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THE SUCCESS STORY OF A NEW GENERATION
FUEL-EFFICIENT DEEP SEA MULTI-PURPOSE FISHING VESSEL

CENTRAL INSTITUTE OF FISHERIES TECHNOLOGY
(Indian Council of Agriculture Research)

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Fisheries undoubtedly has played a pivotal role in the economic development of India. The impact of development in the fisheries sector in India is such that today she ranks 6th in world fish production and, the export of fish and fishery products brings in over US $ one billion annually raising it to the status of single largest net foreign exchange earner from trade. Central Institute of Fisheries Technology (CIFT), the national institute devoted to research and development in all aspects of fisheries technology, has rendered yeoman services in the country's march forward to the level it has attained in fisheries development.

The single major factor that has contributed to the phenomenal achievement in fish production in India is mechanisation of fishing craft, which started in the late 50's and the early 60's, and spread further. Till then, fishing was carried out in hand-rowed traditional craft employing traditional gear. CIFT, entrusted with the responsibility of developing the technological base for increased fish production for its national need as well as export, took up the challenge of introducing innovative technologies in fish production. The first step in this effort was mechanisation of fishing craft. This being an entirely new approach in India, the required expertise in design and development of mechanised craft was practically unavailable. Realising the urgency, Government of India, without wasting any time decided to seek the help of Food and Agriculture Organisation of the United Nations (FAO) to assist in the country's need for mechanisation of fishing craft. With the assistance of naval architects deputed by FAO, CIFT developed the designs of a series of small mechanised fishing craft of 25 feet and above in overall length, constructed the

prototypes and operated them under the field conditions. The superiority of these vessels in their catch efficiency was widely demonstrated and thus created history in the area of mechanisation of fishing craft in India. The output was phenomenal. Impressed by the high returns, many jumped into the arena of mechanised fishing. Even those who considered fishing as a 'fishy' business entered this field in scores. Even established corporate business houses found good prospects in fishing and related industries.

However, the joy and exhilaration were rather short-lived. In the beginning stages of mechanisation the virgin resources were abundant and available in near shore waters. Short cruises and bountiful catches were the order. Lured by the easy money, many made their foray into fishing with consequent increase in the number of fishing vessels disproportionate to the sustained availability of the resources. Naturally, the resources depleted and the fishers were compelled to move beyond the near shore area to ensure their very existence.

Side by side with depletion of stock and increase in fishing efforts, the fuel price was increasing steadily in the beginning and soaring very high from the beginning of the 70's. The 70's and 80's also witnessed an injudicious increase in the number of mechanised fishing fleet. This created a competition among the fishers to reach the fishing grounds and back to the harbour earlier than others and to have hauls with maximum power at the grounds, in a bid to make the venture profitable. One recourse to achieve this target was to increase the size of the vessel and power of the engine. However, little did the vessel owners understand the complexities of hydrodynamics associated with marine craft such that the much needed

and expected speed and pull characteristics could not be attained proportionate to the increase in power. The other negative effect was the increased fuel bill with no proportionate increase in income. On a fair estimate, 70% of the operational cost of a mechanised fishing vessel is accounted for by fuel cost alone. With ever increasing fuel price and the increased input of power necessitating still higher consumption of fuel, it is left to the imagination of any body about the gargantuan expenses involved in the operation of these craft. Thus once lucrative mechanised fishing lost its glory and became an unattractive business venture.

Soon it is understood that in order to sustain sufficient profitability in fishing enterprise, two factors require urgent attention. One is that medium class vessels should replace the small vessels for greater endurance and voyages lasting for a few days at least; second is economising on the fuel consumption of these mechanised fishing units. Putting these two factors together, it became apparent that the immediate need of the fishing sector is a medium class fuel-efficient fishing vessel.

It should be appreciated at this point that this situation is not peculiar to India alone. The fishing industry, the world over, is facing a similar crisis. Fishing has become less profitable and even non-remunerative in several fishing nations. Increasing operational costs, particularly that of fuel, and the diminishing stock are the two major problems threatening the fishing sector everywhere. Spiralling cost of fuel is the single largest factor contributing to the adverse economical prospects of the Indian fishing sector.

A frontal institution like CIFT could not remain with its eyes closed when the country was facing such a crisis. The institute was constantly under pressure from the fishing sector to develop innovative technologies to effect fuel saving in fishing operations. Research and development of systems and practices to save energy in fishing was always live and active in the agenda of CIFT. Such activities gained momentum with the re-induction of qualified naval architects in its staff and re-establishment of a *fishing vessel design section*.

The team of scientists first conducted an exploratory survey on the present fishing fleet with respect to their functional efficiency and design features. They identified the possible methods of economising fuel consumption without affecting the functional efficiency of the craft as

- Optimisation of hull design for achieving reduction in resistance, thus reducing the power requirements at various operating conditions

- Improvement in propeller design to achieve reduction in hydrodynamic losses, thus increasing the thrust available to overcome resistance for a comparable reduction in power requirements leading to fuel saving

Optimisation of hull design is possible only on new construction and hence, as the first step, the attempts were focussed on improvement of the design of propellers. The study team could identify that the hydrodynamic efficiencies of the existing propellers were only to the tune of 30-35% in practice against a theoretical prediction of 45-50%. An improved design of the propeller focusing on the shapes of propeller

blade elements was developed, prototype made and tested in actual field conditions by fitting on existing medium class vessels. The results were encouraging. 10-12% fuel saving could be achieved by this innovation alone.

The speed-pull characteristics of a fishing craft are not proportional to the power input alone. The complexities of hydrodynamics of the craft operating under marine conditions, which have a direct bearing on their physical characteristics, are matters to be given due consideration. Introduction of any new design feature on an existing craft is not feasible. It was also clear that for any further increase in fuel saving over and above that obtainable by employing the newly developed propeller, one necessarily has to go for new designs of hull. Therefore, the efforts were oriented towards developing a hydrodynamically efficient hull design. Computer simulations were extensively used for this purpose at the Computer Aided Design Centre of the Institute. Finally a design could be made incorporating several features to ensure, better hydrodynamic charecteristics for the hull with a matching propeller system for higher speed-pull characteristics, efficient and ergonomic gear operation, easy maintenance, operational convenience, endurance, crew safety etc. Based on these design features and the level of performance expected, the vessel promised a saving of about 20% in fuel consumption at the drawing board stage.

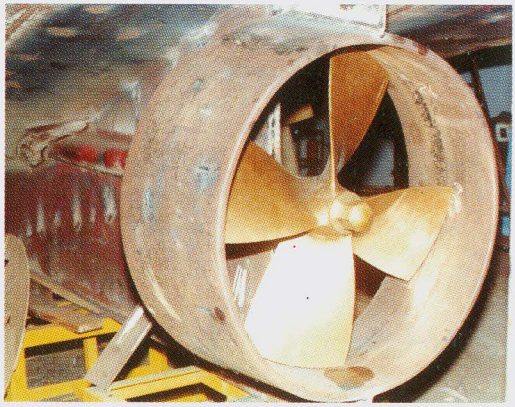
The major outwardly visible distinguishing feature of the new design is its shape. Most of the current fishing vessels have a blunt forward shape. The new design feature incorporates a narrow forward shape of the vessel peculiar of fast marine craft. Such a modification, in the normal course, might

have made the motion characteristics of the vessel worse for fishing operations. Thus it became necessary to devise ways and means of offsetting this problem by incorporating necessary remedial features in the design. This problem was solved by modifying the aft shape. This modified aft shape, which is unconventional in fishing vessels, creates a higher pressure zone and twisting of flow streamlines to achieve improved hydrodynamic efficiency for the hull. The improvement in the aft shape help the vessel to achieve better stability for operation in more rough and deep waters. The design features also involves an asymmetric nozzle propeller system, the aerofoil sections of which were developed at CIFT to generate hydrodynamically optimum thrust

NOZZLE UNDER FABRICATION

factors in complex flow conditions peculiar to small and medium marine craft. The design also incorporates ergonomic design factors for better operation and maintenance of the vessel, better accommodation standards, large and well-insulated fish holds and, improved deck arrangements.

The design on the drawing board will not deliver the goods unless it is translated into the working system and the claims of capabilities are proved beyond doubt under actual operational conditions only. Demonstration of the fuel efficiency achievable as also the improved performance and facilities incorporated in the design was considered an urgent need of national interest as the fishing fleet of the country itself accounts for almost 50% of the fuel consumed by the shipping industry in India. Therefore, CIFT took up construction of prototype of this vessel with the assistance of the Indian Council



NOZZLE-PROPELLER SYSTEM AFTER FABRICATION

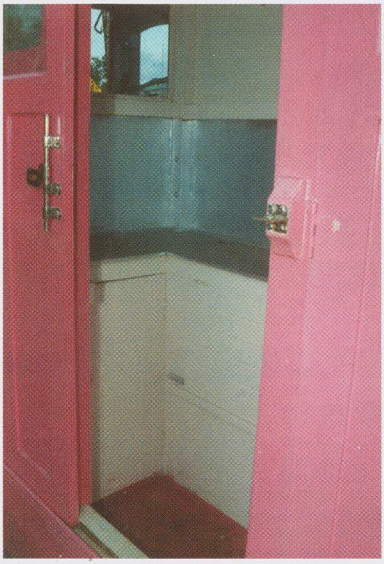
of Agricultural Research (ICAR) in the form of a research grant under the Agricultural Cess Fund scheme of ICAR. The encouragement and partial funding extended by the Engineering Division of ICAR is gratefully acknowledged. The vessel was constructed in the institute's campus by M/s Steel Industries Ltd. Kerala under the supervision of the institute's Naval Architect. Named 'Sagarkripa', the vessel was dedicated to the Fishing Industry on 17th September 1999 by Dr. Anwar Alam, Deputy Director General (Engg.), ICAR at a function organised by CIFT. The vessel was launched on 26th of the same month.

Sagarkripa is a 15.5 m multi-purpose steel vessel capable of fishing in the entire exclusive economic zone of the country. It is made out of roughly 22 tonnes of steel and incorporates several design features not normally seen in similar class vessels made of either steel or wood. Some of salient features of the vessel are:

Length overall	15.50 m
Length bp	14.00 m
Breadth mld	4.60 m
Depth mld	2.30 m
Draft mean	1.50 m
Power plant	1 x Leyland ALM 412; 125 hp at 2000 rpm
Propulsion	Asymmetric nozzle propeller; Aerofoil profiles developed by Central Institute of Fisheries Technology

Fish hold	Capacity $30m^3$; Insulated with 150mm expanded polystyrene between marine plywood and finished with FRP
Trawl winch	Split type; connected to main engine power take-off; 1200m. of 12 mm wire rope or 1500 m of 10mm wire rope on each drum
Free running Speed Trawling Speed	9. 5 Knots (max) 4.0 Knots (max)
Hull design	Deep "V" low angle of entrance high speed shape forward of midship; Full "U", broad semi-planing shape with twisted bottom profile aft of midship
Electronics Fish locating Navigation	 50/200 dual frequency SIMRAD fish finder GARMIN 128 GPS Navigator
Fresh water capacity	1000 l x 2 synthetic tanks in Engine Room
Fuel tank capacity	2250 l x 2 steel tanks in Engine Room

Sagarkripa, is 15.5m. in length and 4.6m in width like any other medium class fishing vessel. But, the depth is 2.3 m., which is about 20% higher; and the draft 1.5m. which is 15% higher, compared to existing medium class fishing ves-



KITCHEN

ACCOMODATION

INSULATED FISH HOLD

sels. While similar size vessels in operation has a fish hold capacity of 15-20 m^3 only, Sagarkripa is equipped with 30m^3 of fish hold volume in two compartments and insulated with 150mm insulation against the standard of 75mm. The fish holds were divided in to small bays with removable wooden partitions to facilitate graded storage of fish and finished with FRP to meet international hygienic standards insisted by for-

FISHING DECK

eign buyers of Indian seafood. The sleeping accommodation is compact, but comfortable to support six adults at a time, which is sufficient, as eight crew will man this vessel. The

vessel also features a small kitchen and a toilet as standard, which are considered luxuries on existing vessels of similar size. The fishing deck aft is spacious and uncluttered which is almost 15% more and sheathed with FRP to ensure high standards of hygiene and durability compared to similar sized vessels. Side gallows with foldable booms instead of fixed central gallows facilitates a higher net opening and working on the fishing deck even during the trawling operation. The winch is large and split type usually seen on large trawlers only, and each drum can support 1200m of 12mm. wire rope. Drum capacity is a crucial factor limiting the depth of operation of the vessel. With the featured arrangement, Sagarkripa can conveniently trawl in 200m. of water depth. Split winch with the special trawl boom design can support large trawl rope angles for bigger nets. Yet, with all these pluses, Sagarkripa is to be propelled with an engine of only 125 hp. This vessel can cruise at a maximum speed of 9.5 knots and trawl at 4.5 knots. With these powering features, Sagarkripa is expected to about 16000 liters of HSD per annum compared existing designs of similar size for equivalent fishing operations. The arrangement of skipper controls in wheelhouse and the lay-out of engine room are ergonomically organized for easy operation and convenient maintenance of the vessel. Unlike similar size steel fishing vessels, Sagakripa was made of ship-building standard steel adopting classification standards of fabrication. Surface protection adopted for the vessel is the same as that for modern day large ships, and will save on the maintenance. With all these features this vessel can be completed for less than Rupees Twenty two Lakhs within four months.

Sagarkripa was extensively tested under field conditions by the Scientist and technicians of CIFT and could confirm fuel saving capacity and the superiority in several operational parameters. However, ultimately it is the fishing industry which should adopt it commercially. Therefore it is very essential that they should be convinced about the claims made on the vessel. Therefore CIFT took a very bold and unconventional step to get the claims verified and confirmed by the fishing industry itself. The vessel was entrusted with M/s Munambam Boat Owners Co-operative Society Ltd., No.991, Pallipuram, 683 515, one of the largest and the only registered trawler owners' co-operative societies owning and operating around 90 fishing vessels from the Fisheries Harbour at Munambam in Ernakulam District. The Society operated the boat for three months and confirmed that compared to similar vessels operated by them there is substantial saving in fuel in the operation of Sagarkripa, which is of the order of 300 litres of diesel per voyage of one week's duration. The Society is also very much impressed about the stability, catch efficiency, convenience and facilities available onboard Sagarkripa. The society has documented their appreciation of the performance of the vessel as also the fuel saving achieved.

The report from M/s Munambam Boat Owners Co-operative Society Ltd. states,

"The fuel consumption of vessel Sagarkripa is found 15 to 17% less than comparable sized fishing vessels presently operating in our location. Vessel Sagarkripa gets better free running and trawling speed at lesser RPM when compared to other our own boats. At present the vessel seems to be capable for operating in all weather condition in

deeper water in Indian coast and also seems to be stable. The deck layout and other arrangements have maximum spaces and convenience for the crew to engage in efficient fishing operation."

Sagarkripa is now very popular in the Munambam area and CIFT is receiving many requests for providing guidance in the construction of similar vessels. Boat building yards from different parts of the country are also approaching the institute for guidance in this regard. Even a party who wants to construct fishing vessels for Mauritius has approached the institute for guidance in the construction of vessels of this design.

Sagarkripa, the new 15.5 m steel vessel with better stability, fuel efficiency and other conveniences is thus creating a history in fishing vessel design and construction in the country. In these days of fuel scarcity, when every drop of oil saved is a national service, this innovative design is proving to be a boon to the foreign exchange earning fishing industry of the country.

Central Institute of Fisheries Technology is equipped to guide those who are interested to construct and operate fuel-efficient multi-purpose fishing vessels of any size incorporating client's needs.

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SAGARKRIPA