplying fish seedsto them for modern fish farming..

1.14.3. Karnataka:

The extension work is carried out as an integrated part of fisheries developmental activities (Rao, 1980). Fisheries wall postures, charts, display panels etc. are used in the extension work. Training in various aspects of fisheries is arranged for fisher boys. Fish Farmers

Development Agency is arranging training for the fish farmers and providing technical know-how and guidance. Fish famine relief schemes, rehabilitation and colonisation schemes, fishermen distress relief grant, subsidy and loan schemes for fishing etc. are some of the programmes of Fisheries Department. Primary co-operatives and co-operative fish marketing federation are functioning in the state. Department is running fisheries schools and fishermen training centres. The Deparrment is producing fish seeds in the production farms and rearing them into fry and fingerling stages in the rearing farms and nurseries constructed at Taluk Headquarters and then transporting to various places for stocking in suitable water areas.

1.14.3.1. University of Agricultural Sciences:

The fisheries college under the University of Agricultural Sciences, Karnataka is undertaking various extension activities like agricultural production programme, Lab to Land programme etc. through its staff and students. In addition to transferring the improved technologies to the field, the staff members of the college prepare extension literature and give extension talk and radio talk. The field programmes include demonstrations of scientific methods of fish culture and fish processing. The fish products developed at the college are distributed to nutritionally weaker sections of the society through the Department of Social Welfare. Visits are made to the fish farms and fish processing factories and technical advice is given on improved methods of farming and processing. Under the Lab to Land Programme, families are adopted and technologies on fish culture and fish processing are transferred.

1.15. Scope of the present study

Curing is the oldest and cheapest method of preservation of fish all over the world. Fish curing industry has not shown much improvement from its primitive nature because this industry is mainly handled by illiterate and less educated fishermen/fisherwomen. They do not know much about the importance of scientific methods of fish curing. The cured fish produced by them is unhygienic and poor in quality. Because of the negligence and ignorance of the fish curers, a considerable quantity of this protein rich food is spoiled and lost every year.

Cured fish is generally consumed by the poorer section of the society to whom standards, hygiene, sanitation etc. have no meaning. The dealers who export or sell these products are usually not the producers, but only middle men. No quality control will be effective from the stage of the dealers

Inspite of all the deficiencies of fish curing, this is the most important one among all the preservation methods in India. In view of the low per capita income of the people in India and other developing countries, cured fish suits most to the consumers (Saxena, 1973). Even though freezing and canning of fish have well advanced, these account only about 5% of the total fish catch in India while about 18-20% of the catch is processed into cured products. Moreover, fish processed by freezing and canning are too costly and far beyond the purchasing capacity of the common man. Cured fish is the cheapest item of processed fish available to him. This clearly shows the importance of fish curing in India. This situation demands urgent steps to be taken for rectifying the defects of the fish curing industry and for adopting improved practices to avoid the wastage and enhance the quality of cured fish. If the quality is improved, cured fish will have more demand in internal as well as external markets. High quality cured fish can be prepared by following the improved methods. Therefore, the transfer of new technology to the fish curing industry is the solution of the problems existing in this industry. Taking into consideration the importance of cured fish in India, Central and State Governments have invested considerable amount of money to investigate the technological problems in the production of cured fish and to suggest methods for solving the problems. Research has been conducted extensively in the Central and State sectors and various remedial measures have been suggested to improve the fish curing industry in India. Inspite of the prejudice against cured fish because of their existing low quality, research work in recent years have indicated that their quality can be greatly improved and shelf-life prolonged if the methods are standardised. To achieve this aim, Central and State Departments have already made considerable efforts to transfer the improved methods to the fish curing industry by way of training courses, demonstrations, Lab to Land Programmes, film shows, exhibitions, personal discussion etc. As the result of this, fish curers have started adopting the improved practices in fish curing. Still there seems to be a considerable gap between the technology available and the technology adopted in this field. A comprehensive study on the extent of adoption of improved practices in fish curing and the factors involved in low or non-adoption of certain aspects is lacking at present. This gap has to be filled up. The possible methods for the effective transfer of technology for the production and distribution of high quality cured fish products and improvement of socio-economic condition of fishermen engaged in fish curing have to be identified.

1.16. Objectives

The main objectives of the present study are the following:

1. To identify the technological gap in terms of the knowledge of fish curing technology among fish curers and fisheries extension workers.
2. To identify the technological gap in terms of adoption of fish curing technology among fish curers.
3. To study the reasons for partial adoption or non-adoption of improved fish curing practices by fish curers.
4. To evolve a strategy for effective transfer of technology related to fish curing.

1.17. Limitations

The study had the limitations of time, personnel and languages. However, care was exercised to make the study as systematic as possible. The strategy suggested for technology transfer in fish curing industry may not be suitable as such for all the states. But the main problems of fish curing industry being the same for all the states, the recommendations may be valid in general with some modifications taking into consideration the conditions existing in each state.

REVIEW OF LITERATURE
ON HANDLING AND CURING OF FISH

CHAPTER TWO

REVIEW OF LITERATURE
ON HANDLING AND CURING OF FISH

Fish is a rapidly perishable food item which requires extreme care in its handling and preservation. The quality of fish reaching the consumer or the processing factories will greatly depend on how the fish is handled after the catch on board the vessels and how it is preserved, packed and transported before it reaches the user. Preservation of the catch from hauling till it is unloaded at the landing centres is the responsibility of personnel on board the vessels. The objective shall be to land the fish in as good a quality as at the time of catch within the limits of practicability under good commercial practice. The fish that is landed is marketed fresh or taken for various types of processing. It is well known that the quality of the end product will depend on how fresh the raw material was and therefore, in order to assure good quality for the products, it is necessary that extreme care should be taken in preserving the catch by scientific handling on board the vessels. Various factors affect the quality of the fish coming to the land, the main factors being the uncleanliness on the deck and fish holds, temperature at which the fish is kept, packing conditions and mode of handling in general. Good handling of the fish at sea should ensure that the catch retains its natural freshness as far as possible until landing. The important requirements are to clean the fish to make it free from dirt and extraneous matters and chill immediately, prevent its temperature from rising and maintain a high standard of cleanliness during handling. Cleanliness, in other words sanitation, requires particular attention. The fish should not be allowed to get contaminated with objectionable microbes, chemicals used in cleaning and disinfection, metals, paints, oils etc. There are various types of fishing vessels and the main mode of preservation on board the vessels is by icing. However, modern big size fishing vessels have facilities to preserve the catch by chilling with refrigerated sea water or by freezing and storing in cold storages. At the same time, there are small fishing boats which have no facilities even for icing. In any case, the consumer or the processor is ready to pay a higher remuneration for a raw material of better quality. Since the size and type of fishing craft vary very much, it is not possible to suggest uniform codes of handling the catch.

2.1. Spoilage of fresh fish

When a fish dies, it stiffens almost immediately, the flesh becoming rather firm and elastic. This is called rigor mortis. Chemically, an increase in the amount of lactic acid is noted.

When fish is still in rigor mortis, or immediately after it passes off, the proteolytic enzymes begin to hydrolyse the highly complex protein of the fish muscle into simpler proteins, poly peptides and amino acids. This is called autolysis.

The process usually accompanying autolysis is bacterial decomposition. In addition to the bacteria naturally present in the fish, further additions take place as contaminants from utensils, water, ice etc. during handling and processing. The result of bacterial action on proteins is the formation of the same type of compounds as are produced during autolysis, such as amino acids in the first stage. These are only intermediate products which are later decomposed into a wide variety of substances including ammonia, amines, indole, hydrogen sulphide etc. many of which have disagreeable odours. However, when bacterial decomposition occurs at low temperature, as in the case of iced fish, the principal products are intermediate ones i.e. amino acids. This is why fish is properly iced to control the spoilage. The following methods are usually employed for reducing the bacterial spoilage of fish.

2.2. Icing

One of the most effective and most commonly used means to retard spoilage is to reduce the temperature of the fish and hence control the proliferation of microorganisms which cause deterioration. Simple chilling of fish with ice works well for short term preservation.

Govindan (1962) observed the changes taking place in iced prawns. Under the influence of leaching of soluble nitrogenous constituents from the muscle and absorption of water by the muscle from the melted ice, the total nitrogen, water soluble nitrogen and non-protein nitrogen contents of the prawn muscle showed very rapid fall, especially during the first 8-10 days of storage. He also recommended (1966) immediate icing of fish in alternate layers just after catch. Unprotected sources of water for cleaning the raw materials resulted in contamination with heavy bacterial load.

Gopalakrishna Iyer and Choudhuri (1966) pointed out the importance of purity of ice and water to be used in fish processing for improving the bacterial quality. They have shown the sources of contamination of water and ice and suggested remedial measures.

Govindan (1971) has also reported tremendous loss in solids and hence nutritive values during preservation of prawns in ice. He stressed that processors must reduce the pre-process storage period in ice to the minimum so as to retain the maximum nutrients and flavour bearing compounds and thereby to maintain high overall quality of the processed products.

Vasantha Shenoy and James (1974) found that seer fish in the form of chunks held out of direct contact with ice was acceptable upto 13 days based on organoleptic evaluation. The chunks and fillets held in direct contact with ice were acceptable only upto 10 days. Perch kept in ice upto 9 days was found to be in acceptable condition (Solanki _et al._, 1977). Solanki and Venkataraman (1978) noted that urea content could be considerably reduced by icing shark fillets.

2.3. Chemical preservation of fresh fish

The primary aim of preservation of fish is to maintain the quality during storage for long periods. Chemical treatment in fish for preventing different types of spoilage has been suggested by many workers.

Surendran and Iyer (1971) reported that CTC when incorporated in ice at 5 p.p.m. level could prolong the shelf-life of prawn by at least six days. They stated that use of higher levels of CTC in ice was not advisable since it would result in higher amounts of absorbed CTC in muscle which was not completely destroyed during cooking. They observed a dull colour to the shell of CTC treated prawns. Since the effects of the antibiotic treatment become pronounced only after 8 days of storage, the use of CTC - ice would be restricted to fishing trips where the vessels have to remain off shore for more than 8 days. Later, the same authors (1973) again stated that 5 p.p.m. CTC treatment considerably reduced bacterial load in sardinesand gave a better appearance to the fish. The high fat content in sardines resulted in rapid development of rancidity. Hence CTC treatment of sardines was found to be of limited advantage in extending the storage life of sardines in ice.

2.4. Packing and transportation of fresh iced fish

Large quantities of fresh fish are transported to distant and interior centres for regular distribution. During this transit, fish get spoiled and lost due to lack of proper care in packing and transportation. A survey conducted at Howrah, a major fish consuming centre, has revealed that about 50-80% of the fish arriving in the markets was of substandard quality when the period of journey from production centre to Howrah varied from 24 hours to 120 hours. This shows the tremendous economic loss incurred by the trade and fishermen due to the improper methods of handling, icing, chilling, packing and transport.

In tropical temperature conditions, ice melts at rapid rates necessitating re-icing at frequent intervals to keep the fish at low temperature. Moreover, rapid melting of ice affects the quality of fish adversely. The maximum period of ice storage of fish in the round form under the above conditions is also limited. Certain varieties of fish like sardines pose special problems like belly bursting.

Rao and Perigreen (1964) attempted to reduce the rate of melting of ice and to increase the storage life of iced fish by providing additional lining to the conventional bamboo baskets used for transport of fish. They reported that iced fish (1:1) could be preserved for a period of 16-18 hours by using bamboo baskets lined with gunny, polythene or kraft paper.

Kamasastri _et al_. (1967) reported that fresh iced pomfrets transported in insulated holds from Gujarat to Bombay in mechanised boats were in better condition than those transported in non-insulated holds.

Venkataraman _et al_. (1976) reported that polythene lined thermocole insulated plywood boxes (second hand tea-chests) could be successfully used for transport of fresh iced fish. They found that a maximum of 25 mm thermocole insulation was necessary during summer (April-June) and 15 mm during winter (November-March). By using these insulated boxes, the initial fish-to-ice ratio could be brought down to 1:0.75 and still further to 1:0.50 at the height of winter in January to February.

Rao _et al_. (1978) conducted a comparative study of the insulation efficiencies of thermocole slabs and multi-layer gunny fabric in long distance transportation of fresh iced fish and found that their insulation efficiencies were comparable in respect of bacterial counts, organoleptic qualities and TMA and TVN values of the transported fish.

Govindan et al. (1978) conducted trials with a dismantlable insulated galvanised iron container for transportation of iced fish from Kakinada to Howrah, Kakinada to New Delhi and Paradeep to Howrah. The dismantlable container performed exceedingly well.

2.5. Salting of fish

Salting is the most important among the curing methods in India. Salting is also done as a preliminary step in the drying and smoking operations. During salting of fish, common salt exerts a high osmotic pressure and reduces the moisture content of the flesh.

During salting, a solution of salt is formed in the water extracted from fish. The salt, as a result of its hygroscopic ability and osmosis, absorbs water from the fish and is then dissolved by it. Adequate quantity of salt is very essential for salting fish.

Kandoran *et al*. (1964) studied the effect of calcium, magnesium and sulphate on penetration of sodium chloride in fish. They reported that the rate of penetration of salt had no relationship to the calcium and magnesium contents even at a level of 0.75%. The presence of calcium appeared to slightly retard the rate of drying of the salted fish.

Kandoran *et al*. (1965) suggested desalting of heavily salted shark flesh in 5% brine for removing urea from the flesh.

Rangaswami and Rao (1969) found that use of liberal amounts of salt kept the products free from insect infestation during storage.

Govindan (1969) studied the changes occurring in moisture, sodium chloride, extractable nitrogen, non-protein nitrogen and free amino acid nitrogen in dressed sardine and mackerel during heavy salting for short and prolonged periods and subsequent drying as well as pickling in saturated brine. The weight loss due to loss of water during heavy salting of sardine and mackerel was about 50% by the absorption of salt by the muscle. A certain amount of proteolysis was also indicated as shown by the higher NPN and free amino nitrogen values. Loss in salt extractability was rapid during the drying stages of the heavily salted sardine. During pickling of heavily salted mackerel in saturated brine, moisture content of the muscle attained a steady value of 60% and drastic loss in salt extractability of proteins took place.

2.6. Quality of salt

Quality of salt to be used in fish is very important. ISI (1962) has laid down standards for the common salt to be used for salting, but it is very difficult to get such salt.

Solar salt contains higher amounts of calcium and magnesium in the form of chlorides and sulphates when compared to rock salt. Their presence in considerable quantity affects the colour, texture and taste of the fish. Fine salt has the advantage of dissolving rapidly. Coarse salt is less soluble and the delay in salt penetration leads to some initial spoilage. Yellow or brown discolouration of salt is due to the presence of iron. Salt containing copper induces rancidity of fat affecting the colour and appearance of fatty fish. The insoluble matter present in salt leaves an unattractive crust on the cured fish (Rao and Sen, 1966).

Srinivasan *et al.* (1967) examined a total of 290 samples of common salt used for fish curing in Government curing yards, private fish curing yards etc. for their chemical analysis and compared the data with ISI standards. Only 46.8% of the samples drawn from Government fish curing yards, about 25% of that collected from private fish curing yards and 34.37% of the salt offered by salt manufacturers confirmed to the ISI specifications of 1954 with regard to minimum sodium chloride content of 96%. However, according to the revised IS standards of 1962 prescribing a minimum of 98% sodium chloride, none of the private fish curing yard salt samples satisfied the specificationss. Only 1% of the Government yard samples and 10.4% of the salt samples offered by salt manufacturers confirmed to the revised standards.

2.7. Drying

Drying is the most important step in fish curing. Proper drying gives high quality fish. Fungal and bacterial attack will be quick if the moisture content of cured fish is high. ISI has recommended moisture levels for different species of cured fish. During sun drying precaution should be taken to avoid contamination of fish with dust. This can be achieved by drying fish on raised platforms (Rao, 1967).

Bhattacharyya et al. (1982) reported that a better sun dried product of 'Gudusia chapra' could be obtained by blanching the material in 7% brine for one minute prior to drying.

2.8. Dehydration of fish

Sun dried fish invariably contains higher percentage of moisture which adversely affects its storage life. Sun dried fish may also be contaminated with pathogenic bacteria, flies, sand, dirt etc. Cured products could be prepared with better quality in all respects when processed under controlled conditions in the artificial dryers. Mechanical drying with hot air avoids most of the drawbacks of sun drying. Dryer will also facilitate continuous drying of fish during night time and rainy season. Prabhu et al. (1963) studied the drying characteristics of some important commercial fishes of India in a laboratory tunnel dryer. Swaminath (1964) reported that the optimum temperature for drying of commercial fish like mackerel, sardines, white baits and silver bellies in a half tonne dehydrator was about 45°C at 50% R.H. Relative humidity appreciably influenced the drying rate mainly during the first part of the drying operation. To avoid case hardening, it was necessary to use low relative humidity in the beginning and to increase it during the later part of the operation.

Balachandran (1969) found that high temperature accelerated drying of fish considerably, but temperature above 50°C caused a certain amount of cooking of the muscle. The lower the R.H., the higher the rate of moisture loss. But R.H. below a certain level resulted in case hardening. Unduly high R.H. values increased the duration of drying. By increasing the temperature of drying after the constant rate period, the drying time could be considerably reduced without sacrificing the product quality.

2.9. Chemical preservation of cured fish

Several research investigations have been carried out in the field of chemical preservation of cured fish and new findings and recommendations on improved method of fish curing have been brought out.

Pickling is one of the earliest known methods of preservation of fish. Preservative action of salt coupled with the acidity of vinegar has been accounted for as a very effective principle in maintaining the quality of preserved fish. Rao and Valsan (1962) showed that the storage life of pickled fish could be extended considerably by giving them a pre-dip treatment in propionic acid. The same authors (1962) also suggested dipping of fresh fish with 4% propionic acid for prevention of mould and red halophillic attack on dry salted fish. They observed that the treated samples had a storage life of about 62 weeks while the control could be stored only for 15-20 weeks.

Joseph (1962) reported that turmeric powder (5%) in curing salt enhanced the keeping quality of cured white-bait.

Cured fish is largely attacked by fungus and bacteria causing huge national loss of processed fish. The main reason for this problem is the high moisture content of the cured fish. Easy remedy is to bring down the moisture content of the cured fish to 30-35%. But the fish curers are not prepared to dry the fish to that extent because the weight of the product is considerably reduced. Moreover, hard dried product is not relished by many of the consumers. To preserve the cured fish with high moisture content for quite long time, some chemical preservatives can be used.

Valsan (1968) suggested that by smearing a mixture of 3% sodium propionate, 0.5% BHA and 0.5% sodium sulphate in dry powdered salt over cured fish, the product could be kept for 9-12 months free from any visible sign of spoilage, browning or rancidity.

Conventional Colombo curing using 'Gorukha puli' (Garcina cambogiea) as preservative had been extensively practiced for preservation of oil sardine, mackerel etc. especially along the west coast. This method affected the appearance and texture of the pickled fish. Devadasan et al. (1975) reported that treatment with tartaric acid in combination with garlic was effective for giving better appearance, texture, taste and shelf-life of pickled fish. Balachandran and Muraleedharan (1975) suggested sodium benzoate along with salt and small amount of 'Gorukha puli' for better quality of the salted fish.

Valsan (1982) recommended calcium propionate, an indigenously available, cheap and effective chemical, in the place of sodium propionate to preserve cured fish. Unnikrishnan Nair et al. (1982) reported that the fungus already present in cured fish could be removed and its re-infestation could be prevented by washing the affected samples and drying followed by smearing a mixture of refined salt and sodium propionate. Kalaimani et al.

(1982) found that sardine dipped in betel leaf extract immediately after salting followed by drying had better keeping qualities and lesser rancidity.

2.10. Packing and storage of cured fish

Method of packing and storage is important in the fish curing industry. At the same time, this is the most neglected aspect. The existing method of packing and storage of cured fish is very crude and unhygienic.

Govindan (1966-67) has shown specific area in the layout of fish curing shed for storage of cured fish. Sripathy (1967) also suggested layout for improved fish curing yard. Rao (1967) suggested 'Cool storages' at 60-70°F for storing cured fish. Kandoran and Valsan (1974) suggested improved containers like plywood box, gunny bag etc. lined with polythene for bulk packing. For retail marketing, packing of cured fish can be made in polythene bags.

2.11. Quality Control in cured fish

Quality control means maintenance of quality at levels and tolerance acceptable to the buyers while minimising the cost to the producer. Quality control may be viewed from two angles (1) to prevent spoilage and

(2) to protect food from contamination. The national standard specifications have been published by Indian Standards Institution. Many dried fish products are covered by these specifications and they are important both in the internal as well as export trade. The specifications mainly relate to size, freedom from infestation with fungus and mites, freedom from excessive sand and salt, absence of deterioration etc. Specifications relating to moisture, salt and acid insoluble ash for some dried fish are shown in Table 3.

Maintenance of sanitation is an important step in the production of cured fish. Systematic application of detergents and disinfectants and proper cleaning of the curing yard and the utensils are essential to check the contamination of bacteria, mold, insects etc.

Sen and Sripathy (1967) also reported that most of the sun dried mackerel collected from the market showed 40-50% moisture whereas for the microbiological stability and proper storage fish should be dried to 30% moisture level. They also reported that the use of BHA and proper drying and packing would minimise oxidation of dry salted fish.

By maintaining proper hygienic conditions with better

Table 3. Requirements for dried fish and shellfish

Sl. No.	Item	Moisture % (max)	Sodium chloride % (min)	Acid insoluble ash % (max)
1.	White baits	20	2.5	7.0
2.	Tuna (Surai)	35	25.0	1.5
3.	Prawn pulp	20	5.0	1.0
4.	Dried Bombay duck	15	7.5	1.0
5.	Laminated Bombay duck	15	6.0	1.5
6.	Mackerel (dry salted)	35	25.0	1.5
7.	Cat fish (dry salted)	35	25.0	1.5
8.	Dara (dry salted)	45	25.0	1.5
9.	Ghol (dry salted)	40	20.0	1.5
10.	Leather jacket	40	25.0	1.5
11.	Horse mackerel	40	25.0	1.5
12.	Shark	40	30.0	1.5
13.	Seer	45	30.0	1.5
14.	Shark fin	10	-	1.5

Source: ISI Standards

salt, preservative chemicals, proper containers and packaging materials and storage conditions, the market for cured fish can be improved (Sen, 1969).

Unnikrishnan Nair and Valsan (1971) stressed the importance of freshness of raw fish used for curing. They reported that the maximum permissible time lag between catching of mackerel and its curing should be 8 hours in room temperature or 3 days in ice.

Sripathy (1974) reported that cured fish products obtained from market had very limited storage life and were subject to mould growth and attack by red halophiles, development of yellow or brown discolouration and rancid and off odour. The samples were contaminated with sand and when cooked, they were tough in texture and were often bitter in taste. Sripathy suggested the possibility of preparing better products by salting and sun drying than were being produced in commerce. Such products attractively packed and advertised could improve the market and fetch better prices in the internal and export markets. A transformation of this traditional trade into a modern industry would benefit the fishermen, trade and the consumer.

Mathen (1974) reported that the usually observed quality defects in dried fish products are (1) inadequate drying limiting the shelf-life (2) heavy admixture with sand due to drying of the fish on the open beach (3) low salt content and (4) attack by fungus and dun and porous appearance of the product.

Valsan (1974) suggested to discard the age old curing sheds and change over to well built fish curing factories with provision for modern facilities for maintaining the quality of cured fish products.

2.12. Adoption of technology

No systematic investigation seems to have been made in fisheries technology on various factors associated with the adoption of improved or new technology. Therefore a few relevant references to studies in the related fields are cited here.

2.12.1. Age:

Hoffer (1942), Ryand and Gross (1950) Gross and Taves (1952), Wilkening (1952), Hess and Miller (1954) and Lionberger (1952) have reported that the age of operators was negatively associated with the adoption of improved farm practices.

However, Colemann (1951) and Wilson (1953) did not find any significant correlation between age and adoption. Sawhney (1961) also reported that there was no significant association between age and adoption of improved practices.

2.12.2. Education:

Hoffer (1942), Gross (1949), Ryan and Gross (1950), Gross and Taves (1952) and Wilkening (1952) found that education of the farmers was positively associated with adoption of improved practices. Dimit (1954) reported that four or more completed years of schooling by the farm operator was positively associated with the adoption of improved farm practices. Copp (1956) found that educational level of cattlemen was significantly associated with the number of practices adopted. Copp (1958) again concluded that education was definitely associated with adoption behaviour. Indian studies too, on the relation between education and adoption of improved practices revealed similar trends. Bose and Vishnoi (1960) concluded that education always played dominant role in the acceptance of the innovations. Bose (1961) and Dube (1961) found that those who adopted more practices were literate.

2.12.3. Social participation:

Past studies have shown that there is a positive association between extent of farmer's social participation and his level of adoption of improved farm practices. Hoffer (1942) observed that social participation of an individual farmer was positively associated with the acceptance of improved farm practices. Gross (1949) stated that acceptors reported higher social participation and participated more fully in co-operatives. Ryan and Gross (1950) in a study of differential acceptance of hybrid corn established that earlier adopters had higher social participation and participated more frequently in co-operatives. Colemann (1951), Gross and Taves (1952) and Wilkening (1953) observed positive association between formal social participation and adoption of improved farm practices. Copp (1956) reported that formal social participation, membership in farm organisations and churches were significantly associated with number of practices adopted. Reddy (1962) found high association between farmer's social participation and adoption of improved practices. Sinha (1963) found that the high formal social participation group was significantly superior to medium and low participation groups in all stages of the adoption process.

2.12.4. Contact with extension agency:

Colemann (1951) observed a direct relationship between extension contacts and the level of adoption of practices. Gross (1949), Lionberger (1952) and Bose (1961) support the generalisation that contacts with formal and informal agencies are significantly related to the adoption of practices. Sawhney (1961) reported that comparatively larger proportion of the respondents who had contacts with extension agencies adopted more practices than those who did not have contacts with them. Dhaliwala and Sohal (1965) found that frequency of contact with extension agency was significantly related to the adoption of agricultural practices. Thus it can be concluded that other things being constant, the higher the contacts a person has with extension agency, more are the number of improved practices followed by him.

2.12.5. Perception of profitability of technology:

Griliches (1957) indicated that the perception of profit from the innovation was highly related to the rate of adoption. Kivlin (1960) found that profitability measured by initial cost, continuing cost and recovery cost, as perceived by a panel of judges was not related to the rate of adoption. Perhaps the individual did not perceive that the innovation was profitable. Havens and Rogers (1961) pointed out that profitability like any other items of information about an innovation must be diffused. It was their contention that what really determined the rate of adoption of an innovation was the adoptor's perception of profitability and not the objective profitability.

2.12.6. Income:

Gross (1949) observed that acceptors had higher income. Ryan and Gross (1950) found that farmers with higher income tended to adopt improved practices earlier than the farmers with lower income. Dimit (1954) showed that economic status was positively associated with adoption. Sahay (1960) and Singh (1960) reported that low income of the farmers was one of the main handicaps in their response to improved practices. Bose and Vishnoi (1960) concluded that economic condition always plays an important role in the acceptance of an innovation.

2.12.7. Debt:

Dubey (1958), Sahay, (1960), Singh (1960) Bose and Vishnoi (1960) and Reddy (1962) who carried out their research projects in different parts of India concluded that economic condition plays a dominant role in the acceptance of improved practices.

2.13. Knowledge

Hess and Miller (1954) reported that operators rating high on a knowledge test had higher producing herds than farm operators with low scores. Williams (1958) reported that lack of knowledge regarding fertilizer composition and use was an important factor which retarded the use of fertilizer.

Hoffer and Stangland (1958) found that level of knowledge of farmers regarding the improved practices was a significant factor affecting the adoption of improved practices. Sizer and Porter (1960) found a significant and positive relationship between knowledge about the recommended practices and their adoption. They reported that knowledge about innovations, social status, education and social participation of the farmers explained 25-88% variance in the innovations. Reddy (1962) reported that 41% of the respondents under study gave lack of information and knowledge about the practices as the reason for non-adoption of chemical control of weeds.

2.14. Improved method of fish curing

It has already been explained in the previous pages about the existing methods of fish curing in different centres and it was also established that the cured fish products brought out from these centres were poor in quality due to lack of a standard method of processing. To avoid these problems, improved methods of fish curing were worked out for different types of products on the basis of research investigations carried out by different workers and transferred to the fish curing industry. A standard method of fish curing for dry salted fish is given below.

Select absolutely fresh fish for curing and wash well with chlorinated (10 p.p.m.) water to remove blood, slime, dirt etc. Mix the fish with ice in the ratio 1:1 and store till processing is started. Processing should be started as early as possible. However, if the delay of curing is unavoidable fish can be kept under iced condition upto 3 days. In such cases, iced fish should be properly stored in the specific place in the yard allotted for fish storage. Icing should be done in thin alternate layers in such a way that there is intimate contact between ice and fish. Not more than 3 ft depth of the material (fish and ice) should be put in one container, as otherwise the bottom layers are liable to get squeezed and bruised. Thermocole insulated containers should be used for storing iced fish.

If ice is not available or icing is nott done, the fresh fish should be processed immediately within a maximum time lag between catching and processing as 8 hours.

The fish is dressed on the processing table and the viscera is removed immediately. Care should be taken to keep the table always clean. In the case of small fishes, evisceration and scaling are not practicable. In such cases, fish is salted directly after proper cleaning.

The dressed fish is washed in chlorinated water and the water is allowed to drain completely. Draining of water can be conveniently done in perforated plastic containers. After complete draining, the fish is taken out to the salting table where good quality salt is applied to the fish uniformly by hand. Proportion of salt to fish can be 1:4 in case of large fish, 1:5 for medium fish and 1:6 for small fish.

After salting, the fish is stalked in carefully cleaned cement tanks and kept for at least 24 hours in these tanks. After this, the fish is taken out and rinsed in freshly prepared brine to remove excess solid salt adhering to its surface. The salted fish is then dried on clean drying platform. This can be either raised cement or bamboo platform. The ideal way is to dry the fish in a tunnel dryer. Fish should be dried to a moisture level as per the specification. The dried fish is then dusted with calcium propionate to prevent the attack of mould and red halophiles. One gram of calcium propionate is used for 1 kg fish. The treated fish is packed in polythene lined plywood boxes or gunny bags for bulk packing. Retail quantity of 500 gm or 1 kg of the treated fish can be packed in polythene bags and stored.

When the fish is soaked in water just before cooking to remove excess salt, calcium propionate already added also will be removed. Calcium propionate is even otherwise known to be a completely safe, harmless and acceptable chemical preservative for food material. This chemical is widely used in food items like bread to prevent spoilage. The dried fish preserved in this method can be kept in very good condition for a minimum of eight months while the conventional cured fish can be kept in good condition only for about two months.

RESEARCH METHODOLOGY

CHAPTER THREE

RESEARCH METHODOLOGY

3.1. Selection of improved practices

Several steps are involved in the production of cured fish and proper care has to be taken to strictly follow each step. Each step is important in the resultant quality of the cured fish. First of all, the list of improved practices in fish curing was prepared and then addition, deletion, correction and verification of the practices were made by the scientists working in the related fields. Six major practices with their 28 sub-practices eovering the entire operation of fish curing were finally selected for this study as given below:
As the importance and description of these steps/ techniques have already been explained in the review of literature, they are not described here again in detail.

3.1.1. Construction of improved fish curing shed:

1. Construction of shed.
2. Provision of drainage facilities.
3. Provision of tables/platforms for dressing fish.

3.1.2. Cleaning and maintenance of hygiene in the fish curing shed:

4. Use of potable water in the shed.
5. Use of detergents and disinfectants for cleaning.
6. Adoption of cleaning schedule.
7. Regular washing of mat used for drying fish.

3.1.3. Handling and pre-processing of fish:

8. Use of fresh fish.
9. Proper washing of fresh fish.
10. Proper dressing and evisceration of fish.
11. Proper washing of gutted fish.
12. Use of ice for preserving fish.

3.1.4. Salting of fish:

13. Use of sufficient salt.
14. Salting of fish in cement tanks or other suitable containers.
15. Allowance of sufficient salting period.
16. Covering of salted fish to avoid flies.

17. Rinsing of salted fish in freshly prepared salt water.
18. Removal of urea from shark by desalting.
19. Removal of self-brine and addition of saturated brine in the case of pickling of fish.
20. Covering of fish with sufficient quantity of brine in the case of pickling.

3.1.5. Drying of salted fish:

21. Allowance of sufficient drying of fish.
22. Drying of fish on mat.
23. Drying of fish on raised platform.
24. Drying of fish in tunnel dryer.

3.1.6. Packing and storage of cured fish:

25. Use of chemical preservatives in cured fish.
26. Retail packing of cured fish in polythene bags.
27. Bulk paking of cured fish in improved containers.
28. Proper storage of cured fish.

3.1.7. Construction of shed:

Curing of fish is usually done in sheds constructed on the beach near the fish landing centres. Sheds may be thatched or tiled, enclosed or open, electrified or non-electrified and with or without brick walls.

Generally the fish curing sheds are not properly constructed to achieve safety and hygiene. This results in the production of very poor quality fish products having short shelf-life. Various research workers have studied the condition of fish curing sheds in India and pointed out the necessity of constructing better fish curing sheds with proper walls and safety measures.

3.1.8. Provision of drainage facilities:

The waste water, brine etc. from the curing shed usually get stagnated around the curing shed. This would adversely affect the sanitary condition of the curing yard and the quality of the cured products. Proper suggestions have been made for providing drainage facilities during the construction of fish curing shed. The fish curers have been advised to provide drainage facilities even in the absence of an improved fish curing shed.

3.1.9. Provision of tables/platforms for dressing fish:

The main cause of spoilage of cured fish is bacterial attack. Bacterial contamination takes place when fish come into contact with various dirty surfaces. The traditional way of dressing the fresh fish before salting is to cut it on the ground which is usually very dirty.

This step partly contributes to the bacterial contamination and spoilage of cured fish. It has been recommended that dressing and cutting of fish should be done on clean table, cement platform etc. to avoid contamination with bacteria and other spoilage agents.

3.1.10. Use of potable water in the shed:

One of the most important steps in handling fish is proper washing with potable water. Washing with dirty water has been found to be a major cause of spoilage of cured fish. Provision should be made in the curing shed for the availability of sufficient quantity of potable water.

3.1.11. Use of detergents and disinfectants for cleaning:

The poor quality of cured fish available at present is partly due to the unhygienic condition of the curing yards. Proper cleaning of curing yard is one of the most important steps in the production of hygienically sound cured fish. Sanitary condition of the yard can be maintained by using detergents and disinfectants in the cleaning process.

3.1.12. Adoption of cleaning schedule in the shed:

Hygiene is an important factor in any food processing establishment. Maintenance of sanitary condition is essential for avoiding bacterial spoilage of cured fish. A schedule of cleaning to maintain the hygienic condition in fish curing yard has been recommended after exhaustive survey and investigation on the curing yards and the environments.

3.1.13. Regular washing of mat used for drying fish:

Due to continuous contact with fish, mat may become a favourable harbouring place for bacteria, fungus, maggots etc. The fresh lot of fish when put on such mat will get infected with these organisms and spoiled. To overcome these problems, the mat to be used for drying fish should be washed and cleaned regularly.

3.1.14. Use of fresh fish:

The quality of the finished product depends on the quality of raw material. In the past, fish was taken for curing only when it could not be sold as fresh. By that time fish would become spoiled. Naturally, curing of this spoiled fish could produce only poor quality finished product. The fish curers had been convinced of this fact and advised to take only fresh fish for processing into cured products.

3.1.15. Proper initial washing of fresh fish:

Fish taken out of sea water may contain different

Fresh fish being thoroughly washed

types of organisms and matters which adversely affect the quality of fish. Contamination must have occurred from fishing gear, fishing boat deck, containers etc. Fish should be properly washed to remove such contaminants and kept fresh out of contact with spoilage agents. Proper washing of fish is an essential step in its processing. Very often fish curers wash the fish with sea water from the shore area containing pathogenic organisms. Fish washed with such water get more contaminated with spoilage organisms. To avoid this, potable water should be used for washing fish.

3.1.16. Proper dressing and evisceration of fish:

The intestine, gills etc. of fish contain different types of bacteria and other spoilage agents. They should be removed before fish is salted. Fish cured without removing intestine, gills etc. will spoil quickly by the action of the above spoilage agents. To get a quality cured products, the raw fish should be dressed and eviscerated before curing.

3.1.17. Proper washing of gutted fish:

The intestinal contents, blood etc. come out when fish is gutted. The spoilage agent present in these parts contaminate the fish flesh. The gutted fish should be cleaned well and properly washed before salting.

Washed fish being gutted

Cleaning and washing of gutted fish

3.1.18. Use of ice for preserving fresh fish:

Fish spoilage starts quickly at room temperature just after few hours of catch. The usual procedure to prevent spoilage is to keep the fish at extremely low temperature or to follow heat processing. A cheap and easy way of temporary preservation of fresh fish is icing to bring down the storage temperature of fish. Fish intended for curing should be stored in ice till it is cured.

3.1.19. Use of sufficient salt:

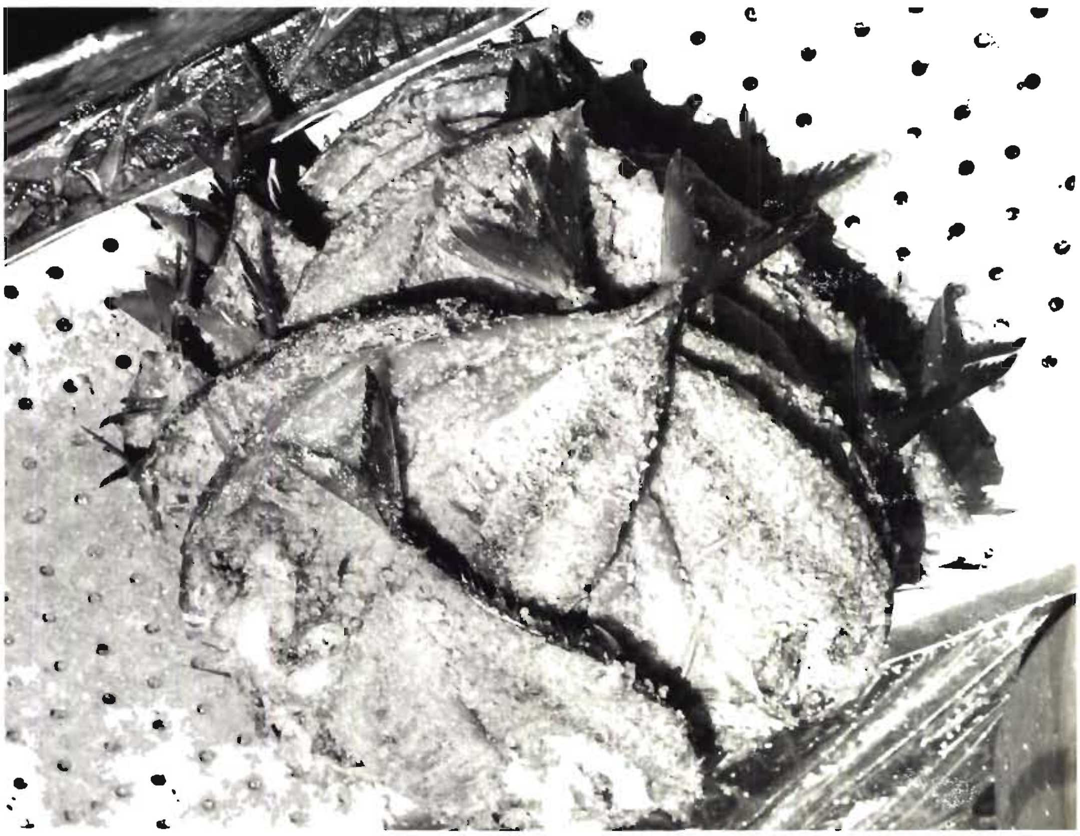
The effect of salt on fish has been already described. Salt content should be in the required level to reduce the spoilage and extend the shelf-life of the cured product. Specific salt contents for different species of salted fish have been prescribed by the Indian Standards Institution. Sufficient salt shall be added to maintain this specific level.

3.1.20. Salting of fish in cement tanks or other suitable containers:

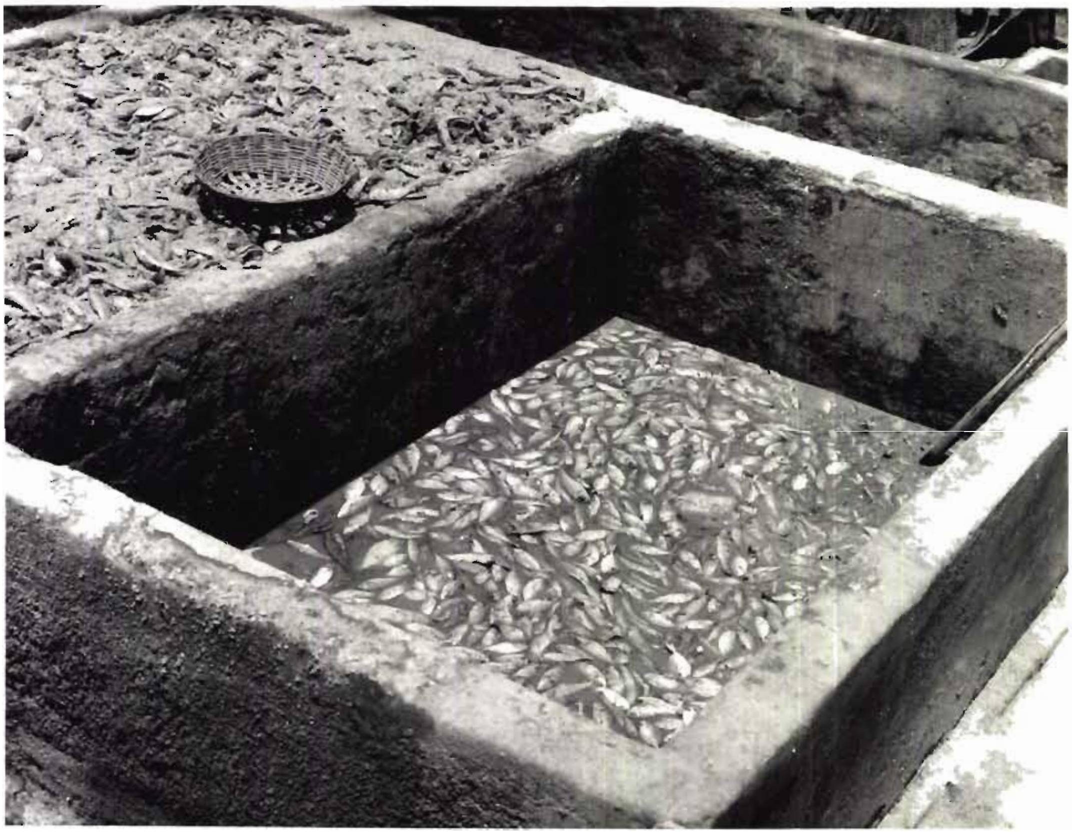
During salting the fish should be in thorough contact with salt. There should be provision to retain the self-brine in the salted fish or to allow it to flow out depending on the type of cured fish required.

Salting of fish

Another view of salting of fish



Salted fish being stacked



Salted fish being kept in commercial
salting tanks

In any case, suitable tanks or containers are necessary requisites for salting fish. The most convenient method is to provide sufficient number of cement tanks in the fish curing shed.

3.1.21. Allowance of sufficient salting period:

The period of salting is equally important as that of sufficient quantity of salt used. Salt penetration in fish continues for more than 24 hours. On several occasions it has been observed that salting period is considerably reduced because the fish curer is in a hurry to sell the salted fish. This seriously affects the quality of the cured fish. To avoid this defect, fish should be salted for sufficient period of time.

3.1.22. Covering of salted fish to avoid flies:

Attack of maggots on salted fish is a usual occurrence in unhygienic fish curing sheds. The flies deposit their eggs on the salted fish or on the containers/ tanks and the eggs hatch out within a few days. Salted fish and salting tanks/containers shall be properly covered to avoid the flies.

3.1.23. Rinsing of salted fish in freshly prepared salt water:

Salted fish is taken out from the self-brine for drying. Such fish is usually rinsed in self-brine, sea water or even in fresh water. Investigation has shown that rinsing or washing of salted fish with sea water which is usually highly polluted will contaminate the fish. Washing salted fish with fresh water will cause leaching of salt from the salted fish leading to the dull appearance of the fish on drying. Salt deposit may be observed on the surface of dried fish, if it is initially rinsed in self-brine. To avoid all these defects, salted fish should be rinsed in freshly prepared brine.

3.1.24. Removal of urea from shark by desalting:

Dried shark is an important item of cured fish. But many people do not relish shark flesh because of its peculiar ammoniacal odour evolved by the decomposition of urea present in the fish. Removal of urea from shark flesh is essential to over come this defect. A simple method of desalting the heavily salted shark flesh has been suggested to remove urea from shark flesh. Desalted fish can be lightly salted again and dried for storage.

3.1.25. Removal of self-brine and addition of saturated brine in the case of pickling of fish:

In the case of pickling, the salted fish remains immersed in self-brine for many days. Self-brine may contain various nutrients leached out from the fish which are ideal foods for bacteria. If fish remains in this medium, it will be spoiled quickly. To avoid this, self-brine should be replaced with fresh saturated brine for storage of pickled fish.

3.1.26. Covering of fish with sufficient quantity of brine in the case of pickling:

It has been often observed that the top layer of fish pickled in brine is exposed to atmosphere. This layer of fish in contact with atmosphere gets spoiled quickly. Spoilage thus sets in and spreads to the bottom layers of fish. To avoid this defect in pickling, fish should be completely immersed in brine. Sufficient saturated brine should be added to fully immerse the salted fish.

3.1.27. Allowance of sufficient drying of fish:

Bacteria grow and multify in fish when the moisture level is above a certain level. If the fish is dried to a moisture level below this point, bacterial spoilage can be controlled and shelf-life of the dried product can be enhanced. Usually in commerce, fish is not dried to the required moisture level. Importance of sufficient drying of fish to bring down the moisture level has been brought to the notice of the fish curers.

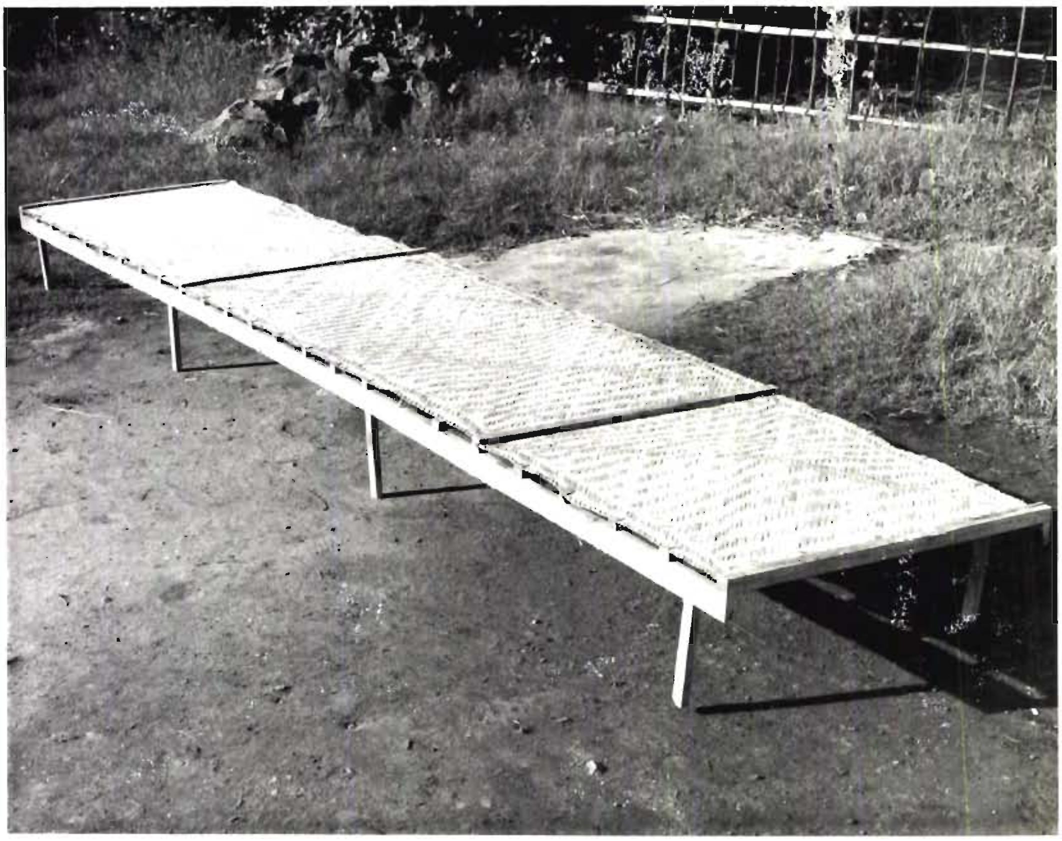
3.1.28, 29 & 30. Drying of salted fish on mat, raised platform or in a dryer:

Salted fish is usually dried unhygienically. Often fish is directly spread on the ground or sea shore for drying. This step causes the fish to be contaminated with sand and pathogenic organisms leading to the quick spoilage of dried fish. The best way to overcome this defect is to dry the fish in artificial dryer. But this is a costly process which ordinary fish curer cannot afford. Under these circumstances, construction of a raised platform is suggested for drying fish under the sun. In the absence of a raised platform, fish should be dried either on a cemented floor or on mat spread on the ground so as to avoid the contact of fish with sand and dirt.

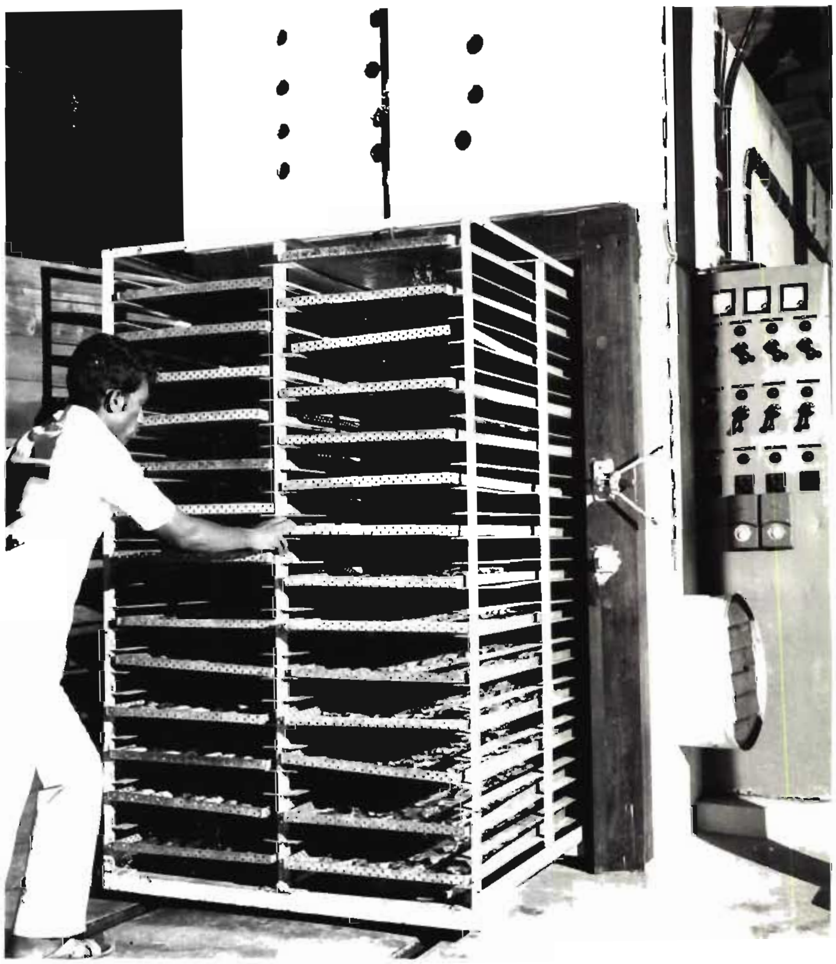
3.1.31. Use of chemical preservatives in cured fish:

Salt cured fish is usually attacked by fungus and red halophiles within a short period of storage, particularly under high humidity levels. Large quantities of cured fish get spoiled and wasted every year due to these defects. Treatment of cured fish with sodium propionate or calcium propionate is suggested for preventing the fungal and red attack.

Drying of fish on raised platform



Raisod platform for drying fish



Drying of fish in tunnel dryer

Dry salted fish attacked by fungus and
red halophiles

Calcium propionate being applied on
dried fish

3.1.32. Retail packing of cured fish in polythene bags:

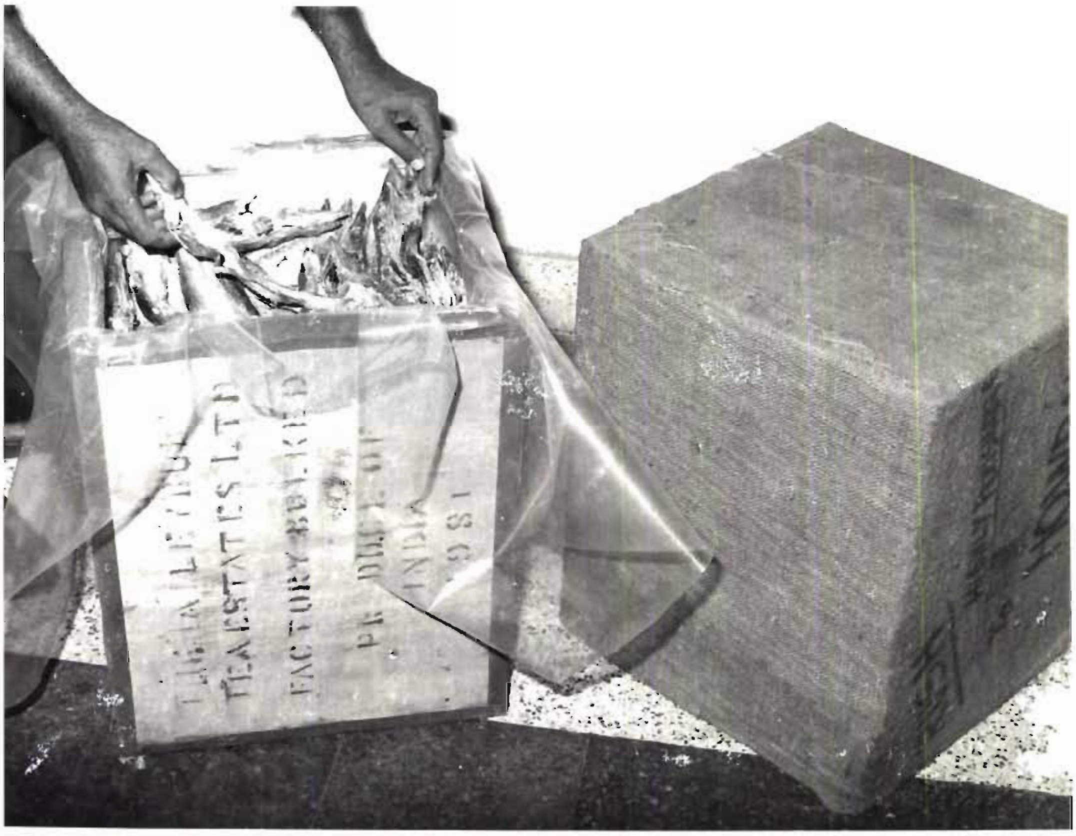
People belonging to medium and high income groups do not usually purchase salt cured fish. One reason for this is that cured fish is displayed for sale on the shop floor in an unhygienic manner. If the product is hygienically packed in consumer size polythene bags, there will be more demand for this item. The fish curers have been informed about this trend.

3.1.33. Bulk packing of cured fish in improved containers:

Plywood or dealwood boxes, gunny bags, palmirah or screw pine leaf mats, card board boxes etc. are normally used for packing cured fish. As these materials are not moisture proof, cured fish packed in such containers either pick up moisture or dry up depending on the weather ultimately leading to their spoilage.

Even though technological advancement has taken place in the packaging of many food items, similar developments have not occured in the fish curing industry on account of the comparatively low price of the cured fish and high cost of the packaging materials. Under these circumstances, costly packaging materials cannot be used for cured fish. Therefore an improved method of packing cured fish with the traditional packaging

Dried fish packed in polythene bags



Dried fish being packed in polythene
lined ply-wood box

A view of commercial fish curing yard

Commercial packing of dried fish

materials is suggested. Plywood box, deal wood box, gunny bags etc. lined with polythene has been found to be good for packing cured fish.

3.1.34. Proper storage of cured fish:

Storage of cured fish without proper protection will lead to the spoilage of the product. Rats, cats, dogs, birds etc. may eat away the fish stored openly infecting the whole lot. Rancidity also may develop quickly when the cured fish, particularly fatty fish is kept open. Cured fish should be properly stored in well constructed and hygienically maintained rooms.

3.2 Locale of study

The coast line of India is more than 6100 km covering many states along the west and east coasts. It is not practically possible to conduct a study all over these coasts under a single research project. Therefore, only three important states in South India viz. Kerala and Karnataka in the west coast and Tamilnadu in the east coast were selected for the present study. Considering the importance with respect to the fish curing industry, the regions namely Calicut (Kerala), Malpe (Karnataka) and Tuticorin (Tamilnadu) were identified for this study. For Calicut region, fish curing yards located in

Puthiyappa, Vellayil and Beypore areas were included. In Malpe, curing yards which are concentrated in a single centre adjascent to the fishing harbour were taken. The fish curing centre at Tuticorin and the nearest important centre Punnakayal were taken together to represent the Tuticorin region.

3.3. <u>Sampling plan</u>

The total population of fish curers was taken for the study in all the regions. Thus Calicut region has 140 fish curers, Malpe region has 125 fish curers and Tuticorin region has 40 fish curers actively engaged in the fish curing. At present only the officials from Central and State Fisheries Departments are involved in the technology transfer in fish curing industry. The Scientists, Technologists, Assistant Directors, Research Assistants, Fisheries Extension Officers, Fisheries Inspectors etc. under Central and State Fisheries Departments involved in extension activities were categorised as 'extension workers' for the purpose of this study. All the fish curers have been taken as respondents for this study. Table 4 shows the distribution of respondents identified for the study.

Table 4. Distribution of respondents in different regions

State	District	Region	Fish curing centres	Total number of respondents identified for the study
Kerala	Calicut	Calicut	Puthiyappa, Vellayil and Beypore	140
Karnataka	South Kanara	Malpe	Malpe	125
Tamilnadu	Trinelveli	Tuticorin	Tuticorin and Punnakayal	40

3.4. Selection of independent variables

Selection of independent variables was made on the basis of discussion with the experts, a preliminary study in the areas of investigation and the review of the literature available pertaining to the subject. A list of eighteen variables considered to be important, based on the above programme, was sent to judges for their judgement with regard to their relevance to the dependent variables. The judges were drawn from the field of fisheries. Only seven independent variables judged to be relevant were finally selected for detailed investigation. The selected variables are given below.

(1) Age of fish curer.

(2) Level of education.

(3) Social participation.

(4) Contact with extension agency.

(5) Perception of profitability of the technology.

(6) Income.

(7) Debt.

The conceptual frame work developed for the study showing the independent variables and the technological gap is given in figure 1.

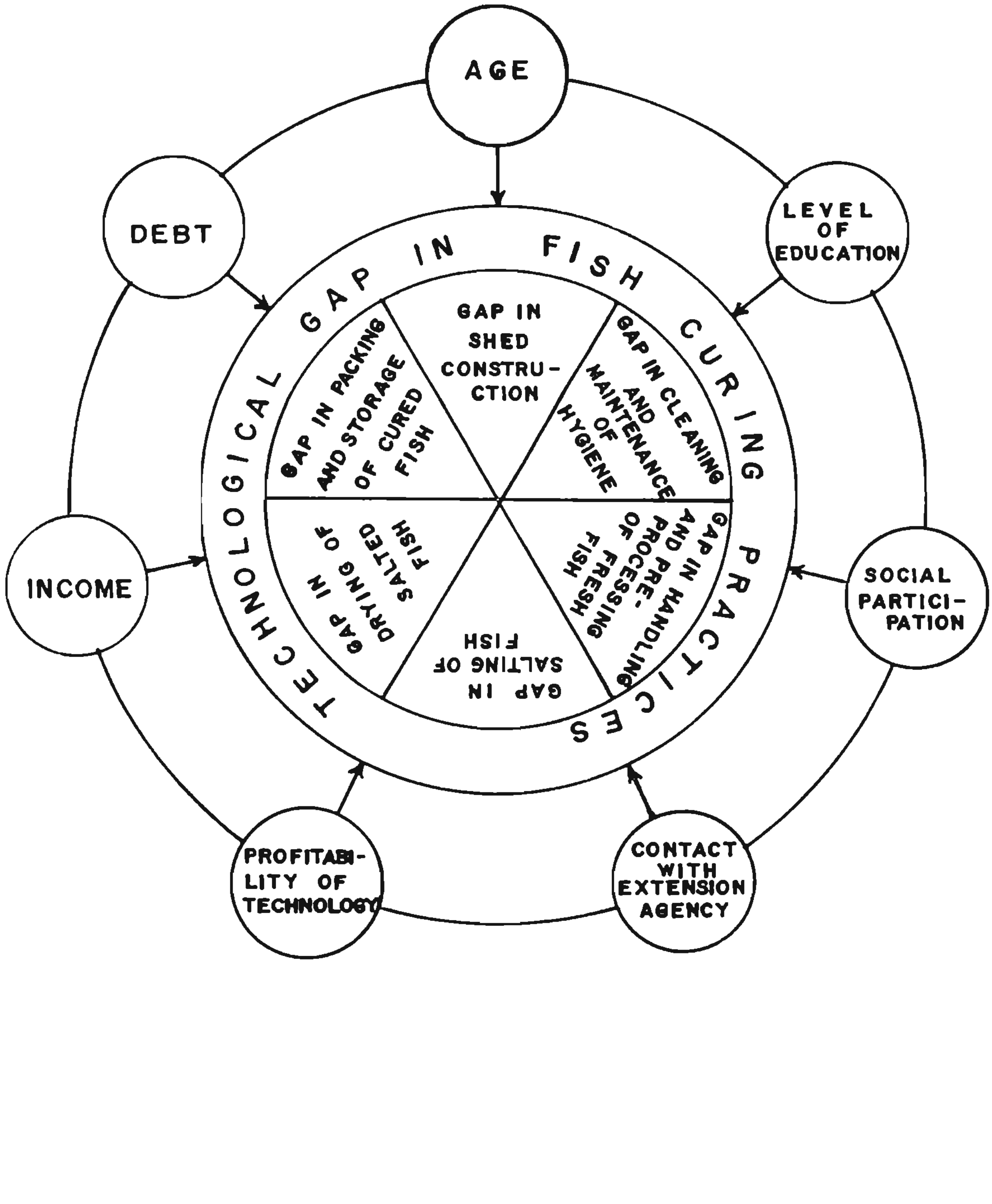
3.5. Methods used in measurement of variables

No investigation seems to have been made in fish curing or fish processing technology to study the variables similar to those taken up in this project. Therefore the general scales developed and followed in other fields for similar studies were used in this investigation after necessary modification wherever required.

3.5.1. Knowledge:

All the twenty eight fish curing practices selected for this study were considered to study the knowledge with

FIG.1 CONCEPTUAL FRAME WORK SHOWING THE INDEPENDENT VARIABLES AND TECHNOLOGICAL GAP.



respect to fish curing technology. Knowledge of the fisheries extension workers (officials engaged in extending the improved practices) as well as fish curers (respondents) was tested. For each practice, the extension workers and the fish curers were asked whether they "have full knowledge" or "have partial knowledge" or "did not have knowledge". If known, they were asked further about the practices to confirm the possession of the knowledge. Score '2' was given if they possessed full knowledge, score '1' for partial knowledge and score '0' for no knowledge of each practice. Thus a respondent could get the maximum score '56' for full knowledge with respect to all the 28 practices and minimum score '0' for having no knowledge of any of the practices. The knowledge gap up to 33% was categorised as "low", gap between 33% and 66% as "medium" and above 66% as "high".

3.5.2. Adoption:

The term adoption is applied to acceptance and use of improved practices. This implies that adopter is satisfied with the innovation. Adoption is defined as the overt behaviour of fish curers taking up the improved practices. Partial adoption in this study is referred to the adoption of a practice in part or irregularly.

Non-adoption refers to the non-practising of the improved practices.

Questions related to each of the 28 practices selected for the study were posed separately to the fish curers to know the specific adoption of the individual practices. Score '2' was given for full adoption of each practice. Score '1' was given for each practice adopted partly. Score '0' was given for non-adoption of the practice. Thus a fish curer could get a maximum score of '56' for full adoption of all the 28 practices and a minimum score of '0' for non-adoption of all the improved practices.

3.5.3. Age:

In this study, age was measured in terms of completed years. The number of completed years of the respondent was taken as the index of his age. To study the correlation of age with adoption, the respondents were categorised under different age groups as per the following scale.

Category of respondents	Score
up to 30 years	1
30 to 35 years	2
35 to 40 years	3
40 to 45 years	4
45 to 50 years	5
Above 50 years	6

3.5.4. Level of education:

Education was measured in terms of number of years of formal school or college studies undergone by the respondent. Level of education of the respondents was quantified as per the scale developed by Trivedi (1963).

Category of respondents	Score
Illiterate	0
Can read only	1
Can read and write	2
Up to primary school	3
Up to middle school	4
Up to high school	5
College education	6

3.5.5. Social participation:

This refers to participation of the respondents in social institutions as a member or as an office bearer. The fish curers were asked to indicate the institutions in which they had membership or they were office bearers. The scale developed by Trivedi (1963) was used with slight modification to measure social participation of the respondents in the present study.

Category of respondents	Score
No membership in any organisation	0
Membership in one organisation	1
Membership in more than one organisation	2
Office bearer in one organisation	3
Office bearer in more than one organisation	4
Distinctive features (MLA, MP etc.)	6

3.5.6. Contact with extension agency:

This refers to the contact of the respondents with the extension workers by a visit, discussion, consultation, advice etc. providing information to the respondents about the fish curing practices. The respondent was asked as to how often he came in contact with the extension workers. The following procedure developed by Tripathy (1977) was adopted to score for the contact with extension agency.

Responses	Score
Most frequently (weekly)	6
Frequently (fortnightly)	5
Most often (monthly)	4
Often (once in two months)	3
Occasional (once in 3 months)	2
Rarely (once in six months)	1

3.5.7. Perception of profitability of technology:

This was operationalised as the respondents perception of additional gain in terms of money by adopting the improved fish curing practices. Profitability was measured as per the scale developed by Tripathy (1977) with slight modification.

Responses	Score
Most profitable	6
Very profitable	5
Profitable	4
Marginally profitable	3
Least profitable	2
Not profitable	1

3.5.8. Income:

This refers to the total annual income in terms of money the respondent had at the time of the investigation. Respondent was given score for income on the basis of the following scale.

Annual income	Score
Up to Rs.4000/-	1
Rs.4000 to Rs.5500/-	2
Rs.5500 to Rs.7000/-	3
Rs.7000 to Rs.8500/-	4
Rs.8500 to Rs.10,000/-	5
Above Rs.10,000/-	6

3.5.9. Debt:

This refers to the total debt in terms of money the respondent had at the time of the investigation. Score was given to the respondent on the basis of debt with the following procedure.

Debt	Score
Up to Rs.250/-	1
Rs.250 to Rs.500/-	2
Rs.500 to Rs.750/-	3
Rs.750 to Rs.1000/-	4
Rs.1000 to Rs.1500/-	5
Above Rs.1500/-	6

3.5.10. Technological gap:

Technological gap with respect to knowledge and adoption was measured separately.

3.5.10.1. Knowledge gap:

Knowledge gap in overall practices was measured among fisheries extension workers and the fish curers. Knowledge gap was measured by the following formula and expressed in percentage.

$$\frac{k - p}{k} \times 100$$

where k = the total knowledge score (56)

p = the score obtained for the knowledge actually possessed.

3.5.10.2. Adoption gap:

Adoption gap index was calculated against the total practices and also against the 6 major practices as given below.

3.5.10.2.1 Over all adoption gap against fish curing practices:

The gap index in the entire recommended practices was calculated by the following formula and expressed in percentage.

$$\frac{R - A}{R} \times 100$$

where R = the maximum score for all the 28 practices (56).

A = score obtained out of 56.

3.5.10.2.2. Adoption gap against construction of improved fish curing shed:

The gap in the practice of constructing improved fish curing shed was calculated against three sub-practices by the following formula and expressed in percentage.

$$\frac{R - A}{R} \times 100$$

where R = the total score of 6 for the above three components.

A = score obtained out of 6.

3.5.10.2.3. Adoption gap against cleaning and maintenance of hygiene in fish curing shed:

The gap against this major practice was calculated against four sub-practices by the following formula and expressed in terms of percentage.

$$\frac{R - A}{R} \times 100$$

where R = the total score of 8 for the above four components.

A = score obtained out of 8.

3.5.10.2.4. Adoption gap against handling and pre-processing of fish:

The gap in handling and pre-processing of fish was calculated against five components and expressed in percentage by the following formula.

$$\frac{R - A}{R} \times 100$$

where R = total score of 10 for five sub-practices.

A = score obtained out of 10.

3.5.10.2.5 Adoption gap against salting of fish:

Gap against this major practice was calculated against 8 sub-practices and expressed in percentage using the following formula.

$$\frac{R - A}{R} \times 100$$

where R = total score of 16 for 8 sub-practices.

A = score obtained out of 16.

3.5.10.2.6. Adoption gap in drying of salted fish:

Gap against this major practice was calculated against four sub-practices and expressed in percentage using the following formula.

$$\frac{R - A}{R} \times 100$$

where R = total score of 8 for four practices.

A = score obtained out of 8.

3.5.10.2.7. Adoption gap against packing and storage of cured fish.

The gap index in packing and storage of cured fish was calculated against the four components and expressed in percentage by using the following formula.

$$\frac{R - A}{R} \times 100$$

where R = the total score of 8 for four sub-practices.

A = score obtained out of 8.

3.6. Construction of interview schedule

Draft interview schedules were prepared and administered to 25 fish curers in a fishing village adjascent to the area of investigation to study the adoption gap and knowledge gap. In the light of the results of this pre-testing, the schedules were suitably modified and finalised.

3.7. Method of data collection

The data were collected by interviewing the respondents individually. In Calicut, the researcher whose mother-tongue is Malayalam conducted the interview directly. In Malpe and Tuticorin the local fisheries officials knowing the regional language were taken to assist the researcher for conducting the interview. The data were collected during 1983-84.

3.8. Test- re-test method

Re-test was conducted in all these centres after a period of two months to judge the reliability of the response. From Calicut centre 50, from Malpe 40 and from Tuticorin 25 respondents were selected for the re-test. The coefficient of correlation for the re-test from the three centres were 0.91, 0.95 and 0.92 respectively for adoption and 0.89, 0.92 and 0.95 respectively for knowledge. The coefficient of correlation for knowledge in the test and re-test method for extension workers was 0.87 for 8 pairs of observation. These correlations are highly significant ($P < 0.01$) indicating that there is very good agreement between the responses in the test-re-test method.

3.9. Statistical procedure

To study the interdependency of different variables, correlation analysis was carried out. The coefficient of correlation was calculated by using the formula.

$$r = \frac{\sum (x - \bar{x})(y - \bar{y})}{n \sigma x \sigma y}$$

where 'r' is the Pearsons' coefficient of correlation

$\bar{x}$ and $\bar{y}$ are the mean values of x and y.

σx and σy are the standard deviation of x and y. respectively. The significance of 'r' was tested using 't' test.

$$t = \frac{r \sqrt{n-2}}{\sqrt{1 - r^2}}$$

The degrees of freedom of 't' is (n-2)

To test the significance of association between various attributes in the contingency table, chi-square statistic was employed. The chi-square statistic defined as

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

where O = the frequency observed and

E = the frequency expected.

The degree of freedom of χ^2 in a contingency table of size m X n is (m-1) $\times$ (n-1)

Multiple regression analysis was employed to study the dependency of adoption on various independent variables selected for the study. Also, the contribution of each variable on adoption was estimated. The multiple regression model adopted for this purpose was

$$Y = b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7$$

where Y = adoption

x_1 = Age

x_2 = Education

x_3 = Social participation

x_4 = Contact with extension agency

x_5 = Perception of profitability of technology

x_6 = Income

x_7 = Debt

The amount of variability explained by the regression was decided by R^2, the multiple correlation coefficient. The relative importance of each variable was worked out by the method suggested by Snedecor and Cochran (1956). The relative importance of ith variable is worked out by using

$$bi \times \sqrt{\frac{\Sigma xi^2}{\Sigma y^2}}$$

where bi is the regression coefficient of the ith variable and Σxi^2 and Σy^2 are the sum of squares of deviations from the mean values of xi and y respectively.

RESULTS AND DISCUSSIONS

CHAPTER FOUR

RESULTS AND DISCUSSIONS

4.1. Classification of fish curers

The fish curers in the different regions under study were classified and compared on the basis of different variables taken up for this investigation.

4.1.1. Sex:

Table 5 shows the classification on the basis of their sex. Calicut region showed maximum percentage of male members with 97.2% followed by 92.5% in Tuticorin and 23.2% in Malpe. An interesting point noted here was that female fish curers dominated the fish curing industry in Malpe region.

Table 5. Classification of fish curers on the basis of their sex

Category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
Male	136	97.2	29	23.20	37	92.50
Female	4	2.80	96	76.80	3	7.50

4.1.2. Age:

Table 6 shows the categorisation of fish curers on the basis of their age. Percentage of fish curers in the lowest age group (up to 30 years) was maximum (13.6%) in Calicut region followed by Malpe (6.4%) and Tuticorin (5%). In Calicut region, 11.4% of the people were under the age group of 30 to 35 years while the corresponding figures for Malpe and Tuticorin were 11.2% and 5% respectively. Similarly, 10% of the fish curers in Calicut were under the age group of 35 to 40 years while Malpe had 11.2% and Tuticorin had 2.5% of the fish curers in the same category. Among the people in the age group of 40 to 45 years, Calicut had 21.4%, Malpe had 24.8% and Tuticorin had 15% of their total fish curing population. The single largest percentage of fish curers in all the regions was seen in the age group of 45 to 50 years. Under this group, Calicut had 30.7%, Malpe showed 28.8% and Tuticorin recorded 42.5%. Coming to the oldest group of people in the age group of 50 years and above, Calicut had 12.9%, Malpe had 17.6% and Tuticorin had 30%. It was interesting to note that the percentage of fish curers in the age groups of 40 to 45 years and above were 65%, 71.2% and 87.5% for Calicut, Malpe and Tuticorin respectively. This showed that younger fish curers were more in Calicut region followed by Malpe and Tuticorin.

Table 6. Classification of fish curers on the basis of their age

Category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
Up to 30 years	19	13.60	8	6.40	2	5.00
30 to 35 years	16	11.40	14	11.20	2	5.00
35 to 40 years	14	10.00	14	11.20	1	2.50
40 to 45 years	30	21.40	31	24.80	6	15.00
45 to 50 years	43	30.70	36	28.80	17	42.50
Above 50 years	18	12.90	22	17.60	12	30.00

4.1.3. Education:

Table 7 shows the classification of the fish curers on the basis of their education. The illiterate fish curers constituted 4.3% in Calicut region, 27.2% in Malpe and 20% in Tuticorin. The percentage of people who could only read was 5.7 in Calicut, 22.4 in Malpe and 27.5 in Tuticorin. Those who could read and write constituted 21.4% in Calicut, 19.2% in Malpe and 27.5% in Tuticorin. Calicut had 38.6%, Malpe had 12% and Tuticorin had 12.5% of the fish curers with education up to primary school. Fish curers with middle school education constituted 18.6% in Calicut, 13.6% in Malpe and 2.5% in Tuticorin. High school educated fish curers constituted 11.4%, 5.6% and 10% in Calicut, Malpe and Tuticorin respectively.

The data generally showed that the single largest group of fish curers in Calicut region had education up to primary school while the largest group in Malpe was illiterate and that in Tuticorin could either read only or could read and write. The smallest group in Calicut was illiterate while the smallest group in Malpe was high school educated and that in Tuticorin was middle school educated. Taking together the fish curers with education level of middle school and above, they constituted 30% in Calicut, 19.2% in Malpe and 12.5% in Tuticorin.

Table 7. Classification of fish curers on the basis of their education

Category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
Illiterate	6	4.30	34	27.20	8	20.00
Can read only	8	5.70	28	22.40	11	27.50
Can read and write	30	21.40	24	19.20	11	27.50
Up to primary school	54	38.60	15	12.00	5	12.50
Up to middle school	26	18.60	17	13.60	1	2.50
Up to high school	16	11.40	7	5.60	4	10.00
College education	0	0.00	0	0.00	0	0.00

The chi-square value is calculated as 78.37 with degrees of freedom 8 which is significant at 0.1% level. This shows that the level of education and regions are dependent i.e. level of education differs from region to region. The observation shows that Calicut region registered the highest level of education among the three centres.

A comparatively higher level of education of the fish curers in Calicut may be the result of the existing high level of literacy in Kerala as a whole. This has helped the fish curers understand and adopt the improved fish curing practices to a greater extent compared to the other two centres.

4.1.4. Social participation:

Table 8 shows the classification of fish curers on the basis of their social participation. Calicut had 13.6%, Malpe had 17.6% and Tuticorin had 20% of the fish curers without membership in any organisation. People with membership in only one organisation constituted 47.9% of the total fish curers in Calicut, 56.8% in Malpe and 50% in Tuticorin. Twenty percent of the respondents in Calicut had membership in more than one organisation while the corresponding figures for Malpe and Tuticorin were 15.2% and 17.5% respectively. Calicut had 18.5% of its fish curers as office bearers in one organisation while Malpe had 10.4% and Tuticorin had 12.5% in the same category.

The chi-square value is calculated as 6.185 with degrees of freedom 6 which is not significant. This shows that the level of social participation is almost same in all the three regions.

Table 8. Classification of fish curers on the basis of their social participation

Category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
No membership in any organisation	19	13.60	22	17.60	8	20.00
Membership in one organisation	67	47.90	71	56.80	20	50.00
Membership in more than one organisation	28	20.00	19	15.20	7	17.50
Office bearer in one organisation	26	18.50	13	10.40	5	12.50
Office bearer in more than one organisation	0	0.00	0	0.00	0	0.00
Distinctive features	0	0.00	0	0.00	0	0.00

The picture generally showed that fish curers with membership in one organisation dominated in all the three centres with maximum percentage in Malpe followed by Tuticorin and Calicut. The second largest group belonged to those without membership in any organisation in the case of Malpe and Tuticorin while in Calicut the second position was occupied by the respondents with membership in more than one organisation. In general, fish curers in Calicut showed maximum social participation followed by Malpe and Tuticorin.

A higher level of social participation among fish curers in Calicut may be partly attributed to their higher level of education. The social participation also might have helped the adoption of improved practices by the fish curers.

4.1.5. Contact with extension agency:

Table 9 shows the classification of fish curers on the basis of their contact with extension agency. People with weekly contact with extension agency constituted 4.3% in Calicut, 1.6% in Malpe and 5% in Tuticorin. The percentage of people having fortnightly extension contact were 5.7, 3.2 and 7.5 in Calicut, Malpe and Tuticorin respectively. Respondents with monthly contact constituted 12.9% in Calicut, 11.2% in Malpe and 12.5% in Tuticorin. Ten percent of the people in Calicut, 8% in Malpe and 15% in Tuticorin had extension contact once in two months. In Calicut, 36.4% of the fish curers had extension contact once in three months while the figures for Malpe and Tuticorin in this respect were 44% and 25% respectively. People with extension contact once in six months constituted 30.7% in Calicut, 32% in Malpe and 35% in Tuticorin.

Table 9. Classification of fish curers on the basis of their contact with extension agency

Category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
Weekly contact	6	4.30	2	1.60	2	5.00
Fortnightly contact	8	5.70	4	3.20	3	7.50
Monthly contact	18	12.90	14	11.20	5	12.50
Once in two months	14	10.00	10	8.00	6	15.00
Once in 3 months	51	36.40	55	44.00	10	25.00
Once in 6 months	43	30.70	40	32.00	14	35.00
Never	0	0.00	0	0.00	0	0.00

The chi-square value is calculated as 8.067 with degrees of freedom 8 which is not significant, that is, the contact with extension agency is almost same in all the three regions under study.

In general it was seen that the largest single group of fish curers was those having extension contact once in three months in Calicut and Malpe while the same in

Tuticorin belonged to those with extension contact once in six months. Frequent extension contact was noted only in negligible cases in all the centres. This situation demands the necessity for organising more extension activities to contact the fish curers in all the centres.

4.1.6. Profitability:

Table 10 presents the data classifying the fish curers on the basis of their perception on profitability of the fish curing technology. Calicut had 5.7% of its fish curers perceiving the technology as most profitable while the same category of people constituted 3.2% in Malpe and 10% in Tuticorin. Calicut had 7.1%, Malpe had 5.6% and Tuticorin had 2.5% of the fish curers perceiving the fish curing technology as very profitable. Regarding the people who perceived the technology as 'profitable', Calicut showed 12.1%, Malpe showed 5.6% and Tuticorin had 5%. Fish curers perceiving the technology as marginally profitable constituted 25.7% in Calicut, 16% in Malpe and 30% in Tuticorin. The percentages were 36.5, 27.2 and 30 in Calicut, Malpe and Tuticorin respectively for the people who perceived the technology as least profitable. Those who perceived the technology as not profitable constituted 12.9% in Calicut, 42.4% in Malpe and 22.5% in Tuticorin.

Table 10. Classification of fish curers on the basis of their perception of profitability of the technology

Category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
Most profitable	8	5.70	4	3.20	4	10.00
Very profitable	10	7.10	7	5.60	1	2.50
Profitable	17	12.10	7	5.60	2	5.00
Marginally profitable	36	25.70	20	16.00	12	30.00
Least profitable	51	36.50	34	27.20	12	30.00
Not profitable	18	12.90	53	42.40	9	22.50

The chi-square value is calculated as 31.967 with degrees of freedom 6 which is highly significant at 0.1% level. That means, perception of profitability varies from region to region. For working out the chi-square value, the three categories viz. most profitable', very profitable and profitable were combined. It is seen from the table that 24.9% of the fish curers in Calicut reported the technology as profitable while the corresponding figures for Malpe and Tuticorin are 14.47% and 17.5% respectively. In Calicut, 49.4% perceived the technology as least/non-profitable while 69.6% in Malpe and 52.5% in Tuticorin expressed the same view.

The improved practices will be adopted by the fish curers only when they perceive that such practices are superior to the existing ones.

The picture generally shows that the improved fish curing technology was not considered highly profitable by the fish curers. This factor might have contributed to the lower adoption of the technology by the fish curers. They should be properly educated about the advantages of the technology so as to create a favourable attitude towards the improved technology.

4.1.7. Income:

Table 11 shows the classification of fish curers on the basis of their income. In Calicut, 25.7% of the fish curers had annual income up to Rs.4000/- while the corresponding figures for Malpe and Tuticorin were 56% and 35% respectively. The percentages of fish curers in the category of annual income of Rs.4000/- to Rs.5500/- were 25.7% in Calicut, 19.2% in Malpe and 42.5% in Tuticorin. Calicut showed 24.3% of the fish curers, Malpe showed 13.6% and Tuticorin showed 10% of the fish curers coming in the category of annual income of

Table 11. Classification of fish curers on the basis of their income

Income category (Annual)	Calicut (N-140) No.	Calicut (N-140) %	Malpe (N-125) No.	Malpe (N-125) %	Tuticorin (N-40) No.	Tuticorin (N-40) %
Up to Rs.4000/-	36	25.70	70	56.00	14	35.00
From Rs.4000/- to Rs.5500/-	36	25.70	24	19.20	17	42.50
From Rs.5500/- to Rs.7000/-	34	24.30	17	13.60	4	10.00
From Rs.7000/- to Rs.8500/-	16	11.40	8	6.40	0	0.00
From Rs.8500/- to Rs.10,000/-	8	5.70	1	0.80	1	2.50
Above Rs.10,000/-	10	7.20	5	4.00	4	10.00

Rs.5500/- to Rs.7000/-. People with annual income of Rs.7000/- to Rs.8500/- constituted 11.4% in Calicut and 6.4% in Malpe. Tuticorin did not have any fish curer in this category. Regarding fish curers with annual income of Rs.8500/- to Rs.10000/-, Calicut had 5.7%, Malpe had 0.8% and Tuticorin had 2.5%. People with annual income above Rs.10000/- constituted 7.2% in Calicut, 4% in Malpe and 10% in Tuticorin.

For computing chi-square value, categories 3 and 4 (Rs.5,500-7,000 and Rs.7,000-8,500) and 5 and 6 (Rs.8,500-10,000 and above 10,000) were combined. Chi-square value is 38.6 with degrees of freedom 6 which is highly significant at 0.1% level. This shows that the income level and regions are dependend. The income varies from region to region. The high income group falling in the last category (Rs.8,500/- to Rs.10,000/- and above) comprised of 12.9% in Calicut, 4.8% in Malpe and 12.5% in Tuticorin. The middle income group (Rs.5,500-8,500) formed 35.7% in Calicut, 20% in Malpe and 10% in Tuticorin. Thus the Calicut region was found to be economically better than the other regions.

It was generally seen from the data that most of the fish curers came under low income group. This situation might have made them unable to adopt improved technology which required a slightly more financial investment compared to the traditional methods.

4.1.8. Debt:

Table 12 presents the classification of fish curers on the basis of their debt. People with out debt constituted 45% of the fish curers in Calicut, 18.4% in Malpe and 12.5% in Tuticorin. Calicut had 12.1% of the fish curers with a debt of up to Rs.250/- while the corresponding figures for Malpe and Tuticorin were 3.2% and 5% respectively. Calicut showed 19.3%, Malpe showed 28.8% and Tuticorin showed 15% of the fish curers with the debt of Rs.250/- to Rs.500/-. People with debt of Rs.500/- to Rs.750/- constituted 14.3% in Calicut, 34.4% in Malpe and 27.5% in Tuticorin. Percentages of fish curers with a debt of Rs.750/- to Rs.1000/- were 8.6% in Calicut, 15.2 in Malpe and 30% in Tuticorin. In the range of debt of Rs.1000/- to Rs.1500/-, Calicut had 0.7% and Tuticorin had 10% with none in Malpe.

Table 12. <u>Classification of fish curers on the basis of their debt</u>

Category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
No debt	63	45.00	23	18.40	5	12.50
Debt up to Rs.250/-	17	12.10	4	3.20	2	5.00
Rs.250/- to Rs.500/-	27	19.30	36	28.80	6	15.00
Rs.500/- to Rs.750/-	20	14.30	43	34.40	11	27.50
Rs.750/- to Rs.1000/-	12	8.60	19	15.20	12	30.00
Rs.1000/- to Rs.1500/-	1	0.70	0	0.00	4	10.00

For the calculation of chi-square value, categories of debt up to Rs.500/- are combined. Similarly, categories of debt from Rs.750/- to Rs.1500/- are combined. Chi-square value is calculated as 52.09 with degrees of freedom 6 which is highly significant at 0.1% level. Debt and region are dependent. Forty five percent of the fish curers is free from debt in Calicut whereas only 18.4% belonged to this category in Malpe and 12.5% in Tuticorin. Debt is high to the rate of 40% in Tuticorin followed by 15.2% in Malpe and 9.3% in Calicut.

The picture generally shows that the single largest group in Calicut did not have any debt while the same group in Malpe and Tuticorin had debt in the range of Rs.500/- to Rs.750/- and Rs.750/- to Rs.1000/- respectively. Debt might have affected adversely the extent of adoption of the improved fish curing practices.

4.1.9. Adoption gap:

Table 13 shows the classification of fish curers on the basis of their adoption gap. Calicut had 16.4% of the fish curers in medium adoption gap while the corresponding figures for Malpe and Tuticorin were 9.6% and 12.5% respectively. People in the category of high adoption gap constituted 83.6% of the fish curers in

Calicut, 90.4% in Malpe and 87.5% in Tuticorin. There was no fish curer in low adoption gap in any region.

Table 13. Classification of fish curers on the basis of adoption gap in fish curing practices

Adoption gap category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
Low	0		0		0	
Medium	23	16.40	12	9.60	5	12.50
High	117	83.60	113	90.40	35	87.50

The picture generally shows that fish curers in Calicut region had less adoption gap compared to Malpe and Tuticorin. This may partly be attributed to the higher level of education, social participation, perception of profitability etc. of the fish curers in Calicut region. The influence of the nearby Research Centre of Central Institute of Fisheries Technology, where research in fish curing is carried out might have also contributed to the lower adoption gap in Calicut.

4.1.10. Knowledte gap:

Table 14 shows the classification of fish curers on the basis of their knowledge gap. People in low knowledge gap category constituted 9.3% of the fish curers in Calicut and 4% in Malpe with nobody in Tuticorin region. Calicut had 25.7% of the fish curers in medium knowledge gap group while the corresponding figures were 22.4% and 32.5% for Malpe and Tuticorin respectively. Sixty five percent of the fish curers in Calicut, 73.6% in Malpe and 67.5% in Tuticorin showed high knowledge gap.

It was generally seen that knowledge gap was maximum in Malpe and minimum in Calicut. This may be the result of the higher level of education, social participation, nearness of the research institute etc. in Calicut. More extension work has to be carried out to reduce the knowledge gap of the fish curers in all the centres with maximum stress in Malpe region.

Table 14. Classification of fish curers on the basis of their knowledge gap in fish curing practices

Knowledge gap category	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
	No.	%	No.	%	No.	%
Low	13	9.30	5	4.00	0	0.00
Medium	36	25.70	28	22.40	13	32.50
High	91	65.00	92	73.60	27	67.50

4.1.11. Average knowledge gap and adoption gap:

Table 15 shows the average knowledge gap and average adoption gap for all the regions under study. Average knowledge gap was 66.1% for Calicut, 78.2% for Malpe and 74.17% for Tuticorin. Average adoption gap was 77.65% for Calicut, 83.02% for Malpe and 85.72% for Tuticorin.

Table 15. Average knowledge gap and adoption gap among fish curers

Centre	Average knowledge gap (%)	Average adoption gap (%)
Calicut (N-140)	66.10	77.65
Malpe (N-125)	78.20	83.02
Tuticorin (N-40)	74.17	85.72

The chi-square value of knowledge gap is calculated as 4.746 with degrees of freedom 2 which is not significant. Knowledge gap is independent of region. The calculated value of adoption gap is 1.7192 with degrees of freedom 2 which is also not significant. Therefore adoption gap also is independent of region.

The table generally shows that knowledge gap and adoption gap in Calicut region are considerably less compared to the figures for Malpe and Tuticorin. A positive correlation between knowledge gap and adoption gap is noted. Neglecting the minor discrepancies at Malpe and Tuticorin, it can be generally concluded that increase in knowledge leads to higher rate of adoption.

A comparatively less knowledge gap and the consequent less adoption gap at Calicut can again be partly attributed to the higher level of education, social participation, nearness of research Institute etc. This shows the necessity of intensive extension education of fish curers.

It is seen that the adoption level is always lower than the knowledge level of fish curers. That means, the fish curers have not adopted the technology to the extent of their knowledge level. This can be mainly attributed to the facts that (a) the fish curers do not have sound finance to adopt the new practices, (b) they perceive that the cured fish produced by the improved methods which involve additional expenditure may not fetch a propotionally higher selling price and (c) the attitude of fish curers has not changed to the required extent.

4.2. Knowledge level of fish curers

4.2.1. Construction of improved fish curing shed:

Table 16 shows the knowledge level of fish curers in construction of improved fish curing shed. As the construction of shed is concerned, 8.75% of the fish curers in Calicut and 12.5% in Tuticorin have got full knowledge. Partial knowledge on the same aspect was possessed by 43.57% of fish curers in Calicut, 24% in Malpe and 30% in Tuticorin. In Calicut 47.86% has no knowledge about construction of shed while the corresponding figures for Malpe and Tuticorin were 76% and 57.5% respectively.

Regarding the provision of drainage facilities 2.5% of the fish curers in Tuticorin has full knowledge. Partial knowledge is possessed by 39.3% of the fish curers in Calicut, 25.6% in Malpe and 25.0% in Tuticorin. Knowledge on drainage facilities was nil in 60.7% in Calicut, 74.4% in Malpe and 72.5% in Tuticorin.

In Calicut, 8.57% of the fish curers has full knowledge on provision of tables/platforms in the curing shed. Partial knowledge was possessed by 22.86% of the fish curers in Calicut, 30.4% in Malpe and 30% in Tuticorin. There was no knowledge on this aspect in the case of 68.57% of the fish curers in Calicut, 69.6% in Malpe and 70% in Tuticorin.

The picture generally shows that the knowledge of fish curers on construction of improved fish curing shed is very poor in all the centres. Huge investment is

Table 16. Knowledge level of fish curers-1 Construction of improved fish curing shed

Practice		Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
		No.	%	No.	%	No.	%
1. Construction of shed	F	12	8.75	0	0.00	5	12.50
	P	61	43.57	30	24.00	12	30.00
	N	67	47.86	95	76.00	23	57.50
2. Provision of drainage facilities	F	0	0.00	0	0.00	1	2.50
	P	55	39.30	32	25.60	10	25.00
	N	85	60.70	93	74.40	29	72.50
3. Provision of tables/platforms for dressing fish	F	12	8.57	0	0.00	0	0.00
	P	32	22.86	38	30.40	12	30.00
	N	96	68.57	87	69.60	28	70.00

required to construct a modern fish curing shed. The poor fish curers cannot afford that. Probably realising this situation, the extension workers might have not discussed or stressed or not even distributed literature on construction of curing shed. This situation, coupled with the lack of interest on the part of fish curers, might

F = full knowledge; P = partial knowledge; N = no knowledge

have resulted in the low level of knowledge of the fish curers in this practice. Maximum care should be taken to educate the fish curers on construction of improved fish curing sheds.

4.2.2. Cleaning and maintenance of hygiene:

Table 17 shows the knowledge level of fish curers in cleaning and maintenance of hygiene in fish curing shed. In Calicut 20.71% of the people has full knowledge on the use of potable water while the corresponding figures for Malpe and Tuticorin were 12% and 7.5% respectively. Partial knowledge was possessed by 42.14% in Calicut, 21.6% in Malpe and 27.5% in Tuticorin. Knowledge on the same aspect was nil in 37.14% of the fish curers in Calicut, 66.4% in Malpe and 65% in Tuticorin. In Calicut, 8.57% has full knowledge on the use of detergents and disinfectants. Fifty five percent of the fish curers has partial knowledge in Calicut while the corresponding figures were 34.4% and 37.5% for Malpe and Tuticorin respectively. Knowledge on this aspect was nil in 36.4% of the fish curers in Calicut, 65.6% in Malpe and 62.5% in Tuticorin.

In Calicut, 16.43% has full knowledge on adoption of cleaning schedule while 0.8% has the same knowledge in Malpe. Partial knowledge was possessed by 54.29% of the fish curers in Calicut, 37.6% in Malpe and 37.5% in Tuticorin. No knowledge was noticed in 29.29% in Calicut, 61.6% in Malpe and 62.5% in Tuticorin.

In Calicut, 14.28% of the fish curers had full knowledge on regular washing of mat used for drying fish. The same level of knowledge was observed in 7.2% in Malpe and 7.5% in Tuticorin. Partial knowledge on this aspect was noted in 27.86% in Calicut, 24% in Malpe and 30% in Tuticorin. Knowledge was nil in 57.86% in Calicut, 68.8% in Malpe and 62.5% in Tuticorin.

The picture generally shows that major part of the fish curers has no knowledge about cleaning. Cleanliness was not considered as an important aspect of fish curing. Fish curers followed the crude method for curing fish. Moreover, the unhygienically cured fish also had demand in the market. There was no agency to control the quality of cured fish particularly for internal market. The fish curers are not highly educated to understand the importance of hygiene and sanitation. All these factors were responsible for the lack of sufficient knowledge of fish curers on this aspect. This situation necessitates organisation of more extension work to educate them on cleaning and maintenance of hygiene in fish curing shed.

Table 17. Knowledge level of fish curers-2. Cleaning and maintenance of hygiene in fish curing shed

Practices		Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
		No.	%	No.	%	No.	%
1. Use of potable water in the shed	F	29	20.71	15	12.00	3	7.50
	P	59	42.14	27	21.60	11	27.50
	N	52	37.14	83	66.40	26	65.00
2. Use of detergents and disinfectants	F	12	8.57	0	0.00	0	0.00
	P	77	55.00	43	34.40	15	37.50
	N	51	36.43	82	65.60	25	62.50
3. Adoption of cleaning schedule	F	23	16.43	1	0.80	0	0.00
	P	76	54.29	47	37.60	15	37.50
	N	41	29.29	77	61.60	25	62.50
4. Regular washing of mat used for drying fish	F	20	14.28	9	7.20	3	7.50
	P	39	27.86	30	24.00	12	30.00
	N	81	57.86	86	68.80	25	62.50

F = full knowledge; P = partial knowledge; N = no knowledge

4.2.3. Handling and pre-processing of fresh fish:

The table 18 shows the knowledge level of fish curers on handling and pre-processing of fresh fish. Full knowledge on use of fresh fish was observed in 10.71% of the fish curers in Calicut, 11.2% in Malpe and 2.5% in Tuticorin. In Calicut, 34.29% had only partial knowledge on this aspect while the corresponding figures for Malpe and Tuticorin were 26.9% and 42.5% respectively. Fifty five percent of the fish curers in Calicut and Tuticorin and 62.9% in Malpe had no knowledge about the importance of using fresh fish.

Full knowledge on proper washing of fresh fish was noted in 11.42% of the fish curers in Calicut and 2.4% in Malpe. Thirty percent of the fish curers in Calicut, 27.2% in Malpe and 32.5% in Tuticorin had partial knowledge on this aspect. There was no knowledge in the case of 58.58% in Calicut, 70.4% in Malpe and 67.5% in Tuticorin.

In Calicut, 11.43% of the fish curers had full knowledge on proper dressing and evisceration of fresh fish while the corresponding figure was 4.8% for Malpe. Partial knowledge was observed in 37.86% in Calicut, 26.4% in Malpe and 32.5% in Tuticorin. Knowledge was

Table 18. Knowledge level of fish curers-3. Handling and preprocessing of fish

Practices		Calicut (N-140) No.	Calicut (N-140) %	Malpe (N-125) No.	Malpe (N-125) %	Tuticorin (N-40) No.	Tuticorin (N-40) %
1. Use of fresh fish	F	15	10.71	14	11.20	1	2.50
	P	48	34.29	33	26.90	17	42.50
	N	77	55.00	78	62.90	22	55.00
2. Proper washing of fresh fish	F	16	11.42	3	2.40	0	0.00
	P	42	30.00	34	27.20	13	32.50
	N	82	58.58	88	70.40	27	67.50
3. Proper dressing and evisceration of fish	F	16	11.43	6	4.80	0	0.00
	P	53	37.86	33	26.40	13	32.50
	N	71	50.71	86	68.80	27	67.50
4. Proper washing of gutted fish	F	22	15.71	4	3.20	0	0.00
	P	65	46.43	38	30.40	13	32.50
	N	53	37.85	83	66.40	27	67.50
5. Use of ice for preserving fish	F	12	8.57	16	12.80	4	10.00
	P	25	17.86	26	20.80	9	22.50
	N	103	73.57	83	66.40	27	67.50

F = full knowledge; P = partial knowledge; N = no knowledge

nil in the case of 50.71% of fish curers in Calicut, 68.8% in Malpe and 67.5% in Tuticorin.

In Calicut, 15.71% of fish curers had full knowledge on proper washing of gutted fish while the corresponding figure was 3.2% for Malpe. Partial knowledge was observed among 46.43% fish curers in Calicut, 30.4% in Malpe and 32.5% in Tuticorin. No knowledge was possessed on this aspect by 37.85% in Calicut, 66.4% in Malpe and 67.5% in Tutocorin.

Full knowledge on use of ice for preserving fish was noted in 8.57% of the fish curers in Calicut, 12.8% in Malpe and 10% in Tuticorin. Partial knowledge was observed in 17.86% in Calicut, 20.8% in Malpe and 22.5% in Tuticorin. Knowledge on this aspect was nil in 73.57% in Calicut, 66.4% in Malpe and 67.5% in Tuticorin.

In this case also it can be clearly seen that the largest group of fish curers do not possess any knowledge on the importance of proper handling and pre-processing of fresh fish. The tendency is to dispose the fish at a reasonable rate immediately after landing for fresh consumption. Only the fish which cannot be disposed in fresh condition is taken for curing. Very often considerable time is lapsed between landing and disposal of fresh fish. Consequently the fish taken for curing become spoiled in many cases. Extension agencies have to stress on this point.

4.2.4. Salting of fish:

Table 19 shows the trend of knowledge of fish curers on salting of fish. In Calicut, 14.29% had full knowledge on the necessity of using sufficient salt while the corresponding figures for Malpe and Tuticorin were 13.6% and 15.0% respectively. Partial knowledge was possessed by 54.29% in Calicut, 23.2% in Malpe and 42.5% in Tuticorin. No knowledge was observed in 31.43% of the fish curers in Calicut, 63.2% in Malpe and 42.5% in Tuticorin.

Full knowledge about using cement tanks for salting fish was observed in the case of 18.5% of the fish curers in Calicut, 8% in Malpe and 2.5% in Tuticorin. In Calicut, 25.75% had partial knowledge on this aspect and in Malpe and Tuticorin, the figures were 29.6% and 30% respectively. Knowledge was nil in 55.75% in Calicut, 62.4% in Malpe and 67.5% in Tuticorin.

Nineteen percent of the fish curers in Calicut, 10.4% in Malpe and 7.5% in Tuticorin had full knowledge on sufficient salting period. Thirty percent in Calicut,

Table 19. Knowledge level of fish curers -4. Salting of fish

Practices		Calicut (N-140) No.	%	Malpe (N-125) No.	%	Tuticorin (N-40) No.	%
1. Use of sufficient salt	F	20	14.29	17	13.60	6	15.00
	P	76	54.29	29	23.20	17	42.50
	N	44	31.43	79	63.20	17	42.50
2. Salting of fish in cement tanks or other suitable containers	F	26	18.50	10	8.00	1	2.50
	P	36	25.75	37	29.60	12	30.00
	N	78	55.75	78	62.40	27	67.50
3. Allowance of sufficient salting period	F	27	19.99	13	10.40	3	7.50
	P	43	30.00	32	25.60	10	25.00
	N	72	51.00	80	64.00	27	67.50
4. Covering of salted fish to avoid flies	F	22	15.71	2	1.60	1	2.50
	P	42	30.00	35	28.00	16	40.00
	N	76	54.29	88	70.40	23	57.50

Table contd.

Table 19 contd.

Practices		Calicut (N-140) No.	%	Malpe (N-125) No.	%	Tuticorin (N-40) No.	%
5. Rinsing of salted fish in freshly prepared salt water	F	14	10.00	3	2.40	0	0.00
	P	34	24.29	38	30.40	15	37.50
	N	92	65.71	84	67.20	25	62.50
6. Removal of urea from shark by desalting	F	8	5.72	0	0.00	0	0.00
	P	12	8.57	0	0.00	0	0.00
	N	120	85.71	125	100.00	40	100.00
7. Removal of self-brine and addition of saturated brine in the case of pickling	F	64	45.71	2	1.60	0	0.00
	P	75	53.57	71	56.80	20	50.00
	N	1	0.72	52	41.60	20	50.00
8. Covering the fish with sufficient quantity of brine in the case of pickling	F	20	14.28	2	1.60	6	15.00
	P	107	76.42	74	59.20	20	50.00
	N	13	9.30	49	39.20	14	35.00

F = full knowledge; P = partial knowledge; N = no knowledge

25.6% in Malpe and 25% in Tuticorin had partial knowledge on this aspect. No knowledge was observed in the case of 51% of the fish curers in Calicut, 64% in Malpe and 67.5% in Tuticorin.

In Calicut 15.71% of the fish curers had full knowledge on covering of salted fish to avoid flies while the corresponding figures for Malpe and Tuticorin were 1.6% and 2.5% respectively. Thirty percent in Calicut, 28% in Malpe and 40% in Tuticorin had partial knowledge on this aspect. No knowledge was noticed in 54.29% in Calicut, 70.4% in Malpe and 57.5% in Tuticorin.

Ten percent of the fish curers in Calicut and 2.4% in Malpe showed full knowledge on rinsing of salted fish in freshly prepared salt water. Partial knowledge was observed in the case of 24.29% of the respondents in Calicut, 30.4% in Malpe and 37.5% in Tuticorin. There was no knowledge on this aspect. in 65.71% of the fish curers in Calicut, 67.2% in Malpe and 62.5% in Tuticorin.

On removal of urea from shark flesh by desalting the heavily salted fish, full knowledge and partial knowledge were observed only in 5.72% and 8.57% of the fish curers respectively in Calicut. Knowledge was nil in 85.71% of the respondents in Calicut and cent percent in Malpe and Tuticorin.

Full knowledge on removal of self-brine and addition of saturated brine in pickling was shown by 45.71% in Calicut and 1.6% in Malpe. There was partial knowledge in 53.57% in Calicut, 56.8% in Malpe and 50% in Tuticorin. There was no knowledge on this aspect in 0.72% in Calicut 41.6% in Malpe and 50% in Tuticorin.

Full knowledge was shown by 14.28% of the fish curers in Calicut on covering the fish with sufficient brine in pickling while the corresponding figures of Malpe and Tuticorin were 1.6% and 15% respectively. Knowledge was partial in 76.42% in Calicut, 59.2% in Malpe and 50% in Tuticorin. There was no knowledge in 9.3% in Calicut, 39.2% in Malpe and 35% in Tuticorin.

The picture generally shows that major part of the people in all the centres has no knowledge about many aspects of salting fish. Only in the case of removal of brine and addition of sufficient quantity of saturated brine to cover the salted fish, most of the fish curers have partial knowledge. In the pickling of fish for long storage period, the fish curers face the problems of spoilage of salted fish if the self-brine is not replaced by fresh brine. On such occasions they were forced to understand the problem and solve it. But in the case of other aspects of salting, consequence of faulty method is not surfacing immediately. Such problems are coming up at a later stage. By that time the fish curers might have sold out the cured fish. So the fish curers are not interested or not forced to study such problems and acquire sufficient knowledge. Special care has to be taken to improve the knowledge of fish curers in all the centres particularly in the first six aspects.

4.2.5. Drying of salted fish:

Table 20 shows the knowledge level of drying of salted fish. Full knowledge on sufficient drying of fish was noted in 81.43% of the fish curers in Calicut, 27.2% in Malpe and 22.5% in Tuticorin. Partial knowledge was shown by 18.57% in Calicut, 49.6% in Malpe and 47.5% in Tuticorin. No knowledge on this aspect was possessed by 23.2% in Malpe and 30% in Tuticorin.

In Calicut 77.86% of the fish curers had full knowledge on drying of fish on mat while the corresponding figures for Malpe and Tuticorin were 32.8% and 32.5% respectively. Partial knowledge was observed in 22.14% in Calicut, 67.2% in Malpe and 67.5% in Tuticorin.

Regarding drying of fish on raised platform, 8.57% had full knowledge in Calicut while this was 17.6% in Malpe and 17.5% in Tuticorin. Partial knowledge on this

Table 20. Knowledge level of fish curers-5. Drying of salted fish

Practices		Calicut (N-140) No.	Calicut (N-140) %	Malpe (N-125) No.	Malpe (N-125) %	Tuticorin (N-40) No.	Tuticorin (N-40) %
1. Sufficient drying of fish	F	114	81.43	34	27.20	9	22.50
	P	26	18.57	62	49.60	19	47.50
	N	0	0.00	29	23.20	12	30.00
2. Drying of fish on mat	F	109	77.86	41	32.80	13	32.50
	P	31	22.14	84	67.20	27	67.50
	N	0	0.00	0	0.00	0	0.00
3. Drying of fish on raised platform	F	12	8.57	22	17.60	7	17.50
	P	48	34.29	21	16.80	7	17.50
	N	80	57.14	82	65.60	26	65.00
4. Drying of fish in tunnel dryer	F	19	13.57	9	7.20	3	7.50
	P	20	14.29	23	18.40	8	20.00
	N	101	72.14	93	74.40	29	72.50

F = full knowledge; P = partial knowledge; N = no knowledge

aspect was observed in 34.29% in Calicut, 16.8% in Malpe and 17.5% in Tuticorin. In Calicut, 57.14% had no knowledge on this aspect while the corresponding figure for Malpe and Tuticorin were 65.6% and 65% respectively.

In the case of drying of fish in tunnel dryer, 13.57% had full knowledge in Calicut, 7.2% in Malpe and 7.5% in Tuticorin. Partial knowledge was observed by 14.29% in Calicut, 18.4% in Malpe and 20% in Tuticorin. There was no knowledge on this aspect among 72.14% in Calicut, 74.4% in Malpe and 72.5% in Tuticorin.

The picture generally shows interesting facts that all the fish curers in all the centres either had full or partial knowledge on drying of fish on mat. On the other hand, most of the respondents in all the centres had no knowledge at all on drying of fish in tunnel dryer. If the salted fish is dried on floor, the dried fish will have high sand content and so poor market. To avoid this, fish curers are forced to dry the fish on mat which is having the minimum cost compared to drying on platform or tunnel dryer. This shows that fish curers acquire knowledge only when they face some problems due to lack of knowledge or adoption of the new practices. Extension effort should be made to educate fish curers in all the centres particularly on improved method of drying on raised platform or in dryer.

4.2.6. Packing and storage of cured fish:

Table 21 presents the data on packing and storage of cured fish. No body was having full knowledge on chemical treatment in cured fish in any of the centres. Partial knowledge was observed in 24.29% in Calicut, 30.4% in Malpe and 30% in Tuticorin. As high as 75.71% in Calicut, 69.6% in Malpe and 70% in Tuticorin did not have any knowledge on this aspect.

Regarding retail packing of cured fish in polythene bags, 20.71% had full knowledge in Calicut and 1.6% in Malpe. Partial knowledge was possessed by 20.71% in Calicut, 29.6% in Malpe and 25% in Tuticorin. No knowledge was shown by 58.5% in Calicut, 68.8% in Malpe and 75% in Tuticorin.

Full knowledge on packing of cured fish in improved containers was shown by 15.7% of the fish curers in Calicut region. Partial knowledge was observed by 19.3% in Calicut, 36.8% in Malpe and 30% in Tuticorin. Sixty five percent in Calicut, 63.2% in Malpe and 70% in Tuticorin had no knowledge on this aspect.

Table 21. Knowledge level of fish curers-6. Packing and storage of cured fish

Practices		Calicut (N-140) No.	%	Malpe (N-125) No.	%	Tuticorin (N-40) No.	%
1. Use of chemical preservatives in cured fish	F	0	0.00	0	0.00	0	0.00
	P	34	24.29	38	30.40	12	30.00
	N	106	75.71	87	69.60	28	70.00
2. Retail packing of cured fish in polythene bags	F	29	20.71	2	1.60	0	0.00
	P	29	20.71	37	29.60	10	25.00
	N	82	58.58	86	68.80	30	75.00
3. Bulk packing of cured fish in improved containers	F	22	15.70	0	0.00	0	0.00
	P	27	19.30	46	36.80	12	30.00
	N	91	65.00	79	63.20	28	70.00
4. Proper storage of cured fish	F	0	0.00	0	0.00	0	0.00
	P	28	20.00	45	36.00	15	37.50
	N	112	80.00	80	64.00	25	62.50

F = full knowledge; P = partial knowledge; N = no knowledge

Nobody showed full knowledge on proper storage of cured fish in any centre. Twenty percent in Calicut, 36% in Malpe and 37.5% in Tuticorin had partial knowledge on this aspect. Eighty percent in Calicut, 64% in Malpe and 62.5% in Tuticorin showed no knowledge.

The data generally show that fish curers had very poor knowledge about packing and storage of cured fish. Here also it is seen that the fish curer does not feel the impact of lack of knowledge on packing and storage of cured fish because the dried fish is usually sold out to middle men within one or two weeks during which no spoilage symptom usually starts. The fish curers do not want to spend money or acquire knowledge until and unless they are adversely affected by the lack of knowledge or lack of adoption.

The lack of knowledge of fish curers is mainly due to their lack of curiosity, ignorance, less education, less social participation, lack of sufficient extension contact, absence of legal problems against the poor maintenance of the curing shed and poor quality of cured fish etc.

4.3. Adoption of technology

4.3.1. Construction of improved fish curing shed:

Table 22 shows the very poor adoption of technology on construction of fish curing shed. This was not adopted fully by any body. In Calicut 28.57% and in Tuticorin 17.5% of the fish curers adopted this technology partially. All the fish curers in Malpe, 71.43% in Calicut and 82.5% in Tuticorin did not adopt this practice.

Full drainage facilities have not been provided by any party. This technology was partially adopted by 30% in Calicut, 18.4% in Malpe and 25% in Tuticorin. Seventy percent in Calicut, 81.6% in Malpe and 75% in Tuticorin did not provide drainage facilities. Nobody in any centre provided table/platform in the fish curing shed.

It can be generally concluded that adoption of technology on construction of improved fish curing shed is very poor. This is mainly due to lack of sufficient fund and legislative measures. Morover, in most of the cases, the land on which curing shed is constructed does not belong to the fish curers but belongs to either State Government or Port Department. They are not permitted and also do not want to invest money for construction of improved shed on other's land. Developmental agencies should come forward to assist the fish curing industry to construct improved shed.

Table 22. Adoption of technology-1 construction of improved fish curing shed

Practices		Calicut (N-140) No.	Calicut (N-140) %	Malpe (N-125) No.	Malpe (N-125) %	Tuticorin (N-40) No.	Tuticorin (N-40) %
1. Construction of shed	F	0	0.00	0	0.00	0	0.00
	P	40	28.57	0	0.00	7	17.50
	N	100	71.43	125	100.00	33	82.50
2. Provision of drainage facilities	F	0	0.00	0	0.00	0	0.00
	P	42	30.00	23	18.40	10	25.00
	N	98	70.00	102	81.60	30	75.00
3. Provision of tables/ platforms for dressing fish	F	0	0.00	0	0.00	0	0.00
	P	0	0.00	0	0.00	0	0.00
	N	140	100.00	125	100.00	40	100.00

F = full adoption; P = partial adoption; N = no adoption

4.3.2. Cleaning and maintenance of hygiene:

Table 23 shows the level of adoption of cleaning and maintenance of hygiene in fish curing shed. Only 9.29% of the fish curers fully used potable water in the shed in Calicut and 2.86% partially. Cent percent of the fish curers in Malpe and Tuticorin and 87.85% in Calicut had not adopted the use of potable water in the fish curing shed.

In Calicut, 17.14% showed full adoption on the use of detergents and disinfectants in the shed while it was only 4.8% for Malpe. Partial adoption of this technology was noted in 3.57% in Calicut, 4.8% in Malpe and 7.5% in Tuticorin. This technology was not at all adopted by 79.29% in Calicut, 90.4% in Malpe and 92.5% in Tuticorin. Nobody adopted cleaning schedule in any centre fully. Partial adoption was noted in the case of 11.43% in Calicut, 9.6% in Malpe and 25% in Tuticorin. Cleaning schedule was not adopted by 88.57% of the fish curers in Calicut, 90.4% in Malpe and 75% in Tuticorin.

The practice of regular washing of mat used for drying fish was adopted fully by 18.57% in Calicut, 4.8% in Malpe and 7.5% in Tuticorin. This practice was partially adopted by 25.71% in Calicut, 12% in Malpe and

Table 23. Adoption of technology-2. Cleaning and maintenance of hygiene in fish curing shed

Practices		Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
		No.	%	No.	%	No.	%
1. Use of potable water in the shed	F	13	9.29	0	0.00	0	0.00
	P	4	2.86	0	0.00	0	0.00
	N	123	87.85	125	100.00	40	100.00
2. Use of detergents and dis-infectants	F	24	17.14	6	4.80	0	0.00
	P	5	3.57	6	4.80	3	7.50
	N	111	79.29	113	90.40	37	92.50
3. Adoption of clean-ing schedule	F	0	0.00	0	0.00	0	0.00
	P	16	11.43	12	9.60	10	25.00
	N	124	88.57	113	90.40	30	75.00
4. Washing of mat used for drying fish	F	26	18.57	6	4.80	3	7.50
	P	36	25.71	15	12.00	2	5.00
	N	78	55.72	104	83.20	35	87.50

F = full adoption; P = partial adoption; N = no adoption

5% in Tuticorin. The practice was not adopted by 55,72% in Calicut, 83.2% in Malpe and 87.5% in Tuticorin.

In general technology of cleaning and maintenance of hygiene was not adopted by the fish curers. Main reason for not using potable water is its non-availability. Even drinking water is not supplied in most of the places. Fish curers are not concerned about the cleanliness of the shed due to lack of knowledge and legilsative measures. They feel that they do not get a higher price for their products by maintaining cleanliness in the shed by using detergents and disinfectants and following the cleaning schedule. It is felt that fish curers will take interest to maintain hygiene if there are some legislative measures and also marketing facilities with better price for the items produced under such conditions.

4.3.3. Handling and pre-processing of fish:

Table 24 shows the adoption level of technology of handling and pre-processing of fish. Fresh fish for curing was used by 16.42% of the fish curers in Calicut, 36.8% in Malpe and 12.5% in Tuticorin. Partial adoption of this technology was noted in 44.29% in Calicut, 40% in Malpe and 77.5% in Tuticorin. Fresh fish was not at all used by 39.29% in Calicut, 23.2% in Malpe and 10% in Tuticorin.

Table 24. Adoption of technology-3. Handling and pre-processing of fish

Practices		Calicut (N-140) No.	Calicut (N-140) %	Malpe (N-125) No.	Malpe (N-125) %	Tuticorin (N-40) No.	Tuticorin (N-40) %
1. Use of fresh fish	F	23	16.42	40	36.80	5	12.50
	P	62	44.29	50	40.00	31	77.50
	N	55	39.29	20	23.20	4	10.00
2. Proper washing of fresh fish	F	11	7.86	7	5.60	0	0.00
	P	16	11.43	8	7.20	0	0.00
	N	113	80.71	109	87.20	40	100.00
3. Proper dressing and evis-ceration of fresh fish	F	24	17.14	19	15.20	3	7.50
	P	96	68.57	72	57.60	6	15.00
	N	20	14.29	34	27.20	31	77.50
4. Proper washing of gutted fish	F	11	7.86	9	7.20	0	0.00
	P	16	11.43	7	5.60	0	0.00
	N	113	80.71	109	87.20	40	100.00
5. Use of ice for preserv-ing fish	F	0	0.00	0	0.00	0	0.00
	P	0	0.00	0	0.00	0	0.00
	N	140	100.00	125	100.00	40	100.00

F = full adoption; P = partial adoption; N = no adoption

Practice of proper washing of fresh fish was adopted fully by 7.86% in Calicut and 5.6% in Malpe. Partial adoption of this practice was noted in 11.43% in Calicut and 7.2% in Malpe. This was not practiced by 80.71% in Calicut, 87.2% in Malpe and cent percent in Tuticorin.

Technology of proper dressing and evisceration of fresh fish was adopted by 17.14% in Calicut, 15.2% in Malpe and 7.5% in Tuticorin. This practice was partially adopted by 68.57% in Calicut, 57.6% in Malpe and 15% in Tuticorin. It was not adopted by 14.29% in Calicut, 27.2% in Malpe and 77.5% in Tuticorin.

Technology on proper washing of gutted fish was fully adopted by 7.86% in Calicut and 7.2% in Malpe. Partial adoption was noted in 11.43% in Calicut and 5.6% in Malpe. This practice was not adopted by 80.71% in Calicut, 87.2% in Malpe and cent percent in Tuticorin.

Regarding use of ice for preserving fish, none had shown either full or partial adoption in any centre.

The chi-square value was calculated for the sub-practices 1) use of fresh fish and 2) proper dressing and evisceration of fresh fish.

4.3.3.1. Use of fresh fish:

a) Full adoption: The calculated value of chi-square is 18.392 with degrees of freedom 2 which is significant at 1% level. Full adoption is not independent of region. The adoption of this practice is more pronounced in Malpe than in Calicut and Tuticorin.

b) Partial adoption: The chi-square value is found to be 17.797 with degrees of freedom 2 which is significant at 1% level. Partial adoption is not independent of region. Partial adoption is higher in Calicut and Malpe than in Tuticorin.

c) Non-adoption: Chi-square value is 16.464 with degrees of freedom 2 significant at 1% level Non-adoption is not independent of region. Non-adoption is more pronounced in Calicut than in the other two regions.

4.3.3.2. Proper dressing and eviseration of fresh fish:

a) Full adoption: The chi-square value is found to be 2.264 with degrees of freedom 2 which is not significant. Full adoption is independent of region.

b) Partial adoption: Chi-square value is 57.267 with degrees of freedom 2 significant at 1% level. Partial adoption is not independent of region. Partial adoption is significantly high in the case of Calicut and Malpe.

c) Non-adoption: Here the chi-square value is 61.89% with degrees of freedom 2 significant at 1% level. Non-adoption is not independent of region. Non adoption is more in Tuticorin than in other centres.

As in the cases of previous items of technology, fish curers generally showed less adoption of the handling and pre-processing practices. Usually the landed fish is taken for curing only if there is no possibility of marketing it as fresh. By this time, fish becomes partially spoiled which is taken for curing. As there is no potable water available, washing cannot be effected properly. Non-availability of ice is also a problem. To avoid additional labour and to save time, fish curers do not properly eviscerate the fish. They feel that even without this step, cured fish is having demand in the market though such items are fetching a lower price. Fish curers shall be educated in the importance of handling and pre-processing of fish.

4.3.4. Salting of fish:

Table 25 shows the adoption of the technology of salting of fish. In Calicut, 23.57% showed full adoption

Table 25. Adoption of technology-4. Salting of fish

Practices		Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
		No.	%	No.	%	No.	%
1. Use of sufficient salt	F	33	23.57	10	8.00	5	12.50
	P	20	14.29	15	12.00	6	15.00
	N	87	62.14	100	80.00	29	72.50
2. Salting in cement tanks or other suitable containers	F	45	32.14	42	33.60	5	12.50
	P	95	67.86	83	66.40	35	87.50
	N	0	0.00	0	0.00	0	0.00
3. Sufficient salting period	F	36	25.71	8	6.40	5	12.50
	P	28	20.00	15	12.00	12	30.00
	N	76	54.29	102	81.60	23	57.50
4. Covering of salted fish to avoid flies	F	0	0.00	0	0.00	0	0.00
	P	66	47.14	76	60.80	14	35.00
	N	74	52.86	49	39.20	26	65.00

Table contd.

Table 25(contd)

Practices		Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
		No.	%	No.	%	No.	%
5. Rinsing of salted fish in freshly prepared salt water	F	0	0.00	0	0.00	0	0.00
	P	115	82.14	101	80.80	8	20.00
	N	25	17.86	24	19.20	32	80.00
6. Removal of self brine and addition of saturated brine in pickling	F	0	0.00	0	0.00	0	0.00
	P	140	100.00	26	20.80	0	0.00
	N	0	0.00	99	79.20	40	100.00
7. Covering the fish with sufficient brine in pickling	F	0	0.00	0	0.00	0	0.00
	P	140	100.00	111	88.80	5	12.50
	N	0	0.00	14	11.20	35	87.50
8. Removal of urea by desalting	F	0	0.00	0	0.00	0	0.00
	P	9	6.43	0	0.00	0	0.00
	N	131	93.57	125	100.00	40	100.00

F = full adoption; P = partial adoption; N = no adoption

regarding use of sufficient salt while the corresponding figures for Malpe and Tuticorin were 8% and 12.5% respectively. Partial adoption was observed in 14.29% in Calicut, 12% in Malpe and 15% in Tuticorin. This practice was not adopted by 62.14% in Calicut, 80% in Malpe and 72.5% in Tuticorin.

In Calicut, 32.14% showed full adoption regarding the use of cement tanks or other suitable containers while the corresponding figures for Malpe and Tuticorin were 33.36% and 12.5% respectively. Partial adoption was noted in 67.86% in Calicut, 66.4% in Malpe and 87.5% in Tuticorin.

Allowance of sufficient salting period was given by 25.71% in Calicut, 6.4% in Malpe and 12.5% in Tuticorin. Twenty percent in Calicut, 12% in Malpe and 30% in Tuticorin adopted this practice partially. This was not adopted by 54.29% in Calicut, 81.6% in Malpe and 57.5% in Tuticorin.

Nobody adopted fully the practice of covering the salted fish to avoid flies. This practice was partially adopted by 47.14% in Calicut, 60.8% in Malpe and 35% in Tuticorin. It was not adopted by 52.86% in Calicut, 39.2% in Malpe and 65% in Tuticorin.

The practice of rinsing the salted fish in freshly prepared salt water was not fully adopted by any of the fish curers in any centre. It was partially adopted by 82.14% in Calicut, 80.8% in Malpe and 20% in Tuticorin. The practice was not at all adopted by 17.86% in Calicut, 19.2% in Malpe and 80% in Tuticorin.

Removal of self-brine and addition of saturated brine in pickling of fish was not fully practised by anybody. In Calicut, all the fish curers practised it partially and in Malpe 20.8%. This practice was not adopted by 79.2% in Malpe and cent percent in Tuticorin.

The practice of covering fish with sufficient brine in the case of pickling was not fully adopted by any fish curer. Partial adoption was noted in 100% of the fish curers in Calicut, 88.8% in Malpe and 12.5% in Tuticorin. The practice was not adopted by 11.2% in Malpe and 87.5% in Tuticorin.

Technology of removal of urea from shark flesh was not fully adopted in any centre. Partial adoption was noted in 6.43% in Calicut. This technology was not adopted by 93.57% in Calicut and cent percent in Malpe and Tuticorin.

The chi-square value was calculated for the first four sub-practices.

4.3.4.1. Use of sufficient salt:

a) Full adoption: Chi-square value is calculated as 45.43 with degrees of freedom 2 significant at 1% level. Full adoption is not independent of region. Full adoption is high in Calicut compared to the other two centres.

b) Partial adoption: Chi-square value is calculated as 0.4092 with degrees of freedom 2 which is not significant. Partial adoption is independent of region.

c) Non-adoption: The calculated value of chi-square is 10.286 with degrees of freedom 2 which is significant at 5% level. Non-adoption is not independent of region. Non-adoption is more in Malpe followed by Tuticorin and Calicut.

4.3.4.2. Salting in cement tanks:

a) Full adoption: The calculated value of chi-square is 3.148 with degrees of freedom 2 which is not significant. Full adoption is independent of region.

b) Partial adoption: Chi-square value is calculated as 11.7492 with degrees of freedom 2 significant at 5% level. Partial adoption is not independent of region. Partial adoption is significantly high in Tuticorin than in other region.

4.3.4.3. Sufficient salting period:

a) Full adoption: The calculated value of chi-square is 18.671 with degrees of freedom 2 significant at 1% level. Full adoption is not independent of region. Full adoption is significantly high in Calicut than in the other centres.

b) Partial adoption: The chi-square value is calculated as 7.331 with degrees of freedom 2 significant at 5% level. Partial adoption is not independent of region. Partial adoption of this practice is more in Tuticorin compared to other centres.

c) Non-adoption: The chi-square is 23.400 with degrees of freedom 2 which is significant at 1% level. Non-adoption is not independent of region. Malpe is having significantly high non-adoption of this practice.

4.3.4.4. Covering of salted fish to avoid flies:

a) Partial adoption: Chi-square value is 9.711

with degrees of freedom 2 signifidant at 5% level. Partial adoption is not independent of region. Partial adoption is significantly high in Malpe.

b) Non-adoption: The chi-square value is calculated as 9.757 with degrees of freedom 2 significant at 5% level. Non-adoption is not independent of region. Non-adoption of this technique is more in Tuticorin.

Salt is an important item under inputs in fish curing. Often the fish curers are tempted to reduce the expenses towards salt by adding less salt. As the salted/dried fish is sold out usually within one to two weeks the poor quality of the light salted fish is not experienced by the fish curers. As there are no facilities available in some sheds, fish curers salt fish without any proper containers or tanks. As mentioned earlier, such fish curers do not want to spend money for constructing the cement tanks. Non-adoption of all other practices under salting is due to lack of sufficient knowledge of the fish curers on such items. Adoption of the technology on salting of fish has to be generally improved. Extension education including demonstration of improved methods of salting of fish should be organised in fish curing yards.

4.3.5. Drying of salted fish:

Table 26 shows the adoption level of drying of salted fish. Practice of giving sufficient drying time was fully adopted by 42.14% in Calicut, 35.2% in Malpe and 12.5% in Tuticorin. Ten percent in Calicut, 5.6% in Malpe and 22.5% in Tuticorin partially adopted this technology. This practice was not adopted by 47.86% in Calicut, 59.2% in Malpe and 65% in Tuticorin.

Practice of drying salted fish on mat was fully adopted by 35% in Calicut, 27.2% in Malpe and 12.5% in Tuticorin. Partial adoption was noted in 59.29% in Calicut, 64.8% in Malpe and 87.5% in Tuticorin. The practice was not adopted by 5.71% in Calicut and 8% in Malpe. None of the fish curers used raised platform or tunnel dryer for drying fish.

As there is no good market for fish dried on ground, most of the fish curers are forced to dry fish on mat. Even though quality of fish dried on raised platform or in tunnel dryer is better than that dried on mat, fish curers do not expect a proportional increase in selling price for such dried products. So they do not adopt the improved practices of drying fish on raised platform or dryer. Moreover their knowledge about raised platform and tunnel dryer is also very limited or nil. All these

Table 26. Adoption of technology-5. Drying of salted fish

Practices		Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
		No.	%	No.	%	No.	%
1. Sufficient drying of fish	F	59	42.14	54	35.20	5	12.50
	P	14	10.00	7	5.60	9	22.50
	N	67	47.86	74	59.20	26	65.00
2. Drying of fish on mat	F	49	35.00	34	27.20	5	12.50
	P	83	59.29	81	64.80	35	87.50
	N	8	5.71	10	8.00	0	0.00
3. Drying of fish on raised platform	F	0	0.00	0	0.00	0	0.00
	P	0	0.00	0	0.00	0	0.00
	N	140	100.00	125	100.00	40	100.00
4. Drying of fish in tunnel dryer	F	0	0.00	0	0.00	0	0.00
	P	0	0.00	0	0.00	0	0.00
	N	140	100.00	125	100.00	40.	100.00

F = full adoption; P = partial adoption; N = no adoption

factors caused the non-adoption of the practices of drying fish on raised platform and in tunnel dryer.

4.3.6. Packing and storage of cured fish:

Table 27 shows the adoption of practices in packing and storage of cured fish. Chemical treatment in cured fish was partially practised by 7.2% in Malpe. This practice was not adopted by cent percent fish curers in Calicut and Tuticorin and 92.8% in Malpe.

Retail packing of dried fish in polythene bags was partially practised by 7.2% in Malpe. All the fish curers in Calicut and Tuticorin and 92.8% in Malpe did not adopt this practice. Bulk packing in improved containers was not adopted by any fish curer in any centre. Proper storage of cured fish was not adopted fully by any body in any centre. This was partially adopted by 22.14% of the fish curers in Calicut and 12.5% in Tuticorin. The practice was not adopted by 77.86% in Calicut, cent percent in Malpe and 87.5% in Tuticorin.

The picture clearly shows the very poor adoption of the improved practices on packing and storage of cured fish. Even though packaging has advanced much in other items of food, this system has not been adopted in fish curing. The main reason is that such packaging

Table 27. Adoption of technology-6. Packing and storage of cured fish

Practices		Calicut (N-140) No.	%	Malpe (N-125) No.	%	Tuticorin (N-40) No.	%
1. Use of chemical preservatives in cured fish	F	0	0.00	0	0.00	0	0.00
	P	0	0.00	9	7.20	0	0.00
	N	140	100.00	116	92.80	40	100.00
2. Retail packing of cured fish in polythene bags	F	0	0.00	0	0.00	0	0.00
	P	0	0.00	9	7.20	0	0.00
	N	140	100.00	116	92.80	40	100.00
3. Bulk packing of cured fish in improved containers	F	0	0.00	0	0.00	0	0.00
	P	0	0.00	0	0.00	0	0.00
	N	140	100.00	125	100.00	40	100.00
4. Proper storage of cured fish	F	0	0.00	0	0.00	0	0.00
	P	31	22.14	0	0.00	5	12.50
	N	109	77.86	125	100.00	35	87.50

F = full adoption; P = partial adoption; N = no adoption

materials are very costly and cost of packing cured fish in such materials will not be compensated by the selling price of the cured fish. Therefore fish curers are not prepared to make any advancement in this line. Usually the spoilage of cured fish starts after the disposal of the products from the curing yards. So fish curers do not face the major problems of spoilage of cured fish. Therefore they are not interested to give any chemical treatment in cured fish. Lack of knowledge on chemical treatment also adds to partial or non-adoption of this practice. At present, the middle men who purchase cured fish from the curing yards also are not prepared to give higher rate for the treated products. All these factors force the fish curers not to give any chemical treatment to the cured fish. They cannot store the fish properly due to lack of space in the curing yard. Fish curers have to be educated on these practices and arrangements should be made for the fish curers to get higher price for the properly packed and stored cured fish.

4.4. Knowledge gap

Knowledge gap in different fish curing regions under the investigation was studied in relation to various factors like age, education, social participation, contact with extension agency, perception of profitability, income and debt of the fish curers.

4.4.1. Knowledge gap in relation to age:

Figure 2 shows the knowledge gap in relation to age of the fish curers in Calicut region. Among fish curers in the age group up to 30 years, 36.8% showed low knowledge gap, 36.8% showed medium knowledge gap and 26.4% showed high knowledge gap. In the case of respondents in the age group of 30 to 35 years, 37.5% comes under low knowledge gap, 25% under medium knowledge gap and 37.5% under high knowledge gap. It was observed that among fish curers in the age group of 35 to 40 years, 35.7% had medium knowledge gap, 64.3% with high knowledge gap and nobody was in low knowledge gap category. In the case of fish curers of 40 to 45 years, 23.3% showed medium knowledge gap, 76.7% high knowledge gap and nobody showed low knowledge gap. Regarding people in the age group of 45 to 50 years, 20.9% recorded medium knowledge gap, 79.1% showed high knowledge gap and nobody was in low knowledge gap group. Among those above 50 years old, 27.8% showed medium knowledge gap, 72.2% high knowledge gap and nobody showed low knowledge gap.

Trend of knowledge gap in relation to the age of the fish curers in Malpe is shown in Fig.3. Twenty five

KNOWLEDGE GAP IN RELATION WITH AGE OF FISH CURERS IN CALICUT REGION (N - 140)

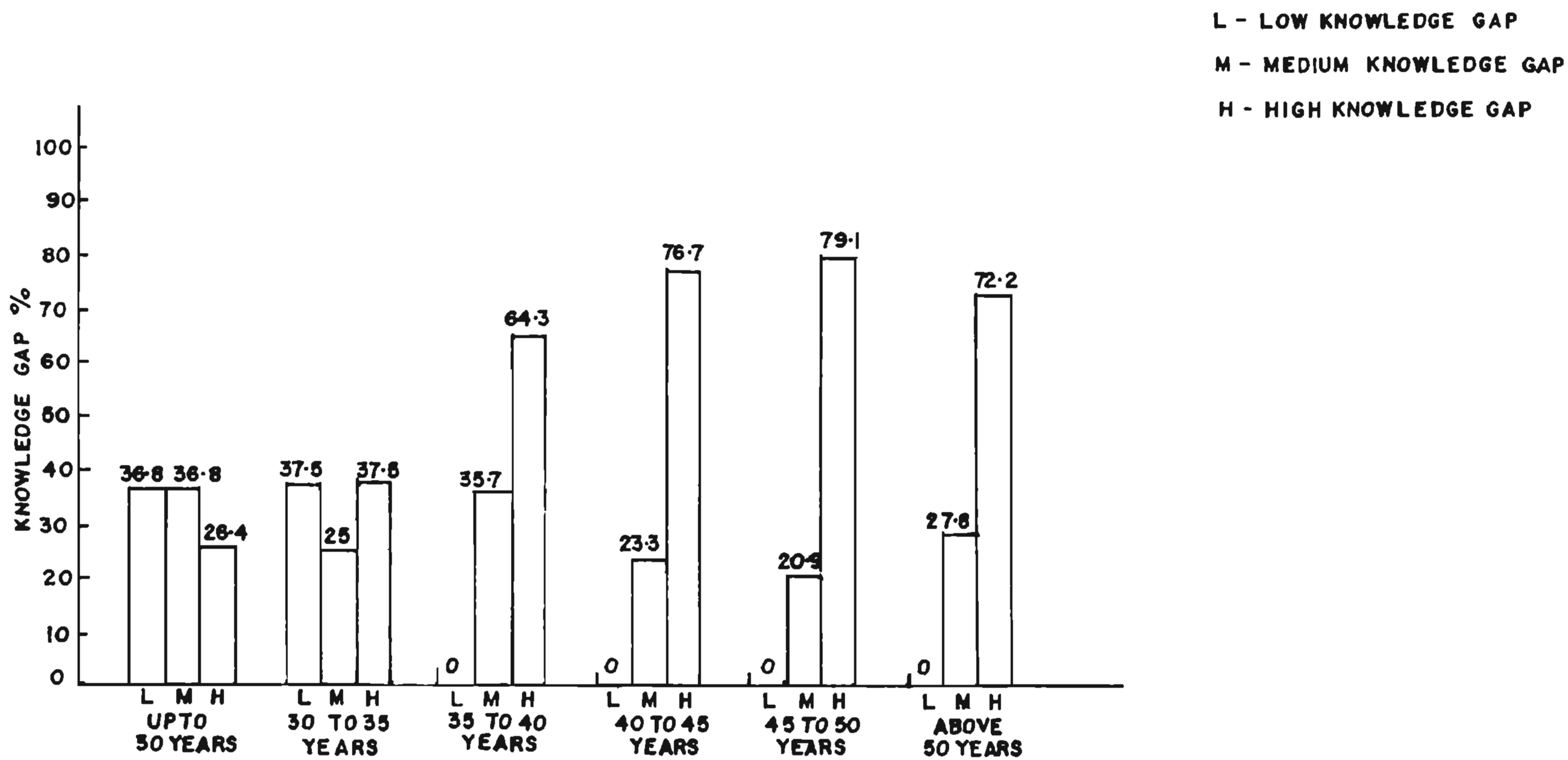


FIG. 2

KNOWLEDGE GAP IN RELATION WITH AGE OF FISH CURERS IN MALPE REGION (N-125)

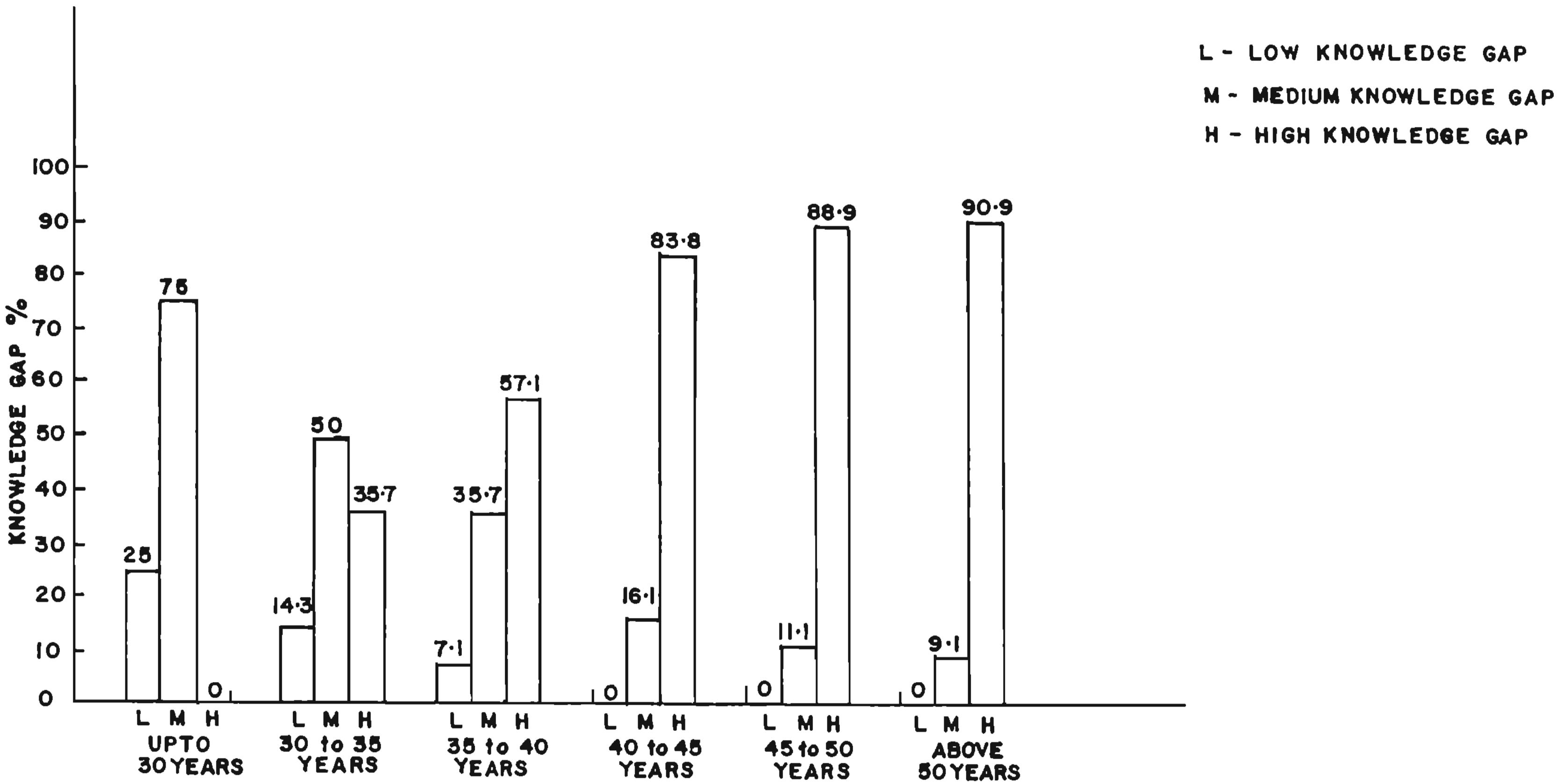


FIG. 3

percent of the fish curers in the age group up to 30 years showed low knowledge gap, 75% showed medium knowledge gap and nobody showed high knowledge gap. Low knowledge gap was observed in 14.3%, medium knowledge gap in 50% and high knowledge gap in 35.7% of the respondents in the age range of 30 to 35 years. Among respondents in the age group of 35 to 40 years, 7.1% showed low knowledge gap, 35.7% medium knowledge gap and 57.1% high knowledge gap. Regarding fish curers in 40 to 45 years, 16.1% showed medium knowledge gap, 83.8% showed high knowledge gap and none showed low knowledge gap. In the case of people between the age of 45 and 50 years, 11.1% showed medium knowledge gap, 88.9% showed high knowledge gap and none showed low knowledge gap. In the case of respondents with age of 50 years and above, 9.1% recorded medium knowledge gap, 90.9% high knowledge gap and nobody showed low knowledge gap.

Figure 4 shows the picture at Tuticorin. All the respondents in the age group of up to 30 years, 30 to 35 years and 35 to 40 years showed medium knowlege gap. In the case of people with 40 to 45 years, 66.7% showed medium knowledge gap and 33.3% high knowledge gap. Among fish curers in the age group of 45 to 50 years, 23.5% showed medium knowledge gap, 76.5% high knowlege gap

KNOWLEDGE GAP IN RELATION WITH AGE OF FISH CURERS IN TUTICORIN REGION - (N= 40)

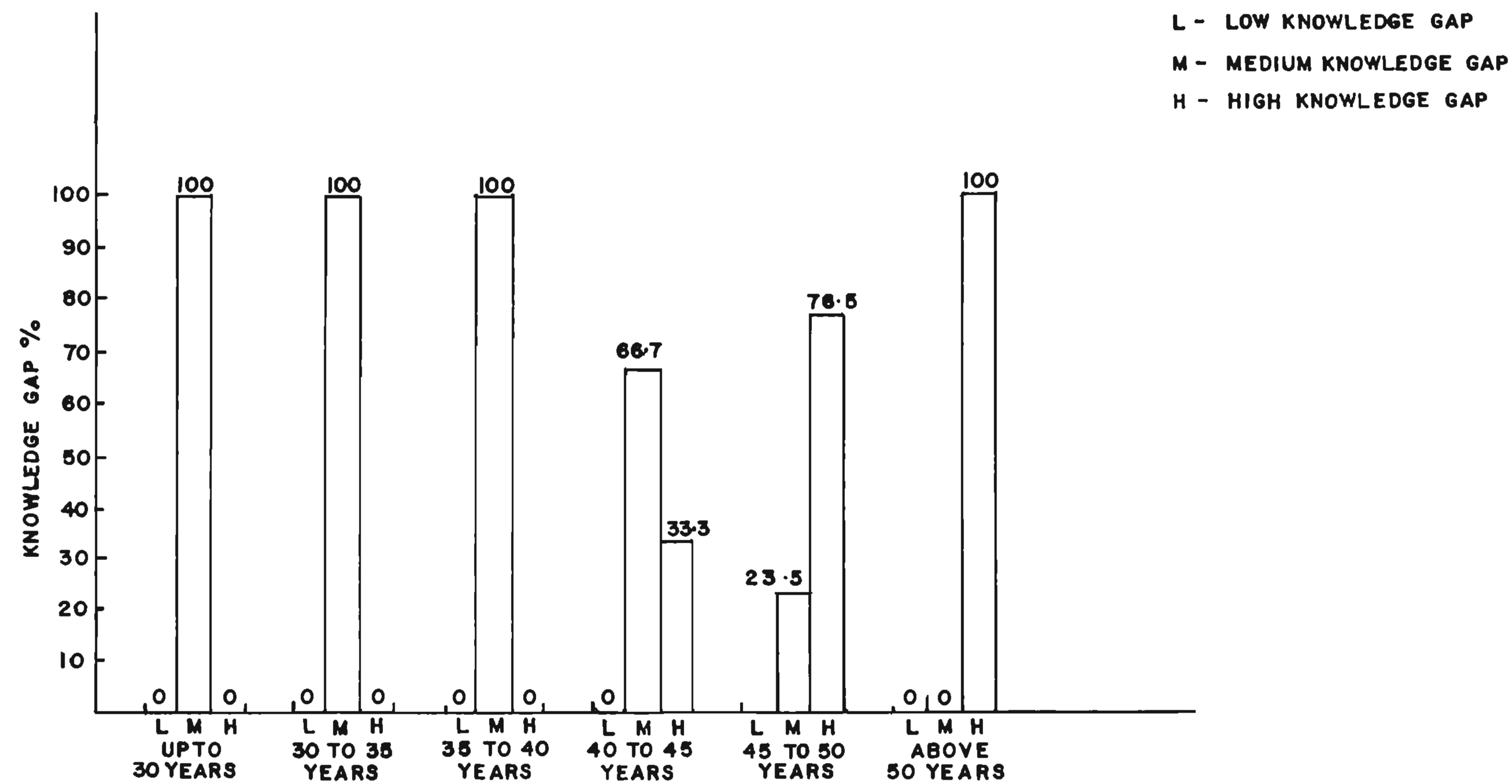


FIG. 4

and none showed low knowledge gap. All the respondents with the age above 50 years showed high knowledge gap.

In general, the knowledge gap in improved methods of fish curing practices was found to be more in aged people compared to the younger ones.

4.4.2. Knowledge gap in relation to educational level:

Figure 5 shows the trend of knowledge gap in relation to the educational level of fish curers in Calicut. Among illiterate fish curers, 33.3% showed medium knowledge gap, 66.7% showed high knowledge gap and none showed low knowledge gap. In the case of those who could only read, 25% showed medium knowledge gap, 75% showed high knowledge gap and none showed low knowledge gap. Twenty percent of the people who could read and white had medium knowledge gap, 80% high knowledge gap and none had low knowledge gap. Regarding fish curers with primary school education, 24.1% showed medium knowledge gap, 75.9% high knowledge gap and nobody showed low knowledge gap. It was observed that 11.5% had low knowledge gap, 34.6% had medium knowledge gap and 53.9% had high knowledge gap in the case of fish curers with middle school education. Among people with high school education, 62.5% had low, 25% had medium and 12.5% had high knowledge gap.

KNOWLEDGE GAP IN RELATION WITH EDUCATION LEVEL OF FISH CURERS IN CALICUT REGION (N-140)

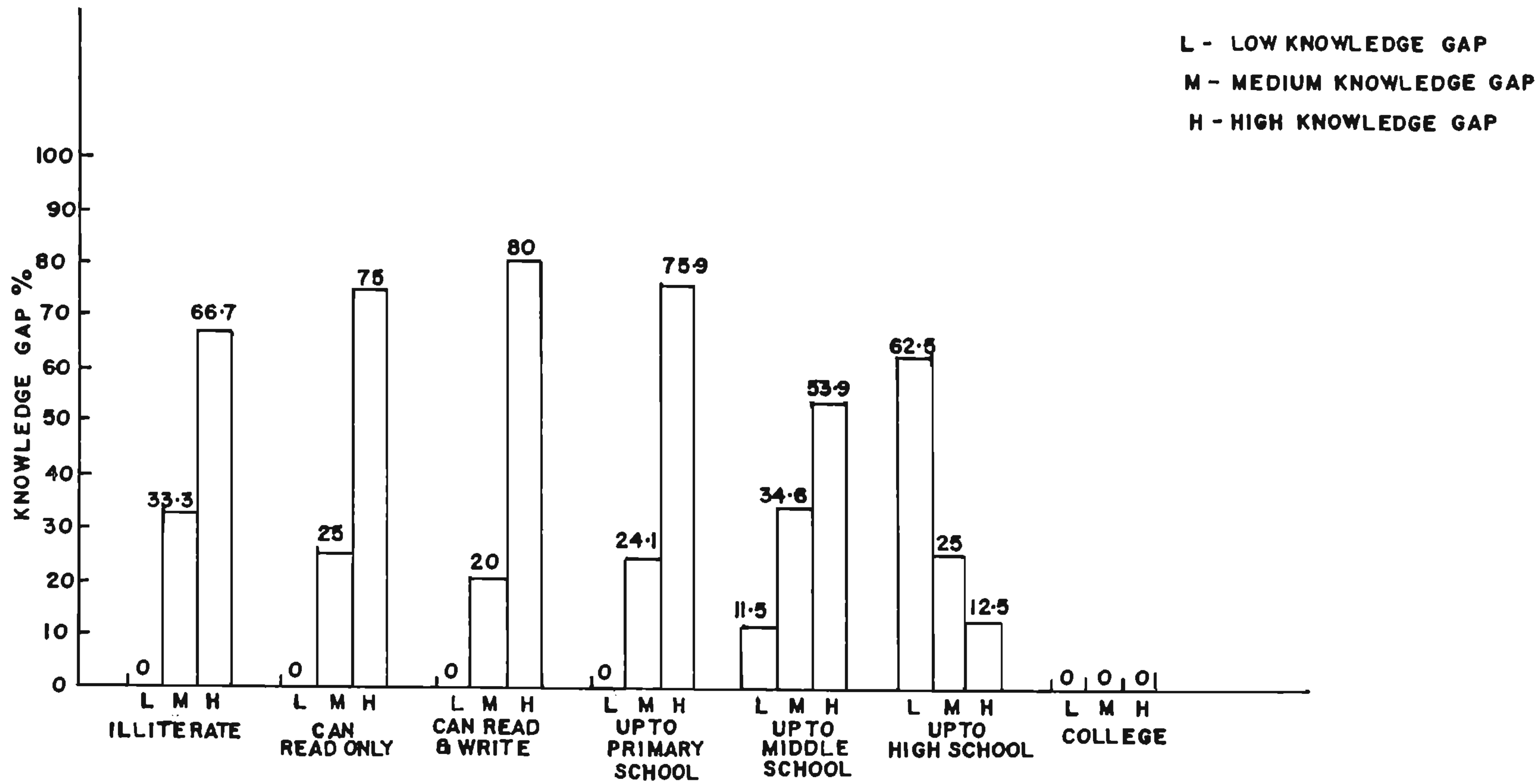


FIG. 5

Examining the case of fish curers in Malpe under Figure 6, it was found that 11.8% of the illiterate had medium, 88.2% had high and nobody had low knowledge gap. All the people who could only read showed high knowledge gap. In the case of fish curers who could read and write, 25% showed medium and 75% showed high knowledge gap with nobody in the category of low knowledge gap. Among people with primary school education, 40% showed medium and 60% showed high knowledge gap with none in low knowledge gap category. Regarding the respondents with middle school education, 23.5% showed low, 47.1% showed medium and 29.4% showed high knowledge gap. Under the category of people with high school education, 57.1% showed low, 28.6% showed medium and 14.3% showed high knowledge gap.

Coming to the case of Tuticorin in Figure 7, 12.5% of the illiterate had medium, 87.5% had high and none had low knowledge gap. Among those who could only read, 9.1% showed medium knowledge gap, 90.9% showed high knowledge gap and none showed low knowledge gap. In the case of fish curers who could read and write, 18.2% had medium, 81.8% had high and none had low knowledge gap. Regarding the people with primary school education, 80% had medium, 20% had high and nobody had low knowledge gap. All the people with middle school and high school education showed medium knowledge gap.

KNOWLEDGE GAP IN RELATION WITH EDUCATION LEVEL OF FISH CURERS IN MALPE REGION (N=126)

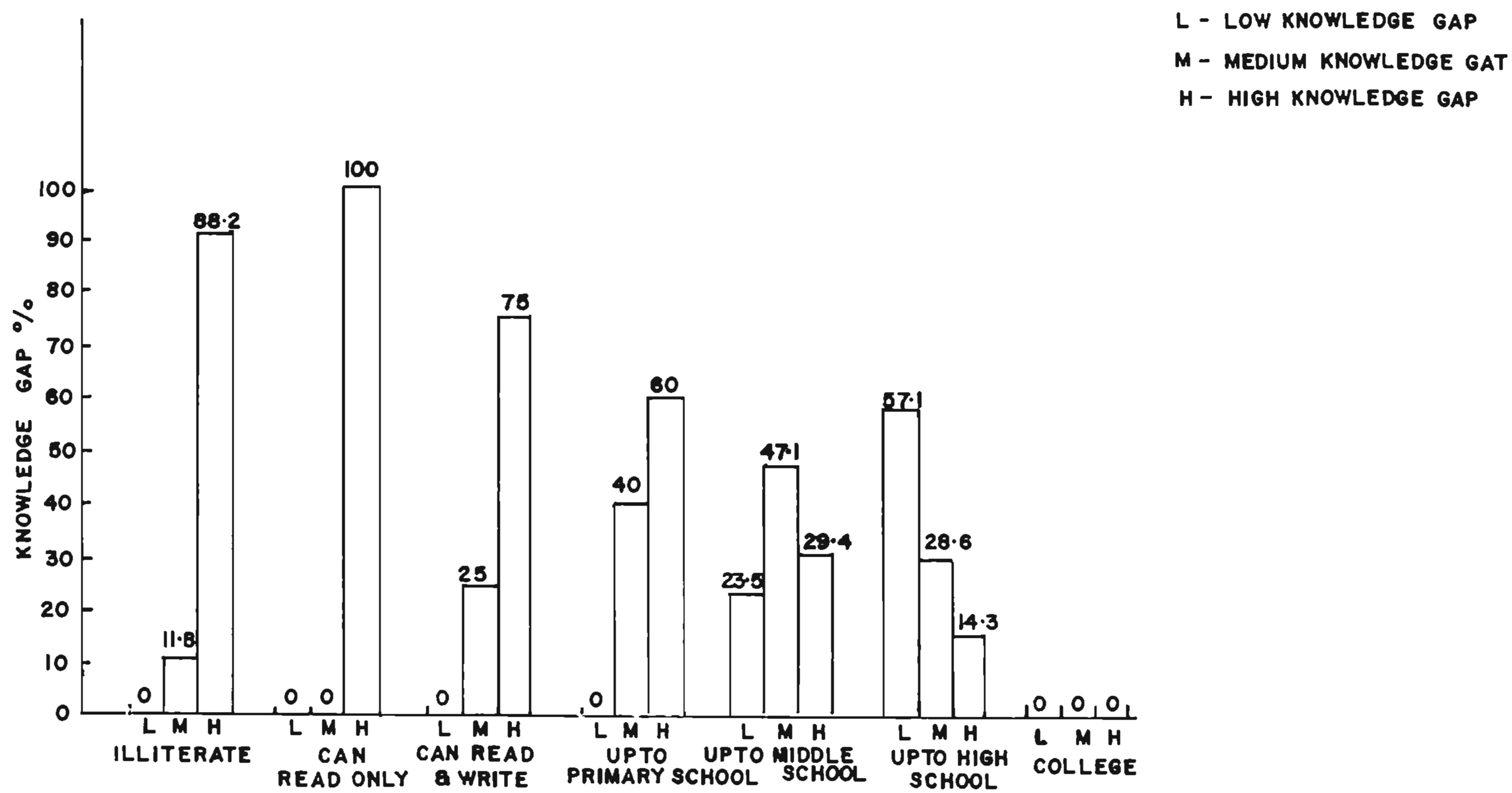


FIG. 6

KNOWLEDGE GAP IN RELATION WITH EDUCATION LEVEL OF FISH CURERS IN TUTICORIN REGION (N - 40)

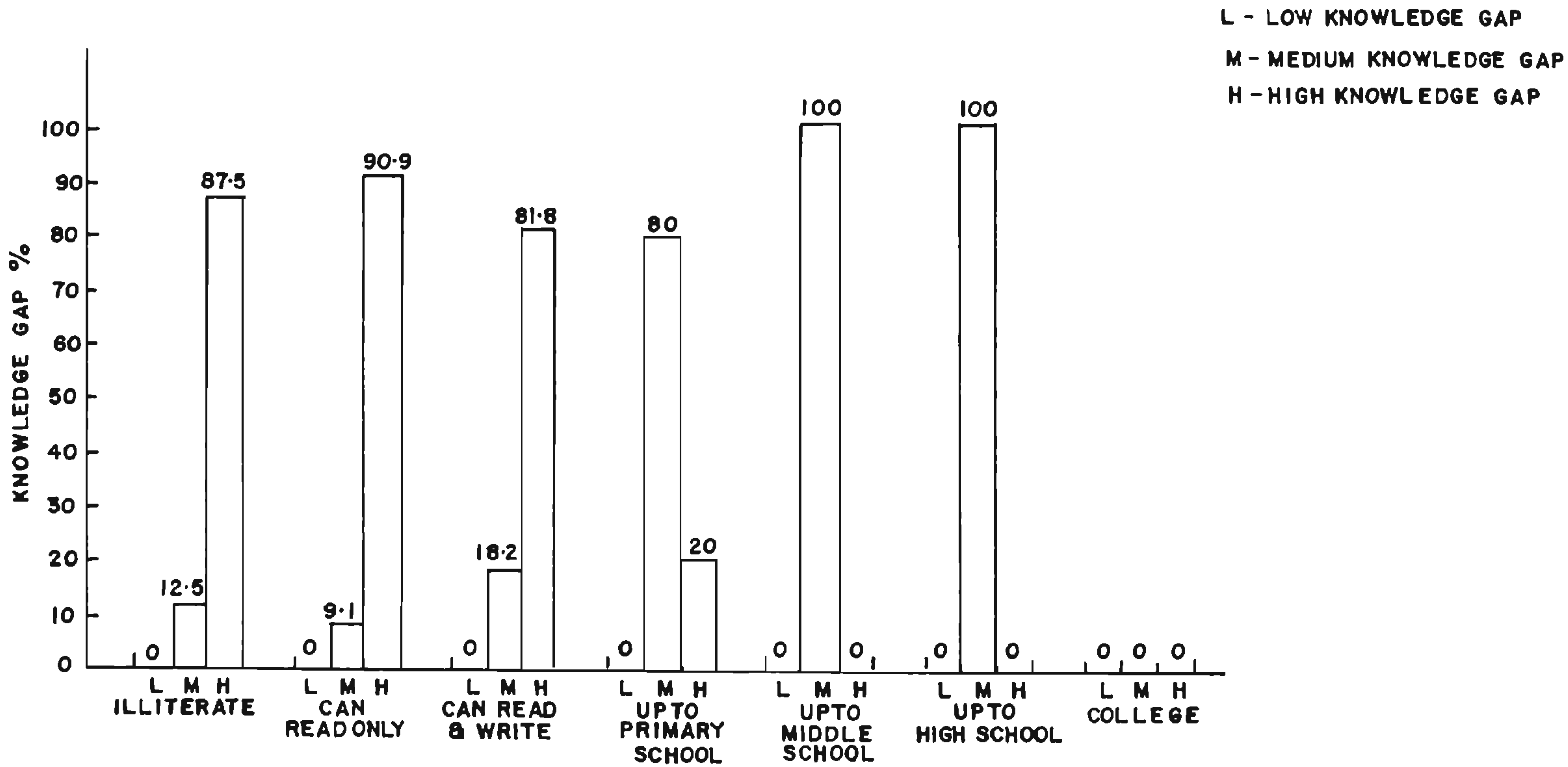


FIG. 7

It could be generally inferred that when the education level was higher the knowledge gap was lower. This showed that knowledge gap could be reduced by giving more education.

4.4.3. Knowledge gap in relation to social participation:

Figure 8 reveals the knowledge gap in relation to the social participation of the fish curers in Calicut region. Among those who had no membership in any organisation, 26.3% showed medium, 73.7% showed high and none showed low knowledge gap. In the case of people with membership in one organisation, 20.9% showed medium, 79.1% showed high and none showed low knowledge gap. Regarding the people with membership in more than one organisation, 3.6% showed low knowledge gap, 39.3% medium and 57.1% showed high knowledge gap. Among fish curers who were office bearers in one organisation, 46.2% showed low knowledge gap, 23.1% showed medium knowledge gap and 30.7% showed high knowledge gap.

Figure 9 presents the case of Malpe. Among fish curers with no membership in any organisation, 4.5% showed medium, 95.5% showed high and none showed low knowledge gap. In the case of people with membership in one organisation, 15.5% showed medium, 84.5% showed high and nobody showed low knowledge gap. Regarding people with membership in more than one organisation, 10.5% showed low, 57.9% showed medium and 31.6% showed high knowledge gap. In the case of fish curers who were office bearers in one organisation, 23.1% showed low, 53.8% showed medium and 23.1% showed high knowledge gap.

KNOWLEDGE GAP IN RELATION WITH SOCIAL PARTICIPATION OF FISH CURERS IN CALICUT REGION (N = 140)

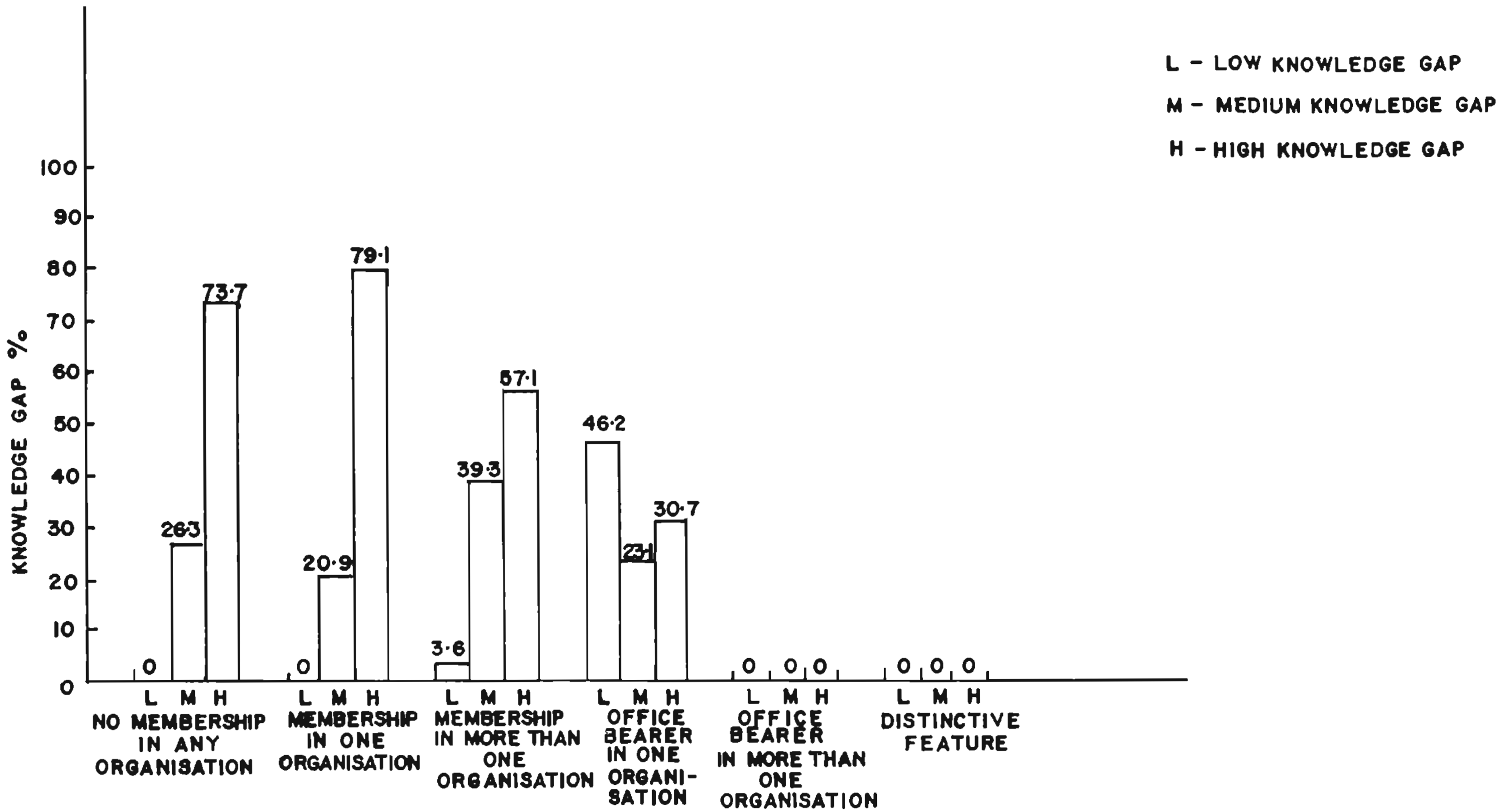


FIG. 8

KNOWLEDGE GAP IN RELATION WITH SOCIAL PARTICIPATION OF FISH CURERS IN MALPE REGION (N=125)

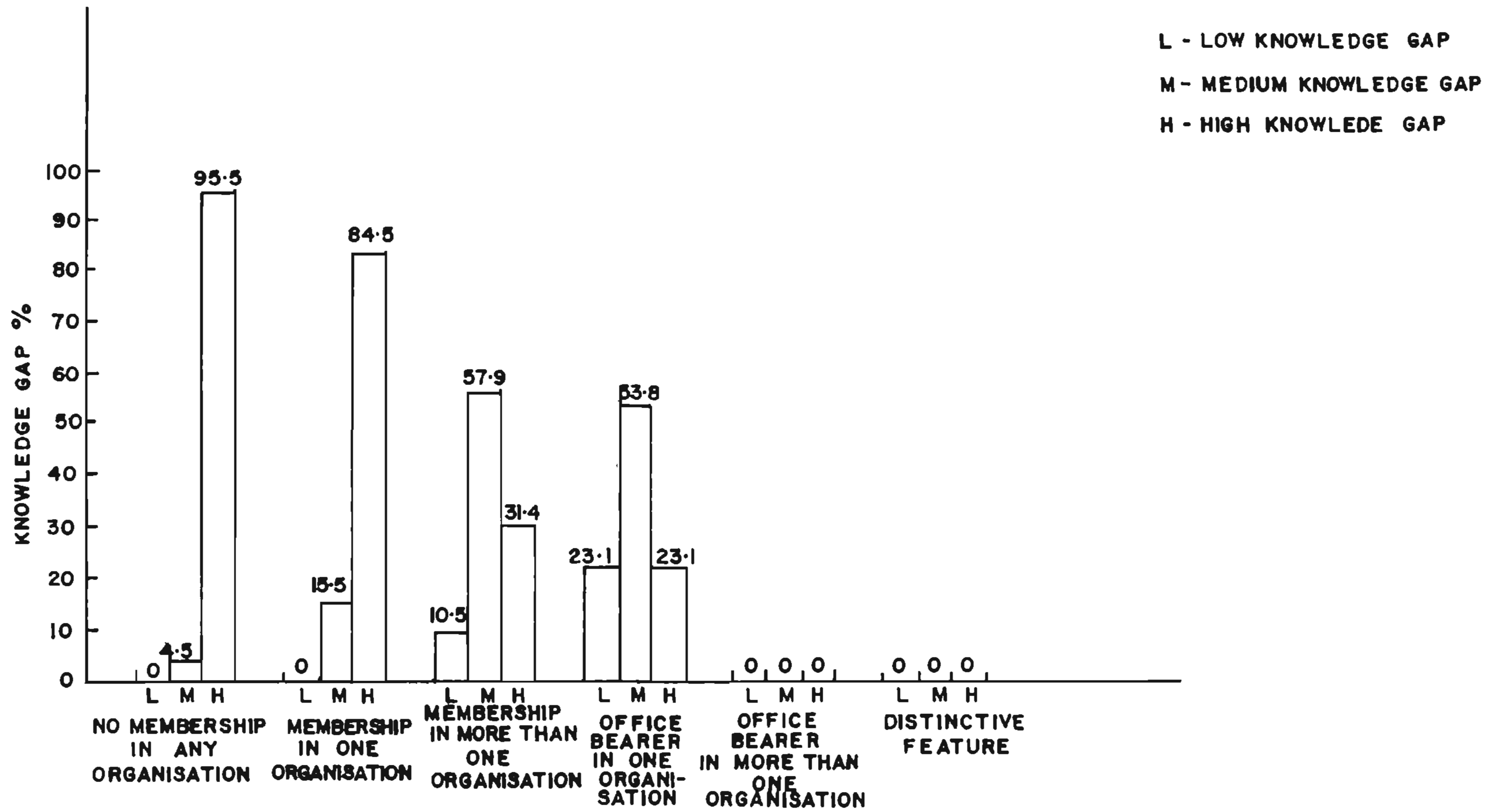


FIG. 9

Figure 10 shows the trend of knowledge gap in Tuticorin. All the fish curers who had no membership in any organisation showed high knowledge gap. Among those who had membership in one organisation, 20% showed medium, 80% showed high and none showed low knowledge gap. Regarding the respondents having membership in more than one organisation 57.1% showed medium, 42.9% showed high and none showed low knowledge gap. All the fish curers who were office bearers in one organisation showed medium knowledge gap.

It could be generally concluded that knowledge gap was less when the level of social participation of fish curers was more.

4.4.4. Knowledge gap in relation to the contact with extension agency:

Figure 11 illustrates the knowledge gap of the fish curers in Calicut region in relation to their contact with extension agency. Among those having weekly contact with extension agency, 66.7% had low knowledge gap and 33.3% had medium knowledge gap with nobody having high knowledge gap. In the case of respondents with fortnightly contact with extension agency, 62.5% showed low, 25% showed medium and 12.5% showed high knowledge gap. Among those having monthly extension contact, 11.1% recorded low, 33.3% showed medium and 55.6% had high knowledge gap. Regarding the fish curers having extension contact once in two months, 14.3% showed low knowledge gap, 28.6% showed medium and 57.1% showed high knowledge gap.

KNOWLEDGE GAP IN RELATION WITH SOCIAL PARTICIPATION OF FISH CURERS IN TUTICORIN REGION (N=40)

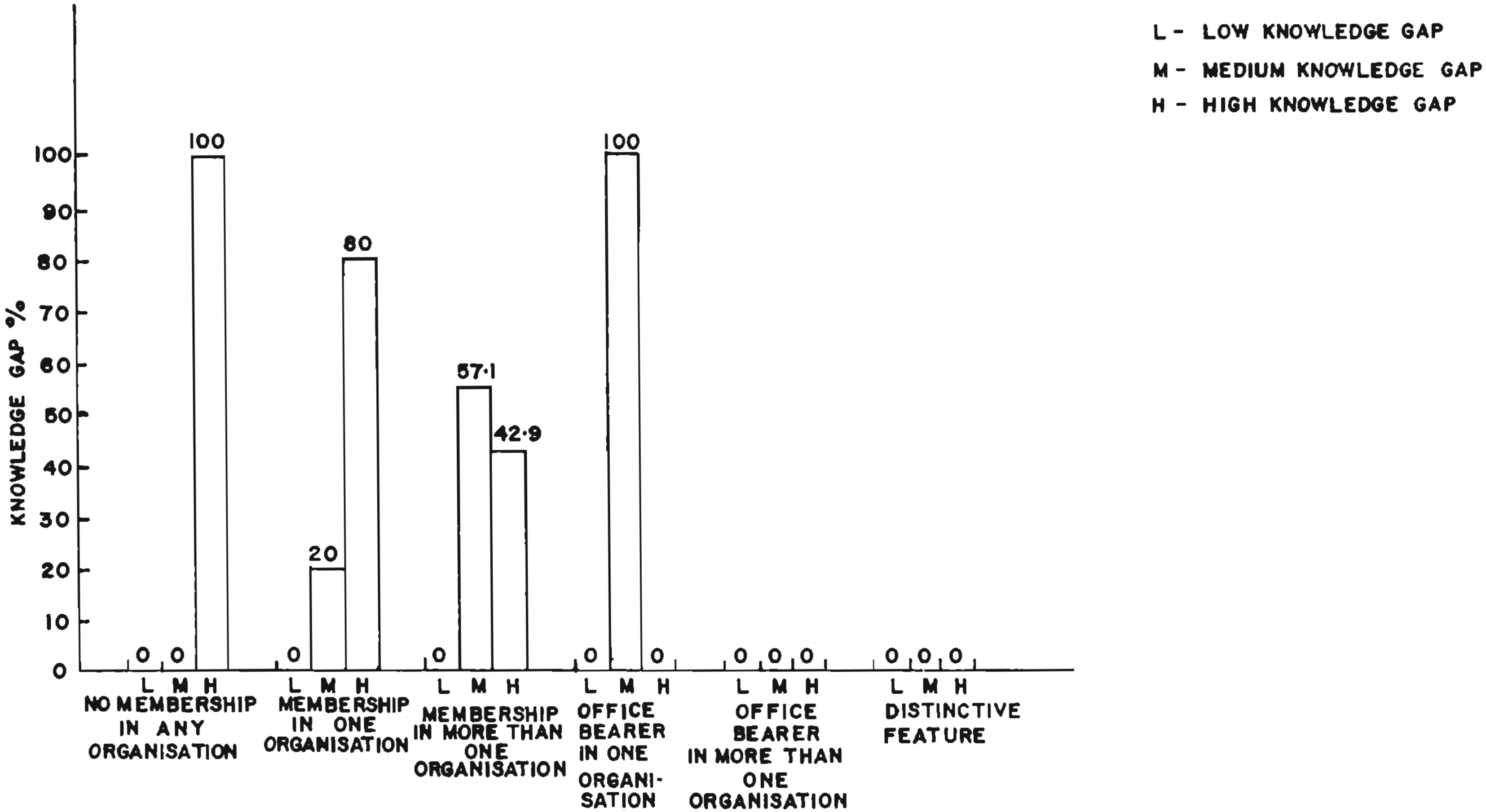


FIG. 10

KNOWLEDGE GAP IN RELATION WITH CONTACT WITH EXTENSION AGENCY OF FISH CURERS IN CALICUT REGION (N- 140)

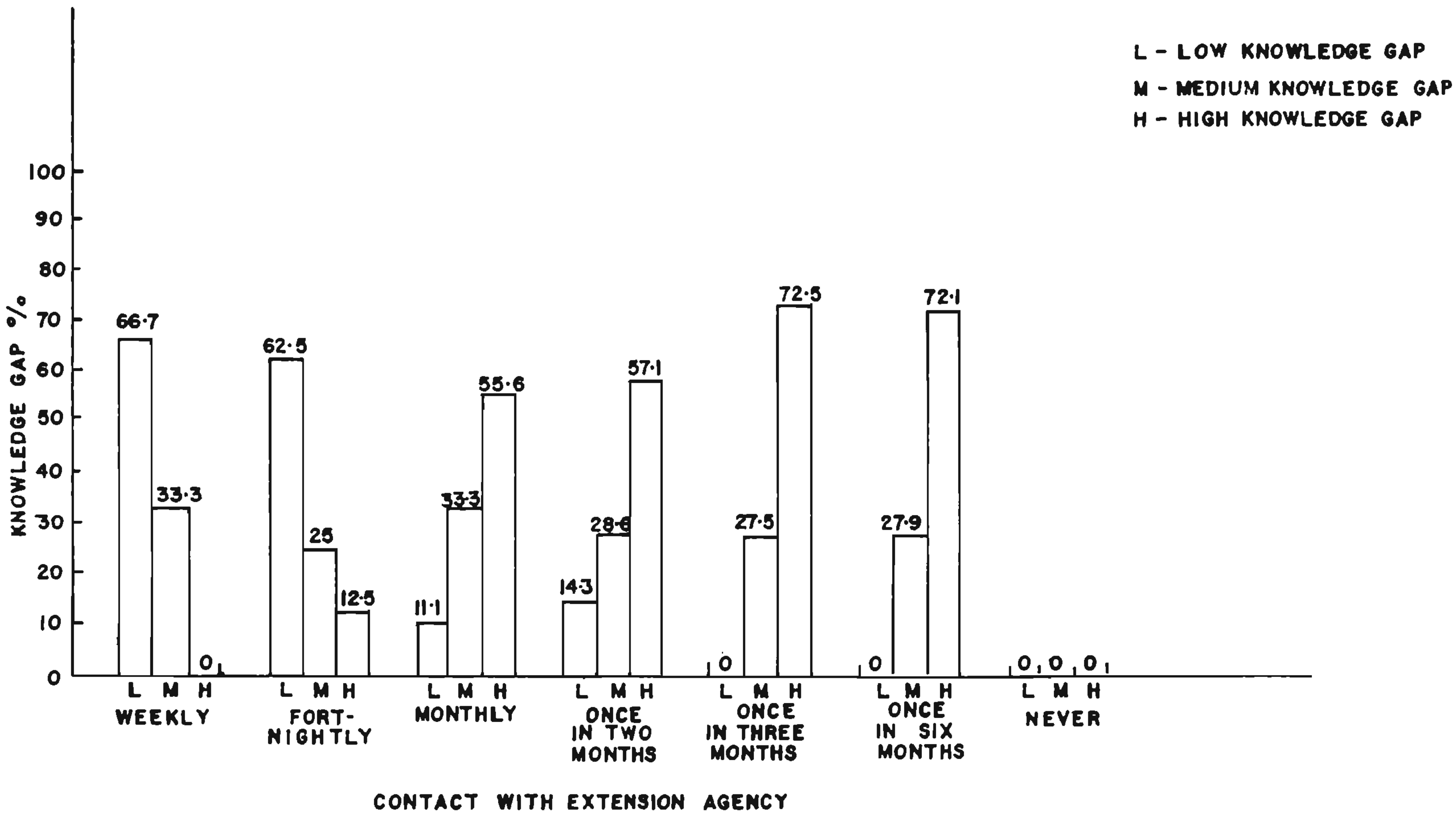


FIG. II

It was found that 27.5% of the people having extension contact once in three months had medium knowledge gap. 72.5% had high knowledge gap and nobody showed low knowledge gap. Again, 27.9% of the fish curers with extension contact once in six months showed medium and 72.1% showed high knowledge gap with none in low knowledge gap category.

Figure 12 presents the data pertaining to Malpe. Fifty percent of the fish curers with weekly extension contact showed low knowledge gap and the remaining 50% showed high knowledge gap. Twenty five percent of the respondents with fortnightly contact showed low, 50% showed medium and 25% showed high knowledge gap. Among the fish curers with monthly extension contact, 14.3% showed low, 64.3% showed medium and 21.4% showed high knowledge gap. Ten percent of the people with extension contact once in two months had low knowledge gap, 50% had medium and 40% showed high knowledge gap. Regarding people having extension contact once in three months, 12.7% showed medium, 87.3% showed high and none showed low knowledge gap. Ten percent of the fish curers with extension contact once in six months showed medium knowledge gap and 90% showed high knowledge gap with none under low knowledge gap categery.

KNOWLEDGE GAP IN RELATION WITH CONTACT WITH EXTENSION AGENCY OF FISH CURERS IN MALPE REGION (N - 125)

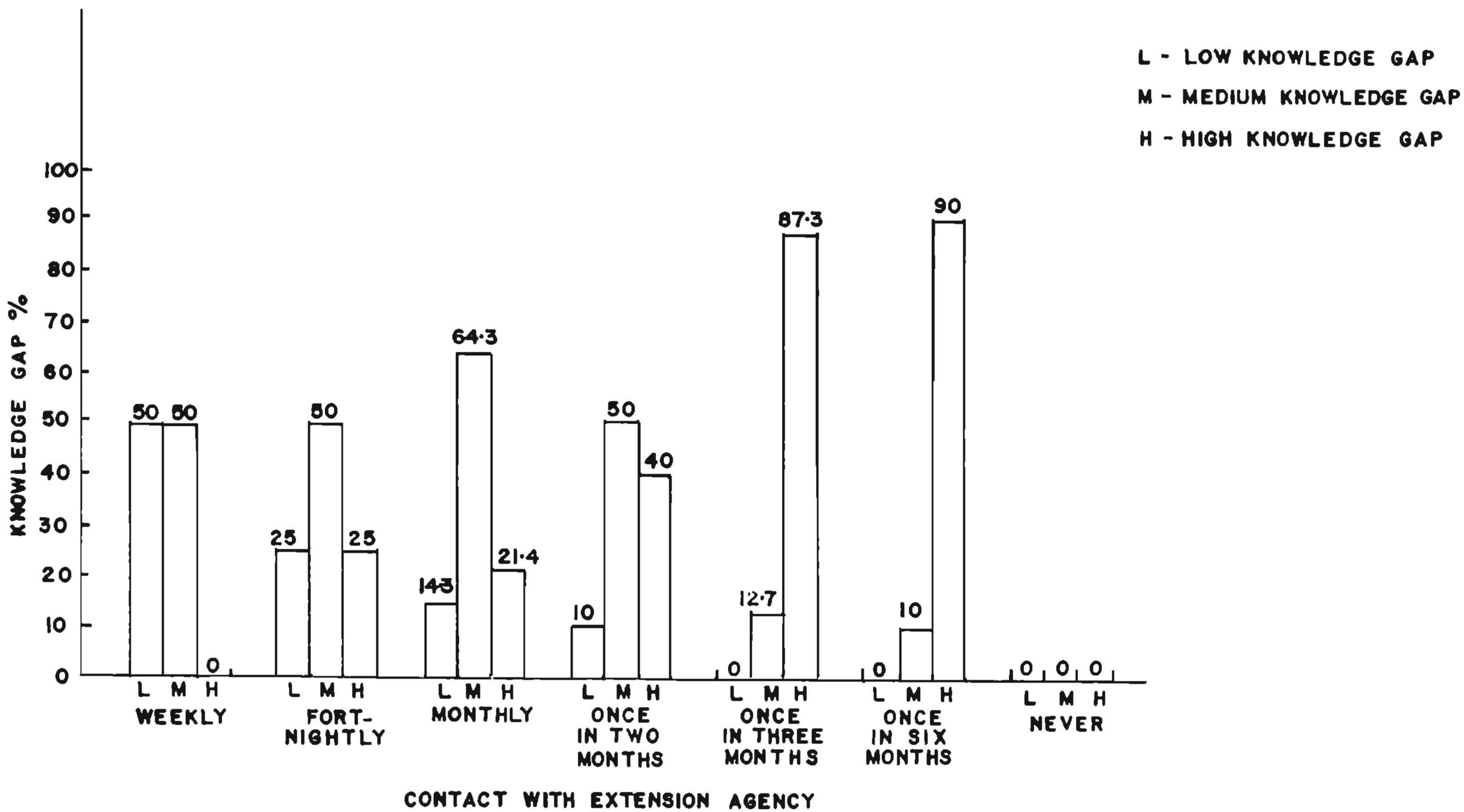


FIG. 12

Figure 13 shows the situation in Tuticorin. All the fish curers with weekly and fortnightly extension contact showed medium knowledge gap. Among those having monthly extension contact, 60% showed medium and 40% showed high knowledge gap with none in low knowledge gap category. Fifty percent of the fish curers having extension contact once in two months showed medium knowledge gap while the remaining 50% showed high knowledge gap. Twenty percent of the people with extension contact once in three months showed medium knowledge gap and the remaining 80% showed high knowledge gap. All the fish curers having extension contact once in six months showed high knowledge gap.

The results in general showed that the knowledge gap increased when the frequency of extension contact was less. This shows that more extension work among fish curers should be conducted to reduce the knowledge gap.

4.4.5. Knowledge gap in relation to the profitability of technology as perceived by fish curers:

Figure 14 shows the relation between knowledge gap and profitability of the technology as perceived by the fish curers in Calicut. Seventy five percent of the respondents having the perception about the fish curing technology as most profitable showed low knowledge gap,

KNOWLEDGE GAP IN RELATION WITH CONTACT WITH EXTENSION AGENCY OF FISH CURERS IN TUTICORIN REGION (N-40)

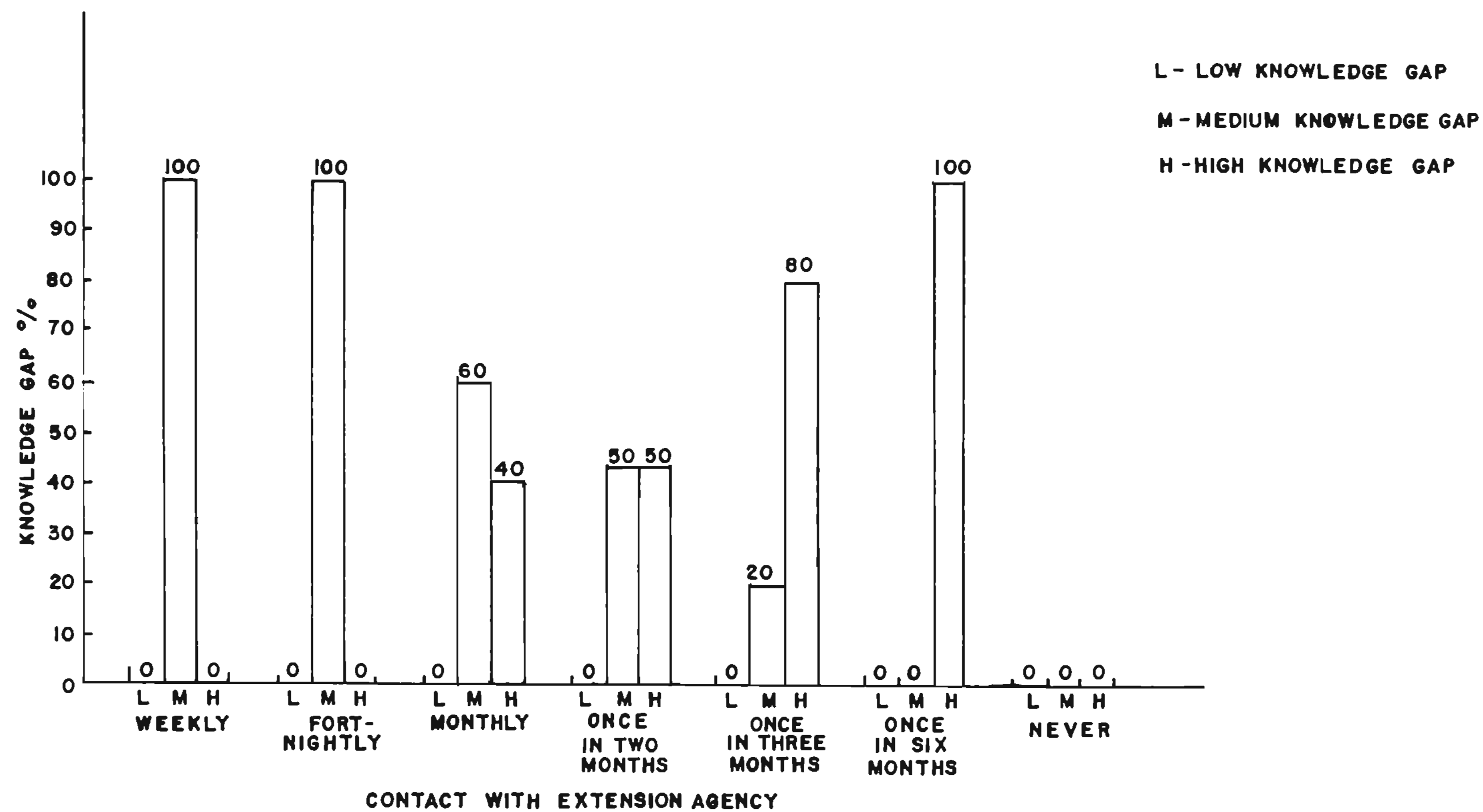


FIG 13

KNOWLEDGE GAP IN RELATION WITH PROFITABILITY
OF FISH CURERS IN CALICUT REGION (N - 140)

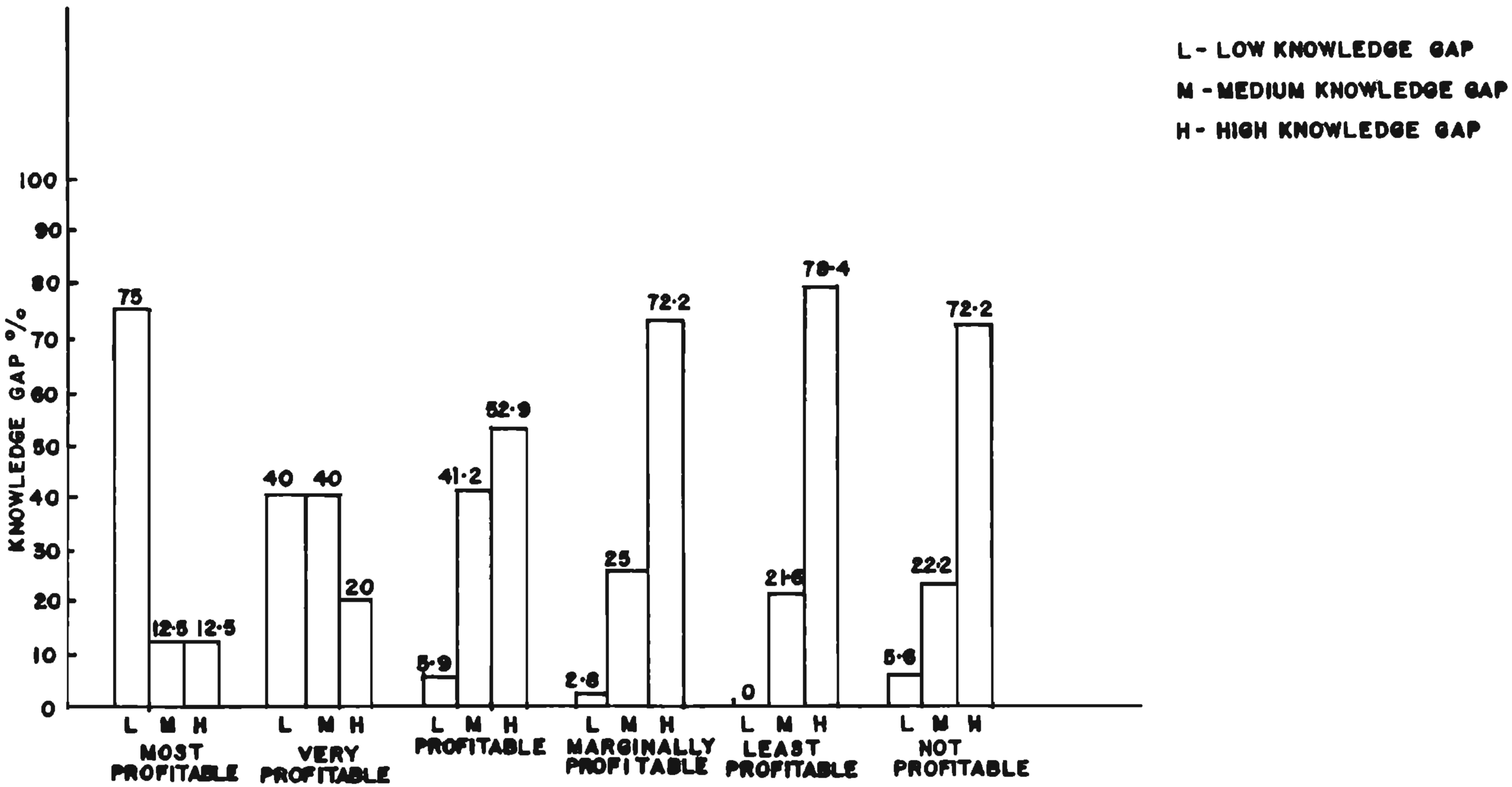


FIG. 14

12.5% showed medium and 12.5% showed high knowledge gap. Among those who perceived the technology as very profitable , 40% showed low, 40% showed medium and 20% showed high knowledge gap. Regarding fish curers perceiving the technology as profitable , 5.9% showed low, 41.2% showed medium and 52.9% showed high knowledge gap. In the case of fish curers perceiving the technology as marginally profitable , 2.8% showed low, 25% medium and 72.2% showed high knowledge gap. Among the people perceiving the technology as least profitable , 21.6% showed medium, 78.4% showed high and none showed low knowledge gap. However, 5.6% of the people perceiving the technology as not profitable showed low knowledge gap compared to 22.2% showing medium and 72.2% showing high knowledge gap.

Figure 15 presents the data pertaining to Malpe. Fifty percent of the fish curers with the perception as most profitable showed low and 50% showed medium knowledge gap with none having high knowledge gap. Among people with perception of technology as very profitable, 14.3% showed low, 57.1% showed medium and 28.6% showed high knowledge gap. In the case of fish curers with the perception as profitable, 14.3% had low, 28.6% had medium and 57.1% had high knowledge gap.

KNOWLEDGE GAP IN RELATION WITH PROFITABILITY
OF FISH CURERS IN MALPE REGION (N - 125)

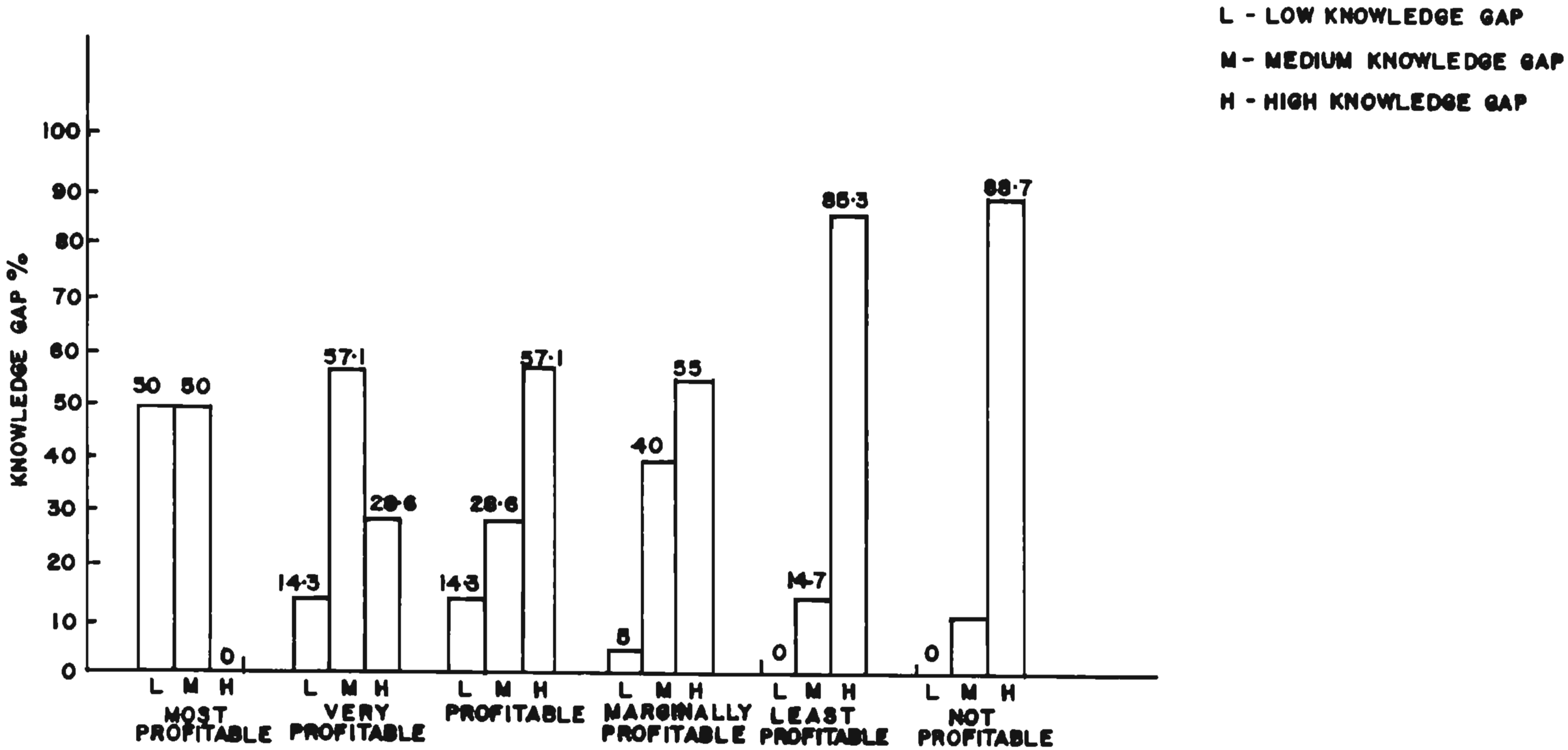


FIG. 15

Five percent of the people with the perception as marginally profitable showed low, 40% showed medium and 55% showed high knowledge gap. Among fish curers perceiving the technology as least profitable, 14.7% showed medium and 85.3% showed high knowledge gap with none having low knowledge gap. Regarding fish curers with the perception as not profitable, 11.3% showed medium knowledge gap and and 88.7% showed high knowledge gap with none having low knowledge gap.

Figure 16 shows the knowledge gap in relation to the profitability of the technology as perceived by the fish curers in Tuticorin region. All the respondents having the perception of technology as most profitable, very profitable and profitable showed medium knowledge gap. Among those having the perception of technology as marginally profitable, 33.3% showed medium and 66.7% high and none showed low knowledge gap. In the case of people perceiving the technology as least profitable, 16.7% showed medium knowledge gap, 83.3% showed high knowledge gap and none showed low knowledge gap. All the fish curers perceiving the technology as not profitable showed high knowledge gap.

In general, it was seen that the knowledge gap was reduced when the fish curers perceived the improved fish

KNOWLEDGE GAP IN RELATION WITH PROFITABILITY OF FISH CURERS IN TUTICORIN REGION (N- 40)

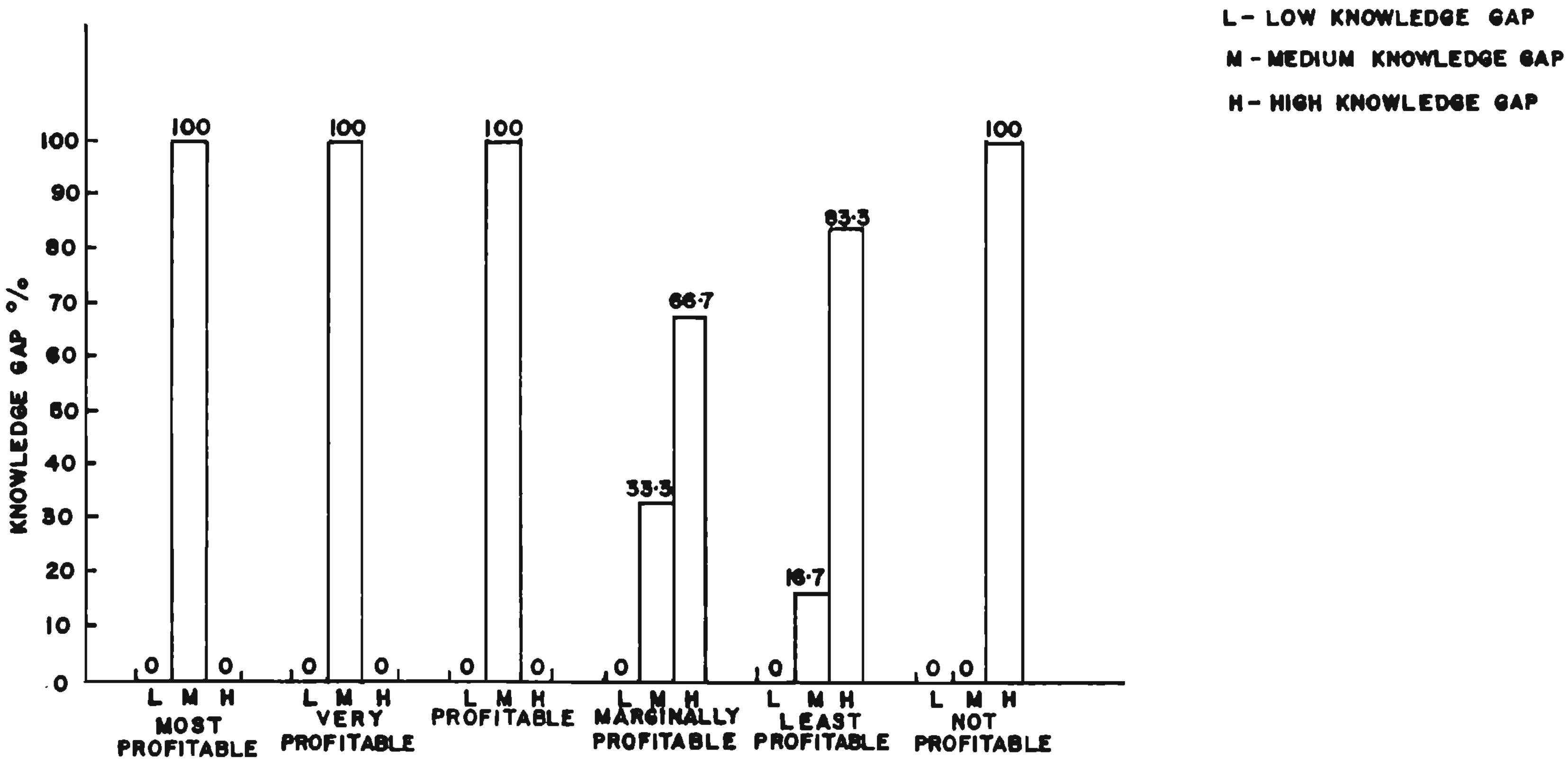


FIG. 16

curing practices as profitable. When the fish curers were convinced about the profitability of the technology they might gather more knowledge about the same. Therefore, to reduce the knowledge gap, intensive extension efforts have to be made.

4.4.6. Knowledge gap in relation to income:

Figure 17 shows the knowledge gap in relation to the income of the fish curers in Calicut. Among the people having annual income up to Rs.4000/-, 27.8% showed medium knowledge gap and 72.2% showed high knowledge gap. In the case of people having annual income of Rs.4000/- to Rs.5500/-, 22.2% showed medium and 77.8% showed high knowledge gap. Regarding those having annual income between Rs.5500/- and Rs.7000/-, 2.9% had low, 26.5% had medium and 70.6% had high knowledge gap. Among the fish curers with the annual income of Rs.7000/- to Rs.8500/-, 12.5 showed low, 31.3% showed medium and 56.3% showed high knowledge gap. It was found that 37.5% of the fish curers having annual income of Rs.8500/- to Rs.10,000/- had low, 50% had medium and 12.5% had high knowledge gap. Sixty percent of the people with annual income above Rs.10,000/- showed low, 30% medium and 10% showed high knowledge gap.

KNOWLEDGE GAP IN RELATION WITH INCOME OF FISH CURERS
OF CALICUT REGION (N - 140)

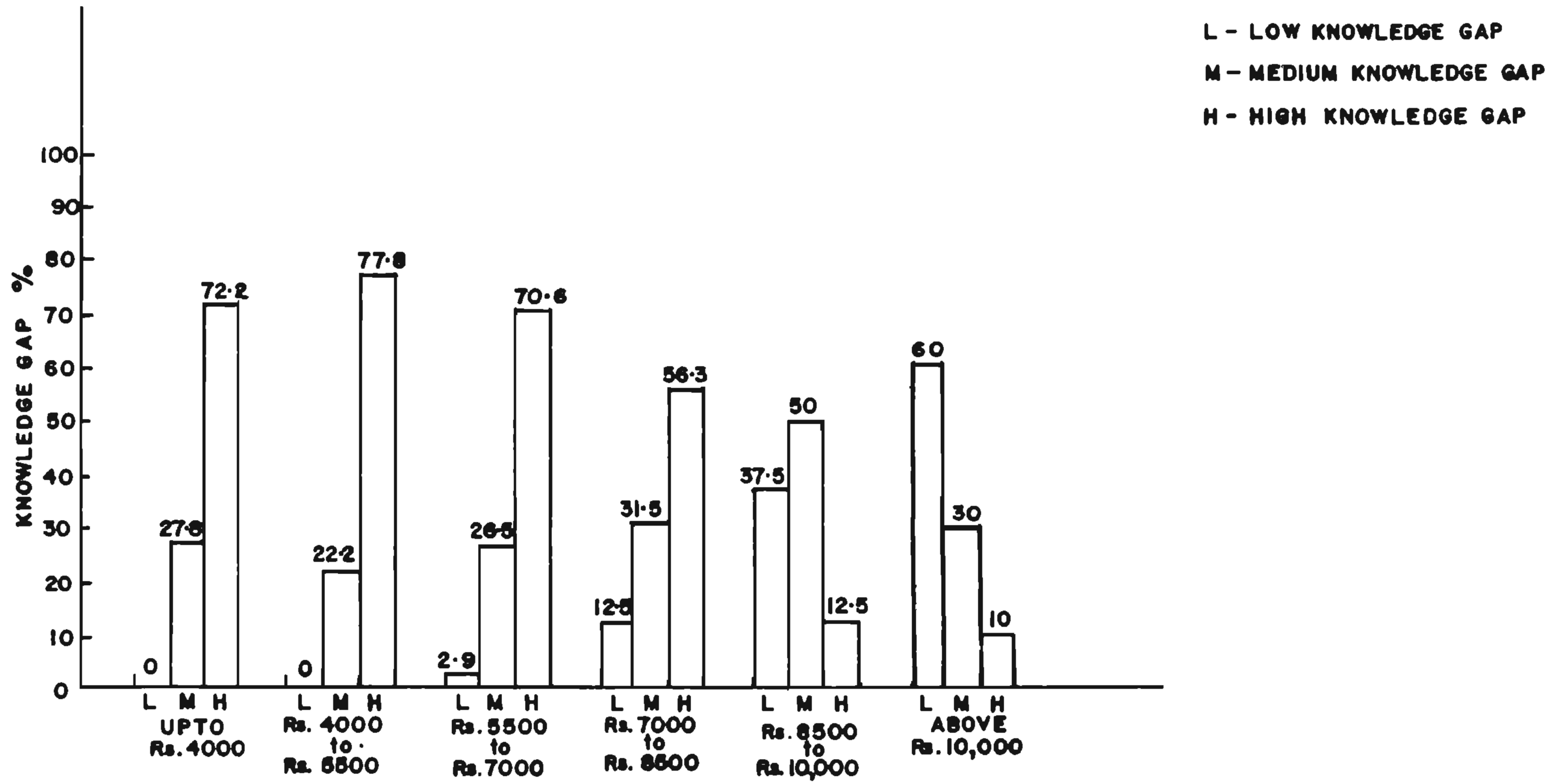


FIG. 17

Figure 18 presents the data pertaining to Malpe region. Among fish curers having annual income up to Rs.4000/-, 7.1% showed medium knowledge gap and 92.9% showed high knowledge gap. In the case of people with annual income Rs.4000/- to Rs.5500/-, 33.3% showed medium knowledge gap while 66.7% had high knowledge gap. It was seen that 17.6% of the fish curers having the annual income of Rs.5500/- to Rs.7000/- showed low, 35.3% showed medium and 47.1% showed high knowledge gap. Regarding the respondents with annual income of Rs.7000/- to Rs.8500/-, 12.5% had low, 37.5% had medium and 50% had high knowledge gap. The single fish curer with the annual income in the range of Rs.8500/- to Rs.10,000/- showed medium knowledge gap. Forty percent of the fish curers having annual income above Rs.10,000/- showed low, 40% showed medium and 20% showed high knowledge gap.

The situation in Tuticorin is described in Figure 19. All the fish curers with annual income up to Rs.4000/- showed high knowledge gap. In the case of the respondents having the annual income between Rs.4000/- and Rs.5500/-, 35.3% had medium and 64.7% had high knowledge gap. Fifty percent of the fish curers with annual income of Rs.5500/- to Rs.7000/- showed medium knowledge gap and 50% showed high knowledge gap. The

KNOWLEDGE GAP IN RELATION WITH INCOME OF FISH CURERS IN MALPE REGION (N - 125)

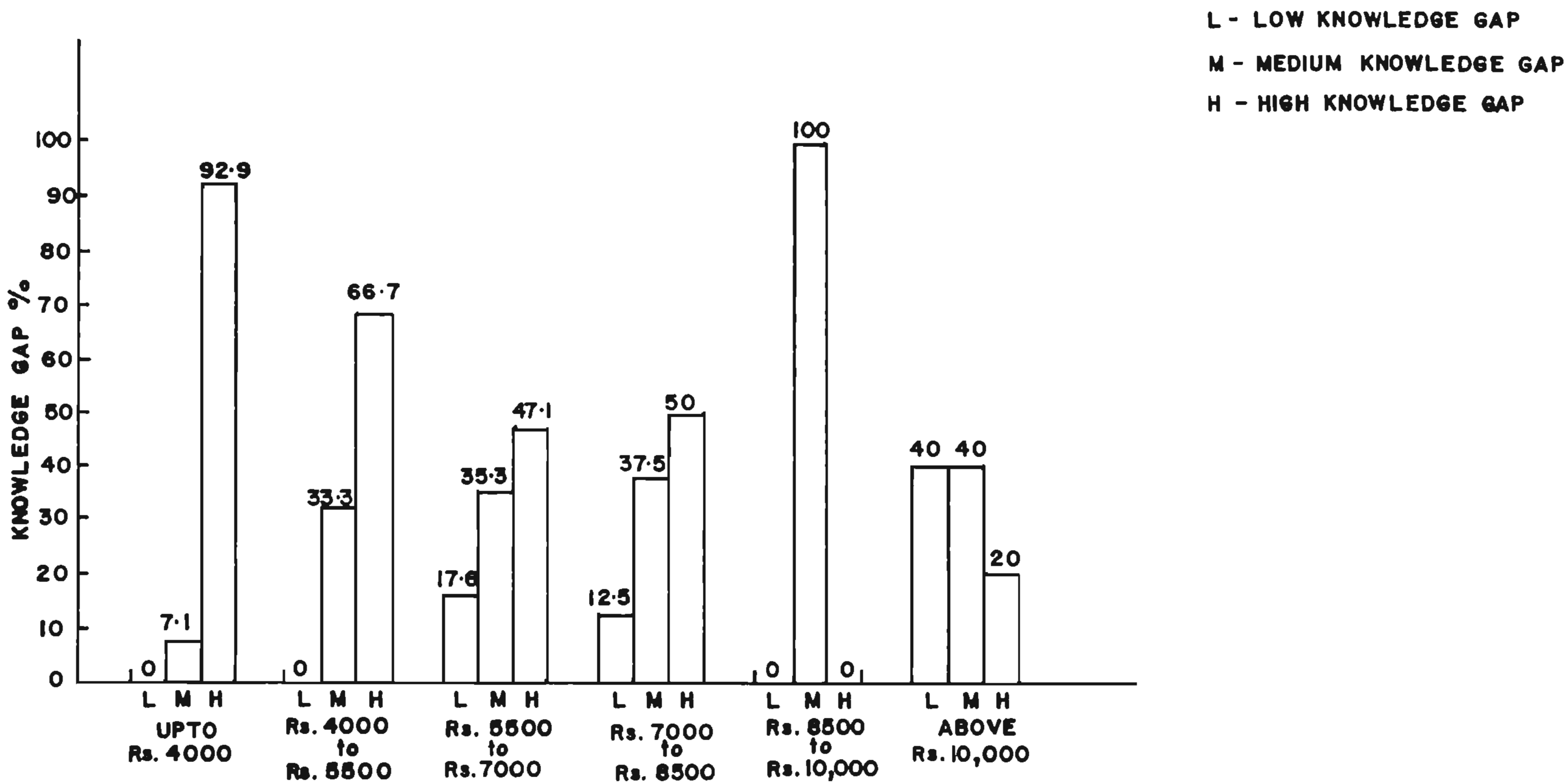


FIG. 18

KNOWLEDGE GAP IN RELATION WITH INCOME OF FISH CURERS IN TUTICORIN REGION (N - 40)

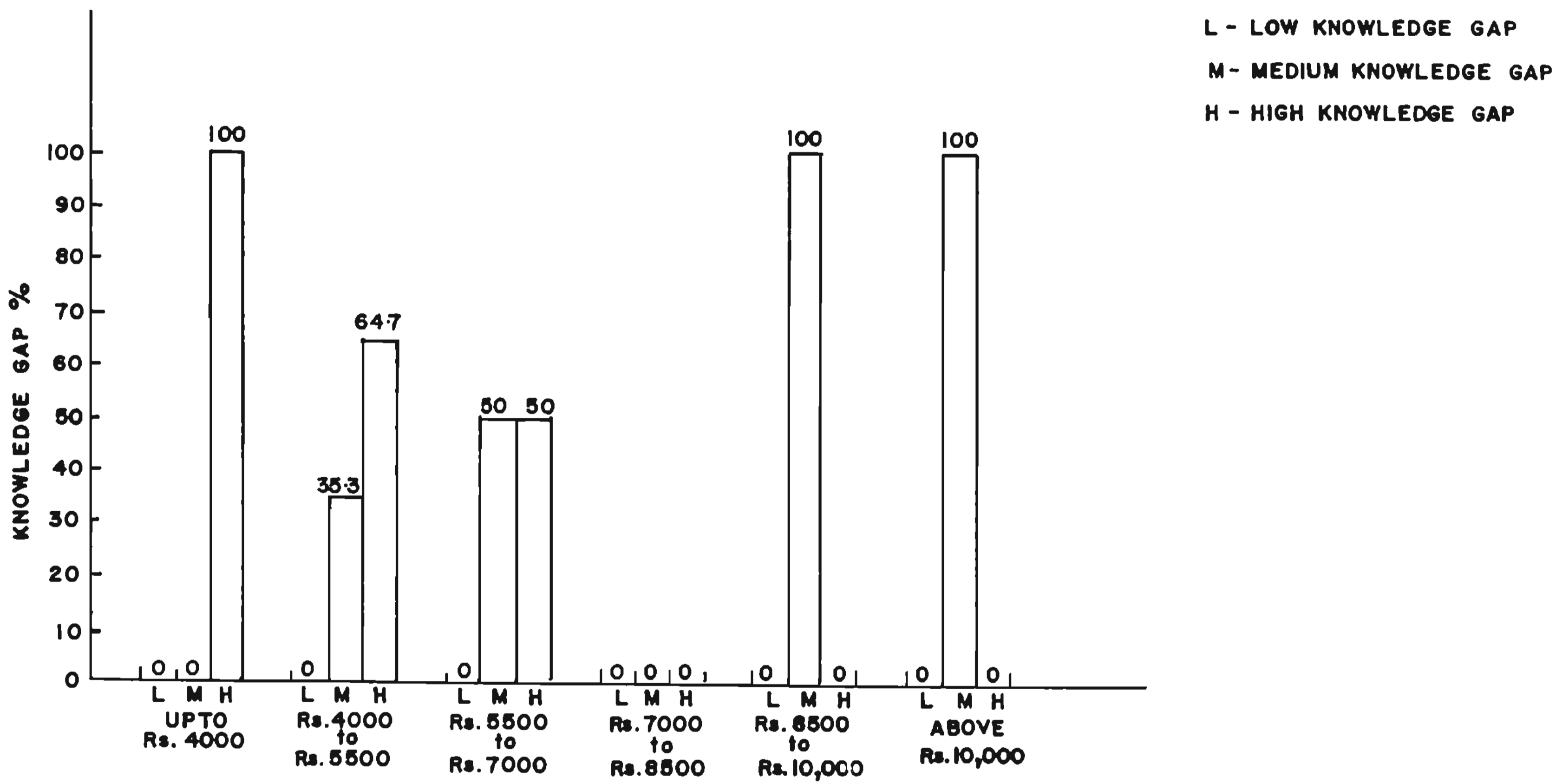


FIG. 19

single fish curer with the annual income in the range of Rs.8500/- to 10,000/- showed medium knowledge gap. All the fish curers having the income above Rs.10,000/- showed medium knowledge gap.

The data generally showed that knowledge gap was more when income was less. The better financial position of the fish curers might have helped them to gather more knowledge on improved technology and adopt it.

4.4.7. Knowledge gap in relation to debt:

Figure 20 shows the knowledge gap of the fish curers in Calicut in relation to their debt. Among people without any debt, 20.6% showed low, 28.6% showed medium and 50.8% showed high knowledge gap. In the case of people with debt up to Rs.250/-, 17.6% showed medium knowledge gap and 82.4% showed high knowledge gap. It was seen that 14.8% of the people with a debt of Rs.250/- to Rs.500/- had medium and 85.2% had high knowledge gap. Regarding the fish curers with debt of Rs.500/- to Rs.750/-, 35% showed medium and 65% showed high knowledge gap with none in low knowledge gap category. Coming to the group of people having debt of Rs.750/- to Rs.1000/-, 33.3% showed medium knowledge gap and 66.7% recorded high knowledge gap. The single fish curer with debt in the range of Rs.1000/- to 1500/- showed medium knowledge gap.

KNOWLEDGE GAP IN RELATION WITH DEBT OF FISH CURERS IN CALICUT REGION (N - 140)

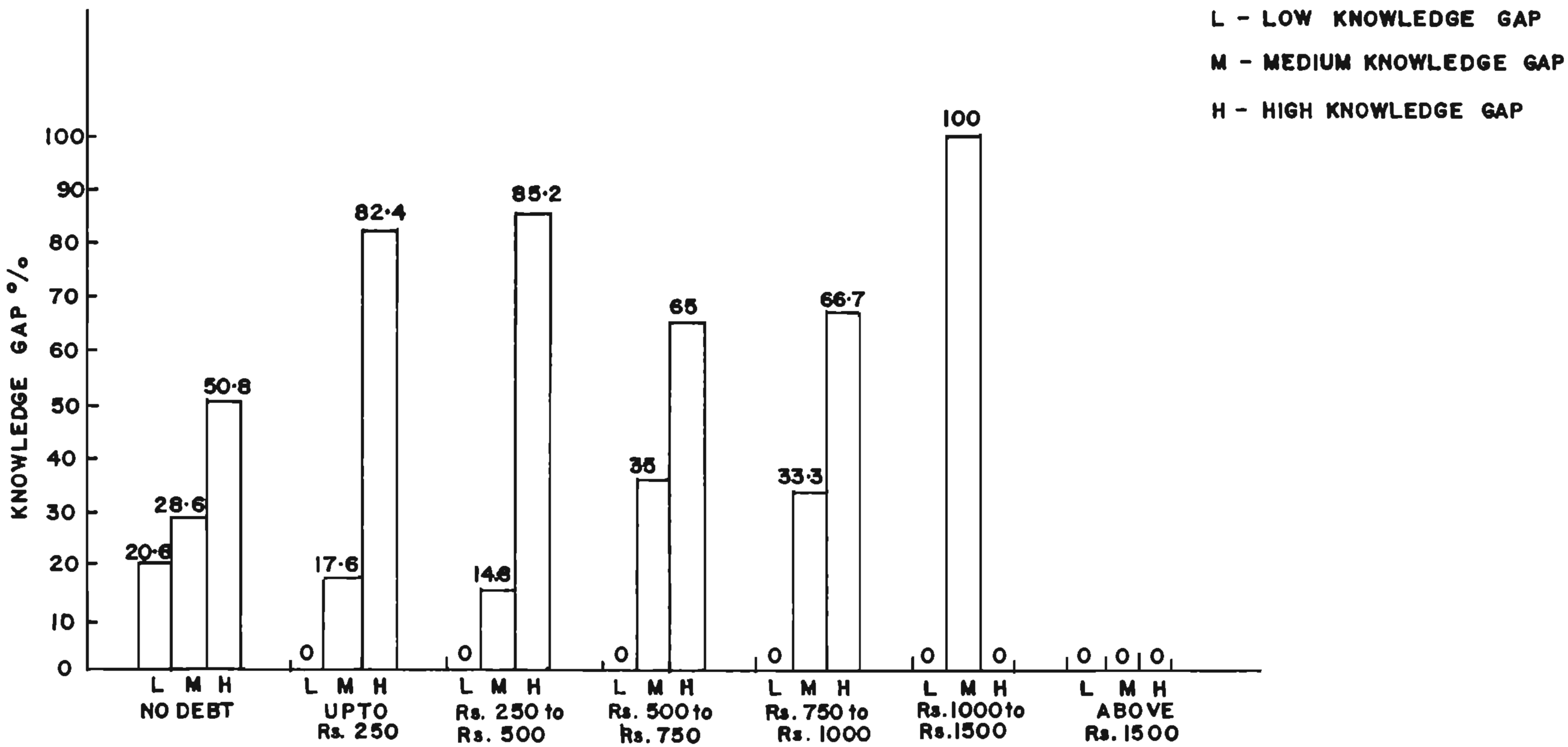


FIG. 20

Figure 21 shows the knowledge gap of the fish curers in Malpe in relation to their debt. Among those having no debt, 21.8% showed low, 43.4% showed medium and 34.8% showed high knowledge gap. Fifty percent of the fish curers with a debt of up to Rs.250/- showed medium knowledge gap and 50% showed high knowledge gap with nobody in the low knowledge gap group. In the case of fish curers having debt of Rs.250/- to Rs.500/-, 22.2% showed medium and 77.8% showed high knowledge gap. It was found that 11.6% of the respondents with a debt of Rs.500/- to Rs.750/- had medium knowledge gap and 88.4% had high knowledge gap. Regarding the people with a debt of Rs.750/- to Rs.1000/-, 15.8% showed medium knowledge gap and 84.2% showed high knowledge gap with none under the category of low knowledge gap.

The data collected from Tuticorin is presented in the Figure 22. All the fish curers without any debt or with debt up to Rs.250/- showed medium knowledge gap. Fifty percent of the people with the debt of Rs.250/- to Rs.500/- showed medium knowledge gap while the remaining 50% had high knowledge gap. In the case of fish curers with a debt of Rs.500/- to Rs.750/-, 27.3% showed medium and the remaining 72.7% showed high knowledge gap. It was found that 8.3% of the respondents with a debt of

KNOWLEDGE GAP IN RELATION WITH DEBT OF FISH CURERS
IN MALPE REGION (N-125)

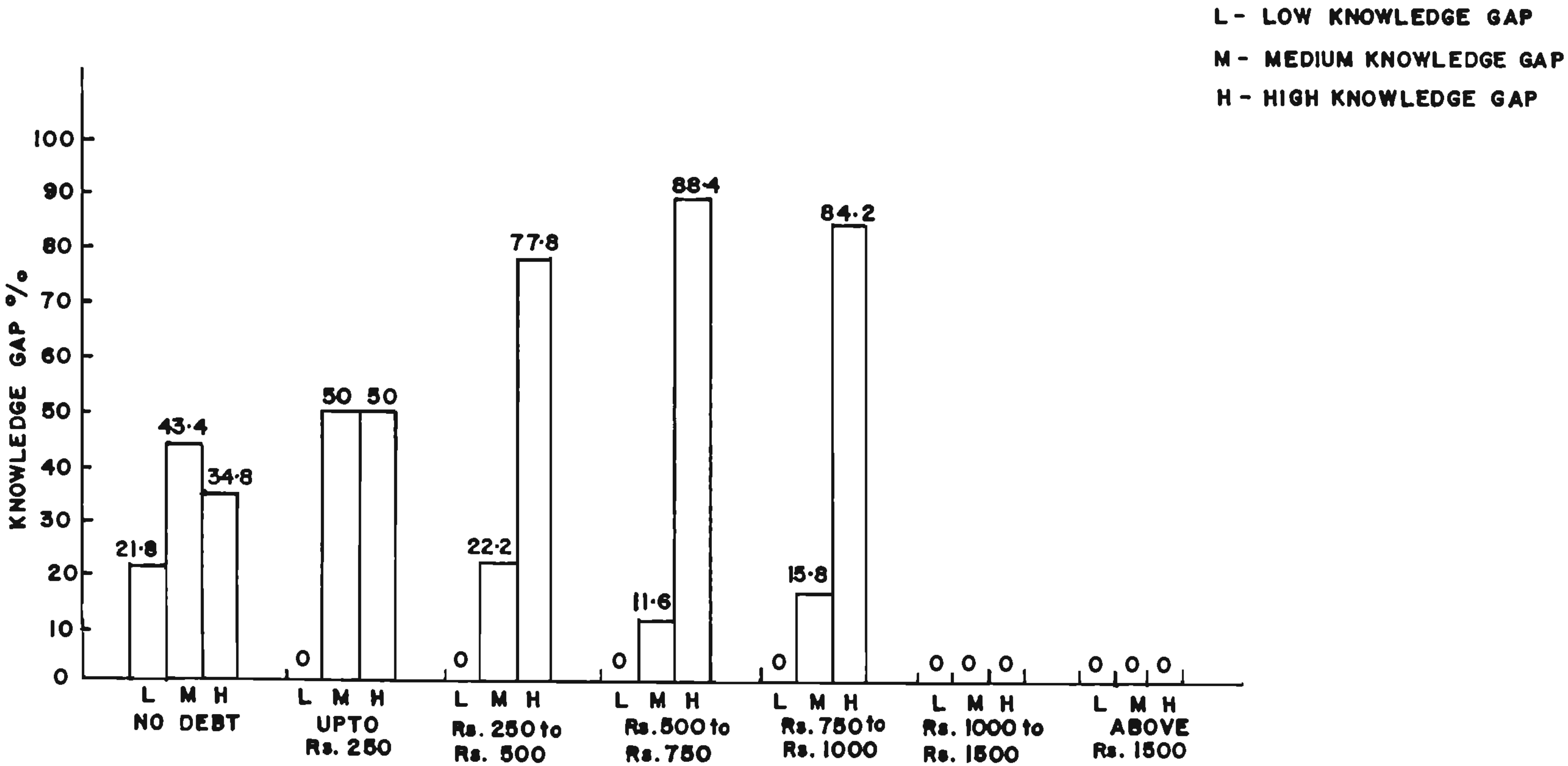


FIG. 21

KNOWLEDGE GAP IN RELATION WITH DEBT OF FISH CURERS IN TUTICORIN REGION (N - 40)

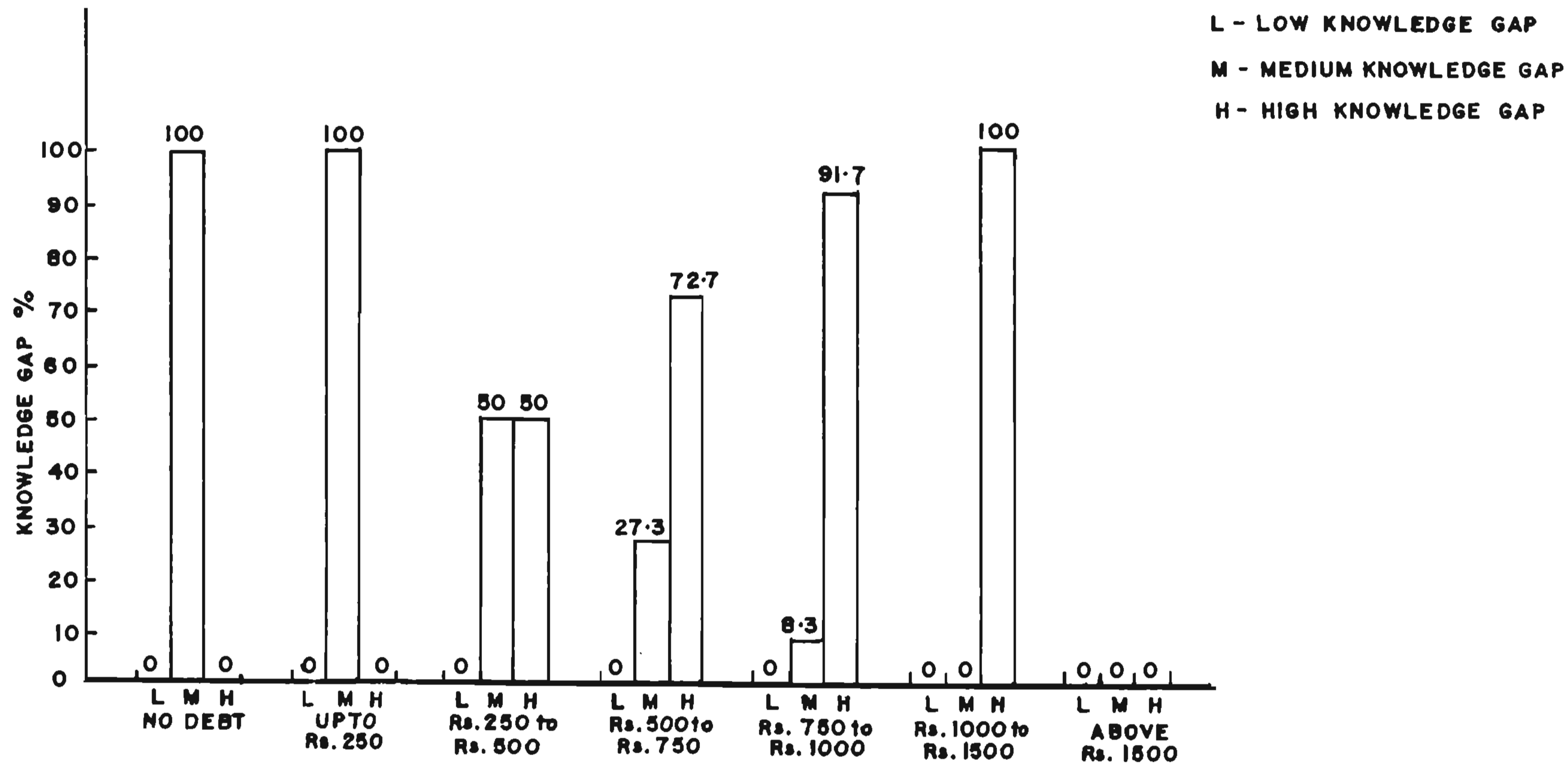


FIG. 22

Rs.750/- to Rs.1000/- had medium knowledge gap and 91.7% had high knowledge gap with none having low knowledge gap. All the fish curers with a debt of Rs.1000/- to Rs.1500/- showed high knowledge gap.

The results in general showed that the knowledge gap was reduced when debt was decreased. The extension education should be intensified so as to instill more knowledge and spirit in the fish curer to adopt the improved technology of fish curing so as to increase his income and save him from debt.

The younger fish curers are naturally more educated and having more contact with extension agency and social participation. They are having a positive perception on the profitability of the improved practices. All these variables are interrelated and are negatively correlated with the knowledge gap. These situations lead to more learning of fish curers on fish curing technology reducing the knowledge gap. Similarly a higher income helps fish curers to create a situation favourable to more learning.

4.5. Adoption gap

Adoption gap in different fishing regions was studied in relation to the knowledge gap, sex, age, education, social participation, contact with extension agency, perception of profitability, income and debt of the fish curers.

4.5.1. Adoption gap in relation to sex:

Table 28 shows the adoption gap in relation to the sex of the fish curers in Calicut region. Male members dominated in this region. Eighty three percent of male members showed high adoption gap and 16.8% showed medium adoption gap. Regarding female members, all have showed high adoption gap.

Table 28. Adoption gap in relation to sex in Calicut region

(N-140)

Sex	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Male	136	0	0.00	23	16.80	113	83.00
Female	4	0	0.00	0	0.00	4	100.00

Table 29 shows the trend of adoption gap at Malpe. In this area, female fish curers dominated in fish curing industry. Among male members, 79.3% showed high adoption gap and 20.7% showed medium adoption gap. In the case of female members, 92.7% had high and 7.3% had medium adoption gap.

Table 29. Adoption gap in relation to sex in Malpe region

(N-125)

Sex	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Male	29	0	0.00	6	20.70	23	79.30
Female	96	0	0.00	7	7.30	89	92.70

Table 30 reveals the picture in Tuticorin. In this centre, male members dominated the industry. Among male members, 86.2% showed high adoption gap and 13.8% showed medium adoption gap. In the case of female members, all were under high adoption gap category.

Table 30. Adoption gap in relation to sex in Tuticorin region

(N-40)

Sex	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Male	37	0	0	5	13.80	32	86.20
Female	3	0	0	0	0.00	3	100.00

The results of all the three centres generally showed that adoption gap was comparatively less among male members. Females are generally having less time available for learning, social participation, contact with extension agency etc. This situation reduces the chances for exposure to improved fish curing practices leading to higher adoption gap compared to male members. More care has to be taken in educating female fish curers so as to improve their knowledge, skill and attitude and enhance adoption rate.

4.5.2. Adoption gap in relation to age:

Table 31 shows the range of adoption gap in Calicut in relation to age group. Among fish curers under the age group up to 30 years, 68.4% showed medium adoption gap while 31.6% people recorded high adoption gap. In the case of fish curers under the age group of 30 to 35 years, 62.5% showed medium adoption gap and 37.5% showed high adoption gap. All the fish curers under the age group of 35 to 40 years, 40 to 45 years, 45 to 50 years and above 50 years showed high adoption gap.

Table 32 shows the trend in Malpe region. Medium adoption gap was noted in the case of 75% of the fish curers in the age group up to 30 years while 25%

Table 31. Adoption gap in relation to age in Calicut region

(N-140)

Age group	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Up to 30 years old	19	0	0.00	13	68.40	6	31.60
30 to 35 years	16	0	0.00	10	62.50	6	37.50
35 to 40 years	14	0	0.00	0	0.00	14	100.00
40 to 45 years	30	0	0.00	0	0.00	30	100.00
45 to 50 years	43	0	0.00	0	0.00	43	100.00
Above 50 years	18	0	0.00	0.	0.00	18	100.00

showed high adoption gap in the same age group. Among fish curers in the age group of 30 to 35 years, 50% showed medium adoption gap and the remaining 50% recorded high adoption age. All the fish curers in the age groups of 35 to 40 years, 40 to 45 years, 45 to 50 years and above 50 years showed high adoption gap.

Table 32. Adoption gap in relation to age in Malpe region

(N-125)

Age group	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Up to 30 years old	8	0	0.00	6	75.00	2	25.00
30 to 35 years	14	0	0.00	7	50.00	7	50.00
35 to 40 years	14	0	0.00	0	0.00	14	100.00
40 to 45 years	31	0	0.00	0	0.00	31	100.00
45 to 50 years	36	0	0.00	0	0.00	36	100.00
Above 50 years	22	0	0.00	0	0.00	22	100.00

Table 33 shows the results in Tuticorin. It was observed that all the fish curers in the category up to 30 years and 30 to 35 years showed medium adoption gap. Similarly all the fish curers in the age groups of 35 to 40 years, 40 to 45 years and above 50 years showed high adoption gap. Only in the age group of 45 to 50 years, 94.2% of the fish curers showed medium adoption gap and 5.8% showed high adoption gap.

Table 33. <u>Adoption gap in relation to age in Tuticorin region</u>

(N-40)

Age group	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Up to 30 years old	2	0	0.00	2	100.00	0	0.00
30 to 35 years	2	0	0.00	2	100.00	0	0.00
35 to 40 years	1	0	0.00	0	0.00	1	100.00
40 to 45 years	6	0	0.00	0	0.00	6	100.00
45 to 50 years	17	0	0.00	16	94.20	1	5.80
Above 50 years	12	0	0.00	0	0.00	12	100.00

It was generally observed that no fish curer was seen in low adoption gap group in any of the three regions. In the case of Calicut and Malpe regions, the general trend was that adoption gap increased with the increase in age of the individual fish curer, However, this could not be substantiated in the case of Tuticorin region.

As explained already under knowledge gap, the aged people are usually having less education, less social participation, less contact with extension agency and low perception of profitability of the improved practices. These situations might have led to a higher adoption gap among aged fish curers compared to younger ones. However this trend cannot be generalised in all regions because even the younger fish curers may show high adoption gap if other factors are unfavourable.

4.5.3. Adoption gap in relation to education:

Table 34 shows the adoption gap in Calicut region. Illiterate fish curers and all those having education up to primary school level showed high adoption gap. In the case of fish curers with middle school education, 26.9% showed medium adoption gap and 73.1% showed high adoption gap. All the fish curers with high school education showed medium adoption gap. Nobody could be traced in the low adoption gap category.

Table 35 presents the data collected from Malpe region. Here also, illiterate and all others with education up to primary school showed high adoption gap. Among fish curers with middle school education, 35.3% showed medium adoption gap and 64.7% showed high adoption gap. All the fish curers with high school education showed medium adoption gap. There was no fish curer in the low adoption gap category in Malpe region.

Table 34. Adoption gap in relation to education in Calicut region

(N-140)

Level of education	Total Number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Illiterate	6	0	0.00	0	0.00	6	100.00
Can read only	8	0	0.00	0	0.00	8	100.00
Can read and write	30	0	0.00	0	0.00	30	100.00
Up to primary school	54	0	0.00	0	0.00	54	100.00
Up to middle school	26	0	0.00	7	26.90	19	73.10
Up to high school	16	0	0.00	16	100.00	0	0.00
College	0	0	0.00	0	0.00	0	0.00

Table 35. Adoption gap in relation to education in Malpe region

(N-125)

Level of education	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Illiterate	34	0	0.00	0	0.00	34	100.00
Can read only	28	0	0.00	0	0.00	28	100.00
Can read and write	24	0	0.00	0	0.00	24	100.00
Up to primary school	15	0	0.00	0	0.00	15	100.00
Up to middle school	17	0	0.00	6	35.30	11	64.70
Up to high school	7	0	0.00	7	100.00	0	0.00
College	0	0	0.00	0	0.00	0	0.00

Table 36 shows the results in Tuticorin. Here also the illiterate and all other fish curers up to the category of primary school education showed high adoption gap. All fish curers in the categories of middle school and high school education showed medium adoption gap. Nobody could be found in the category of low adoption gap at any educational level.

Table 36. Adoption gap in relation to education in Tuticorin region

(N-40)

Level of education	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Illiterate	8	0	0.00	0	0.00	8	100.00
Can read only	11	0	0.00	0	0.00	11	100.00
Can read and write	11	0	0.00	0	0.00	11	100.00
Up to primary school	5	0	0.00	0	0.00	5	100.00
Up to middle school	1	0	0.00	1	100.00	0	0.00
Up to high school	4	0	0.00	4	100.00	0	0.00
College	0	0	0.00	0	0.00	0	0.00

It was generally seen from the observations in all the regions that education up to primary school did not make any impact on the adoption gap. Education up to high school level showed cent percent medium adoption gap in all the centres. Impact of middle school education varied from region to region. As there was no fish curer with college education, impact of such level of education could not be studied. The data clearly suggested that by giving more education, adoption gap could be reduced.

4.5.4. Adoption gap in relation to social participation:

Table 37 shows the adoption gap in relation to social participation of fish curers in Calicut region. All the fish curers who were either having membership in one organisation or having no membership in any organisation showed high adoption gap. Among fish curers having membership in more than one organisation, 10.7% showed medium adoption gap and 89.3% showed high adoption gap. In the case of fish curers who were office bearers in one organisation, 76.9% showed medium adoption gap and 23.1% showed high adoption gap. There was no fish curer with the position of office bearer in more than one organisation or any other distinctive features in Calicut region. Low adoption gap was not seen in any fish curer in this region.

Table 38 shows the trend of adoption gap in Malpe region. Here also all the fish curers who were having membership in one organisation or having no membership in any organisation showed high adoption gap. Among the fish curers who were having membership in more than one organisation, 15.8% showed medium adoption gap and

Table 37. Adoption gap in relation to social participation in Calicut region

(N-140)

Social participation	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
No membership in any organisation	19	0	0.00	0	0.00	19	100.00
Membership in one organisation	67	0	0.00	0	0.00	67	100.00
Membership in more than one organisation	28	0	0.00	3	10.70	25	89.30
Office bearer in one organisation	26	0	0.00	20	76.90	6	23.10
Office bearer in more than one organisation	0	0	0.00	0	0.00	0	0.00
Distinctive features	0	0.	0.00	0	0.00	0	0.00

Table 38. Adoption gap in relation to social participation in Malpe region

(N-125)

Social participation	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
No membership in any organisation	22	0	0.00	0	0.00	22	100.00
Membership in one organisation	71	0	0.00	0	0.00	71	100.00
Membership in more than one organisation	19	0	0.00	3	15.80	16	84.20
Office bearer in one organisation	13	0	0.00	10	76.90	3	23.10
Office bearer in more than one organisation	0	0	0.00	0	0.00	0	0.00
Distinctive features	0	0	0.00	0	0.00	0	0.00

84.2% recorded high adoption gap. In the case of fish curers who were office bearers in one organisation, 76.9% showed medium adoption gap and 23.1% showed high adoption gap. In Malpe, there was no fish curer who was office bearer in more than one organisation or having distinctive featurers. None of the fish curers showed low adoption gap in any category.

Table 39 shows the data pertaining to the adoption gap of fish curers in Tuticorin in relation to their social participation. All the fish curers having membership in one or more organisations or having no membership in any organisation showed high adoption gap. All the fish curers who were office bearers in one organisation showed medium adoption gap. There was no fish curer who was office bearer in more than one organisation or having distinctive features. There was nobody in low adoption gap category.

The results generally showed that as the extent of social participation increased the adoption gap reduced. Therefore by increasing facilities for social participation, the adoption gap can be reduced.

Table 39. Adoption gap in relation to social participation in Tuticorin region

(N-40)

Social participation	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
No membership in any organisation	8	0	0.00	0	0.00	8	100.00
Membership in one organisation	20	0	0.00	0	0.00	20	100.00
Membership in more than one organisation	7	0	0.00	0	0.00	7	100.00
Office bearer in one organisation	5	0	0.00	5	100.00	0	0.00
Office bearer in more than one organisation	0	0	0.00	0	0.00	0	0.00
Distinctive features	0	0	0.00	0	0.00	0	0.00

4.5.5. Adoption gap in relation to the contact with extension agency:

Table 40 shows the adoption gap among fish curers in Calicut region in relation to their contact with extension agency. Fish curers with weekly and fortnightly contact with extension agency showed medium adoption gap. Among the fish curers having monthly contact, 27.7% showed medium adoption gap and 72.3% showed high adoption gap. Medium adoption gap was observed in 28.6% and high adoption gap in 71.4% of the fish curers having extension contact once in two months. All fish curers with extension contact once in three months and once in 6 months showed high adoption gap.

Table 41 reveals the trend of adoption gap in Malpe. All the fish curers with weekly and fortnightly contact showed medium adoption gap. Among fish curers with monthly contact with extension agency, 35.7% showed medium adoption gap and 64.3% recorded high adoption gap. In the case of fish curers with extension contact once in two months, 30% showed medium adoption gap and 70% showed high adoption gap. All the respondents with extension contact once in three months and 6 months showed high adoption gap.

Table 40. Adoption gap in relation to contact with extension agency in Calicut region

(N-140)

Contact with extension agency	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Weekly	6	0	0.00	6	100.00	0	0.00
Fortnightly	8	0	0.00	8	100.00	0	0.00
Monthly	18	0	0.00	5	27.70	13	72.30
Once in 2 months	14	0	0.00	4	28.60	10	71.40
Once in 3 months	51	0	0.00	0	0.00	51	100.00
Once in 6 months	43	0	0.00	0	0.00	43	100.00
Never	0	0	0.00	0	0.00	0	0.00

Table 41. Adoption gap in relation to contact with extension agency in Malpe region

(N-125)

Contact with extension agency	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Weekly	2	0	0.00	2	100.00	0	0.00
Fortnightly	4	0	0.00	4	100.00	0	0.00
Monthly	14	0	0.00	5	35.70	9	64.30
Once in 2 months	10	0	0.00	3	30.00	7	70.00
Once in 3 months	55	0	0.00	0	0.00	55	100.00
Once in 6 months	40	0	0.00	0	0.00	40	100.00
Never	0	0	0.00	0	0.00	0	0.00

Table 42 reveals the trend in Tuticorin. All the fish curers with weekly and monthly contact with extension agency showed medium adoption gap. High adoption gap was observed in all the fish curers having extension contact at the intervals of one month, two months, three months and 6 months.

Table 42. Adoption gap in relation to contact with extension agency in Tuticorin region

(N=40)

Contact with extension agency	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Weekly	2	0	0.00	2	100.00	0	0.00
Fortnightly	3	0	0.00	3	100.00	0	0.00
Monthly	5	0	0.00	0	0.00	5	100.00
Once in 2 months	6	0	0.00	0	0.00	6	100.00
Once in 3 months	10	0	0.00	0	0.00	10	100.00
once in 6 months	14	0	0.00	0	0.00	14	100.00
Never	0	0	0.00	0	0.00	0	0.00

The observation generally showed that adoption gap decreased when the contact with extension agency increased.

This situation demands more extension contact with the fish curers for higher rate of adoption of improved fish curing practices.

4.5.6. Adoption gap in relation to profitability:

Table 43 depicts the adoption gap in relation to the profitability of the improved fish curing technology as perceived by the fish curers in Calicut region. Among the fish curers who perceived improved fish curing technology as most profitable, 87.5% showed medium adoption gap and 12.5% revealed high adoption gap. However, all fish curers with the perception as very profitable, showed medium adoption gap. In the case of fish curers who perceived improved fish curing practices as profitable, 17.6% recorded medium adoption gap and 82.4% revealed high adoption gap. Medium adoption gap was noticed in 5.5% and high adoption gap in 94.5% of the fish curers who perceived improved fish curing practices as marginally profitable. All the respondents who perceived the practices as either least profitable or not profitable showed high adoption gap.

Table 44 shows the adoption gap in relation to profitability of the technology in Malpe region. All the fish curers who perceived improved fish curing technology as most profitable showed medium adoption gap.

Table 43. Adoption gap in relation to profitability in Calicut region

(N-140)

Category	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Most profitable	8	0	0.00	7	87.50	1	12.50
Very profitable	10	0	0.00	10	100.00	0	0.00
Profitable	17	0	0.00	3	17.60	14	82.40
Marginally profitable	36	0	0.00	2	5.50	34	94.50
Least profitable	51	0	0.00	0	0.00	51	100.00
Not profitable	18	0	0.00	0	0.00	18	100.00

Among fish curers who perceived fish curing technology as very profitable, 85.7% showed medium adoption gap and 14.3% recorded high adoption gap. With a perception as profitable, 28.6% fish curers had medium adoption gap and 71.4%, had high adoption gap. Among those with the perception as marginally profitable, 5% showed medium adoption gap and 95% recorded high adoption gap. All the respondents with the perception as least profitable and not profitable showed high adoption gap.

Table 44. Adoption gap in relation to profitability in Malpe region

(N-125)

Category	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Most profitable	4	0	0.00	4	100.00	0	0.00
Very profitable	7	0	0.00	6	85.70	1	14.30
Profitable	7	0	0.00	2	28.60	5	71.40
Marginally profitable	20	0	0.00	1	5.00	19	95.00
Least profitable	34	0	0.00	0	0.00	34	100.00
Not profitable	53	0	0.00	0	0.00	53	100.00

Table 45 presents the data in Tuticorin region. All the fish curers with the perception as most profitable and very profitable showed medium adoption gap. All the respondents with the perception of fish curing technology as profitable, marginally profitable, least profitable and not profitable showed high adoption gap.

Table 45. Adoption gap in relation to profitability in Tuticorin region

(N-40)

Category	Total Number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Most profitable	4	0	0.00	4	100.00	0	0.00
Very profitable	1	0	0.00	1	100.00	0	0.00
Profitable	2	0	0.00	0	0.00	2	100.00
Marginally profitable	12	0	0.00	0	0.00	12	100.00
Least profitable	12	0	0.00	0	0.00	12	100.00
Not profitable	9	0	0.00	0	0.00	9	100.00

It was generally seen in all the regions that adoption gap decreased when the fish curers had higher degree of perception of profitability. Considerable amount of extension work is required to be carried out to convince the fish curers about the profitability of the improved fish curing practices.

Adoption has been found to be positively correlated with the education, social participation, contact with extension agency, perception of profitability of the technology and income. The fish curers in the regions having these variables at a higher rate showed less adoption gap.

The lower knowledge gap and adoption gap in Calicut region may partly be attributed to the facts that this region comes under Calicut city with extensive educational facilities. A central research organisation pertaining to fish curing is also located in this region which has also helped the fish curers increase their knowledge and adoption rate.

4.5.7. Adoption gap in relation to income:

Table 46 shows the adoption gap of fish curers in Calicut region in relation to their income. All those who had annual income up to Rs.5500/-showed high adoption gap. Among fish curers with the annual income from Rs.5500/- to Rs.7000/-, 8.8% showed medium adoption gap and 91.2% showed high adoption gap. Regarding the fish curers in the income group of Rs.7000/- to Rs.8500/-, 25% showed medium adoption gap and 75% showed high adoption gap. All the fish curers with annual income of Rs.8500/- and above showed medium adoption gap.

Table 46. <u>Adoption gap in relation to income in Calicut region</u>

(N-140)

Annual income	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Up to Rs.4000/-	36	0	0.00	0	0.00	36	100.00
From Rs.4000/- to Rs.5500/-	36	0	0.00	0	0.00	36	100.00
Rs.5500/- to Rs.7000/-	34	0	0.00	3	8.80	31	91.20
Rs.7000/- to Rs.8500/-	16	0	0.00	4	25.00	12	75.00
Rs.8500/- to Rs.10,000/-	8	0	0.00	8	100.00	0	0.00
Above Rs.10,000/-	10	0	0.00	10	100.00	0	0.00

Table 47 reveals the position of adoption gap in Malpe region on the basis of the income of fish curers. All the respondents with annual income up to Rs.5500/- showed high adoption gap. In the case of fish curers with annual income range of Rs.5500/- to Rs.7000/-, 29.4% showed medium adoption gap and 70.6% recorded high adoption gap. Similarly 25% of the fish curers with annual income range of Rs.7000/- and Rs.8500/- showed medium adoption gap and 75% showed high adoption gap. All the respondents with annual income of Rs.8500/- and above showed medium adoption gap.

Table 47. Adoption gap in relation to income in Malpe region

(N-125)

Annual income	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Up to Rs.4000/-	70	0	0.00	0	0.00	70	100.00
Rs.4000/- to Rs.5500/-	24	0	0.00	0	0.00	24	100.00
Rs.5500/- to Rs.7000/-	17	0	0.00	5	29.40	12	70.60
Rs.7000/- to Rs.8500/-	8	0	0.00	2	25.00	6	75.00
Rs.8500/- to Rs.10,000/-	1	0	0.00	1	100.00	0	0.00
Above Rs.10,000/-	5	0.00		5	100.00	0	0.00

The picture in Tuticorin region is presented in Table 48. Fish curers with annual income up to Rs.7000/- showed high adoption gap and those with annual income of Rs.8500/- and above showed medium adoption gap.

Table 48. Adoption gap in relation to income in Tuticorin region

(N-40)

Annual income	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Up to Rs.4000/-	14	0	0.00	0	0.00	14	100.00
Rs.4000/- to Rs.5500/-	17	0	0.00	0	0.00	17	100.00
Rs.5500/- to Rs.7000/-	4	0	0.00	0	0.00	4	100.00
Rs.7000/- to Rs.8500/-	0	0.	0.00	0	0.00	0	0.00
Rs.8500/- to Rs.10,000/-	1	0.	0.00	i	100.00	0	0.00
Above Rs.10,000/-	4	0	0.00	4	100.00	0	0.00

In general, it could be concluded that when the income increased the adoption gap was reduced. When income was more, fish curers might have been able to invest more money required for the adoption of improved fish curing technology.

4.5.8. Adoption gap in relation to debt:

This is described in Table 49 for the fish curers in Calicut. Among the respondents who had no debt, 34.9% recorded medium adoption gap and 65.1% showed high adoption gap. Among those having up to Rs.250/- as debt, 5.9% showed medium adoption gap and 94.1% showed high adoption gap. Cent percent high adoption gap was seen among the respondents with a debt of Rs.250/- to Rs.500/-. Among the fish curers with debt of Rs.500/- to Rs.750/-, 10% showed medium adoption gap and 90% showed high adoption gap. Respondents with debt of Rs.750/- and above showed high adoption gap in this region.

Table 49. Adoption gap in relation to debt in Calicut region

(N-140)

Debt	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
No debt	63	0	0.00	22	34.90	41	65.10
Up to Rs.250/-	17	0	0.00	1	5.90	16	94.10
Rs.250/- to Rs.500/-	27	0	0.00	0	0.00	27	100.00
Rs.500/- to Rs.750/-	20	0	0.00	2	10.00	18	90.00
Rs.750/- to Rs.1000/-	12	0	0.00	0	0.00	12	100.00
Rs.1000/- to Rs.1500/-	1	0	0.00	0	0.00	1	100.00
Above Rs.1500/-	0	0	0.00	0	0.00	0	0.00

Table 50 shows the results in Malpe region. Among respondents who were free from debt, 52.1% showed medium adoption gap and 47.9% showed high adoption gap. All the fish curers with debt up to Rs.250/- showed high adoption gap. In the case of fish curers with debt of Rs.250/- to Rs.500/-, 16.7% indicated medium adoption gap and 83.3% showed high adoption gap. All the respondents having debt above Rs.500/- showed high adoption gap.

Table 50. Adoption gap in relation to debt in Malpe region

(N-125)

Debt	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
No debt	23	0	0.00	12	52.10	11	47.90
Up to Rs.250/-	4	0	0.00	0	0.00	4	100.00
Rs.250/- to Rs.500/-	36	0	0.00	6	16.70	30	83.30
Rs.500/- to Rs.750/-	43	0	0.00	0	0.00	43	100.00
Rs.750/- to Rs.1000/-	19	0	0.00	0	0.00	19	100.00
Rs.1000 to Rs.1500/-	0	0	0.00	0	0.00	0	0.00
Above Rs.1500/-	0	0	0.00	0	0.00	0	0.00

Table 51 explains the position in Tuticorin. All the fish curers with no debt showed medium adoption gap. All others with different ranges of debt showed high adoption gap.

Table 51. Adoption gap in relation to debt in Tuticorin region

(N-40)

Debt	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
No debt	5	0	0.00	5	100.00	0	0.00
Up to Rs.250/-	2	0	0.00	0	0.00	2	100.00
Rs.250/- to Rs.500/-	6	0	0.00	0	0.00	6	100.00
Rs.500/- to Rs.750/-	11	0	0.00	0	0.00	11	100.00
Rs.750/- to Rs.1000/-	12	0	0.00	0	0.00	12	100.00
Rs.1000/- to Rs.1500/-	4	0	0.00	0	0.00	4	100.00
Above Rs.1500/-	0	0	0.00	0	0.00	0	0.00

The picture generally shows the high adoption gap of the fish curers in all the centres. One of the reasons for high adoption gap could be attributed to the debt of the fish curers because adoption of improved technology normally calls for better financial situation.

4.5.9. Adoption gap in relation to knowledge gap:

Table 52 shows the adoption gap of fish curers in Calicut region in relation to their knowledge gap. Eighty five percent of the fish curers under low knowledge gap group showed medium adoption gap and 15% showed high adoption gap. In the case of fish curers under medium knowledge gap, 16.7% showed medium adoption gap while 83.3% recorded high adoption gap. In the case of respondents under high knowledge gap, 6.6% showed medium adoption gap while 93.4% showed high adoption gap. There was no fish curer in low adoption gap in any category.

Table 52. Adoption gap in relation to knowledge gap in Calicut region

(N-140)

Knowledge gap	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Low	13	0	0.00	11	85.00	2	15.00
Medium	36	0	0.00	6	16.70	30	83.30
High	91	0	0.00	6	6.60	85	93.40

Table 53 shows the trend of adoption gap in relation to knowledge gap of fish curers at Malpe. Among fish curers under low knowledge gap, 80% showed medium adoption gap and 20% showed high adoption gap. In the case of fish curers under medium knowledge gap, 28.6% showed medium adoption gap while 71.4% recorded high adoption gap. High adoption gap was observed among 97.8% of the fish curers under high knowledge gap while only 2.2% fish curers under this category showed medium adoption gap.

Table 53. Adoption gap in relation to knowledge gap in Malpe region

(N-125)

Knowledge gap	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Low	5	0	0.00	4	80.00	1	20.00
Medium	28	0	0.00	8	28.60	20	71.40
High	92	0	0.00	2	2.20	90	97.80

Table 54 shows the adoption gap in Tuticorin. There was no fish curer with low knowledge gap at this centre. Among those under medium knowledge gap, 38.5% showed medium adoption gap and 61.5% showed high adoption gap. All the fish curers under high knowledge gap showed high adoption gap.

Tabie 54. Adoption gap in relation to knowledge gap in Tuticorin region

(N-40)

Knowledge gap	Total number	Adoption gap					
		Low		Medium		High	
		No.	%	No.	%	No.	%
Low	0	0	0.00	0	0.00	0	0.00
Medium	13	0	0.00	5	38.50	8	61.50
High	27	0	0.00	0	0.00	27	100.00

The more facilities available at Calicut region compared to the other two regions for education, social participation, higher income and contact with extension agency for technical consultation, demonstration etc. helped the fish curers in Calicut region to acquire more knowledge and skill in the improved fish curing practices leading to higher rate of adoption. Thus the knowledge gap and so the adoption gap in Calicut region are at a lower level compared to Malpe and Tuticorin regions.

Observations in all the three regions showed that when knowledge gap increased adoption gap also increased. It was inferred that adoption of improved technology in fish curing could be increased by reducing the knowledge gap. Knowledge gap could be reduced by more educational efforts to increase the knowledge of fish curers about the improved fish curing practices.

4.6. Summary pattern of knowledge gap and adoption gap among fish curers

4.6.1. Calicut:

Table 55 shows the summary pattern of knowledge gap and adoption gap in Calicut region. Among six major practices, low knowledge gap with respect to drying of salted fish was observed in maximum (23.57%) number of fish curers while the low knowledge gap with respect to construction of improved shed was noted in minimum (8.57%) number. Medium knowledge gap with respect to drying of salted fish was possessed by maximum (68.57%) number of fish curers as against a minimum (14.29%) with respect to the practice on packing and storage of cured fish. High knowledge gap was noted in maximum number (75.71%) with respect to packing and storage of cured fish while minimum (7.86%) with respect to drying of salted fish.

Table 55. Summary pattern of knowledge gap and adoption gap among fish curers in Calicut region

(N-140)

Major Practices	Number of fish curers in different knowledge gap categories						Number of fish curers in different adoption gap categories					
	Low		Medium		High		Low		Medium		High	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1. Construction of improved shed	12	8.57	37	26.43	91	65.00	0	0.00	22	15.71	118	84.29
2. Hygiene in shed	19	13.57	48	34.30	73	52.14	11	7.86	14	10.00	115	82.14
3. Handling of fish	19	13.57	24	17.14	97	69.29	12	8.57	14	10.00	114	81.43
4. Salting of fish	15	10.71	44	31.43	81	57.86	0	0.00	45	32.14	95	67.86
5. Drying of salted fish	33	23.57	96	68.57	11	7.86	0	0.00	65	46.43	75	53.57
6. Packing and storage of cured fish	14	10.00	20	14.29	106	75.71	0	0.00	0	0.00	140	100.00

Fish curers possessed low adoption gap only with respect to cleaning and maintenance of hygiene (7.86%) and handling and pre-processing of fresh fish (8.57%). Medium adoption gap was possessed by maximum fish curers (46.43%) with respect to drying of salted fish and nobody with respect to packing and storage of cured fish. High adoption gap was noted maximum (100%) with respect to packing and storage and minimum (53.57%) with respect to drying of salted fish.

Chi-square value of knowledge gap is calculated as 174.88 with degrees of freedom 10 significant at 1% level. The knowledge gap is not independent of practices. The calculated value of chi-square is 200.74 for adoption gap with degrees of freedom 10 significant at 1% level. Adoption gap also is not independent of practices.

The picture generally shows that adoption gap with respect to packing and storage of cured fish is maximum (cent percent) while the gap with respect to salting and drying of fish is minimum in the range 53.57% to 67.88%. Therefore during extension programmes more emphasis has to be given on packing and storage of cured fish.

4.6.2. Malpe:

Table 56 presents the data on the summary pattern of knowledge gap and adoption gap in Malpe region. Low

Table 56. Summary pattern of knowledge gap and adoption gap among fish curers in Malpe region

(N-125)

Major practices	Number of fish curers in different knowledge gap categories						Number of fish curers in different adoption gap categories					
	Low		Medium		High		Low		Medium		High	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1. Construction of improved shed	0	0.00	33	26.40	92	73.60	0	0.00	0	0.00	125	100.00
2. Hygiene in shed	6	4.80	24	19.20	95	76.00	4	3.20	7	5.60	114	91.20
3. Handling of fish	10	8.00	23	18.40	92	73.60	7	5.60	18	14.40	110	88.00
4. Salting of fish	0	0.00	33	26.40	92	73.60	0	0.00	30	24.00	95	76.00
5. Drying of salted fish	25	20.00	26	20.80	74	59.20	0	0.00	42	33.60	83	66.40
6. Packing and storage of cured fish	0	0.00	33	26.40	92	73.60	0	0.00	3	2.40	122	97.60

knowledge gap with respect to drying of salted fish was observed in maximum number (20%) while nobody possessed low knowledge gap with respect to contruction of improved curing shed, salting of fish and packing and storage of cured fish. Fish curers possessing medium knowledge gap with respect to all the practices were within the range of 19.2% to 26.4%. High knowledge gap with respect to all the practices except drying of salted fish was noticed in 73.6 to 76% of the fish curers while that for drying of salted fish was observed in 59.2%.

Low adoption gap with respect to maintenance of hygiene and handling and pre-processing of fish was noticed in 3.2% to 5.6% of the fish curers while low adoption gap with respect to other practices was not observed in any party. Medium adoption gap was found maximum (33.6%) with respect to drying of salted fish while it was nil with respect to construction of improved fish curing shed. High adoption gap with respect to maintenance of hygiene, packing and storage of cured fish and construction of improved fish curing sheds was noticed in the respondents in the range of 91.2% to 100%.

The chi-square value of knowledge gap is 60.68 with degrees of freedom 10 significant at 1% level. Knowledge gap is not independent of practices. Chi-square value of adoption gap is calculated as 115.30 with degrees of freedom 10 significant at 1% level. Adoption gap also is not independent of practices.

The data generally show that practices on packing and storage of cured fish and construction of improved fish curing shed are having maximum adoption gap (97.6 to 100%) and drying of salted fish having minimum gap (66.4%). Here also emphasis should be given in extension work to educate people on construction of the improved shed and packing and storage of cured fish.

4.6.3. Tuticorin:

Table 57 shows the summary pattern of knowledge gap and adoption gap at Tuticorin. Nobody showed low knowledge gap with respect to the practices on salting of fish and packing and storage of cured fish. Maximum number (17.5%) of fish curers under low knowledge gap was with respect to drying of salted fish. Medium knowledge gap with respect to all the practices was shown by 27.5 to 30% of the fish curers. High knowledge gap with respect to salting of fish and packing and storage of fish was observed in 72.5% of the fish curers while only 55% showed high knowledge gap with respect to drying of salted fish.

Table 57. Summary pattern of knowledge gap and adoption gap among fish curers in Tuticorin region

(N-40)

Major practices	Number of fish curers in different knowledge gap categories						Number of fish curers in different adoption gap categories					
	Low		Medium		High		Low		Medium		High	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
1. Construction of improved shed	3	7.50	11	27.50	26	65.00	0	0.00	5	12.50	35	87.50
2. Hygiene in shed	2	5.00	12	30.00	26	65.00	0	0.00	3	7.50	37	92.50
3. Handling of fish	1	2.50	12	30.00	27	67.50	0	0.00	2	5.00	38	95.00
4. Salting of fish	0	0.00	11	27.50	29	72.50	0	0.00	6	15.00	34	85.00
5. Drying of salted fish	7	17.50	11	27.50	22	55.00	0	0.00	5	12.50	35	87.50
6. Packing and storage of cured fish	0	0.00	11	27.50	29	72.50	0	0.00	0	0.00	40	100.00

Nobody showed low adoption gap in this centre. Medium adoption gap with respect to packing and storage of cured fish also was not observed in any fish curer. Medium gap with respect to other practices was noticed in 5 to 15% of the fish curers.

High adoption gap with respect to packing and storage of cured fish was shown by cent percent fish curers while the adoption gap with respect to other practices varied from 85 to 95% of the fish curers.

The calculated value of chi-square for knowledge gap is 17.22 with degrees of freedom 10 which is not significant. Knowledge gap is independent of practices. Regarding adoption gap, chi-square value is 7.98 with degrees of freedom 5 which is not significant. Adoption gap is independent of practices. Comparing the observations of all the three regions, adoption gap on packing and storage of cured fish was maximum in all regions. This is particularly because the improved packing materials are costly and it was perceived by the fish curers that the selling price of cured fish in improved packing materials may not compensate the higher investment for such packing. Cured fish is usually sold out within two weeks after drying. No spoilage symptoms are observed within this short period. Therefore fish curers do not want to invest for elaborate arrangements for preservative treatment or storage.

Construction of improved fish curing sheds is very costly. Here also fish curers do not expect a proportionally higher price for the cured fish prepared in improved fish curing sheds. Moreover, fish curers are all financially poor. They cannot afford to invest heavily for improved fish curing yard. Loan and subsidy facilities are also not available from developmental agencies.as reported by the fish curers in all the regions.

4.7. Knowledge level of extension workers

4.7.1. Construction of improved fish curing shed:

Table 58 presents the data on knowledge level of extension workers in the construction of improved fish curing shed. Full knowledge on construction of shed was possessed by 32% of the extension workers while 68% showed only partial knowledge on this aspect. Thirty two percent of the extension workers had full knowledge on provision of drainage facilities while 48% showed partial knowledge and 20% having no knowledge. Full knowledge on provision of tables/platforms was observed in 32% of the extension workers while 68% showed partial knowledge.

Table 58. Knowledge level of extension workers

1. Construction of improved fish curing shed

(N-25)

Sl. No.	Practices	Knowledge level	Number	%
1.	Construction of shed	F	8	32.00
		P	17	68.00
		N	0	0.00
2.	Provision of drainage facilities	F	8	32.00
		P	12	48.00
		N	5	20.00
3.	Provision of tables/platforms	F	8	32.00
		P	17	68.00
		N	0	0.00

F = full knowledge; P = partial knowledge; N = no knowledge

The chi-square value is 10.90 with degree of freedom 4 significant at 5% level. Knowledge level of extension workers on this practice is not independent of practices.

The above data show an interesting point that most of the extension workers have only partial knowledge on the construction of improved fish curing shed.

4.7.2. Cleaning and maintenance of hygiene:

Table 59 shows the knowledge of extension workers in the cleaning and maintenance of hygiene in fish curing shed. Thirty two percent of the extension workers had full knowledge and 68% had partial knowledge on use of potable water and detergents and disinfectants in the curing shed. Twenty percent had full knowledge, 48% had partial knowledge and 32% had no knowledge on adoption of cleaning schedule in the fish curing shed. Regarding regular washing of mat, 76% of the extension workers had full knowledge and 24% had partial knowledge.

The chi-square value is calculated as 41.71 with degrees of freedom 6 significant at 1% level. The knowledge level of extension workers in this practice is not independent of practices.

Table 59. Knowledge level of extension workers

2. Cleaning and maintenance of hygiene in fish curing shed

(N-25)

Sl. No.	Practices	Knowledge level	Number	%
1.	Use of potable water in the shed	F	8	32.00
		P	17	68.00
		N	0	0.00
2.	Use of detergents and disinfectants in the shed	F	8	32.00
		P	17	68.00
		N	0	0.00
3.	Adoption of cleaning shedule in the shed	F	5	20.00
		P	12	48.00
		N	8	32.00
4.	Regular washing of mat used for drying fish	F	19	76.00
		P	6	24.00
		N	0	0.00

F = full knowledge; P = partial knowledge; N = no knowledge

The picture generally shows that most of extension workers had only partial knowledge on the cleaning and maintenance of hygiene in fish curing sheds. Some of them did not have any knowledge on some practices.

4.7.3. Handling and pre-processing of fresh fish:

Table 60 shows the knowledge level of extension workers on handling and pre-processing of fresh fish. All the officials had full knowledge on using fresh fish. Seventy two percent showed full and 28% had partial knowledge on proper washing of fresh fish. Thirty six percent had full, 44% had partial and 20% had no knowledge on proper dressing and evisceration of fish. Full knowledge on proper washing of gutted fish was observed in 24% and partial knowledge in 76%. Twenty eight percent of the extension workers possessed full knowledge and 72% had partial knowledge on the use of ice for preserving fresh fish.

The chi-square value is calculated as 55.77 with degrees of freedom 8 significant at 1% level. Knowledge of this major practice is not independent of the practices.

While full knowledge was possessed by most of the extension workers on the use of fresh fish and its

Table 60. Knowledge level of extension workers

3. Handling and pre-processing of fresh fish

(N-25)

Sl. No.	Practices	Knowledge level	Number	%
1.	Use of fresh fish	F	25	100.00
		P	0	0.00
		N	0	0.00
2.	Proper washing of fresh fish	F	18	72.00
		P	7	28.00
		N	0	0.00
3.	Proper dressing and evisceration of fresh fish	F	9	36.00
		P	11	44.00
		N	5	20.00
4.	Proper washing of gutted fish	F	6	24.00
		P	19	76.00
		N	0	0.00
5.	Use of ice for preserving fresh fish	F	7	28.00
		P	18	72.00
		N	0	0.00

F = full knowledge; P = partial knowledge; N = no knowledge

proper washing, their knowledge on other aspects of handling and pre-processing of fish was either partial or nil. This is a serious point to be considered. When the knowledge of extension workers is poor, naturally technology transfer will not be effective.

4.7.4. Salting of fish:

Table 61 presents the knowledge level of extension workers in salting of fish. Only 20% possessed full knowledge on the use of sufficient salt while 48% had partial and 32% had no knowledge on this practice. Full knowledge on salting of fish in cement tanks or other suitable containers was observed in 28% of the extension workers. Fifty six percent had partial knowledge and 16% had no knowledge on the various aspects of this practice. Only 16% showed full knowledge, 48% showed partial knowledge and 36% possessed no knowledge on the importance of giving sufficient salting period. Need for covering the salted fish to avoid flies was fully known by 16%, partially known by 56% and not known by 28% of the extension workers. Similarly knowledge on rinsing salted fish in freshly prepared salt water was full, partial and nil in the case of 16%, 44% and 40% respectively of the extension workers. Technique of

Table 61. Knowledge level of extension workers

4. Salting of fish

(N-25)

Sl. No.	Practices	Knowledge level	Number	%
1.	Use of sufficient salt	F	5	20.00
		P	12	48.00
		N	8	32.00
2.	Salting in cement tanks or other suitable containers	F	7	28.00
		P	14	56.00
		N	4	16.00
3.	Sufficient salting period	F	4	16.00
		P	12	48.00
		N	9	36.00
4.	Covering of salted fish to avoid flies	F	4	16.00
		P	14	56.00
		N	7	28.00
5.	Rinsing of salted fish in freshly prepared salt water	F	4	16.00
		P	11	44.00
		N	10	40.00
6.	Removal of urea from shark by desalting	F	0	0
		P	12	48
		N	13	52
7.	Removal of self-brine and addition of saturated brine in the case of pickling	F	4	16.00
		P	12	48.00
		N	9	36.00
8.	Covering of fish with sufficient brine in the case of pickling	F	4	16.00
		P	8	32.00
		N	13	52.00

F = full knowledge; P = partial knowledge; N = no knowledge

removal of urea from shark flesh was known fully by nobody, partially by 48% and not known by 52% of the extension workers. Sixteen percent knew fully on the importance of removing self-brine and addition of saturated brine in pickling of fish while the knowledge on this practice was partial in 48% and nil in 36% of the extension workers. Full knowledge on the necessity of covering fish with saturated brine during pickling was possessed by 16%, partial knowledge was shown by 32% and no knowledge was observed in 52%.

In this major practice also, the knowledge of extension workers was not satisfactory. Only a minor part possessed full knowledge. In some aspects, large number of extension workers possessed no knowledge at all.

The chi-square value is calculated as 16.40 with degrees of freedom 14 which is not significant. Salting of fish is independent of the fish curing practices.

4.7.5. Drying of salted fish:

Table 62 presents the trend of knowledge of extension workers on drying of salted fish. Necessity of drying fish for sufficient period was fully understood by 32%, partially known by 48% and not known by 20%

removal of urea from shark flesh was known fully by nobody, partially by 48% and not known by 52% of the extension workers. Sixteen percent knew fully on the importance of removing self-brine and addition of saturated brine in pickling of fish while the knowledge on this practice was partial in 48% and nil in 36% of the extension workers. Full knowledge on the necessity of covering fish with saturated brine during pickling was possessed by 16%, partial knowledge was shown by 32% and no knowledge was observed in 52%.

In this major practice also, the knowledge of extension workers was not satisfactory. Only a minor part possessed full knowledge. In some aspects, large number of extension workers possessed no knowledge at all.

The chi-square value is calculated as 16.40 with degrees of freedom 14 which is not significant. Salting of fish is independent of the fish curing practices.

4.7.5. Drying of salted fish:

Table 62 presents the trend of knowledge of extension workers on drying of salted fish. Necessity of drying fish for sufficient period was fully understood by 32%, partially known by 48% and not known by 20%

Table 62. Knowledge level of extension workers

5. Drying of salted fish

(N-25)

Sl. No.	Practices	Knowledge level	Number	%
1.	Sufficient drying of fish	F	8	32.00
		P	12	48.00
		N	5	20.00
2.	Drying of fish on mat	F	25	100.00
		P	0	0.00
		N	0	0.00
3.	Drying of fish on raised platform	F	8	32.00
		P	9	36.00
		N	8	32.00
4.	Drying of fish in tunnel dryer	F	8	32.00
		P	11	44.00
		N	6	24.00

F = full knowledge; P = partial knowledge; N = no knowledge

of the extension workers. Importance of use of mat for drying fish was known fully to all the extension workers. But their knowledge on drying fish on raised platform or in tunnel dryer was full only in the case of 32%, partial in 36 to 44% and nil in the case of 24 to 32%.

The calculated value of chi-square is 36.11 with degree of freedom 6 significant at 1% level. This technique is not independent of the fish curing practices.

The picture generally shows that the extension workers had no sufficient knowledge on various aspects of drying fish.

4.7.6. Packing and storage of fish:

Table 63 reveals the knowledge level of extension workers in packing and storage of cured fish. Full knowledge on chemical preservation of cured fish was possessed by 16%, partial knowledge by 52% and 32% had no knowledge about this aspect. Only 36% knew fully about retail packing of cured fish in polythene bags, while 36% knew partially and 32% knew nothing. Full knowledge on bulk packing was possessed by 16%, partial knowledge by 56% and no knowledge by 28% of the extension workers. Knowledge on proper storage of cured fish was

Table 63. Knowledge level of extension workers

6. Packing and storage of cured fish

(N-25)

Sl. No.	Practices	Knowledge level	Number	%
1.	Chemical treatment of cured fish	F	4	16.00
		P	13	52.00
		N	8	32.00
2.	Retail packing of cured fish in polythene bags	F	8	32.00
		P	9	36.00
		N	8	32.00
3.	Bulk packing of cured fish in improved containers	F	4	16.00
		P	14	56.00
		N	7	28.00
4.	Proper storage of cured fish	F	4	16.00
		P	10	40.00
		N	11	44.00

F = full knowledge; P = partial knowledge; N = no knowledge

fully possessed by 16%, partially by 40% and not possessed by 44%. Here also the data show the poor knowledge of the extension workers on packing and storage of cured fish.

The chi-square value is calculated as 4.52 with degrees of freedom 6 which is not significant. This technique is independent of the fish curing practices.

It is seen clearly from the above tables that only about 1/3rd of the extension workers had full knowledge about the improved fish curing technology. More than 1/5th of them had no knowledge about this. One of the reasons for this lack of knowledge on the part of the extension workers was that they were not directly put in charge of the development of fish curing. This work was given least priority by the Department. The State Fisheries Officials were mainly entrusted with the job of assistance on fish farming, supply of inputs and recovery of loans in connection with fishing. Moreover these extension workers were not given training in the improved practices of fish curing technology. Development of fish curing has yet to be taken seriously by the State Fisheries Departments and Agricultural Universities.

4.8. Reasons for partial adoption or non-adoption of improved practices in fish curing as perceived by the fish curers

Ten major reasons as shown in Table 64 were reported by the fish curers for the partial or non-adoption of improved practices in fish curing. All the fish curers in all the centres reported that lack of credit facilities, subsidy and incentives adversely affected the adoption of improved practices. Lack of organised set up for marketing cured fish was perceived as another reason by 85.71% of the fish curers in Calicut region, 76% in Malpe region and 80% of the fish curers in Tuticorin region. While 72.86% of the respondents in Calicut noted lack of ownership of the land as a retarding factor in the adoption of improved practices, the same was perceived by all the respondents in Malpe and by 75% in Tuticorin. According to 78.57% of the curers in Calicut, 96% in Malpe and 87.5% in Tuticorin, lack of input supply caused the partial or non-adoption of improved practices. High cost of equipments, utensils etc. was still another reason suggested by 67.86% of the respondents in Calicut region, cent percent in Malpe and 80% in Tuticorin region. In Calicut, 92.86% of the fish curers

Table 64. Reasons for partial or non-adoption of improved practices in fish curing as perceived by the fish curers

Sl. No.	Reasons	Calicut (N-140)		Malpe (N-125)		Tuticorin (N-40)	
		No.	%	No.	%	No.	%
1.	Lack of credit facilities	140	100.00	125	100.00	40	100.00
2.	Lack of subsidy, incentives etc.	140	100.00	125	100.00	40	100.00
3.	Lack of organised set up for marketing cured fish	120	85.71	95	76.00	32	80.00
4.	Lack of ownership of the land where fish curing shed has been built	102	72.86	125	100.00	30	75.00
5.	Lack of input supply	110	78.57	120	96.00	35	87.50
6.	High cost of equipments, utensils etc.	95	67.86	125	100.00	32	80.00
7.	High labour charge	130	92.86	102	81.60	31	77.50
8.	Non-availability of electricity	105	75.00	125	100.00	31	77.50
9.	Non-availability of potable water	122	87.14	125	100.00	35	87.50
10.	Inadequate technical assistance	95	67.86	85	68.00	28	70.00

perceived high labour charge as a reason for partial or non-adoption of improved practices while the same view was held by 81.6% in Malpe and 77.5% in Tuticorin. Seventy five percent of the respondents in Calicut, cent percent in Malpe and 77.5% in Tuticorin pointed out non-availability of electricity as a reason for partial or non-adoption. Similarly non-availability of potable water prevented or retarded the adoption of improved fish curing practices as reported by 87.14% of the fish curers in Calicut, cent percent in Malpe and 87.5% respondents in Tuticorin. Inadequate technical assistance was also perceived by 67.86% in Calicut, 68% in Malpe and 70% in Tuticorin as a reason for partial or non-adoption of the new technology.

Even though percentage of fish curers perceiving the above reasons for partial or non-adoption varies from place to place, all these aspects have to be considered as very important because 67.86% to 100% of the fish curers perceived these reasons in all the centres. Steps have to be taken by all the concerned agencies to provide all the facilities for accelerating the rate of adoption of improved practices in fish curing.

4.9. Statistical analysis of the data

To study the effect of each of the independent variables on adoption, data were analysed statistically for the three centres separately. The mean score ($\bar{x}$) and standard deviation (σ) were worked out by using the formulae

$$\bar{x} = \sum \frac{xi}{n} \quad \text{and}$$
$$= \sum \frac{(xi - \bar{x})^2}{n-1}$$

where n is the no. of observations taken in each variable. The mean score gives an indication how far the variable is representing the group of observations and standard deviation gives an indication how much each observation in the group varies from the mean.

$$\text{Coeff. of variation} = \frac{\text{Standard deviation}}{\text{mean}} \times 100$$

The interdependency of each variable with the rest of the variables was studied with the help of Pearsons' Coeft. of correlation. The formulae for Pearsons' Coefft. of correlation is

$$r = \frac{\sum (x-\bar{x})\ (y-\bar{y})}{n\sigma x\ \sigma y}$$

where r = is the coeft. of correlation between x & y

$\bar{x}$ = Mean of x values

$\bar{y}$ = Mean of y values

σx = S.D. of x values

σy = S.D. of values and

n = no. of pairs of values

The significance of the observed coefft. of correlation was tested using the 't' statistic.

$$'t' = \frac{r\sqrt{n-2}}{\sqrt{1-r^2}}$$

The statistic 't' is distributed as a student's 't' with (n-2) degrees of freedom.

To examine how far the variables included in the study are representation of adoption and the contribution of each variable on adoption were studied with the help of linear multiple regression model. The multiple regression model employed for this purpose was

$$y = b_0+b_1x_1+b_2x_2+b_3x_3+b_4x_4+b_5x_5+b_6x_6+b_7x_7$$

where b_1 .... b_7 are regression coefft.

y = adoption

x_1 = age

x_2 = education

x_3 = social participation

x_4 = contact with extension agency

x_5 = perception of profitability of technology

x_6 = income

x_7 = debt

The regression equation connecting the variables, the amount of variability explained by the regression and the standard error of estimate were worked out for each centre with the help of micro 2200 computer. The relative importance of each variable in the multiple regression model was worked out by the method suggested by Snedecor and Cochran (1956). The relative importance of the ith variable is woked out by using the formula.

$$bi \sqrt{\frac{\sum xi^2}{\sum y^2}}$$

where bi is the regression coeft. of the ith variable, $\sum xi^2$ and $\sum y^2$ are sum of squares of deviations from their mean values of xi and y respectively.

4.9.1. Calicut:

The mean score and S.D. of each variable are given in Table 65. The matrix of correlation showing the coeft. of correlation of each variable with the other variables is given in Table 66 along with the fitted regression model, R^2, and the standard error of estimate.

4.9.1.1. Age:

The mean score for this variable is 3.8286 with a S.D. of 1.6091. The coeft. of variation is 42.03%. Since the coeft. of variation is high, it indicates that the respondents in various age groups are not homogeneous. The coeft. of correlation of age with the rest of the variables and adoption are negative and significantly high ($p < 0.001$). This indicates that as age increases, the respondent's education, social participation, contact with extension agency, perception of profitability, income and adoption decrease.

4.9.1.2. Education:

The mean score for education is 2.9429 and S.D. is 1.2278. The coeft. of variation is 41.73%. This shows that the selected group consists of people of different educational levels. Education is found to be significantly positively correlated ($p < 0.001$) with social participation, contact with extension agency, perception of profitability, income and adoption. This clearly indicates that the more educated the respondents are, the more will be the degree of adoption, social participation, contact with extension agency, perception of profitability and income. Education is significantly negatively correlated with debt indicating that as the level of education increases, indebtedness decreases.

4.9.1.3. Social participation:

The mean score for social participation worked out to be 1.4357 with a S.D. of 0.9661. The coeft. of variation is 67.29%, indicating that the respondents' social participation is highly dispersed. Social participation is found to be significantly positively correlated ($p < 0.001$) with contact with extension agency, perception of profitability and adoption indicating that the more social participation is in the group, better will be the contact with extension agency, perception of profitability, income and adoption. Social participation is significantly negatively correlated ($p < 0.001$) with debt. This indicates, that the more social participation among respondents, the less will be the debt.

4.9.1.4. Contact with extension agency:

Contact with extension agency is significantly positively correlated ($p < 0.001$) with income, perception of profitability, education, and social participation indicating that with the increase in the contact with extension agency, there is substantial increase in the income, perception of profitability, level of education, social participation and adoption. Contact with extension agency is significantly negatively correlated with age and debt. The mean score for contact with extension agency is 2.8571 and S.D. is 1.3388. The coeft. of variation is 46.86% indicating that extent of contact with extension agency among the respondents vary widely.

4.9.1.5. Perception of profitability of technology:

The mean score for profitability is 2.8143 with a S.D. of 1.3655. The coeft. of variation of profitability score is 48.52%, indicating wide variability in the profitability of the respondents. Perception of profitability is significantly positively correlated ($p < 0.001$) with education, social participation, contact with extension agency, income and adoption and significantly negatively correlated ($p < 0.001$) with age and debt.

4.9.1.6. Income:

The mean income score is 2.6429 with a S.D. of 1.4695. The coeft. of variation of income score is 55.60% indicating that this variable is highly dispersed among the respondents. Income is significantly positively correlated ($p < 0.001$) with education, social participation, contact with extension agency, perception of profitability and adoption. This indicates that with the increase in income, education, social participation, contact with extension agency, perception of profitability and adoption also increase. Income is significantly negatively correlated with age and debt.

4.9.1.7. Debt:

The mean score for debt is 1.3786 with a S.D. of 1.5569. The coeft. of variation is 112.93% indicating very high variability. It is significantly negatively correlated with all variables except age.

4.9.1.8. Adoption:

The mean score worked out for adoption is 12.4070 with a standard deviation of 8.0358. The coeft. of variation is 64.77% showing a high variability of adoption among respondents. Adoption is significantly positively correlated with education, social participation, contact with extension agency, perception of profitability and income. This indicates that the level of adoption increases with the level of education, social participation, contact with extension agency, perception of profitability and income. Adoption is significantly negatively correlated with debt. indicating that as debt increases, adoption decreases.

The multiple regression equation connecting the extent of adoption (y) with the 7 variables worked out for Calicut region is

$$Y = 3.0594 - 0.8856x_1 - 0.0076x_2 + 1.3506x_3 + 2.2717x_4 + 0.4891x_5 + 1.1873x_6 - 0.1331x_7$$

The coeft. of determination (multiple R^2) worked out to be 0.8610. This indicates that 86.10% of variability in adoption is explained by the seven selected variables jointly. The standard error of estimate is 3.0741 which is well within reasonable limits.

Among the seven variables, the relative importance of each variable worked out was as follows:

Variable	Relative importance
Age	-0.1773
Education	-0.0012
Social participation	+0.1624
Contact with extension agency	+0.3785
Perception of profitability of technology	+0.0831
Income	+0.2171
Debt	-0.0258

On the basis of the relative importance of the variables on adoption, it can be concluded that contact with extension agency followed by income, social participation and perception of profitability are main factors responsible for adoption. Age and debt are having a retarding effect on the level of adoption.

Table 65. Mean score and standard deviation of selected variables on adoption in Calicut region

		Mean	Standard deviation
x_1	- Age	3.8286	1.6091
x_2	- Education	2.9429	1.2278
x_3	- Social participation	1.4357	0.9661
x_4	- Contact with extension agency	2.8571	1.3388
x_5	- Perception of profitability of technology	2.8143	1.3655
x_6	- Income	2.6429	1.4695
x_7	- Debt	1.3786	1.5569
x_8	- Adoption	12.4070	8.0358

Table 66. Matrix of correlation showing the interdependency of different variables selected for the study in Calicut region

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
X_1 - Age	1.0000	-0.7588+++	-0.8201+++	-0.7595+++	-0.6433+++	-0.7085+++	+0.4770+++	-0.8269+++
X_2 - Education		1.0000	0.7524+++	0.7128+++	0.7317+++	0.7702+++	-0.4967+++	0.7636+++
X_3 - Social participation			1.0000	0.7367+++	0.6088+++	0.7285+++	-0.4058+++	0.8016+++
X_4 - Contact with extension agency				1.0000	0.7646+++	0.7711+++	-0.4260+++	0.8714+++
X_5 - Perception of profitability of technology					1.0000	0.7483+++	-0.6040+++	0.8379+++
X_6 - Income						1.0000	-0.4912+++	0.7577+++
X_7 - Debt							1.0000	-0.5075+++
X_8 - Adoption								1.0000

$X_8 = 3.0594 - 0.8856x_1 - 0.0076x_2 + 1.3506x_3 + 2.2717x_4 + 0.4891x_5 + 1.1873x_6 - 0.1331x_7$

$R^2 = 0.8610$, Standard error of the estimate = 3.0741, +++ = significant at 0.1% level

4.9.2 Malpe:

The results of the statistical analysis of the data for this centre are presented in Table 67 and 68. The outcome of the analysis is summarised below.

4.9.2.1. Age:

The mean score for age is 4.1360 and S.D. is 1.4720. The coeft. of variation is 35.59% indicating that the age of the respondents taken for the study is very much dispersed. Age is found to be significantly negatively correlated ($p < 0.001$) with all the other variables except debt. This indicates that as age advances, the level of education, social participation, contact with extension agency, perception of profitability, income and adoption get retarded. Age and debt are significantly positively correlated ($p < 0.001$) indicating that as age advances, debt also increases.

4.9.2.2. Education:

The mean score for this variable is 1.8080 with a standard deviation of 1.5898. The coeft. of variation is 87.93%, indicating that the level of education varies very much among the respondents. Education is significantly positively correlated ($p < 0.001$) with social participation, contact with extension agency, perception of profitability, income and adoption indicating that as the level of education increases better will be social participation, contact with extension agency, perception of profitability, income and adoption. Education is significantly negatively correlated ($p < 0.001$) with debt. This indicates that as the level of education increases, the better will be the income leading to lesser indebtedness.

4.9.2.3. Social participation:

The mean score for social participation is 1.1920 with a S.D. of 0.8491. The coeft. of variation is 71.23% indicating that social participation is highly dispersed among the respondents. This variable is found to be significantly positively correlated ($p < 0.001$) with contact with extension agency, perception of profitability, income and adoption. This indicates that the more the social participation, better will be the contact with extension agency, perception of profitability, income and adoption. Social participation is significantly negatively correlated ($p < 0.001$) with debt. This means that as social participation improves, better will be the contact with people and therefore better adoption rate leading to higher income and less debt.

4.9.2.4. Contact with extension agency:

The mean score of contact with extension agency is 2.5600 and S.D. is 1.0954. The coeft. of variation is 42.79%, which is high indicating that contact with extension agency varies with respondents. This variable is significantly ($p < 0.001$) positively correlated with perception of profitability, income and adoption and negatively correlated with debt. This indicates that as contact with extension agency increases, the perception of profitability, income and adoption also increase and debt decreases.

4.9.2.5. Perception of profitability of technology:

The mean perception of profitability score is 2.1280 with a S.D. of 1.3618. The coeft. of variation of perception of profitability is 63.99% indicating wide variability in the perception of profitability of the respondents. Profitability is significantly positively correlated ($p < 0.001$) with education, social participation, contact with extension agency, income and adoption. Therefore, it follows that higher the perception of profitability, better will be social participation, education, contact with extension agency, income and adoption. Perception of profitability is significantly negatively correlated ($p < 0.001$) with age and debt. As the perception of profitability improves indebtedness decreases.

4.9.2.6. Income:

The mean score for income is 1.8720 with S.D. of 1.2635. The coeft. of variation is 67.49% indicating that the level of income varies among the respondents.

This variable is significantly positively correlated ($p < 0.001$) with education, social participation, contact with extension agency, perception of profitability and adoption. The higher the income, the better is the profitability and thereby better will be the rate of adoption. Income is significantly negatively correlated ($p < 0.001$) with debt.

4.9.2.7. Debt:

The mean score for this variable is 2.2480 with a S.D. of 1.2930. The coeft. of variation is 57.52% indicating that this variable too is a highly dispersed one. Debt is significantly negatively correlated ($p < 0.001$) with education, social participation, contact with extension agency, perception of profitability, income and adoption. It is significantly positively correlated with age, indicating that indebtedness is highly associated with age.

4.9.2.8. Adoption:

The mean score for adoption is 9.4880 with a S.D. of 6.0836. Coeft. of variation of adoption score is 64.12% indicating that rate of adoption varies widely with the respondents. Adoption is significantly positively correlated ($p < 0.001$) with education, social participation, contact with extension agency, perception of profitability and income indicating that they are the positive factors responsible for high levels of adoption. Adoption is significantly negatively correlated ($p < 0.001$) with age and debt. This indicates that as age and debt advance, adoption rate decreases.

The multiple regression equation connecting adoption with the rest of the seven variables, in this centre is

$$Y = 10.6186 - 1.6603x_1 - 0.6392x_2 + 0.5424x_3 + 1.5206x_4 + 1.5777x_5 - 0.0341x_6 - 0.4185x_7$$

The coeft. of determination, the multiple R^2, worked out to be 0.8668. This indicates that 86.68% variability in the adoption is explained by the seven variables already included in the study.

The relative importance of each variable on adoption rate is given below for this centre.

Variable	Relative importance
Age	-0.4017
Education	-0.1670
Social participation	+0.0757
Contact with extension agency	+0.2738

Perception of profitability of technology	0.3532
Income	-0.0071
Debt	-0.0889

The variables which are highly responsible for the adoption in Malpe region are perception of profitability of technology followed by contact with extension agencies and social participation. Age, and debt are retarding factors of adoption in this centre.

The standard error of estimate is worked out to be 2.2859 which is well with in reasonable limits.

Table 67. Mean score and standard deviation of selected variables and adoption in Malpe region

		Mean	Standard deviation
x_1	- Age	4.1360	1.4720
x_2	- Education	1.8080	1.5898
x_3	- Social participation	1.1920	0.8491
x_4	- Contact with extension agency	2.5600	1.0954
x_5	- Perception of profitability of technology	2.1280	1.3618
x_6	- Income	1.8720	1.2635
x_7	- Debt	2.2480	1.2930
x_8	- Adoption	9.4880	6.0836

Table 68. Matrix of correlation showing the interdependency of different variables selected for the study in Malpe region

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
X_1 - Age	1.0000	-0.8675 +++	-0.7889 +++	-0.7578 +++	-0.7973 +++	-0.7537 +++	0.7151 +++	-0.8639 +++
X_2 - Education		1.0000	0.8102 +++	0.7937 +++	0.8310 +++	0.8228 +++	-0.7299 +++	0.8128 +++
X_3 - Social participation			1.0000	0.8026 +++	0.7667 +++	0.7373 +++	-0.6608 +++	0.8014 +++
X_4 - Contact with extension agency				1.0000	0.7841 +++	0.8679 +++	-0.7024 +++	0.8396 +++
X_5 - Perception of profitability of technology					1.0000	0.8017 +++	-0.7357 +++	0.8003 +++
X_6 - Income						1.0000	-0.6960 +++	0.8636 +++
X_7 - Debt							1.0000	-0.7373 +++
X_8 - Adoption								1.0000

$X_8 = 10.6186 - 1.6603x_1 - 0.6392x_2 + 0.5424x_3 + 1.5206x_4 + 1.5777x_5 - 0.0341x_6 - 0.4185x_7$

R^2 = 0.8668, Standard error of the estimate = 2.2859, +++ significant at 0.1% level

4.9.3 Tuticorin:

Table 69 gives the mean and S.D. of scores of each variable and Table 70 gives the matrix of correlation of the variables under study. The results of the analysis of the data are summarised below.

4.9.3.1. Age:

The mean score for age is 4.7500 and the S.D. is 1.3349. The coeft. of variation of mean score is 28.10%, indicating that age is less dispersed compared to other variables. From the matrix of correlation it follows that age is significantly ($p < 0.001$) negatively correlated with all other variables except debt indicating that as age advances, education, social participation, contact with extension agency, perception of profitability, income and adoption decrease. Age is significantly positively correlated with ($p < 0.001$) debt, indicating that age and debt are strongly associated variables.

4.9.3.2. Education:

The mean score for education is 1.8000 with a S.D. of 1.4884. The coeft. of variation is 82.69%. Education is one of the highly dispersed variables in the group. Education is significantly positively correlated ($p < 0.001$) with social participation, contact with extension agency, perception of profitability, income and adoption. This indicates that as the level of education increases, better will be the social participation and hence better contact with extension agency, perception of profitability income and adoption. Education is significantly negatively correlated ($p < 0.001$) with debt, indicating that as the level of education increases indebtedness decreases.

4.9.3.3. Social participation:

The mean score for social participation is 1.2250 with a S.D. of 0.9195. The coeft. of variation is 75.06% indicating that this is a highly variable one in the group. Social participation is significantly positively correlated ($p < 0.001$) with education, contact with extension agency, perception of profitability, income and adoption indicating that with the increase in the social participation, contact with extension agency, perception of profitability, income and adoption increase. Social participation is significantly negatively correlated ($p < 0.001$) with age and debt.

4.9.3.4. Contact with extension agency:

The mean score for contact with extension agency is 3.0500 with a S.D. of 1.4313. The coeft. of variation is 46.93%. Next to age, contact with extension agency is less dispersed among the group of variables. Contact with extension agency is significantly positively correlated ($p < 0.001$) with education, social participation, perception of profitability, income and adoption. This indicates that more the contact with extension agency, better will be the social participation, resulting in better perception of profitability, income and adoption. Contact with extension agency is significantly negatively correlated ($p < 0.001$) with age and debt. This indicates that contact with extension agency is dissociated with age and indebtedness to a certain extent.

4.9.3.5. Perception of profitability of technology:

The mean score for perception of profitability is 2.6500 with S.D. of 1.4772. The coeft. of variation is 55.74%. This is also one of the highly dispersed variables in the group. Perception of profitability is significantly positively correlated ($p < 0.001$) with education, social participation, contact with extension agency, income and adoption. This indicates that profitability increases with increase in education, social participation, contact with extension agency, income and adoption. Perception of profitability is significantly negatively correlated with ($p < 0.001$) with age and debt.

4.9.3.6. Income:

The mean score for income is 2.2250 with a S.D. of 1.5104. The coeft. of variation of income is 67.88% indicating high variability of this variable among the group. Income is significantly positively correlated with education, social participation, contact with extension agency, perception of profitability and adoption, indicating that better income is associated with better social participation, contact with extension agency, perception of profitability and adoption. This variable is significantly negatively correlated with ($p < 0.001$) age and debt.

4.9.3.7. Debt:

The mean score for debt is 2.8570 and S.D. is 1.4882. The coeft. of variation is 52.09%. This variable is found to be negatively correlated with all other variables except age. Debt and age are significantly positively correlated ($p < 0.001$) indicating the strong interdependency of the two variables.

4.9.3.8. Adoption:

The mean adoption score is 8.000 with a S.D. of 7.3240. The coeft. of variation is 91.55% indicating that the rate of adoption varies very much among the respondents. Adoption is significantly positively correlated with education, social participation, contact with extension agency, perception of profitability and income. This indicates that the rate of adoption increases with increase in the level of education, contact with extension agency, social participation, perception of profitability, and income. Adoption is significantly negatively correlated ($p < 0.001$) with age and debt indicating that as age advances the indebtedness increases and the rate of adoption decreases.

The multiple regression equation connecting adoption with the rest of the variables under study for the Tuticorin region is

$$Y = -3.7834+0.4371x_1+0.2868x_2-0.1918x_3+0.3880x_4 +0.6352x_5+3.5455x_6-0.4625x_7$$

The coeft. of determination, multiple R^2, worked out for this region is 0.9191. This indicates that 91.91% of the variability in the data is explained by the fitted regression.

The relative importance of each of the variables on adoption is given below for this region.

Variable	Relative importance
Age	0.0797
Education	0.0583
Social participation	-0.0158
Contact with extension agency	0.0758
Perception of profitability	0.1281
Income	0.7312
Debt	-0.0150

It is evident that income and perception of profitability are two major factors responsible for adoption at this region.

The standard error of estimate is 2.2991, indicating that the fitted regression is a good fit for the data.

Table 69. Mean score and standard deviation of selected variables and adoption in Tuticorin region

		Mean	Standard deviation
x_1	- Age	4.7500	1.3349
x_2	- Education	1.8000	1.4884
x_3	- Social participation	1.2250	0.9195
x_4	- Contact with extension agency	3.0500	1.4313
x_5	- Perception of profitability of technology	2.6500	1.4772
x_6	- Income	2.2250	1.5104
x_7	- Debt	2.8570	1.4882
x_8	- Adoption	8.0000	7.3240

Table 70. <u>Matrix of correlation showing the interdependency of different variables selected for the study in Tuticorin region</u>

	X_1	X_2	X_3	X_4	X_5	X_6	X_7	X_8
X_1 - Age	1.0000	-0.7743+++	-0.7677+++	-0.7716+++	-0.7997+++	-0.8616+++	0.7712+++	-0.8104+++
X_2 - Education		1.0000	0.8206+++	0.7751+++	0.8187+++	0.8531+++	0.7524+++	0.8350+++
X_3 - Social participation			1.0000	0.7510+++	0.7579+++	0.8303+++	-0.7659+++	0.7957+++
X_4 - Contact with extension agency				1.0000	0.8817+++	0.8605+++	-0.8757+++	0.8659+++
X_5 - Perception of profitability of technology					1.0000	0.8866+++	-0.8427+++	0.9503+++
X_6 - Income						1.0000	-0.8485+++	0.8888+++
X_7 - Debt							1.0000	-0.8492+++
X_8 - Adoption								1.0000

$X_8 = -3.7834+0.4371x_1+0.2868x_2-0.1918x_3+0.3880x_4+0.6352x_5+3.5455x_6-0.4625x_7$

$R^2 = 0.9191$, Standard error of estimate = 2.2991, +++ significant at 0.1% level

STRATEGY FOR TECHNOLOGY TRANSFER IN THE FISH CURING INDUSTRY

CHAPTER FIVE

STRATEGY FOR TECHNOLOGY TRANSFER IN THE FISH CURING INDUSTRY

5.1. Technology transfer

A wide gap exists between the technological innovations in fish curing developed at our research centres and their actual use by the fish curers. Transfer of technology starts after its perfection and ends in its utilization by the target group.

There are four sets of basic activities involved in the transfer of technology (Jaiswal and Arya, 1981).

1) Technology production system or research system to evolve technology.
2) Extension system to transfer the technology from research organisations to the actual users.

3) Technology utilization system or the client system which adopts the technology.
4) Support system which supports the technology transfer process and provides necessary inputs required for the use of technology and also provides facilities for marketing of the output.

5.1.1. Research system:

The research system takes care of the technology production. It consists of various research institutes where innovations are created. The main organisations conducting research in fish curing technology in the country is Central Institute of Fisheries Technology, Cochin under the Indian Council of Agricultural Research. The Central Food Technological Research Institute, Mysore under the Council of Scientific and Industrial Research is another organisation where some amount of research in fish curing is being carried out. Some of the State Fisheries Departments and Agricultural Universities have also conducted some research investigations in the fish curing technology.

5.1.2. Extension system:

The extension system consists of change agents or extension personnel belonging to government and non-government agencies who act as links between the research system and client (fish curers) system. In addition to transfering the new technology to the potential users, the extension system is also supplying the research system with feed back about the field problems. The extension workers contact the fish curers in person, in groups or through indirect media like newspapers, magazines, leaflets, radio, television etc.

Even though a large net work of extension institutions have been established in the country for the transfer of technology in agriculture, the agencies engaged in transfering fish curing technology are very limited in number. Some of the State Fisheries Departments and Agricultural Universities are having extension systems for fisheries development. But this system gives priority to fish farming. Only minor work is done on fishing or fish processing including fish curing.

Extension work on curing or other aspects of fish processing technology is mainly looked after by the Central Institute of Fisheries Technology. The Marine Products Export Development Authority is also engaged in technology transfer related to processed fish for export. Export Inspection Agency is undertaking in a very small scale the technology transfer in fish processing.

The extension service has not reached the entire fish curing community. Some of the factors responsible for this are administrative bottlenecks, lack of effective linkage between research and extension, lack of sufficient fishermen oriented programmes, lack of an educational approach on effective use of extension methods, lack of coordination among various development departments, lack of an integrated approach, lack of dedication and knowledge among extension workers, supervisors and their administrators, unmanageable areas of operation of extension workers, lack of suitable transport facilities, lack of information, lack of easy, timely and adequate availability of imputs, lack of facilities for marketing of high quality cured products, financial limitations, lack of sufficient price for high quality cured products etc.

5.1.3. Technology utilization/client system:

This system consists of the actual users of the technology. In the case of fish curing industry, this system refers to fish curers. They are scattered all along the coastal belt. They mainly follow the traditional methods of curing resulting in the production of poor quality cured fish.

5.1.4. Support system:

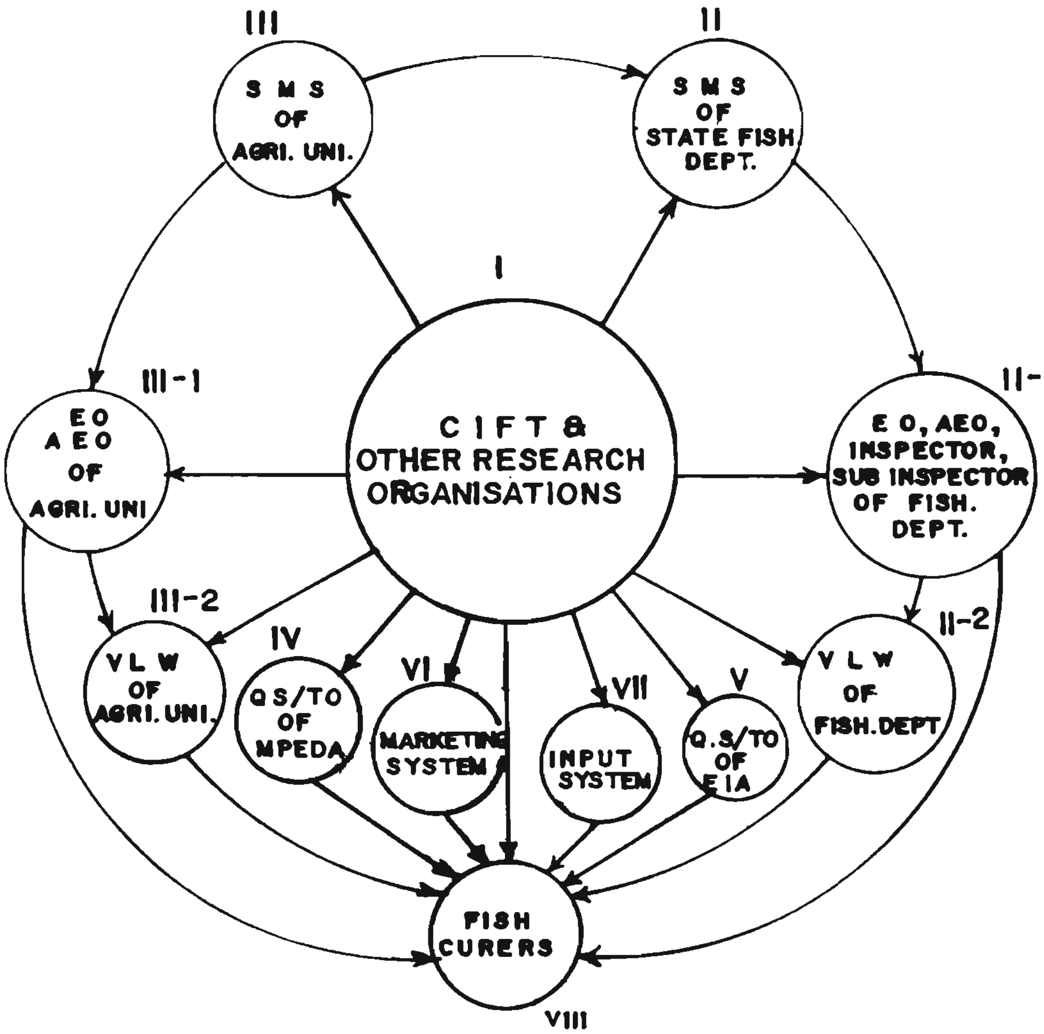
The support system consists of government as well as private agencies dealing with the credit and input supplies and marketing such as co-operatives, corporations, banks etc. This system also includes agencies responsible for the creation and management of other infrastructures like electricity, transport aid and other services.

In the case of fish curing, support system is very weak compared to other agricultural fields. Facilities for loans, subsidy and other inputs are very limited. Potable water, ice and quality salt are not supplied to fish curers. Marketing facilities for securing a higher price for cured fish produced by improved methods are also not existing at present. The administration and management with regard to the fish curing industry are also not properly co-ordinated at any level.

5.2. Strategy for technology transfer in the fish curing industry

Taking into consideration all the existing factors, a new strategy is proposed for technology transfer in the fish curing industry. Figure 23 shows the proposed model of technology transfer related to fish curing.

FIG.23. MODEL OF TRANSFER OF TECHNOLOGY IN FISH CURING INDUSTRY



Description of figure 23

I: CIFT and other research institutes

II: Subject Matter Specialists of Departments of State Fisheries

II-1: Extension Officers, Assistant Extension Officers, Inspectors and Sub-Inspectors of Fisheries Depts.

II-2: Village Level Workers of State Fisheries Departments

III: Subject Matter Specialists of Agricultural Universities

III-1: Extension Officers and Assistant Extension Officers of Agricultural Universities

III-2: Village Level Workers of Agricultural Universities

IV: Marine Products Export Development Authority

V: Export Inspection Agency

VI: Market system

VII: Input system

VIII: Fish curers

There are several improved practices in fish curing developed by the Central Institute of Fisheries Technology and a few other research organisations like Central Food Technological Research Institute. At the first stage, the Subject Matter Specialists of the Departments of Fisheries (II) and Agricultural Universities (III) shall be trained by the above research institutes (I) in the improved fish curing practices. The Subject Matter Specialists should transmit this knowledge to the Extension Officers, Assistant Extension Officers, Inspectors and Sub-Inspectors of Fisheries (II-1 and III-1) working in Fisheries Departments/ Agricultural Universities. They, in turn, shall train the Village Level Workers (II-2 and III-2) of Fisheries Departments/Agricultural Universities if such category of officials is available. The Village Level Workers are to ultimately train the fish curers (VIII) in the improved practices of fish curing. In the absence of Village Level Workers, the Extension officers and other Officials (II-1 and III-1) shall directly train the fish curers. The research institutes (I) shall also train the intermediate agencies under groups II-1, II-2, III-1 and III-2 if and when necessity arises.

Another channel of technology transfer shall be through the Marine Products Export Development Authority (IV) and or Export Inspection Agency (V). The Quality Supervisors and Technical Officers of these Departments shall be trained in improved fish curing practices by the research institutes. After training, these officials can train the fish curers in their respective localities in the improved practices.

The technical personnel, if any, of the marketing (VI) and input (VII) systems such as co-operatives and other organisations shall also be trained by the research institutes in the new methodology so that these personnel can also give sufficient training to the fish curers.

There should be provisions for the research institutes (I) to directly transfer the new technology to the fish curers (VIII) wherever possible and essential.

Thus the improved technology should flow from research system (I) to the fish curers (VIII) through 13 different channels as shown in the model. The problems of fish curers shall be transmitted back to the research institutes through the same channels.

5.2.1. Channels for technology transfer:

The flow of technology related to fish curing through different proposed channels is given below:

1. CIFT and other research Institutes

↓

Subject Matter Specialists of Departments of State Fisheries

↓

Extension Officers, Asst. Extension Officers, Inspectors and Sub-Inspectors of Fisheries Departments

↓

Village Level Workers of State Fisheries Departments

↓

Fish curers

2. CIFT and other research institutes

Extension Officers, Asst. Extension Officers Inspectors and Sub-Inspectors of Fisheries Departments

Village Level Workers of State Fisheries Departments

Fish curers

3. CIFT and other research institutes

Extension Officers, Asst. Extension Officers, Inspectors and Sub-Inspectors of Fisheries Departments

Fish curers

4. CIFT and other research institutes

Village Level Workers of State Fisheries Departments

Fish curers

5. CIFT and other research institutes

Subject Matter Specialists of Agricultural Universities

Extension Officers and Asst. Extension Officers of Agricultural Universities

Village Level Workers of Agricultural Universities

Fish curers

6. CIFT and other research institutes

Extension Officers and Asst. Extension Officers of Agricultural Universities

Village Level Workers of Agricultural Universities

Fish curers

7. CIFT and other research institutes

Extension Officers, and Asst. Extension Officers of Agricultural Universities

Fish curers

8. CIFT and other research institutes

↓

Village Level Workers of Agricultural Universities

↓

Fish curers

9. CIFT and other research institutes

↓

Marine Products Export Development Authority

↓

Fish curers

10. CIFT and other research institutes

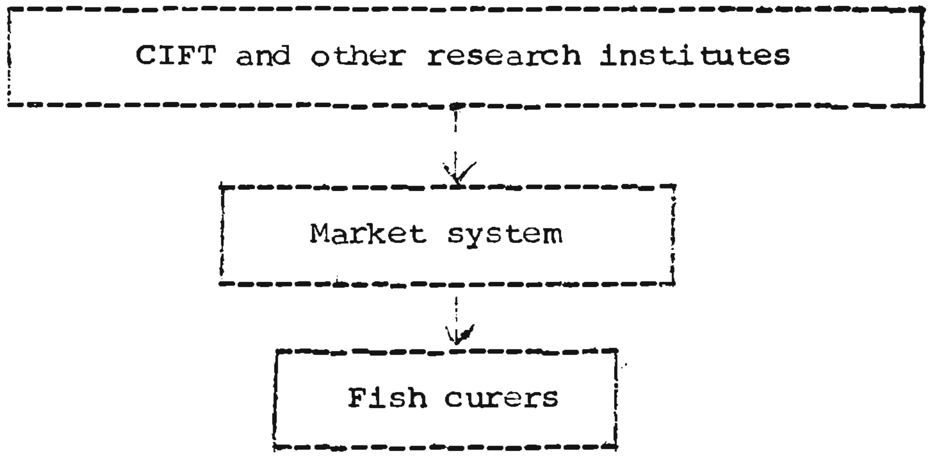
↓

Export Inspection Agency

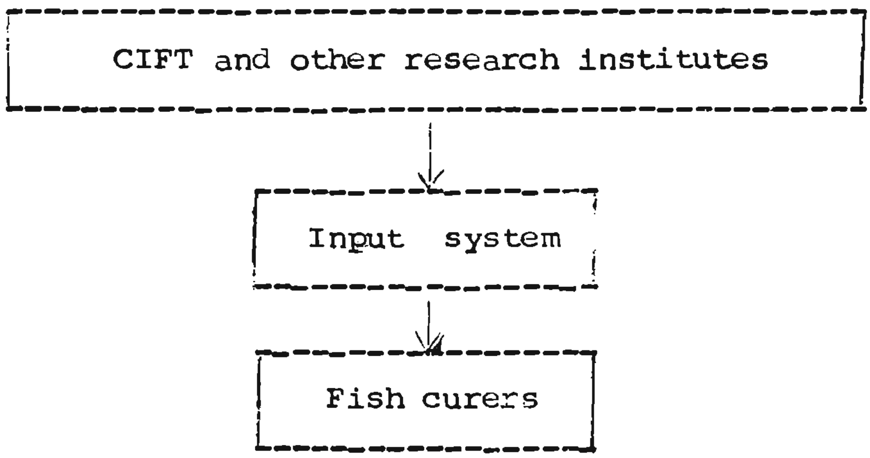
↓

Fish curers

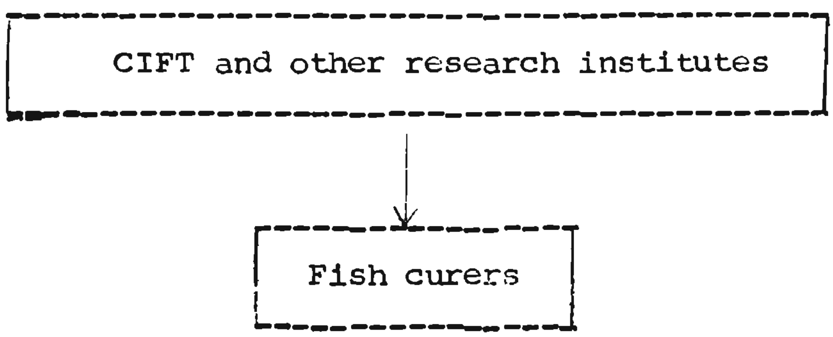
11.


CIFT and other research institutes
Market system
Fish curers

12.


CIFT and other research institutes
Input system
Fish curers

13.


CIFT and other research institutes
Fish curers

Considering the facilities existing at present, it is suggested that the technology transfer shall be carried out by different agencies to the extent as given below:

Agency	Percentage of technology transfer
Department of Fisheries	50
Agricultural University	20
Research Institutes	10
Marine Products Export Development Authority	5
Export Inspection Agency	5
Input system	5
Marketing system	5

The division of responsibility of technology transfer proposed here is only approximate. As the existing man power and the technical skill of the officials vary from state to state, the extent of assignment of duties to the officials related to technology transfer in fish curing shall also vary within reasonable range.

5.2.2. State Fisheries Departments:

At present, state fisheries departments are having large teams of fisheries officials covering the entire coastal areas. Inspectors, Sub-Inspectors, Extension Officers, Assistant Extension Officers and Village Level Workers are posted in these areas to look after various aspects of fisheries. These officials should be given training in improved methods of fish curing technology and they should be assigned with the duty of transfering the new and improved fish curing technology in their respective areas. They should be trained by research institutes where the improved technologies are available. They should also be trained in extension methods to equip themselves for effective extension work. These exte workers, after training, should conduct demonstrations, discussions with fish curers, film shows, exhibitions, distribution of technical leaflets etc. to persuade fish curers to adopt improved practices.

Reasonable targets of extension work for adoption of improved fish curing practices should be fixed for each extension worker and the performance of the individual extension worker should be assessed.

Regular and frequent visits of extension workers to fish curing yards, combined with their sound advice on problems needing immediate attention will create very good impact on fish curers. Adoption of improved fish curing practices, particularly non-monetary type, will receive good response from the fish curers. Effective supervision and technical support should be extended to grass root extension workers.

Close links should be established among research, fish curing and extension so that the problems of fish curers are fed back for solution.

The extension workers should have appropriate training, recognition, incentives and opportunities for advancements. If required, more extension workers should be recruited by the Departments to cover the entire area of fish curing under their jurisdiction.

More fishermen training centres should be estalished. These centres should include fish curing in the syllabus and teach fishermen on improved methods of fish curing and persuade them to cure fish by scientific methods. The fisherwomen and fisheryouth should be encouraged and trained to take up fish curing instead of selling the fresh fish to middle men at very low price. Popular and technical articles should be prepared in regional languages and widely distributed to the fish curers. Film shows on scientific methods of fish curing should be organised in each fishing village. Importance of scientific methods of fish curing should be projected through radio, television and newspapers. Model fish curing yards should be constructed and given on lease to the fish curers for production of cured fish in modern way.

Fisheries Departments should have the overall responsibility of extension work, developmental task, regulatory function and ensuring supplies and services in the field of fish curing. The Departments should study field problems and convey to the research organisations, conduct field trials and demonstrations and organise training programmes for field workers and fish curers. These departments should establish an information cell acting in collaboration with the research institutes and maintain up-to-date data on the development of fisheries. The Departments should properly plan, monitor and evaluate various programmes in fish curing.

5.2.3. Agricultural Universities:

As mentioned earlier, at present the extension work carried out by Agricultural Universities with respect to fisheries is mainly confined to fish farming and only a very limited fisheries extension workers have been appointed in the Universities. More fisheries extension workers of different status shall be appointed by the Universities to carry out extension work related to fish curing and the technology transfer should be effected in the same manner as it is suggested for the Fisheries Departments.

5.2.4. Marine Products Export Development Authority:

MPEDA has posted Quality Supervisors and Technical Officers to look after the quality of processed fish for export. These personnel should be allotted some specific extension work for the transfer of fish curing technology. They may be regularly trained by research organisations in the improved practices of fish curing technology so that they will be able to transfer such technologies to fish curers. MPEDA can help the State Fisheries Departments in publication and distribution of popular and technical leaflets, organisation of film shows, exhibitions and other mass media programmes pertaining to fish curing.

5.2.5. Export Inspection Agency:

This agency is the authority to certify the quality of processed fish including cured fish for export. The Agency has got large number of Technical Officers in all the centres from where processed fish is exported. These personnel can be trained by the research organisations in improved methods of fish curing technology and it should be a part of their duty to transfer this technology to the fish curers in their respective areas.

5.2.6. Research Organisations:

Apart from the research activities, research organisations should conduct training programmes and other extension activities to transfer the technology directly to the fish curers or through extension workers in other departments.

The Central Institute of Fisheries Technology and other research organisations should further mobilise their extension activities in fish curing. They should train the extension workers in other departments in improved fish curing practices and extension methods so that these workers can effectively transfer the technology to the actual users.

In addition to giving training to the change agents in other departments, research organisations should directly transfer the improved technologies to the fish curers in various states in collaboration with the respective State Fisheries Departments.

5.2.7. Input supply and services:

At present, this system has not provided facilities to any considerable extent to the fish curing industry. Banks and other financial agencies should provide certain quota of loans and subsidy for the development of fish curing. Technical Officers in the Banks should also be exposed to fish curing technology so that they can transfer this knowledge to the fish curers in a limited way.

Marine Products Export Development Authority and the State Fisheries Departments, though included in the extension system, have to play a duel role of extension system as well as support system to help the fish curing industry. Loans and subsidy should be provided by MPEDA for construction of improved fish curing sheds and raised platforms for dryihg fish. Provision for good quality ice, salt, chemicals, packing materials etc. should be made by MPEDA. Community drying centres with tunnel dryers, and proper storage rooms should be constructed for providing to the fish curers for their use on nominal charges. The State Fisheries Departments also should share the responsibility of providing the above facilities to fish curers.

The fishermen co-operative societies also should make arrangements for supplying necessary inputs for fish curing by improved methods. They should also contribute to the technology transfer utilising all the facilities available.

5.2.8. Marketing facilities:

Marketing facilities should be developed. The fishermen co-operative societies and/or marketing federations should take the responsibility of marketing the cured fish produced by the individual fish curers. These societies should be in a position to pay advances to the individual fish curers on the basis of quantity and quality of cured fish taken by the society for marketing. The agencies can play active role in persuading the fish curers to take up improved method of fish curing.

5.2.9. Administration and management:

There should be proper co-ordination of the administration and extension efforts of all the concerned organisations as to make the technology transfer more effective.

It is proposed to strengthen the administrative set up in different levels with the assignment of responsibility to senior technical personnel. There should be decentralisation of authority responsibility, planning and monitoring as much as possible. Linkages between various agencies involved should be strengthened.

The interdepartmental co-ordination and linkages among extension, research, input and other supporting agencies, fish curers and local authorities should be ensured at appropriate levels. Committees should be set up at various levels to ensure adequate co-ordination between official agencies and autonomous bodies connected with fisherie development

The extension machinery should be reorganised in such a way that extension workers are available to meet the fish curers often and identify their problems and to guide and train them for wide adoption of fish curing technology

The fishermen co-operative societies should be established where they are not existing and those which are already existing should be mobilised.

Some legislation on quality should be enforced in fish curing sheds and cured fish markets so that the quality of cured fish can be improved. The curing sheds, cured fish, packaging materials, salt, storage rooms, cured fish markets etc. should be frequently inspected by the authorised agencies. License should be issued to fish curing sheds maintained in proper conditions and fish curing should be allowed only in such sheds. Poor quality cured fish should not be allowed to be sold and such products should be immediately removed from godowns, markets etc.

5.2.10. Fish curers:

Fish curers are the ultimate users of the technology. They should analyse their situations, identify their problems and organise themselves to solve such problems with the assistance from other three systems - research, extension and support systems. They should try to improve their socio-economic conditions and develop themselves by making use of the appropriate technologies and other facilities available to them. The other three systems can only provide favourable situations to transfer the improved technology. The fish curers should be mentally prepared to adopt such technologies for their own benefits. They should show a receptive mind to the other systems.

SUMMARY

CHAPTER SIX

SUMMARY

Cured fish industry and export trade have been important aspects of the economic life of the people since the ancient time all over the world. In India, curing was the only method of processing of fish till 1953. In earlier days India exported large quantities of cured fish to Sri Lanka, Burma, Malaysia, Singapore and Hong Kong. But the post war development adversely affected our marine products export. Still, about 20% of fish landed in India is cured. Curing is the largest single method of fish processing in India and it is likely to remain as such for many years to come.

Fish curing industry has not shown much improvements from its primitive nature because this industry has been mainly handled by illiterate and less educated fishermen/fisherwomen. The cured fish produced by them is unhygienic and poor in quality. Such products spoil quickly leading to huge national loss of this protein rich food. This situation demands urgent steps to be taken for rectifying the defects of the fish curing industry and for adopting modern methods to avoid the wastage and improve the quality of cured fish. Therefore, transfer of new technology to the fish curing industry is the solution of the problems existing in this industry.

The Central and State agencies have already made considerable efforts to transfer the improved methods to the fish curing industry by way of training courses, demonstrations, Lab-to-Land programmes, film shows, exhibitions, replies to technical queries, personal discussion etc. As the result of these efforts, fish curers have started adopting the improved practices in fish curing. Still there is a considerable gap between the technology available and the technology adopted in this field. A comprehensive study on the extent of adoption of improved practices in fish curing industry is lacking at present.

The following are the objectives of the present study:

1. To identify the technological gap in terms of knowledge of fish curing technology among fish curers and fisheries extension workers.
2. To identify the technological gap in terms of adoption of fish curing technology among fish curers.
3. To study the reasons for partial adoption or non-adoption of improved fish curing practices by fish curers.
4. To evolve a strategy for effective transfer of technology related to fish curing.

Three important fishing regions, namely, Calicut in Kerala, Malpe in Karnataka and Tuticorin in Tamil Nadu were selected for the present study. Total population of active fish curers in all the three regions were taken as the respondents. Calicut region had 140, Malpe had 125 and Tuticorin region had 40 fish curers actively engaged in fish curing industry. Seven independent variables namely, age, education, social participation, contact with extension agency, perception of profitability of the technology, income and debts of the respondents were selected for this study. The following six major improved practices comprising of 28 sub-practices were taken up to study the adoption gap.

6.1. <u>Construction of improved fish curing shed</u>

1. Construction of shed
2. Provision of drainage facilities
3. Provision of tables/platforms for derssing fish

6.2. <u>Cleaning and maintenance of hygiene in fish curing shed</u>

4. Use of potable water in the shed
5. Use of detergents and disinfectants
6. Adoption of cleaning schedule
7. Regular washing of mat used for drying fish

6.3. <u>Handling and pre-processing of fish</u>

8. Use of fresh fish
9. Proper washing of fresh fish
10. Proper dressing and evisceration of fish
11. Proper washing of gutted fish
12. Use of ice for preserving fish

6.4. <u>Salting of fish</u>

13. Use of sufficient good salt
14. Salting of fish in cement tanks or other suitable containers

15. Sufficient salting period
16. Convering of salted fish to avoid flies
17. Rinsing of salted fish in freshly prepared salt water
18. Removal of urea by desalting
19. Removal of self-brine and addition of saturated brine in the case of pickling
20. Covering of fish with sufficient quantity of brine in the case of pickling

6.5. Drying of salted fish.

21. Allowance of sufficient drying of fish
22. Drying of fish on mat
23. Drying of fish on raised platform
24. Drying of fish in tunnel dryer

6.6. Packing and storage of cured fish

25. Use of chemical preservatives in cured fish
26. Retail packing of cured fish in polythene bags
27. Bulk packing of cured fish in improved containers
28. Proper storage of cured fish

The results showed that Calicut region has a higher percentage of younger fish curers compared to the other two regions. Calicut region registered the highest level of education among the three regions under study. The level of social participation and contact with extension agency do not make any marked difference from region to region. A comparatively high percentage of fish curers at Calicut region perceived that the improved fish curing practices are profitable. The fish curers in Calicut region showed a higher level of income compared to the other two regions. As the result of this situation, Calicut region shows minimum percentage of fish curers having debts. The average knowledge gap was found to be minimum in Calicut and maximum in Malpe. The average adoption gap was observed to be minimum in Calicut and maximum in Tuticorin. Thus the fish curers in Calicut region have comparatively less knowledge gap and adoption gap. It is generally concluded that increase in knowledge lead to higher rate of adoption. Among the 6 major practices, the maximum adoption gap was observed in packing and storage of cured fish and in the construction of improved fish curing shed in all the three regions while adoption gap is comparatively less in salting and drying of fish.

It is seen that about 1/3rd of the extension workers had full knowledge about the improved fish curing practices while 1/5th of them had no knowledge about the improved technology.

Statistical analysis reveals the following situation in general.

6.7. Age

Age and debt of fish curers are found to be positively correlated. As the age of the fish curers increases, their level of education, social participation, contact with extension agency, perception of profitability, income, adoption etc. are found to be decreasing.

6.8. Education

Education is found to be negatively correlated with debt. As the level of education increases, more will be the degree of adoption, social participation, contact with extension agency, perception of profitability and income.

6.9. Social participation

The more social participation among respondents, the less will be the debt. Social participation is found positively correlated with the level of contact with extension agency, perception of profitability, income and adoption.

6.10. Contact with extension agency

This variable is positively correlated with income, perception of profitability, level of education, social participation etc. This is negatively correlated with age and debt.

6.11. Perception of profitability of technology

This variable is positively correlated with education, social participation, contact with extension agency, income and adoption. This variable is negatively correlated with age and debt.

6.12. Income

Income is positively correlated with education, social participation, contact with extension agency, perception of profitability and adoption. Income is negatively correlated with age and debt.

6.13. Debt

Debt is negatively correlated with all the variables except age.

On the basis of the observations made during this study, the following strategy of technology transfer is suggested in four systems to the fish curing industry.

Research system:

The research organisations should evolve training programmes on systematic basis to train extension workers from other departments as well as the fish curers.

Extension system:

The State Fisheries Departments and the other organisations related with fisheries should be brought under this system. The extension workers in these organisations should be trained in improved fish curing practices and extension methods. After this training, they should conduct demonstration, training, technical discussion, film shows etc. and distribute technical publications for the benefit of the fish curers. Reasonable target of extension work for adopting fish curing practices should be fixed for the extension workers and the performance of the individual workers should be assessed.

Effective supervision and technical support should be extended to grass root extension workers. Fishermen training centres should include fish curing as one of the subjects and teach the same with due importance.

State Fisheries Departments and or other development agencies should construct model fish curing yards and community fish curing centres and provide these facilities to the fish curers on nominal charges. State Fisheries Departments should have the over all responsibility of extension work, developmental task, regulatory functions and ensuring supplies and services in the field of fish curing. The Fisheries Departments should properly plan, monitor and evaluate various developmental programmes in fish curing.

In addition to State Fisheries Departments, Marine Products Export Development Authority, Export Inspection Agency and voluntary organisations should share the above responsibility of providing facilities to the fish curing industry.

Client system:

The fish curers should analyse their situations, identify their problems and organise themselves to solve such problems with the assistance from the other three systems (research, extension and support systems).

Support system:

Support system should include Fisheries Departments and voluntary organisations which can support fish curing industry by supplying inputs and marketing the cured fish products. Loans and subsidy should be provided to the fish curing industry. Basic requirements like protected water supply, electricity, good quality salt, ice, chemicals, packaging materials etc. should be provided. Co-operative societies, marketing federations or other agencies should take the entire quantity of cured fish prepared by improved methods and market them.

There should be proper co-ordination of the administration and extension efforts of all the concerned organisations so as to make the technology transfer more effective. Linkage among various agencies involved should be strengthened.

The interdepartmental coordination and linkages among extension, research, input and other supporting agencies, fish curers and local authorities should be ensured at appropriate levels. Committees should be set up at various levels to ensure adequate co-ordination among officials, agencies and autonomous bodies connected with fisheries development. Some legislation on quality should be enforced in fish curing sheds and cured fish markets so that the quality of cured fish can be improved.

Interview Schedule

PART - I

1. a) Name

   b) House Name

   c) House No.

   d) Village

   e) Block

   f) District

   g) State

2. Age

3. Educational qualifications : Illiterate/can read only/can read and write/primary school/middle school/high school/college education.

4. Annual income :

5. Debt

6. From where do you get loan when you need? Relatives/friends/money lenders/co-operative societies/commercial banks/Land mortgage banks/others (specify)

7. a) Are you getting any subsidy/grant/other benefits (specify) Yes/No

   b) If yes, from where and to what extent?

8. a) Do you find difficulties in getting loan? Yes/No

   b) If yes, please give details.

9. Social participation

   a) No membership in any organisation.

   b) Membership in one organisation.

   c) Membership in more than one organisation.

   d) Office bearer in one organisation.

   e) Office bearer in more than one organisation.

   f) Distinctive features (MLA, MP etc.)

10. Contact with extension agency.

    a. weekly :

    b. fortnightly

    c. monthly

    d. once in two months

    e. once in three months

    f. once in six months

11. Profitability of improved fish curing technology as perceived by the fish curer.

    a) Most profitable
    b) Very profitable
    c) Profitable
    d) Marginally profitable
    e) Least profitable
    f) Not profitable

12. Please give the following particulars of your fish curing shed:

    a) Size ________ Length _______ width ___ height ___
    b) Ceiling: tiled/concrete/thatched
    c) Side wall: full/half/no side wall
    d) Floor: concrete/other type (specify)

Item	No.	Total capacity
(1)	(2)	(3)

    e) Salting tank
    f) Ice storage tank
    g) Salt storage room
    h) Fresh fish storage room
    i) Storage room for utensils etc.
    j) Raw material receiving room
    k) Tables/platforms for dressing fish
    l) Office room
    m) Resting room
    n) Cured fish storage room
    o) Water storage tank
    p) Fly proof netting — full/partial/nil
    q) Lighting arrangements — electrified/others (specify)

r) Lavatory facilities

s) Other spaces available and the purpose.

13. Particulars of utensils, tables etc. in the curing yard.

Sl. No.	Item	Total number available					Total capacity	Life	Total cost
		Aluminium	GI	Plastic	Concrete	Wooden			
1.	Tables								
2.	Basins								
3.	Drums								
4.	Baskets								
5.	Others (specify)								

14. Who owns the curing yard and the land? Fish curer/others (specify)

15. How long you have been engaged in fish curing?

16. a) Are you using detergents and disinfectants in your fish curing shed? Yes/No

	b) Please describe briefly the method of cleaning adopted in the curing shed.	
17.	a) Are you using ice in the handling, transportation etc. during curing process?	Yes/No
	b) If yes, at what stage/s?	a) During transportation from landing centre to curing yard. b) During handling up to salting stage. c) Only during initial storage in the curing yard. d) Only after dressing and washing.
18.	What is the source of water used in the curing yard?	Tap water/well water/ bore well water/pond water/others (specify)
19.	Do you chlorinate/ purify water before use?	Yes/No
20.	What is the general quality and condition of fish available for curing?	a) Fresh fish - immediately after landing. b) Fresh fish - with ice. c) Fish without ice. d) Somewhat spoiled fish. e) Spoiled fish.
21.	Do you properly dress and eviscerate fish for curing	Yes/No

22. When do you wash fish in the curing yard.

a) Before dressing.

b) After dressing and evisceration.

c) After salting

23. Where are you purchasing salt from?

24. a) Are you getting subsidy for salt? Yes/No

b) If yes, please give details?

25. Type of curing followed.

a. Sun drying

b. Dry salting

c. Wet salting

d. Pickling

e. Others (specify)

26. Salting method followed

(a) Dry salting

Size of fish	Large fish	Medium fish	Small fish
Salt ratio			
Period of salting			

(b) Wet salting

Size of fish	Large fish	Medium fish	Small fish
Salt ratio			
Period of storage in salt			

(c) Pickling

Size of fish	Large fish	Medium fish	Small fish
Concentration of brine			
Period of storage in brine			

27. Please describe briefly the general methods employed for

a) Sun drying

b) Dry salting

c) Wet salting

d) Pickling

28. Do you remove the self-brine and add saturated brine in the case of pickling?	Yes/No
29. Do you cover the pickled fish with sufficient brine?	Yes/No
30. Where do you salt fish	Cement tanks/ others (specify)
31. Is the fish covered with salt/salt solution during salting period.	Yes/No
32. Do you cover the salted fish tanks to avoid flies	Yes/No
33. a) Are you rinsing the salted fish before drying?	Yes/No
b) If yes, with what?	Self-brine/water/ freshly prepared salt water/others (specify)
34. a) Do you remove urea from shark and other elasmobanch fishes by desalting method or any other way?	Yes/No
b) If yes, please explain the method.	
35. Where do you dry the fish?	a) In the premises of the curing yard. b) In the beach c) Other places (specify)

36.	a) What is the mode of drying followed:	Sun drying/ artificial drying.
	b) If sun drying, is the fish dried on raised platform, on the ground or both ways.	
	c) If on ground, are you using any mat or other spread to prevent contact of the fish with the soil.	Yes/No
	d) If yes, what type of spread?	Bamboo mat/coir mat/ palmirah mat/others (specify)
	e) If raised platform, what type is used?	a) Cement platform. b) Steel frames. c) Wooden platform. d) Others (specify)
	f) If artificial drying, please indicate the type of dryer.	
	g) If mat is used, how frequently and hygienically is it washed?	

37. Period of sun drying

a) Unsalted fish

Species of fish		
Period of drying (in hours)	During summer season	
	During rainy season	

b) Salted fish

Species of fish		
Period of drying (in hours)	During summer season	
	During rainy season	

38. Please describe briefly the method of packing cured fish.

39. Where do you store the the cured fish. : In the curing yard/ other places (specify)

40. Please describe the method followed by you for storing cured fish?

41. What is the normal period of storage of cured fish before marketing?

a) Sun dried

b) Dry salted ....

c) Wet salted

d) Pickled ....

e) Others (specify)

42. Please give details of chemical treatment in fish followed by you.

Stage	Name of chemical	Method of treatment
Handling		
Preservation		
Salting		
Drying		
Packing		
Storage		

43. Do you pack dried fish in polythene bags as consumer packs? Yes/No

44. a) Do you follow bulk packing of cured fish in improved containers. Yes/No

    b) If yes, please give details.

45. How are you selling the cured fish?
    a) By taking to the market.
    b) Merchants come to the yard and take it.
    c) Both ways.

46. What are the constraints in different stages of fish curing faced by you?

Sl. No.	Stage	Constraints
1.	Handling and transportation	
2.	Sun drying	
3.	Dressing	
4.	Dry salting	
5.	Wet salting	
6.	Pickling	
7.	Storage	
8.	Packing	
9.	Marketing	
10.	Others (specify)	

47. What are the reasons for partial adoption or non-adoption of the improved fish curing practices? Please (✓) mark the following reasons wherever applicable.

a) Lack of credit facilities

b) Lack of subsidy, incentives etc.

c) Lack of organised set up for marketing cured fish.

d) Lack of ownership of the land where fish curing shed is built.

e) Lack of input supply.

f) High cost of equipments, utensils etc.

g) High labour charge.

h) Non-availability of electricity.

i) Non-availability of potable water.

j) Inadequate technical assistance.

k) Others (specify)

PART - II

1. According to you what are the facilities required for a modern fish curing yard?

2. (a) Have you heard of any improved method of cleaning. : Yes/No

   (b) If yes, what is it?

3. Do you know that potable water should be used for washing fish? If yes, please explain it.

4. (a) Do you know that water should be chlorinated? :

   (b) If yes, please give details. :

   (c) What is the optimum quantity of water to be used for curing one tonne of fish?

5. a) What is the importance of using detergents and disinfectants in fish curing yard?

   b) Have you heard of any such items to be used? Yes/No

   c) If yes, please explain

6. a) Have you heard of improved method of cleaning? Yes/No

   b) If yes, what is it? Do you follow it? If no, why? Yes/No

7. a) Why do you wash hygienically and frequently the mat used for drying fish?

   b) What is the optimum frequency of such washing?

8. What is the importance of using fresh fish for curing?

9. a) According to you what is the maximum time lapse admissible between landing and curing of fish

   b) How should the fish be stored during this period?

10. Fish cannot be exposed with out ice before curing, why?

11. What is the normal period of ice storage of fish?

12. a) Do you know the optimum ratio of fish:ice for storage? Yes/No

    b) If yes, what is it?

13. a) Do you know about proper washing of fresh fish? Yes/No

b) If yes, how is it?

14. What is the optimum number of washing of fish at different stages of handling and pre-processing?

15. Why do we properly dress and eviscerate fish for curing?

16. What is the importance of washing gutted fish before salting?

17. Dressing of fish should be done on clean table, why?

18. What is the quantity of good salt to be used for different sizes of fish and for different methods of curing?

19. What is the optimum period for different types of salting?

20. a) Is it necessary to salt fish in cement tanks or any other suitable containers? Yes/No

b) If yes, why?

21. Why do we cover salted fish to avoid flies?

22. What is the importance of removing self-brine from salted fish and adding fresh saturated brine in pickling?

23. a) Is it necessary to cover salted fish with sufficient quantity of brine in the case of pickling. Yes/No

    b) If yes, why?

24. a) Do you know any method for removal of urea from shark and other elasmobranch fish. Yes/No

    b) If yes, please explaim.

25. What will happen if salted fish is not rinsed before drying? How is it to be rinsed?

26. What are the merits and demerits of drying fish on ground, mat, raised platform and artificial dryer?

27. What is the optimum period of drying for different types of salted fish? What will happen if salted fish is not dried to the optimum level of moisture?

28. a) Do you know the defects, if platforms are not washed? Yes/No

    b) If yes, what are they?:

29. a) Have you heard of some chemicals which can be used in curing of fish? Yes/No

    b) If yes, please give details about the chemicals, the purpose and method of their use.

30. a) Do you know about packing of cured fish in improved containers and retail packs? Yes/No

    b) If yes, please explain.

31. a) What is the importance of proper storage of cured fish?

    b) What are the improved methods of storage?

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