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SAGAR SAMPADA AS A NATIONAL FACILITY FOR MARINE FISHERIES RESEARCH : WORK DONE AND FUTURE PROSPECTS

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ABSTRACT

The paper gives details on the salient features of the Fishery Oceanographic Research Vessel *Sagar Sampada* owned by the Department of Ocean Development and utilised by 24 different participating agencies. The scientific programme of the vessel is managed by the Central Marine Fisheries Research Institute under the Indian Council of Agricultural Research.

The major research objectives of the vessel in the disciplines of marine fisheries resources, primary and secondary production, oceanography and meteorology are given in detail. The utilisation of the vessel by the various user agencies since January, 1985 is discussed.

The results of work carried out by the vessel during the past four years by effecting 80% coverage of the Indian EEZ at depths beyond 50 m is summarised and given in terms of average catch per unit effort of demersal trawling for a total of seven selected known fishery resources such as threadfin bream, ribbon fish, lizard fish, barracuda, cat fish, Indian mackerel and deep sea lobster which are yet to be exploited commercially by the fishing industry at depths beyond 50 m. The paper also discusses the immense potentiality of another five selected under-exploited deepwater/oceanic resources viz., bull's eye, drift fish, scad, deep sea prawns and cuttle fish.

In what manner the results brought out by *Sagar Sampada* are different from information already brought out on similar resources by other government agencies is also highlighted in the paper. The future programmes of the vessel proposed during the eighth Five Year Plan are discussed in detail.

The paper also briefly summarises the achievements of the vessel in terms of development of fishing gear and post-harvest technology especially for selected under-exploited deep water resources.

The role played by the vessel in manpower development especially in creating the nucleus to build up the future manpower in this highly specialised field is also highlighted in the paper.

INTRODUCTION

The 71.5 m OAL multi-purpose Fishery and Oceanographic Research Vessel *Sagar Sampada* was constructed at the Dannebrog Shipyard Limited, Denmark under the Danish Assistance Programme to India and was delivered to the Dept. of Ocean Development, Govt. of India during November, 1984. The Danish International Development Agency (DANIDA) provided the aid for the scientific equipments.

The Central Marine Fisheries Research Institute under the Indian Council of Agricultural Research is carrying out the responsibility of planning, co-ordination and implementation of the scientific programmes of the vessel. The vessel is manned by the Shipping Corporation of India.

Major research objectives

The FORV *Sagar Sampada* has been designed

for fisheries and oceanographic research in the Exclusive Economic Zone of India and the contiguous high seas. The vessel is ice strengthened to give support to India's Antarctic scientific programmes by working as far south as 60° S lat. FORV *Sagar Sampada* complements Oceanographic Research Vessel *Sagar Kanya* which is equipped for geoscientific, meteorological, physical and chemical oceanographic work by fulfilling the needs of onboard research on marine living organisms in relation to their environment.

Marine fisheries resources research is the principal function of the vessel. She is equipped for locating fish resources, assessing the extent of their distribution in time and space and quantifying the fish stocks in the column waters and on the sea bottom through the effective use of different types of fishing gear such as bottom trawls, pelagic and mid-water trawls and long line with the aid of modern

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underwater acoustics and electronic data processing systems. The data acquired through these integrated methods have a high degree of reliability in estimating the commercial fish stocks and also those which are under-exploited, non-conventional and new to the fishery. Besides, the vessel carries out directed research on spawning population/fishing grounds and also on young fish which are essential for fishery production, conservation and management of resources.

Oceanographic research which forms the integral part of marine fisheries research is the second programme of the operation of the vessel. The physical, chemical and biological factors which influence and control the quality and levels of primary, secondary and tertiary production, life history of fishes and studies on special features such as upwelling, convergence, deep scattering layer and marine pollution are also being investigated. Such wide ranging studies have been made possible onboard this vessel through automatic data acquisition system, water sampling and analysis of different parameters through sophisticated instruments.

Meteorological research forming part of oceanographic research is carried out in the vessel to understand the weather phenomena over the Indian Ocean and the subcontinent particularly the effect of monsoons and tropical cyclones on the water masses.

The Central Institute of Fisheries Technology under the Indian Council of Agricultural Research is entrusted with the responsibility of designing suitable fishing gear for the commercial exploitation of both conventional and nonconventional varieties of fishes, crustaceans and cephalopods from FORV *Sagar Sampada*.

Similarly, product development with special reference to fishery resources caught by *Sagar Sampada*, especially the non-conventional varieties of fishes and other marine life also form some of the significant activities of the vessel.

Performance

The FORV *Sagar Sampada* has completed 58 scientific cruises during the period January, 1985-February, 1989; 27 in the Arabian Sea and 31 in the Bay of Bengal within the Exclusive Economic Zone of the country beyond a depth of 40 m. During the above period the vessel made 10 coverages of the waters around Lakshadweep and Andaman & Nicobar islands based on national priorities. During

the 50 months of operation the vessel made representative coverage of almost 80% of the Exclusive Economic Zone of the country covering a total track distance of more than 2.3 lakhs line km, occupying over 1550 stations where meteorological, oceanographic, plankton and fishing data were collected.

Sea truth data collection in relation to studies on marine living resources conducted onboard for a total of around 1,000 days by more than 950 scientists and technical personnel representing 24 different user agencies brought to light some major findings on which further studies are being undertaken for obtaining confirmatory evidence.

Initially between January, 1985 and March, 1988 the vessel undertook an extensive survey of the Exclusive Economic Zone around the sub-continent with fixed stations for hydrography, plankton and fishing. These studies have thrown light on the large fluctuations noticed in the occurrence and abundance of selected deep water fishes and crustaceans. In order to understand the seasonal fluctuations, it was felt that the vessel should concentrate in specific areas for one year period. From April, 1988 onwards the vessel explored specific areas for a 'one-year' period at frequent intervals to study the seasonal fluctuations of various fishery resources which were found in abundance both exploited as well as under-exploited.

For the above purpose the Exclusive Economic Zone of the country was divided into six zones namely the northeast, southeast, northwest, southwest, Lakshadweep and Andaman & Nicobar waters. Taking into consideration the national priorities, the A & N waters were intensively studied during April, 1988 - February, 1989 while covering the northeast coast in alternate cruises. The programme for 1989-'90 envisages coverage of the southeast coast along with A & N area in alternate cruises.

It is proposed to cover the southwest and northwest coasts of the sub-continent in a similar manner with alternate coverages of the Lakshadweep area during the period 1990-'91 and 1991-'92 respectively. Thus by the middle of 1992 it is envisaged to complete the systematic exploration of the EEZ of the country, arcwise/seasonwise with the ultimate aim of locating and charting new or virgin fishing grounds for both exploited as well as underexploited varieties of fishes, crustaceans and cephalopods.

Procedure adopted for formulation/implementation of cruise programmes

The draft cruise proposals for FORV *Sagar Sampada* for one year period are prepared by a team of scientists/technical personnel from the Central Marine Fisheries Research Institute in consultation with the members of the working groups for fisheries and oceanography for FORV *Sagar Sampada* and presented at the working groups meeting which is held at CMFRI headquarters annually. The programmes as approved by the working groups are placed before the ICAR Co-ordination Committee under the Chairmanship of Deputy Director General (Fisheries), ICAR for necessary clearance and for placement before the Cruise Planning & Programmes Priorities Committee under the Chairmanship of Secretary, DOD, Govt. of India. The scientific programme of the vessel as approved by the above mentioned 3 committees are implemented by the CMFRI. Periodic reports with regard to progress in the implementation of the approved cruise programmes are sent to the Department of Ocean Development at regular intervals.

During the third phase of the operation of the vessel, it is planned to take up detailed studies on individual fishery resources by way of intensively covering specific areas where higher concentration of the particular resources was found from the earlier cruises. During the third phase, the *Sagar Sampada* would have generated necessary information which can be utilised ultimately for the commercial exploitation of specific resources. This will include already exploited conventional resources in the deeper waters and also those of the non-conventional varieties which are yet to be exploited from the deeper and off shore areas of the Indian Exclusive Economic Zone. During the third phase the results are to be tested through the operation of suitable fishing vessels/fishing gear for semi-commercial/commercial exploitation of the stocks.

Analysis, processing and dissemination of information collected by the vessel

During every cruise a total of 14 scientists/technical hands representing the different user agencies are posted onboard for collection of basic data. Two fishing masters and six fishing hands drawn from Central Marine Fisheries Research Institute and Central Institute of Fisheries Technology also participate in each cruise. The data collected in the different disciplines are compiled and submitted to Director,

CMFRI by the Chief Scientist of the cruise nominated for the purpose. Sea water/plankton/fish samples are analysed partly onboard and later in the shore laboratories of the respective institution. The plankton as well as fish samples are sorted and subjected to detailed study by specialist scientists at CMFRI. Similarly samples collected for the purpose of conducting processing experiments are also subjected to various tests at the shore laboratory of the Central Institute of Fisheries Technology. The preliminary results of each cruise are compiled in a standard format and brought out in consolidated preliminary reports of 10 cruises each immediately on completion of the cruises.

In order to utilise the data collected onboard to the fullest extent, specific work pertaining to these aspects are included in the various research projects of the participating agencies which will also ensure detailed studies on individual subject by specialists in the specific discipline.

In order to attempt an evaluation of the results which have accumulated during the first 4 years operation of the vessel, it was decided to conduct a workshop of all concerned scientists and technicians for effecting necessary changes/modifications in the data collection programmes by incorporating the same into the methodology of data collection and also to provide an opportunity for specialist scientist in the various disciplines to sort out some of the problems which they are facing at present and also to suggest ways and means to overcome these difficulties by mutual discussions. A workshop of this kind was organised at Cochin from 5th to 7th June, 1989. Individual specialist scientists were requested to prepare working paper based on results achieved on the basis of analysis and processing of relevant data already collected by them. Selected papers presented at the Workshop will be brought out in the form of a publication for the benefit of policy makers in the government, scientists working in the field elsewhere and also the fishing industry for undertaking commercial ventures on selected resources. Annexure - I gives details of participation by user agencies in the various cruises of FORV *Sagar Sampada* between January, 1985 and February, 1989.

It is worth mentioning in this context that for the first time a large number of young scientists drawn from different agencies could participate in the scientific cruises of a modern fishery oceanographic research vessel and gain experience in the

collection of sea truth data under various disciplines. This training component would form the nucleus for the future manpower requirement in the specialist's field. The success of this scheme has been very evident from the participation of large number of scientists and technical personnel in the various cruises.

FISHING RESULTS

Bottom trawling operations carried out by the vessel in the various fishing grounds surveyed employing different kinds of bottom trawling gear and expending a total of about 300 effective trawling hours revealed the existence of the following major fishery resources which are available in sufficient quantities for commercial exploitation beyond 40 m depth range.

EXPLOITED RESOURCES OFFERING SCOPE FOR INCREASED PRODUCTION

1. **Threadfin bream** (*Nemipterus* sp.): Average CPUE was between 0.65 and 3.5 tonnes per hour of trawling. Comparatively rich grounds were located off Kerala (June, July), off Karnataka (July), Wadge Bank (July, August) and off Gujarat (September-November) upto a maximum depth of 100 m.

2. **Ribbonfish** (*Trichiurus* sp.): Average catch rate varied between 0.9 and 1.9 tonnes per hour of trawling. Rich grounds were located mainly off Gujarat (September-November) upto a maximum depth of 68 m.

3. **Lizard fish** (*Saurida* sp.): Average CPUE varied between 0.25 and 0.95 tonnes per hour of trawling. Comparatively rich grounds were located mainly off Kerala coast (June) upto a maximum depth of 63 m.

4. **Barracuda** (*Sphyraena* sp.): Average CPUE varied between 0.3 and 4.67 tonnes per hour of trawling. Comparatively rich grounds were located in the Wadge Bank (June-August) and off Maharashtra coast (September, October) upto a maximum depth of 70 m.

5. **Catfish** (*Tachysurus* sp.): Mean catch rate was 2.4 tonnes per hour of trawling. Comparatively rich grounds were located mainly off Kerala coast upto a maximum depth of 50 m during June.

6. **Indian mackerel** (*Rastrelliger kanagaruta*): Average CPUE varied between 1.47 and 2.85 tonnes per hour of trawling. Comparatively rich grounds were located mainly off Orissa coast at a depth of

70 m during October.

7. **Deepsea lobster** (*Puerulus sewelli*): Average CPUE varied between 0.1 and 0.25 tonnes/hour of trawling. Comparatively rich grounds were located mainly in the Quilon Bank off the Kerala coast at depths between 130 and 770 m (December, January).

UNDER EXPLOITED DEEP WATER AND OCEANIC RESOURCES

8. **Bull's eye** (*Priacanthus* sp.): Average CPUE was between 0.8 and 4.9 tonnes per hour of trawling. Comparatively rich grounds were located in the Wadge Bank (August), off Goa (September) and off Andhra Pradesh (September) upto a maximum depth of 120 m.

9. **Drift fish** (*Psenes indicus*): Average CPUE was 7.5 tonnes per hour of trawling. Comparatively rich grounds were located mainly along northeast coast at depths between 62 and 68 m in February.

10. **Scad** (*Decapterus russelli*): Average CPUE of 6 tonnes per hour of trawling was recorded. Comparatively rich grounds were located mainly along northeast coast at depths between 60 and 70 m in February.

11. **Deepsea prawns** (*Pontocaris* sp., *Parapandalus* sp., *Aristaeus* sp.): Average CPUE was 0.62 tonnes per hour of trawling. Comparatively rich grounds were located mainly in the Quilon Bank off Kerala coast at depths between 130 and 770 m (December-February).

12. **Cuttlefish** (*Sepia* sp.): Mean catch rate was 1 tonne per hour of trawling. Comparatively rich grounds were located off Karnataka coast at a depth of about 200 m (November).

The observations made by FORV *Sagar Sampada* threw light on the immense potentiality of the deeper and oceanic waters beyond 50 m depth, especially the abundance of fishable concentrations of under exploited deep water resources such as bull's eye, driftfish, scad and deepsea prawns. The studies also revealed the existence of fishable concentrations of resources such as threadfin bream, ribbon fish, lizardfish, barracuda, catfish and the Indian mackerel in deeper waters beyond 50 m.

The observations also confirmed the availability of fairly rich grounds for deep sea lobster in the Quilon Bank off Kerala coast at depths between 130 and 770 m during December, January and also for

TABLE 1. Participation by user agencies in the various cruises of FORV Sagar Sampada between January, 1985 and February, 1989

Name of user agency	No. of participants
1. Central Marine Fisheries Research Institute (ICAR)	556
2. Central Institute of Fisheries Technology (ICAR)	221
3. Madras University	27
4. Annamalai University	22
5. Indian Institute of Technology, Madras	19
6. National Institute of Oceanography (CSIR)	13
7. Zoological Survey of India	12
8. Fishery Survey of India	11
9. Andhra University	11
10. Cochin University of Science & Technology	8
11. National Remote Sensing Agency	8
12. Central Institute of Fisheries Education (ICAR)	7
13. Kerala University	7
14. Naval Physical & Oceanographic Laboratory, Cochin	4
15. Vikram University	4
16. Lakshadweep Fisheries Department	4
17. Berhampur University	3
18. Central Agricultural Research Institute, Port Blair (ICAR)	2
19. Konkan Krishi Vidyalaya	2
20. Fisheries College, Mangalore (UAS)	2
21. Indian Institute of Technology, Bombay	2
22. Fisheries College, Cochin (KAU)	2
23. Space Application Centre	2
24. Fisheries College, Tuticorin (TNAU)	1
TOTAL	950

cuttlefish off Karnataka at a depth of about 200 m during November.

DEVELOPMENT OF FISHING GEAR

While attempting to design suitable indigenous fishing gears for the commercial exploitation of the deep sea demersal resources of the Indian EEZ, the vessel introduced the concept of high speed demersal trawling, as the basis of future developmental activities. The Central Institute of Fisheries Technology designed, fabricated and tested three high speed demersal trawls viz., CIFT High Speed Demersal Trawl No. I, No. II and No. III with distinctive features. The performance of the gears was encouraging and record catches of 10, 8 and 12 t/hour respectively for CIFT HSDT I, II and III were obtained from the Wadge Bank and Quilon Bank.

Between June, 1986 and February, 1988, the CIFT HSDT series have caught 142.77 t of fish in 132 hours of trawling resulting in an average catch of 1.1

t/hour. However, the pre-commercial feasibility studies of the HSDT series, landed 111 t in 52 hours with an overall average of 2.1 t/hour.

The record catches were made possible due to the relatively high speed of trawling (3.5 and 4.5 knots/hour). Side by side with the field trials of the HSDT series, combination wire ropes were tested in the actual field operations by rigging the high speed trawls. This has led to the development of a standard combination wire rope comparable with imported wire ropes. The commercial production has been already taken up by M/s Usha Martin Industries, Calcutta paving the way for import substitution.

Where all the imported bobbin trawls failed, the one developed at CIFT has proved a great success in the trial fishing conducted in December, 1987 along the rocky Wadge Bank area of the southwest coast, with a maximum catch of 1.75 t/hour consisting of rock cods and perches.

Considering the cost factor, when each imported demersal trawl of *Sagar Sampada* costs nearly Rs. 1.25 lakhs, the cost of one HSDT developed by CIFT is between Rs. 50,000/- and Rs. 60,000/-.

DEVELOPMENT ON POST-HARVEST TECHNOLOGY

Suitable methods and technologies are being devised for the proper preservation onboard and onshore laboratories of these 12 varieties of fishes caught during the cruises of FORV *Sagar Sampada*, by CIFT and on perfection, these techniques will help the industry to adopt the preservation techniques before they are marketed.

Freezing characteristics of several deepsea species like *Priacanthus* sp., *Pseneopsis* sp., *Elacate* sp., rock cod, oceanic squid and cuttlefish were studied and the frozen shelf-life of different species were estimated as follows:

<i>Pseneopsis</i> sp.	32 weeks
<i>Elacate</i> sp.	9 to 10 months
<i>Priacanthus</i> sp.	12 months

Delayed icing for rock cod from 5 to 10 hours at ambient temperature and frozen had a shelf-life of 17, 15 and 10 months at -22°C and oceanic squids 18-19 months at -22°C .

Till recently trawling operations were undertaken mostly within 50 m depth range in the coastal waters using comparatively smaller vessels except for observations made by a few of the larger vessels of the Fishery Survey of India, Central Institute of Fisheries Nautical & Engineering Training and Integrated Fisheries Project of the Govt. of India. Based on these results the industry also concentrated their effort in a narrow coastal belt mainly for the exploitation of shrimp because of its high export value.

The observations made by FORV *Sagar Sampada* threw light on the immense potentiality of the deeper waters beyond 50m depth. In terms of fish-

able concentrations, the survey produced formal evidence with regard to availability of a particular resource for fishing in space and time the survey carried out by the vessel during the last four years could identify areas of fish abundance in the deeper waters especially with respect to a total of 10 major varieties which are yet to be exploited commercially from the deeper waters.

MANPOWER DEVELOPMENT

So far a total of 950 scientists and technical personnel representing 24 different user agencies and Research Fellows and Associates of the DOD received training in the collection and analysis of meteorological, oceanographic, plankton and fishing data out at sea using modern standard equipments.

For the first time a large number of young scientists drawn from different agencies could participate in the scientific cruises of a modern fishery oceanographic research vessel and gain experience in sea truth data collection under various disciplines. This training component would form the nucleus for the future manpower requirements in this specialised field. The success of this scheme is very evident from the participation of large number of scientists and technical personnel and also from the achievements given in the foregoing paragraphs.

Based on the achievements of FORV *Sagar Sampada* during the past 4 years and taking into consideration the future needs of the country along these lines, the Central Marine Fisheries Research Institute has already proposed the acquisition of a new vessel in the same size range as *Sagar Sampada* through the VIII Plan document of the Department of Ocean Development to be in position by the year 2000. Similarly the Institute has also proposed acquisition of 2 numbers of slightly smaller fishery oceanographic vessels (55-65 m OAL) and technical personnel to be employed for specific studies on living resources, development of fishing gear, processing and product development.