

CMFRI bulletin 44

Part Three

FEBRUARY 1991



NATIONAL SYMPOSIUM ON RESEARCH AND DEVELOPMENT IN MARINE FISHERIES

MANDAPAM CAMP

16-18 September 1987

Papers Presented
Sessions V, VI & VII

CENTRAL MARINE FISHERIES RESEARCH INSTITUTE
(Indian Council of Agricultural Research)
P. B. No. 2704, E. R. G. Road, Cochin-682 031, India

Central Marine Fisheries Research Institute
40
YEARS
1947-1987

CMFRI

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Bulletins are issued periodically by Central Marine Fisheries Research Institute to interpret current knowledge in the various fields of research on marine fisheries and allied subjects in India.

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Cochin-682 031, India

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STATUS AND PROGRAMMES OF MARINE FISHERIES DEVELOPMENT AND MANAGEMENT IN LAKSHADWEEP

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ABSTRACT

Tuna and tuna like fishes of Indian seas which remain largely underexploited at present, held the greatest promise for development of fishing industry in India. The percentage composition of total tunas in the all India marine fish production ranged from 0.3 in 1970 to 1.36 in 1984-85. Lakshadweep a group of coral islands in the Arabian sea has got the distinction of being the only region in India where an organised fishery for tuna has been established in the small scale mechanised sector. Lakshadweep waters consisting of 20000 sq.kms. of territorial waters and 400000 sq.kms. of exclusive economic zone is potentially rich for tuna and shark. It is estimated that Lakshadweep waters support of fishable stock of 50000 tonnes of skipjack, 50000 tonnes of deep water tuna and allied species and 1 lakh tonnes of shark. Against this the present exploitation is 4807 tonnes of tuna in 1986 forming 87% of its total marine fish catch and around 16% of the total tuna catch of India. The principal gear employed is pole and line. Troll lines and hand lines form subsidiary gears.

The progress achieved in the fisheries sector of Lakshadweep is remarkable. From a meagre annual fish catch of 500 tonnes in 1960 the production has leaped to 5535 tonnes by 1986. Out of the total population of 42000 who are basically coconut growers about 5000 persons find employment in fisheries sector either directly or indirectly. The contribution of income from fisheries sector at current price is about Rs. 2.21 crores annually which works out to a per capita income of Rs. 527. The average catch of a pole and line tuna fishing boat is 70 tonnes worth Rs. 2.7 lakh for 6 months of operation in a year. The income per fisherman is worked out to Rs. 15000 for the said period.

These achievements were made possible due to proper planning and execution of fisheries developmental schemes during the past 25 years. The fisheries developmental activities in Lakshadweep started in the year 1959. Prior to this fishing was primitive with catch insufficient even for local consumption. Tuna was not caught in any island except Minicoy. Various schemes were drawn up and launched by the Deptt. of fisheries for the proper exploitation of the fishery resources of the area. As a result, the fish production gradually increased and by 1986 the fish catch registered 5535 tonnes. Introduction of mechanised boats, popularisation of pole and line, long line and troll line fishing, conducting experimental and demonstration fishing, training of manpower, setting up boat building yards, canning factory and workshops, issue of fishery requisites and oil, providing infrastructural facilities, research and development for the improvement of craft and gear were the important schemes taken up and implemented by the Deptt. of fisheries. The objectives and functions of the Deptt. and the history of fisheries development in Lakshadweep are explained in this paper.

INTRODUCTION

The 36 small islands and islets and submerged reefs lying scattered in the Arabian sea, 250 to 460 km off Cochin between 8° and 12°-30' latitude (north) and 71° and 74° longitude (east) form the Lakshadweep group of islands. Out of these only 10 are inhabited. This Union Terri-

tory having an area of 32 sq.km. is the smallest among all the States and Union Territories in India. But it is unique in terms of its water spread area. It possesses a lagoon area of 4200 sq.km, 20000km. of territorial waters and 400000 sq. km. of exclusive economic zone. According to 1981 census the population of Lakshadweep is

42000. The area of individual island ranges from 0.1 sq.km. to 4.8 sq.km.

Each island except Andrott has a lagoon on the western side with a sandy beach. Lagoons provide safe anchorages for small and medium size fishing boats. The islands are of coral formation. The lagoons and reef provide suitable coral habitat for innumerable varieties of animals and plants. Outside the lagoon the sea bottom steeply down abruptly leaving a very narrow rocky continental shelf.

The oceanic waters surrounding the islands are potentially rich in living resources such as tuna, shark and bill fishes. The area around the islands and submerged reefs are particularly rich in fishery resources, the important of which are (1) Agatti, (2) Bangaram, (3) Tinnakara, (4) Parali, (5) Perumulpur, (6) Pitty, (7) Suheli, (8) Bitra, (9) Cheriyaniam, (10) Valiyapaniam, (11) Kadmat, (12) Andrott, (13) Kalpeni, (14) Elikalpeni, (15) Minicoy.

Good fishing for skip jack in the above places is due to the high concentration of tuna shoals around.

BACKGROUND INFORMATION

The developmental activities in Lakshadweep received a real impetus after the area was formed into a Union Territory in the year 1956. A planned programme for the development of fisheries in Lakshadweep commenced with the establishment of a fisheries section in 1959. Prior to this, fishing in Lakshadweep was by primitive methods of harpooning and cast netting confined to lagoon and reef area with small rowing crafts. However, there existed a regular tuna pole and line fishery in Minicoy using rowing crafts known as 'Mas Odies'. In all other islands tuna fishing was unknown and fish catch was hardly sufficient even for daily consumption. The only source of income to the people was through coconut cultivation. The socio economic condition of the islanders had not undergone any change during the past many centuries. Palm leaf huts, few primitive fishing implements like harpoon and cast nets, superstitious belief, education limited to primary schools, majority below poverty line—these were the general nature of life style of the island community during early sixties.

A fisheries Department was set up at Kavaratti in 1959 under a fisheries Officer on deputation from Kerala state marked the beginning of the fisheries developmental activities in Lakshadweep. The objectives assigned to were:

- 1) to step up fish production,
- 2) motivate the people to take up modern methods of fishing by extension, education and training and by providing incentives,
- 3) to organize intensive surveys on marine fishery resources,
- 4) processing and marketing of fish.

After making a preliminary assessment of the nature and extent of the resources available, a strategy for the fisheries development of the area was chalked out. Appropriate fishing crafts and gear and fishing methods and processing were identified. The following schemes were introduced for the realisation of the objectives.

- 1) Introduction of mechanised fishing boats
- 2) Training of fishermen in modern methods of fishing and handling of mechanised fishing boats, both on the mainland and islands
- 3) Experimental fishing to locate fishing grounds and to determine appropriate fishing methods
- 4) Transfer of technology in fishing and processing
- 5) Issue of fishing boats to islanders
- 6) Establishment of boat building yards, workshops and processing units
- 7) Providing infrastructural facilities like Jetties, Marking Buoys etc.

A brief account of the implementation of each of the scheme mentioned above, problems encountered and how far they have succeeded in yielding the desired result are given in this paper.

INTRODUCTION OF MECHANISED BOATS

This was the first step taken by the Deptt. after its formation in 1959. As the existing indigenous crafts were found not suitable for installation of inboard engines, small mechanised boats from mainland were procured. The first 9.14 metres long mechanised boats were introduced in the year 1959 at Kavaratti. There was much opposition from the local fishermen especially from Minicoy against mechanisation. They feared that the sound produced by the engine would frighten away tuna shoals and claimed that mechanisation would be a failure in pole and line fishing. But practical demonstration in pole and line fishing with mechanised boats in the year 1962 had proved that their fear was not real. There was immediate demand for boats and to meet this 39 mechanised boats were procured from mainland. These boats were open type pablo boats of size 7.62 and 9.14 metres.

Transfer of Technology

In Minicoy the traditional pole and line tuna fishing employing indigeneous sailing crafts called 'mas Odies' was in vogue since about a century with an average annual catch of about 300 tonnes. In 1962 the mechanised boats introduced by the Deptt. for pole and line fishing was proved a tremendous success. But in other islands fishing continued to be the traditional harpooning for shark and bill fishes with practically no fishing for tuna. Transfer of technology of pole and line fishing available in Minicoy to other islands was therefore to be taken on priority basis.

Demonstration Fishing Units

In order to accomplish the task of transfer of technology Depttl. fishing units were set up in all the islands. The first demonstration tuna fishing vessel was introduced in Agatti in the year 1963 which was a mas odi (indigeneous sailing craft of Minicoy). The mas odi was soon replaced by mechanised boats of size 9.14 m. Local fishermen were given intensive training in tuna fishing under the guidance of experts recruited from Minicoy. Simultaneously local people were recruited as fishermen to work in Depttl. boats to accelerate the process.

Fishermen by nature are, as they are everywhere, very conservative and to prevail on them to accept any thing new is a onerous task. They would believe that what the depttl. personnel had developed was a low cost technology most suitable for harvesting the tuna resources. So the Deptt. had to intensify motivation through extension and education. As incentive, liberalised subsidy (100% on cost of engines and 50% on hull) was offered in the issue of boats at the initial stages. The number tuna catches landed by the demonstration fishing boats could create great enthusiasm among the islanders and confidence in taking up tuna fishing as a vocation. By 1975 pole and line technique was picked up in all the islands and consequently the demonstration programme was wound up.

Training of Personnel

Success of implementation of any programme however prudently and scientifically conceived, depends mainly on the skill of the personnels who are involved in it. To the local fishermen of Lakshadweep operation of mechanised boats and fishing with them were the two different fields in which they were new. Hence

when the programmes of mechanisation of fishing crafts was taken up it was felt necessary to make the fishermen trained in the field. In order to fulfil this objective a fishermen training programme was organised in 1959 in which local fishermen were trained in the running and maintenance of mechanised boats, fabrication and mending of fishing gear, fishing with trolling and pole and line and long line and fish curing with salt. This training course of 6 months duration which was continued upto 1968 produced 209 trained hands. Later on the training programme was institutionalised by establishing a Fishermen Training Centre in 1972 at Minicoy. So far 300 persons have been trained in the fishermen training centre. Apart from giving training to local people of Lakshadweep, the fisheries department gave practical training in pole and line fishing to fishermen deputed by Andaman and Nicobar administration during 1977. Trained technical hands to spearhead various developmental schemes was an important necessity. To meet this requirement, 88 officials were got trained in different disciplines at various fisheries institutions like CIFNET, CIFE, etc. Table 1. gives details of technical manpower available with the Deptt.

Mechanised Boat on Subsidy

The programme of mechanisation was launched by the Deptt in order to step up fish production by the exploitation of the rich tuna and shark resources. Though the response from the islanders towards mechanisation was not encouraging during initial stages the Deptt was able to overcome the situation gradually, through extension, education, demonstration and various kinds of incentives including liberalised subsidy schemes. Under this scheme of "issue of mechanised boats to fishermen" boats are issued on subsidised cost repayable in monthly instalments within a period of 9 years. In the beginning the subsidy allowed was @ 100% on the cost of the engine and 25% on the cost of the hull. By 1968 the scheme become popular and Govt. of India reduced the rate of subsidy in stages. The present rate is 33 1/3% on the cost of engine and 20% on the cost of the hull. So for under the scheme 312 Nos of boats have been issued by the Deptt. to local fishermen. The details of islandwise issue of boats are given in Table 2. This is the major scheme launched by the Deptt. Which made remarkable impact on

Table 1. Availability of Trained Manpower for the Fishery

Sector in Lakshadweep

Sl. No.	Description of Training	No. of people trained	
1.	Fishermen trained at Beypore	12	
2.	Fishermen trained at department boat in islands	209	
3.	Fishermen trained in shark liver/oil extraction, Calicut	4	
4.	Tuna-lognline (Deepsea fishing) at Cochin	2	
5.	Beach-de-mer Extraction and flying fish fishing operation at Nagapatnam, Madras	2	
6.	Carpenters - Brunton and Company, Cochin	2	
7.	Training in boat building, Kakinada	1	
8.	M.P.P.T.C.,Mangalore-Training in fish processing	1	
9.	Shore mechanics I.N.P., Cochin	14	
10.	Post Graduate diploma in fishery science at Central Institute of Fisheries Education, Bombay	13	
11.	Training in repair and maintainances of out board engine at Cochin	4	
12.	No. of persons trained in fishermen Training Center, Kadmath	152	
13.	Fishing second hand/Mate fishing vessel course at CIFNET Cochin	27	
14.	Engine driver Course at CIFNET, Cochin	15	
15.	Boat building forman course at	-do-	3
16.	Shore mechanics course at	-do-	5
17.	Gear technician course at	-do-	1
18.	Radio telephone operators course	-do-	2
19.	Teacher training course at	-do-	1
	Total	470	

the socio economic condition of the islanders. In proportion with the increase in the number of boats the total fish landings also shot up to new

heights. Table 3 and 4 shows the yearwise fish landings from 1972 to 1986.

Table 2. Island-wise number of boats in Lakshadweep in 1986

Islands	Pole and line	Long line	Troll line	Engged For shipping purposes	Total
Agatti	51	6	-	6	63
Amini	2	2	19	10	33
Androth	-	-	34	-	34
Bitra	10	-	-	-	10
Chetlat	-	4	12	5	21
Kadmth	-	3	5	10	18
Kalpeni	-	-	5	10	15
Kavaratti	16	-	15	16	47
Kiltan	-	-	16	12	28
Minicoy	35	-	-	5	40
Total	114	15	106	74	309

Mechanisation of Indegenous Crafts

Simultaneous with the issue of mechanised fishing boats facilities were extended to the fishermen by the Deptt to mechanise the traditional fishing vessels of Minicoy by inboard engines. The small country crafts of other islands were supplied with outboard motors at subsidised cost. So far 250 outboard motors have been issued for mechanisation of small crafts through the Deptt. and IRDP. These outboard fitted crafts are being used for troll line operation and lagoon fishing.

Fishery Requisites on Subsidy

While popularising fishing by mechansied boats it was necessary for the local fishermen convinced of the efficiency of various types of essential fishery requisites like nylon twin, monifilament, etc. In order to make these goods available they were issued at subsidised cost through fisheries units in all the inhabited islands. The

scheme served very well, far, allowing the subsidy, though it was discontinued when it was popular and fishermen were financially capable of buying at actual cost.

HSD Lubricating Oil

The supply of HSD oil required for operation of fishing boats was carried out by the Deptt. from the very beginning of mechanisation. In the absence of diesel oil outlets by Petroleum Companys as on the mainland, the work of purchase and supply of HSD and lub oil is still done by the Deptt of Fisheries. A subsidy of 30 paise per litre of HSD is given to the fishermen.

EXPLORATORY FISHING

Besides the rich skip jack resources, Lakshadweep waters is rich in sharks and deep swimming tunas. In order to have an assessment of the potential and to locate rich fishing grounds the Deptt of fisheries started long line operation using 11.60 metres long boats in the year 1966. The exploratory fishing conducted during

Table 3. *Island wise year wise tuna landings in Lakshadweep 1972 - 86 (in tonnes)*

Year	Agatti	Amini	Androth	Bitra	Chetlat	Kadmth	Kalpeni	Kavaratti	Kiltan	Minicoy	Suheli	Annual	Total
1972	136	7	49	5	23	26	12	35	4	217	-	513	
1973	419	24	26	84	16	18	8	28	24	375	-	1021	
1974	518	32	60	116	77	32	14	45	28	333	-	1254	
1975	718	79	69	79	238	61	45	76	32	542	-	1932	
1976	542	44	33	103	39	37	54	70	39	330	-	1291	
1977	392	67	72	49	14	40	30	62	19	420	-	1166	
1978	899	64	173	92	36	49	21	211	19	311	-	1875	
1979	1314	72	303	118	116	100	62	207	86	415	-	2794	
1980	490	46	179	104	32	43	27	150	54	644	-	1760	
1981	820	81	196	126	38	37	41	395	23	485	-	2236	
1982	550	77	243	345	48	38	63	150	102	427	821	2966	
1983	731	53	283	166	96	36	59	164	55	273	1121	3037	
1984	2000	110	210	140	129	58	48	111	93	615	798	4313	
1985	2013	123	183	185	329	113	133	118	173	289	116	3774	
1986	1936	91	334	526	151	39	134	273	103	946	274	4807	

Table 4. Yearwise Specieswise Fish Landings in Lakshadweep 1972-86 (in tonnes)

Name of species	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Barracuda	7.5	11.6	17.2	17.4	20.8	14.9	17.9	10.8	13.7	12.5	10.5	21.1	13.9	8.0	7.6
Coral fish	21.4	29.9	40.6	42.3	53.6	51.1	35.1	31.9	28.8	22.9	26.9	19.9	21.9	6.6	13.9
Caranx	29.7	63.1	60.9	60.9	94.3	65.2	59.6	57.9	77.8	104.9	88.7	59.2	45.2	49.6	51.1
Flying fish	17.5	42.4	43.1	29.6	41.8	29.9	33.6	15.8	28.9	15.5	24.9	29.5	15.4	6.3	13.2
Gar fish	18.8	49.8	26.9	29.1	34.1	57.9	144.2	100.9	99.1	112.9	87.1	100.1	61.8	38.9	42.6
Goat fish	13.1	37.0	32.8	33.1	58.3	29.1	27.2	27.1	26.9	25.1	27.1	33.3	24.3	28.3	45.9
Octopus	17.1	20.0	15.8	18.9	39.8	23.3	19.7	15.6	11.0	14.3	22.3	12.6	13.6	11.1	10.9
Perches	72.3	112.6	132.9	116.7	192.4	154.9	127.1	127.3	250.8	221.8	230.1	257.5	115.3	63.8	71.9
Ray	81.2	75.8	88.7	158.9	151.8	133.6	29.2	171.5	58.7	21.5	18.6	71.8	88.7	70.8	37.0
Rainbow Runner	10.9	15.9	25.8	25.4	49.0	56.5	36.1	76.2	125.7	93.5	126.2	92.2	68.5	44.9	36.5
Sail fish	41.9	51.5	58.3	42.9	29.0	24.5	13.9	15.9	13.3	17.2	42.4	37.3	41.5	73.5	45.3
Seer fish	50.2	77.5	90.9	65.9	85.7	41.5	41.3	23.9	21.4	49.7	99.5	63.1	58.7	58.5	36.3
Shark	76.4	94.1	163.0	157.3	201.4	161.9	168.7	192.5	225.4	188.9	220.3	253.1	198.2	156.9	97.5
Trigger fish	8.4	14.5	6.9	8.9	5.1	7.5	7.4	4.6	3.6	7.4	6.8	9.8	6.9	18.1	9.7
Tuna	513.3	1021.5	1254.9	1932.1	1290.9	1165.5	1874.9	2794.3	1756.9	2236.4	2965.9	3036.7	4312.9	3774.8	4807.2
Miscellaneous	101.7	136.6	173.1	165.1	223.4	197.2	143.9	179.7	162.3	155.9	209.0	203.7	244.3	219.5	209.5
Total	1081.2	1853.7	2231.8	2905.4	2571.5	2214.5	2780.3	3845.8	2906.7	3300.3	4201.2	4300.7	5330.7	4625.5	5535.7

Table 5. Result of Longline operation by the Departmental 30 and 38 footer near the islands of Agatti
and Kadamath and submerged reef of Valiyapani

Station/Months of operation	Depth of operation (in M)	Sharks		Total weight (kg)	Catch/ 100 hooks	Average wt (kg)	No.	Otherfishes Total weight (kg)
		No.of hooks	No.					
1. March / April 1971	30	1010	119	5455	11.8	45.8	4	181
2. November / December, 71 and February, 72	30	570	42	2275	7.4	54.2	Nil	Nil
3. February / March, 1972	30	680	48	2517	7.1	52.5	Nil	Nil
4. April / May, 1972	30	645	38	2415	6.0	63.6	Nil	Nil
5. November / December, 72 and January, 73	110	1330	110	7606	8.3	70.0	4	239
6. March and April, 73	110	1972	131	8489	7.3	65.0	Nil	Nil
7. February, 73	110	485	56	2369	11.6	42.0	3	162
Total		6512	544	31126			11	582
Average					8.4	57.2		

the period 1965-75 around Agatti, Kadmat and submerged reefs of Valiyapani at a depth of 30 to 110 meters disclosed that Lakshadweep waters can support a rich and sustained fishery for shark. The average hooking rate was 8.4% which was comparable to the best. The average weight of one shark was 57 kgs. The results of long line operation is given in Table 5. Since most of the parts of the sharks can be profitably utilised the long line operation was proved highly economical. The long line operated by the Deptt was of Japanese specification meant for catching deep water tuna. But 95% of the catch constituted shark. Gradually this fishing method was popularised and at present there are 15 boats operating long line on regular basis.

Long Line Gear on Subsidy

When the long line fishing operation was proved a success, steps were initiated by the Deptt to popularise this gear among fishermen. As a part of the promotional efforts the Deptt supplied long line gear fabrication materials to promising fishermen on subsidy.

CONSTRUCTION OF MECHANISED BOATS

The demonstration fishing, issue of mechanised boats on subsidised cost and various other incentives, provided the required stimulus for growth of the fishing industry. During the initial period i.e. from 1959 to 1965 boats were purchased from mainland to meet the requirements of the fishermen. In order to keep pace with the growing demand of boats and to provide employment to the local talents in carpentry profitably a boat building yard was established in Kavaratti in the year 1963. The yard provided employment to 50 persons. So far 153 boats of sizes 7.62, 9.14 and 11.6 metres have been launched from this yard. The demand for mechanised boats was increasing and to meet this the second boat building yard was established in the years 1974 at Chetlat. A total of 119 boats have been constructed from this yard.

SETTING UP OF WORKSHOPS

Repairs to fishing boats are to be attended promptly so as to minimise loss of fishing days. Taking engines to mainland every time for repairs is not practical due to high cost of transport and local facilities had to be built up and the first fisheries workshop was started in Kavaratti in 1961.

This was followed by workshops in all the inhabited islands equipped with essential machinery. These workshops are a real boon to the fishermen.

SUPPLY OF SPARE PARTS

Lakshadweep being a remote area where there are no marine engine spare parts dealer, the responsibility of purchase and supply of these items to fishermen is also vested with the Fisheries Deptt.

FISH CURING

The demonstration of curing shark and processing tuna was undertaken by the Deptt in all islands by constructing curing yards and smoking kilns. Prior to sixties sun drying without salt was employed for curing fishes, other than tuna and salt curing method was unknown. In order to popularise salt curing, demonstration programmes in scientific way of salt curing was organised by the Deptt. Simultaneously a scheme to issue salt to fishermen on subsidy was also formulated. Salt curing of fish is now very popular in all the islands.

SETTING UP OF CANNING FACTORY

As a result of implementation of various developmental schemes the production of tuna in island went up substantially which necessitated appropriate modifications in the post harvest technology also. The entire tuna caught in the island was processed into a dried smoked product called 'mas' which has a shelf life of about one year. In order to have a sophisticated product out of tuna acceptable to both internal and foreign markets a pilot canning plant was set up at Agatti in the year 1963. As the pilot plant was found successful action was initiated for the establishment of a canning factory at Minicoy. The tuna canning factory with a production capacity of 10000 cans per day with an ice plant of 5 tonnes and a cold storage of 20 tonnes capacity was commissioned in the year 1969. The produce from this factory is well received both in home and foreign markets. The present production in the factory is around 1,25,000 cans during a season. The factory has opened avenues of employment to 50 persons directly. This is the only tuna factory in India exclusively for tuna. In spite of various constraints the factory has been able to keep up the production targets throughout the period. The production during the last five years is given in Table 6.

Table 6 The Production and sales of the minicoy canning factory 1980-86

YEAR	PRODUCTION	
1981-82	51,976	Cans
1882-83	76,050	"
1983-84	75,752	"
1984-85	1,22,012	"
1985-86	1,09,985	"
TOTAL	4,35,775	"

MARKETING AND PROCUREMENT

Lakshadweep has to depend on mainland for almost all of its day to day requirements. A supply and marketing wing was therefore established in Cochin in the year 1973 to cater the needs of the Fisheries Deptt. Purchase and supply of stores required for running boat building yards, canning factory and work shops, purchase and supply of spares and fuel required for sale to fishermen, marketing of tuna cans are the important functions discharged by this office at Cochin.

INFRASTRUCTURAL FACILITIES

The Deptt. of fisheries has diverted its attention for providing adequate infrastructural facilities to support the industry. Jetties have been constructed in important islands. One slipway installed at Kavaratti is used for hauling up/launching of boats. Oil storage tanks are installed in all the islands for supply of oil to fishing boats.

Submerged reefs and sand beaks like Valiyapani, Cheriyanpani are rich fishing grounds. But only few boats venture to go to these areas for fishing for want of navigational aids and processing facilities. The Deptt. has recently provided marking buoys at Valiyapani and Cheriyanpani to make these places easily accessible to boats. A concrete platform has also been made at Valiyapani to be utilised for fish processing works and for resting. Such facilities for other places are also proposed in the 7th plan.

COLLECTION OF STATISTICAL DATA

Statistics is a powerful tool to evaluate the performance of an industry and to formulate developmental policies. Recognising its significance in the planning process, a well organised

statistical wing has been set up in the Deptt as early in sixtees consisting of a net work of collection centres with Field Assts, Statistical Asst and technical officers. In Lakshadweep daily fish landing data are collected from each craft at the landing site by complete enumeration and not by random sampling. Because of this complete enumeration system, the statistical data on fish landings of Lakshadweep bear greater degree of accuracy. The daily fish landing data craftwise, gearwise and species wise-are collected by the field assistants posted in each island. The data collected are sent to the headquarters at the end of every month and tabulated, analysed and interpreted by the statistical wing of the fisheries directorate. Quarterly bulletins on fish landings are prepared and released regularly from the Directorate.

DIVERSIFICATION IN FISHING

The importance of pole and line as a commercial gear for the exploitation of tuna resources was soon recognised by the industry. Since tuna fishing season was confined to few months in a year the need for a diversification in fishing efforts was felt. The troll line, an effective gear for seer fish, tuna, bill fishes and barracuda and long line for sharks were the two gears introduced by the Deptt. to achieve the goal of diversification. In Andrott, Kiltan, Chetlat and Kadmat the main fishing gear used is troll line. The types of fishing gear employed in different islands are given in Table 2.

EXPERIMENTS ON MARICULTURE

Deptt has also made attempts in the field of mariculture which has assumed much popularity in recent years. Attempt was made by

the Deptt to culture mussel in Kavaratti lagoon. About 2000 mussel spats were transported from Calicut to Kavaratti during August, 1974 for trial culture adopting the rope culture method demonstrated by CMFRI Cochin in the summer Institute held in 1974. But the attempts did not succeed. Attack from predatory fishes, lack of adequate plankton, absence of suitable culture sites in the lagoon protected from wind and wave action are some of the reasons attributed to the culture failure.

Pearl oyster culture on an experimental basis was started at Kavaratti in the year 1981 when the occurrence of oyster spats '*Pinctada fucata*' was noticed on the reefs of the islands. The spats were collected from the reef during low tides and were reared in plastic buckets which were kept suspended from the rafts moored in lagoon. The culture operation was then shifted to Bangaram island where more suitable sites without much wave action were located. Officials of the Deptt. were trained in the CMFRI. However, it was noticed later on that only a very small percentage of the spats collected was of pearl oyster; both *P. fucata* and *P. margaritifera* were seen in small quantities. During 1985, four cultured pearls of size 4 mm to 7 mm have been produced in Bangaram. Shortage of spats of *Pinctada* spp. in the collection nearly failed the experiments. However, due to the timely help by the CMFRI by supplying *Pinctada fucata* from Tuticorin Research Centre enabled the Deptt to continue the culture which is under progress.

SURVEY OF SEAWEED RESOURCES

Marine algal resources of Lakshadweep are quite large. They are found to grow profusely on the reefs and lagoons of all the islands in varying densities. According to the survey conducted on the algal resources by the Central salt and marine chemical Research Institute and the Deptt of Fisheries Lakshadweep, the estimated standing crops of the Agaro-phytes was 1540 tonnes. Out of 82 species collected during the survey, 60 species are found in estimable quantities. The estimated quantities of economic seaweeds are as follows:

<i>Gelidiella acerosa</i>	945	tonnes
<i>Gracilaria edulis</i>	420	"
<i>Gelidium rigidum</i>	75	"
<i>Geliopsis repens</i>	70	"

In contrast, the alginophytes resources are scarce - about 15 tonnes consisting of species of *Turbinaria* and *Sargassum*.

The Deptt has examined in detail the scope for commercial exploitation of the seaweeds and the feasibility of starting an agar agar plant in the island. But the proposal was dropped for want of techno-economic feasibility. Huge requirement of water, electrical power and fuel, problems in transportation of coal to the islands low rate of replenishment of the raw material after initial harvest were some constraints which discouraged the administration in going ahead with the agar agar project. Seaweeds form the major food of herbivores such as Surgeon fishes and turtles which are the dominant members of the lagoons ecosystem. It is feared that large scale exploitation of seaweeds may be disastrous to these organisms.

SURVEY OF HOLOTHURIANS

Many species of sea cucumbers are available in the lagoons of all the islands which are economically important for the Beche-de-mer industry. The occurrence of species as *Actinopyga mauritiana*, *Bohadsehia argus*, *Holothuria atra*, *Holothurianobilis*, and *Thelenota ananas* are found in varying densities in many islands. A survey of the resources was conducted by the Deptt. in collaboration with a private firm in Tamil Nadu during 1975-76. Though the firm could collect and process a large number of sea cucumbers it was found that resource is not abundant enough for a commercial venture.

EXPORT OF ORNAMENTAL FISHES

The multi coloured tropical coral fishes available in abundance in the island's lagoons and reefs offer promising export of ornamental fishes to west European countries. Lakshadweep fisheries department and Marine Products Export Development Authority, Cochin jointly undertook a survey of these resources in 1985 and as a pilot project undertook a survey of these resources in 1985 and as a pilot project some trial consignments of ornamental fishes have been exported to Netherland. The team identified more than 100 species of ornamental fishes belonging to 28 families-that could be exploited and marketed in Europe. Further a study team consisting of officials of MPEDA and Deptt of Fisheries Lakshadweep attended a training mission in Netherland in 1986 on packing and transportation of ornamental fishes. The trial consignment had a

mortality rate of 8% only on transit which is negligible and shows export is feasible. A scheme for export of these fishes has been submitted to the Ministry and sanction awaited.

IMPROVEMENTS IN CRAFT AND GEAR

The Deptt has succeeded in introducing the most suitable design of the craft to the fishing industry. Pole and line is the principal gear used in Lakshadweep. In order to increase the efficiency of the fishing technique new designs of the crafts were experimented to suit the peculiar nature of the area. Initially three types of boats were introduced by the Deptt. They were 9.14 m, 7.62 m. and the island pattern. Out of this 7.62 meters boat was found more suitable on account of its manoeuvrability in shallow reef conditions and low fuel consumption. Since this was found well acceptable to the industry attention was given for the production of these boats. During 1984 boat of 6 m long was introduced by the Deptt mainly for pole and line. This was a multi purpose low cost boat operated by 7 HP out board motor intended to meet the aim of one boat for each family. The boat is under trial run with different gears.

Live bait chumming and spraying water are two techniques employed in attracting tuna fish to aggregate around fishing boats in pole and line fishing. Two persons are now employed in a tuna fishing boat to spray water. This is not only hard but also inefficient. If mechanical spraying is introduced instead of hand spraying it will improve the efficiency of fishing considerably. A spraying mechanism was developed by the Deptt and it was inaugurated at Kavaratti on 15.8.84. Experimental pole and line fishing with mechanical sprayer conducted by the Deptt at Agatti during 1984 was a great success. This device is now accepted by the industry.

INTRODUCTION OF 'PAYAYOS'

The Deptt has succeeded in introducing artificial fish aggregates known as 'PAYAYOS'. During 1981 two aggregates were tried one each in Kavaratti and Agatti. The device was fabricated using empty oil barrels and coconut leaves. These experiments were successful. The aggregate at Kavaratti was drifted away and lost during monsoon. One moored at south west of Agatti is still maintained. Agatti fishermen regularly fish the tuna shoals congregating around it, by pole and line, troll line and hand line. Dolphin

fish, rainbow runners, and *Caranx* sp are other varieties caught.

REQUIREMENT OF RESEARCH SUPPORT

The success of pole and line fishing depends on the availability, catching and preservation of live baits in live condition. *Spratelloids* sp, *Chromis caeruleus*, *Caesio caeruleus*, *Apogon* sp are some of the bait fishes most commonly used. Fishermen almost fully depend on the lagoon for their live bait requirements. In islands other than Minicoy no scarcity for live baits has been felt so far and the species mostly dependent is *Spratelloides delicatulus* locally called 'Hondeli'. But as the number of fishing boats is increasing year by year there is proportional increase in demand for live bait. To meet this demand it will be necessary to find ways to produce more live bait which could be possible by creating artificial habitats. A scheme for this has been approved by the Govt of India and it will be implemented on experimental basis if proved successful.

ENVIRONMENTAL PROTECTION

The islands are nature's precious gifts. The beauty of the islands and fisheries development of the area depends on maintain the ecosystem of lagoon and reef. The bait fish which form the integral part of tuna fishery is collected from the lagoon. Realising the importance of the environmental protection the Deptt has taken action. Banning of unauthorised collection of corals and boulders, enforcing control over blasting and dredging are the major steps taken in this direction. Plans are under way to declare and maintain one or two of the island lagoons as National Marine Park.

ACHIEVEMENTS

The impact of the Fisheries developmental activities on the social and economic life of the islanders is quite significant. The main thrust of development was on augmenting fish production and economic uplift of the population. Both these objectives have been fulfilled. The fish production which was 500 tonnes in 1960 rose to 5535 tonnes in 1986 (Fig.1). The value of export dried fish rose from Rs.11.2 lakhs in 1972 to Rs. 1.94 crores in 1986. The production trend of fish indicate that there has been a growth in the total fish landing in Lakshadweep. The catch of tuna has increased even more rapidly (Table 3) during the same period, the average rate of growth being 18% per annum while the corresponding growth

of total fish landings during the same period being 7% per annum. Consequently the contribution of tuna in the total landings increased from 71% in 1982 to around 87% in 1986. This shows the domination of tuna fishery in the fishing industry of Lakshadweep.(Fig 2.)

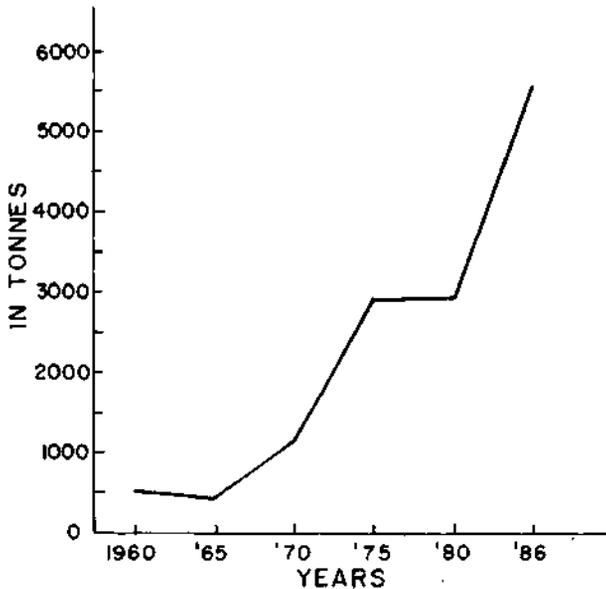


Fig. 1. Fish Landings in Lakshadweep 1960 - 86

■ Tuna	78.72
■ Caranx	1.21
■ Flying fish	0.37
■ Gar fish	1.38
■ Perches	3.09
□ Octopus	0.30
■ Ray	1.19
■ Rainbowrunner	1.53
■ Sail	1.00
■ Seer	1.32
■ Shark	3.86
■ Miscellaneous	6.03

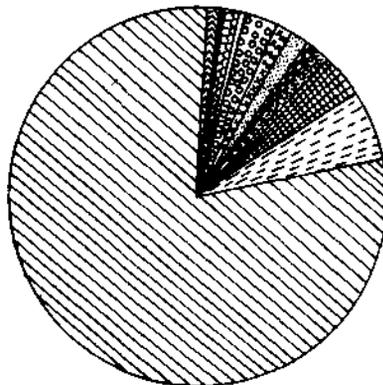


Fig. 2. Composition of fish catch in Lakshadweep based on averages for in years 1982 - 86

The comparative information on total all India tuna landings and tuna catch in Lakshadweep indicate that the contribution of Lakshadweep to the total tuna landings of India has increased from 3.7% in 1965 to around 16% in 1984. It is also significant to note that while the total tuna catch of

the country as a whole remained almost stagnant around the level of 19000 to 20000 tonnes per annum from 1980 to 1984, the tuna catch in Lakshadweep registered a conspicuous increase during the same period.

The emergence of four major pole and line fishing centres viz Agatti, Suheli, Bitra and Minicoy is a great achievement. The economic progress achieved by the people of these islands is quite enviable. The pole and line fishermen derive a high rate of returns which is not attainable from any other trade in the island. Out of the four centres, Agatti island is the most important one landing about 46% of the tuna caught in Lakshadweep. A comparative account of the total fishing efforts and catch per unit effort is given in Table 7. Highest CPUE is at Agatti (419 kgs) followed by Bitra (252 kgs) and Minicoy (179 kgs).

A case study of 15 pole and line fishing boats operated at Agatti during the year 1984 was conducted for the entire year to find out different items of input cost for fish production and the extend of profit gained by a boat. The study has revealed important findings. The capital investment required for the fishing gear and accessories excluding cost of boat is worked out as Rs.16660/-. All the items under variable cost such as fuel, consumption, repair charges, freight etc. shown in Table 8 are actuals collected during the survey. The average total cost of production including fishermen share (labour) was accounted to find out the net profit. The fishermen share constitute the share of 9 fishermen on board. (50% of the catch to the owner of the boat and 50% to the fishermen on board).

It is found that fishermen share accounted for 77.8% of the total variable cost. This cost would have come down if the boat introduced mechanical water sprayers for chumming. Fuel accounted for only 9.1% of the total operational cost which is very low compared to boat operated in mainland. This is because of the engines of low HP employed in tuna fishing boat. Under miscellaneous items (Table 8) various costs such as commission, freight, refreshment etc. are included.

The average net profit of a boat owner after deducting fishermen share, variable cost and overhead charges is Rs.85590/-. The average total earnings per fishermen per fishing season of about 6 months is Rs. 14963/- i.e. a monthly income of Rs. 1247/-. Normally tuna fishing boats are purchased and operated on partnership by

Table 7. Comparative data on fishing effort and C P U E in major tuna landing centers of Lakshadweep for 1982 - 86

Years	AGATHI			MINICOY			BITRA		
	Total tuna catch (t)	Total efforts	Catch per unit effort (kg)	Total tuna catch (t)	Total efforts	Catch per unit effort (kg)	Total tuna catch (t)	Total effort	Catch per unit effort (kg)
1982	551	2038	270	353	2140	164	94	533	176
1983	731	1750	417	254	2298	110	188	969	194
1984	2054	4486	457	523	2670	195	179	939	190
1985	2013	4288	469	255	2597	98	142	627	226
1986	1937	4010	483	946	2878	328	526	1107	475
Average	-	-	419	-	-	179	-	-	252

Table 8. Details of operational cost and earnings of tuna fishing boats at Agatti for 1984

(A case study)

Name of boat	Capital cost in Rs.	Earnings per boat in Rs.	Total variable cost	Total overhead (interest & depreciation) in Rs.	Total cost (4+5)	Profit per boat in Rs.
1	2	3	4	5	6	7
Indira	75160	165800	117605	14856	132461	33339
Jupiter	64248	232940	146234	12875	159109	73821
Neptune	64248	325910	203713	12875	216588	109322
Sainaba	55204	206608	136720	10803	147523	59085
Badrinath	48082	281674	183566	5047	188613	93061
Siddikkal Akbar	60404	337333	214610	13582	228192	109141
Gadapani	55204	368528	228484	9909	238393	130135
Pollack	48237	222630	150885	5662	156547	66083
Kadeeja	55204	308695	202155	10801	212956	95739
Aynama	70404	257940	163707	14083	177790	80150
Hajara	55204	263088	168041	10803	178844	84244
Punjab	51117	260800	162656	5199	167855	92945
Total		3231946	2078376	126495	2204871	1027075
Average per boat		269329	173198	10541	183739	85590

2-3 persons. If all the fishermen of the boat are (9 persons) co-owners of the boat, the fishermen share need not be taken into account to compute the net profit. In that case the average net income per fishermen per fishing season is worked to Rs. 24473/-. The above study indicates that tuna fishing operation is a highly profitable enterprise to be taken up by a group of people.

By 25 years of developmental activities, the fisheries sector of Lakshadweep has grown into a major one providing the largest scope for self employment opportunities. Out of the total population of 42000 who are basically coconut growers, above 5000 people find employment in fisheries sector. The 313 Nos. of mechanised boats issued by the Deptt has given direct employment to about 3000 fishermen with attractive income. The establishment of ancillary industries such as boat building yards, canning factory, workshops, fish marketing etc have provided additional source of employment with lucrative income. The ultimate aim of any Govt. is the economic prosperity of its citizens. It is a matter of pride that this has been achieved as a result of fisheries development. A few islands as a whole and a sizable population in other islands have achieved economic self sufficiency by availing the avenues opened by the fisheries sector. The low cost diversified fishing methods such as troll lines, long line and gill nets introduced by the Deptt are being profitably employed in islands like Andrott, Amini and Kiltan where there is no scope for pole and line fishing.

The marine aquarium and museum set up by the deptt is the outcome of sustained efforts and dedicated team work of the staff of fisheries Deptt. Proper planning and execution coupled with resource availability has made the museum a major attraction with scope for research studies.

Resource surveys conducted by the Deptt have been helpful to study the feasibility of exploitation of seaweeds, octopus and lobsters. The exploratory fishing conducted by the Deptt have succeeded in locating rich fishing grounds for sharks. The Deptt has always been keen in increasing the efficiency of fishing. The innovation of 'Payayos' and mechanical water sprayers have been to the industry.

PROGRAMMES AND TARGETS FOR THE FUTURE

The small scale tuna fishery now existing in the islands can be further developed by increasing the strength of the boats and thereby landing more fish. However, shortage of man power to work more boats is the main constraint in the matter. The introduction of mechanical water sprayer will reduce the man power requirements in each pole and line fishing boat by 2 and with this savings more boats can be operated. The long term solution in this regard is to attract educated unemployed persons in the territory for fishing and serious efforts are made in this regard.

At present 774 tonnes of dried mas is produced from 4250 tonnes of fresh tuna in Lakshadweep. It is sold out in mainland and it fetches Rs.25-35 per kg. This product has long shelf life and excellent taste. It is possible to find a wider market and better price for this product by adopting hygienic method of production and modern packaging system. This will be an inducement for the fishermen to increase fishing efforts. Popularisation of mas should include demonstration of different recipes using mas in different parts of the country. Employment of a mobile snake bar with a market promotion unit is proposed to achieve this objective. Sanction of the Govt. of India on the scheme is already received and the scheme will be launching soon.

COMMERCIAL EXPLOITATION OF TUNA

The present production of 4800 tonnes of tuna from the small scale fishing sector cover only a fraction of the available resource. The bulk of the resource is beyond the operational range of the present small crafts. India has not yet made any attempt for the commercial exploitation of tuna of high seas despite high potential established. Tuna is a much sought after commodity in frozen form in foreign markets. The unexploited tuna resource are either getting perished or get migrated. So the urgent step to be taken is to start commercial operation by employing large purse seiners, pole and line vessel and long liners in collaboration with some foreign country to begin with. The Govt. of India has accepted the necessity of a fisheries development corporation for the above and final sanction is awaited.