

## Post independence Development of Fisheries in Sri Lanka

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### Abstract

*The Island Sri Lanka has a coast line of about 1640 km, she is ideally located in the Indian Ocean to harvest the fish stocks all the way to Antarctic and be one of the leading fishing nations of the world. However, the reality is quite opposite to the above assumption. Her fish production was about 10,000 mt until middle of 20<sup>th</sup> century, around 1948; harvested, primarily using very primitive fishing gear made out of coir, cotton and hemp. Out of the above total catch, about 47 percent was by beach seine (madel), one of the sluggish and inefficient method of fishing in the word. Fish has to approach the gear instead of gear chasing after the fish. Further, the fisherman ventured into the sea to operate their primitive fishing gear in dug out canoes, wooden plank rafts or waded out into sea up to chest height. These were traditional fishing crafts and operated in the continental shelf waters up to a distance of about 10-12 km from shore. The change in the gear from coir nets and ropes to nylon nets and lines commenced around 1958, amidst resistance from other fisherman due to their inability to absorb new technology. In fact fishermen even destroyed nylon nets by dynamiting them, at the same time, traditional log rafts and dug out canoes were fitted with out board motors to increase the efficiency of crafts. There were 104 such mechanized crafts in 1958 and 861 in 1963. **This led to increase fish catch from 25.2 mt in 1952 to 91.2 mt in 1963 an increase of 10,000 mt/year.** Subsequently, in mid 1960s more 3 1/2 toners, 40 of 11 toners were added on to the fleet; the latter were owned and operated by Ceylon Fisheries Corporation. Further 07 trawlers to operate in Wadge Bank from Colombo and tuna clippers to operate in the Oceanic waters were introduced. Research and technology got underway funded by Colombo Plan from mid 1950s; that was a turning point in most development of our fishing industry. **Thus, the Colombo Plan was the sheet anchor of post independent fisheries research in Sri Lanka** The work of Medcoff and Sivalingam brought a wealth of research information on fish resource. These*

*later paved the way for the introduction of multiday fishing boats with freezing facilities. Universities, namely, Vidyodaya started to teach fisheries science in 1966 under the leadership of Dr. K. Sivasubraniam, followed by other Universities to provide scientific manpower for research and management. Then by 1972 our total fish production was about 93,000mt. Around 1970s beach landing Fiber Reinforced Plastic Boats (FRP Boats due to plastic industry and shortage of timber) entered the industry and became very popular. The total fish production was about 179,000 mt around 1979. The declaration of the 200 nautical mile Exclusive Economic Zone (EEZ) in 1976, with an area of 517,000 km<sup>2</sup> helped to increase the fish production further, although, Sri Lanka lost Wadge Bank and northern half of Pedro Bank to India. In mid 1980s Government owned trawlers were disposed of as the fishery was unprofitable. More fish resource surveys were undertaken by R/V Dr. Fridtjof Nansen (1970s and 1980s) and other surveys by NARA and the Universities. This led to expansion of the fishing industry. A great leap in the offshore with multiday boats development took place at the end of 1970. The offshore fishery, mostly for large pelagic species like tuna, sharks, and bill fish like marlins, sword fish and sail fish rose sharply after 1993 to 70 mt/boat/year by 2007 and its rising. Its development initiated around 1960s with the introduction of tuna long liners in the Oceanic waters. By then the coastal fishery for small pelagic species had started to decline due to huge increase in effort, thus, its cpue is now dropping below 5mt/boat/year. The demersal fishery seems to be still in dormant stage due to lack of information on the species and stocks. Therefore, the future of the coastal fishing industry in the future could lie on coastal demersal species and offshore fishery that started to develop after independence.*

### **Key Words**

Saturated Coastal fishery, Developing oceanic fishery, role of Universities

### **Introduction**

Indian Ocean is one of the three major Oceans of the three major oceans of the planet (Gross 1978) earth and she is the smallest of the three oceans, situated at the southern end of Asian subcontinent, with an area of 68.556 million km<sup>2</sup>, covering about 20 percent of the earth surface, Indian Ocean is unique among the major Oceans in that it has a very few Islands, especially large islands, however,

Madagascar and Sri Lanka are major two large islands, in the Indian Ocean (Gross 1972 and G and E Gross 1996), besides; she has many small atoll Islands like Maldives Islands. Also, the mid Indian oceanic ridge and 90° East Ridge are unique characters of Indian Ocean.

The shallow sea bed, not exceeding 200 m, in depth is referred to as continental shelf around any continent or Island is biologically the most productive zone of any Ocean, unlike the deep oceanic zones. Its productivity, in all trophic levels, extends all the way from the surface of the Ocean on to the sea bed. Thus, it's the back bone of the productivity of the ocean and supports highest amount fish production as well. Therefore, the continental shelf is considered as the backbone of the fishing industry and it's directly proportional to the width and length of coast line of the continental shelf. According to Gross (1972), 11 percent of the area of the world Oceans belongs to coastal or continental shelf waters. In the Indian Ocean, the width of the continental shelf is relatively very narrow compared to the other two major oceans especially, in comparison to Atlantic Ocean. In Keeping with the principle that the width of continental shelf as proportional to the strength of fishing industry, the Indian Ocean produces the least amount of fish in the world. According to available information of Food and Agricultural Organization FAO, of the UN, the marine fish production of the world for the year 2005 was 93.2 million MT and that of the Indian Ocean was 9.4 million MT and was 11 percent of the world total. India is the largest fish producer among the countries bordering the Indian Ocean with an annual production of about 3.4 million MT, due to her very long coast line, followed by Bangladesh and Pakistan, and Sri Lanka (NARA, 2005, 2008). Indian Ocean was treated as the ocean with the least primary production and lacked data on the ocean. In fact, it was referred to as "little known Indian Ocean" until 1967, primarily due to lack of scientific knowledge on the Indian Ocean mainly attributed to the poverty of the bordering nations, who were unable to undertake a scientific exploration of this mostly tropical Ocean. The very first fishery survey done in Sri Lanka by Medcof has alleged that the catch per unit of effort is low due to low abundance of fish (Medcof, 1963). Therefore, a scientific study called International Indian Ocean Expedition (IIOE) was undertaken by an International body, UNESCO utilizing her scientists from the develop world. The results of the above study revealed that the Indian Ocean in fact is even richer in her biological productivity than other two Oceans. The results opened the way for accelerated large scale fisheries development among the bordering nations of the Indian Ocean. However, people of the region

besides having a low level of education, also, had long standing rooted taboos, traditions, myths, and cast systems. Most Sri Lankafishermen did not believe that fish like any other living organism, is a result of union between male and the female (union of male and female gametes), they were reluctant to believe sex in fish and believed that fish originated in the sea whenever two water masses met. The above concept was conveyed to me by most fishermen, with whom I had gone on fishing in Trincomalee, Mutwall and Negombo for many years, spending one day out at sea each fishing day. At the same time, in Sri Lanka, fishing was considered to be the employment confined to one or two casts, namely "karava and salagama" people (human social groupings). Those people who were engaged in fishing or **fishermen** were despised and treated as low cast people. Where as, paddy cultivator or farmers were considered as high cast people, who are even fit to be kings and queens of the country, were as they ridiculed and despised fisher folks. Therefore, the above myths and taboos were tumbling blows for the development of fishing industry in Sri Lanka as well as in the region.

Fishing industry in all the countries bordering the Indian Ocean was dependent on traditional fishing methods utilizing traditions crafts. The techniques utilized were primitive and involved heavy human labor and therefore, the efficiency was very low and the amount of fish harvested too was low. The above trend kept phase even today. As a result the fish production in the Indian Ocean is just 11 percent of the world total. Keeping allowances to its small size, the production should have been at least 20 percent of the world total. As a result of the above, the fishing industry generally in the coastal nations of the Indian Ocean was at the mercy of old primitive gear, crafts and deviated far from the modern technology until the middle of the 20<sup>th</sup> century. Sri Lanka was not an exception to the above natural law of the region. Fishing in Sri Lanka was confined to people who lived along the coastal belt, confined to "karavas and salagamayas". These people made a living by fishing in the nearby coastal waters utilizing traditional crafts to go to the coastal waters and then the raft catch fish using lines or nets made out of coir fibers. It had been a Herculean task to convince these fishermen to take to modern fishing gear etc. These fishermen were so opposed to such technological change that they used dynamite to destroy such modern technologies around early 1950s. However, scientific exploration of recognized fishing ground close to the Island or within the shallow sea bed had been undertaken since early 1920s (various authors). However, the colonial masters weren't interested in developing food fisheries for

locals, instead they concentrated on value added fisheries like pearl fishery. Therefore, it is seen that the food fish fisheries development in Sri Lanka started after independence.

Therefore, the purpose of the present study was to review the post independence development of the fishing industry in Sri Lanka.

## **Methods**

Data for the present review was obtained by a survey of published information in the form of statistical reports, annual reports of the Director of fisheries, Statistics published on the fisheries of Sri Lanka by the Department of Fisheries, since 1995 and that of National Aquatic Research and Resources Development agency (NARA) since 1997 were also utilized. Further, personnel discussions were also held with fishery scientists and past fishery administrators. The research and fishing industry experience of the author for about 41 yrs was used to prepare the review paper.

## **History of fishery surveys Sri Lanka**

The Wadge Bank off the southern tip of India, within the depth range between 50 and 100m was completely owned and fished by then Government of Ceylon till the declaration of 200 nautical mile Exclusive Economic Zone, because both India and Sri Lanka were ruled by the British until 1945 and 1948 respectively. According to the Director of Fisheries (1953), the very first fishery survey of Wadge Bank was carried out in 1907 using a trawler "Violet". Subsequently, a complete survey and experimental fishing carried out by then Ceylon Government using a hired trawler, the Lilla and a research vessel Nautilus in 1920 and 1921, they explored the sea bed of Wadge Bank and based on the results of the survey, commercial fishing was undertaken by a private company in 1928 and it lasted until 1935 and the company went into liquidation. Then, Lilla once again surveyed around Galle, Colombo and North of Chilaw, Palk Bay and Point Pedro Bank. Their findings suggested that there are no large fishing grounds in the West Coast except for some sporadic patches off Colombo. These didn't warrant large trawlers but a small trawl could exploit these patchy resources. The species of fish that were caught too were third quality fish. Small traditional wooden crafts such as pairs of "kattumeram" were used in trawling the explored areas by Indian fishermen. The method used was a primitive one and used twin boat trawl or Spanish trawl, handling etc was purely manual. A few more resource surveys were completed on

the demersal fish resource of the Wadge Bank, using hired trawlers by the Government of Ceylon. Trawler Tonkgol surveyed from 1928-29 for survey as well as commercial fishing. Similarly, Buldul, 1928-25, Raglan Castle, 1945-51, aringa, 1947-48, Braconglen, 1951-64, Maple leaf 1951-64, DaishinMaru 1, 1961, Kyoshi Maru 6,12,13 1962-63 were engaged by the Government for commercial fishing in the Wadge Bank. However, all the above trawlers were either hired by the Government or privately operated by companies. One of the very first trawlers bought and operated by the Ceylon Fisheries Corporation was Gandara and trawled in the Wadge Bank from 1964. The first survey of pearl oysters and the fishery was carried out in 1902 by Herdman, subsequently; the pearl oysters were commercially exploited periodically until mid 1929 and trail fishing in 1950s (the author had purchased oysters around 1950s). He too undertook a fish survey in the Pearl Banks and Gulf of Mannar Bay. His works brought a wealth of information, though the fish resource was not properly quantified (Mendis, 1964, 1971).

A fairly comprehensive resource survey was undertaken under Canadian Ceylonese Colombo Plan fisheries development projects. It must be stressed that Colombo Plan helped a long way to conduct a fishery survey and to develop new fishery technologies after independence. The survey was headed by a Canadian fishery scientist, Medcof and lasted from 1953 to 1955. The survey included a study of demersal fish from Galle to Wadge Bank, Palk Straight, Pedro Bank and Mullaitivu. Medcof study included: (i) study of Ceylon's marine fisheries, (ii) Conducting of fishing trials for assessing the resource, (iii) presentation of data and recommendations on how Ceylon could increase her marine fish production and (iv) presentation of a complete report on the survey. The survey was confined to just two years, therefore, its findings were very preliminary, but laid the foundation for commercial exploitation and further development of the fishery, primarily in the Wadge Bank, which is about 150 miles away from Colombo (Weerakoon, 1965). The findings were surprising; the demersal fish catch per unit of effort(cpue) was even higher than that of off Scotland and in some aspects, even fishing grounds off Nova Scotia, off Canada. The mean catch per day was 8578 lbs, were as that in Scotland was 6363 lbs. The above findings showed how rich was the demersal fish belonging to four grades according to Medcof. (1963) in his table, Grade one included pelagic varieties (although he fished for demersal species) like seer, para kelawalla and koppara, grade two included species such as mora,

maduwa, orawa etc, grade three included varieties such as gal malu, kattawa, salaya, soodaya and karally, the last grade include non edible fish like petheya (puffers), thun katuwa (cow fish) etc., From 1950 to 1964 Wadge Bank had been yielding at the rate ranging from 65,000 lbs to 80,000 lbs per trip (32-36,000 kg) .By 1965, the Fisheries Corporation had about seven trawlers operating in Wadge Bank operating from Colombo harbor. Also, Sivalingam and Mudcof (1957) had estimated the potential of Wadge Bank as about 1000 mt a year.

Pedro Bank, which is situated at the north eastern end of the continental shelf of Sri Lanka, was considered a virgin fishing ground until Sri Lanka started exploiting her resources commercially making use of the findings of Sivalingam (1964). Lilla fishing unit indicated that Pedro Bank was economically well worth fishing even without much exploration. However, subsequently, trawler "Bulbul and Regland Castls trawling there had proved that Pedro Bank has a rich ground fish resource such as mullets, croakers, snappers, groupers, rays and skates. However, all the varieties of fish were of grade 3 (Medcof, 1963) and were readily consumed by most Ceylonese at the time. As to why the trawl fishery of Pedro Bank was not developed is a mystery.

The other trawler used in the exploratory fishing in the Wadge Bank was Braconglen and was a superior vessel to that of Maple leaf. Thus, it had landed an average catch of 10,045 lbs of fish per day of trawling (Table 1). Based on the richness of the demersal fish of the Wadge Bank, Medcof (1963) recommended that small boats be used to exploit the rich resource. He recommended small boats, length ranging from 50' to 100' and powered by 120 horsepower engines be used for fishing boats. Bigger vessels with steel hull like the maple leaf etc are far more expensive and were not affordable at the beginning of developing a fishery.

**Table 1: Catch data of Braconglen from Wadge Bank 1951-54. (After Medcof, 1963)**

Year	No of Trips	Total catch (lbs)	CPUE/Day/lbs
1951	12	602,366	7,723
1952	20	1,294,548	7,570
1953	18	1,604,967	8,966
1954	17	1,526,860	10,045

Mr. Victor Halliday who came to Ceylon to assist Ceylon Government conducted further surveys off Mullaitivu, Kytes and Palk Strait. He was of the view that twin boats could be used in trawling with otter trawls (in Medcof, 1963)

The Canadian team, especially, Medcoffe (1963), Babcock (1954), further studied all available traditional fishing gears, including hand lines ("bili pitta") and based on their scientific knowledge at that time, which was more than that of our fishermen, correctly and strongly recommended that traditional hand lines be replaced by colorless monofilament nylon lines. He further recommended that hand made spring-steel hooks be replaced by non corrosive metal hooks and got them made at the Govt Factory. The results of handline operations were surprisingly good and comparable with those of Seychelles and Nova Scotia (Table 2). Thus, Babcock (1954), who was on an assignment for Colombo plan in 1954, though small had contributed heavily and laid the foundation for small scale development of demersal fishery. From the above it is evident that the simple hand line fishery too was analyzed and developed since independence by the Colombo Plan.

**Table 2. Results of hand line catch survey of demersal fish at different places of continental shelf 1945-55**

Fishing Ground	Year of Fishing	CPUE/line/hr/lbs*
Colombo	1954	1.4
Negombo	1954-55	0.5
Karativu (East Coast)	1949	20.0
Thalayadi, Pt Pedro		
And Myllady	1954	0.8
Mullaitivu	1954	11.5
Mankerni (off Batticaloa)	1954	10.3
Wadge Bank	1954	33.2
Seychelles	1949	50.6
Nova Scotia	-	40.0

\* After Medcof, 1963

Fish that inhabit the bottom which are normally referred to as demersal fish, in addition to traditional method of catching - by trawling, also caught by a kind of line set at the bottom with many baited hooks on branch lines attached to a main line, that lie prostrate on the shallow sea bed, depth ranging from about 50-100 fathoms. Each main line has about 50-100 branch lines, each with a baited hook.

This gear is called bottom longline. In Ceylon fishermen had been using the above method of fishing for generations. However, the areas to fish and the density of demersal fish that would be caught by long lines was little known at that time, besides, the local lines made out of coir fibers did not last and decayed soon. Therefore, the fisheries development steering committee recommended that bottom long line fishery be surveyed. Thus, Canadian Colombo Plan authorities acted immediately and ordered gear from Canada. These included semi synthetic ground ropes made of steam-tarred cotton, gangings, straight, large eyed galvanized hooks (60/0) and other required gears were all ordered from Canada. The Colombo Plan order came to Ceylon to survey in 1955. A Canadian fisherman, Mr. Roy Pyne, who was experienced in the longline fishery, was assigned to "RV North Star" and exploratory fishing was conducted. Pyne found small molluscan flesh or squids, mud snails, African garden snail etc available as bait. However, there were large quantities of squid (*Loligo* sp) off Trincomalee that as used as bait for bottom longline. Longline surveys were conducted around Colombo, Chilaw, Galle, Wadge Bank, Trincomalee Chundikulum, Mullaitivu, Karativu and Kytes and on some selected areas in the east coast. The results of the longline catches were very encouraging.

**Table 3. The results of long line survey conducted by North Star of Canada (1954)\***

<b>Year</b>	<b>Location</b>	<b>Catch/100 hooks</b>	<b>Catch in lbs/man</b>
1954	Trincomalee	21.80	10.60
	Chundikulum	1.60	1.50
	Alampil	15.20	13.00
	Mullaitivu	15.00	12.50
	Mankerni	37.50	30.10
	Mylliddy	42.90	5.40
	Kytes	2.90	1.90
1955	Colombo	16.30	12.40
	Negombo	6.90	3.00
	Karativu	3.60	5.00
	Colombo	4.80	4.30

\* After Medcof, 1963

Thus, based on the above results Medcoff (1963) recommended that bottom long line fishery has a good future in Ceylon provided that full mechanization and good bait supply be undertaken. Catches in the East Coast is most rewarding and the potential catch was comparable with that of Wadge Bank trawlers. The above account implies that bottom long line fishery gained ground after 1953.

Long lining in the mid water, or drifting long line or Japanese tuna long line is the ideal method to catch larger species of tuna, in fact the method is called Japanese tuna long lining, although the gear was initially designed by Canadians and Japanese. However, the credit goes to Japanese for refining the same for tuna fishery. They were the pioneers in this method of fishing, although other nations too copied this method of fishing, but it was synonym with Japanese. They were the pioneers in this method of fishing, though Taiwan, Korea Russia and other countries have established tuna long line fisheries. Japanese are still the leaders in this method of fishing. The pole and line method of fishing tuna was very successful and it was also adapted by Japanese.

According to Sivasubramanian (comment made on the manuscript), Tuna long line and pole and line fishery introduced during medieval era was the best method for tuna fishery in Sri Lanka until recent times.

In Ceylon, the above method, one of the best methods to exploit tuna, was tried out for the first time in 1954 by a Japanese fishermen for Fisheries Co-operative Society in Negombo. The long line used in Sri Lanka had been 1,100 fathoms long and carried 1000 hooks and 35 floats. The hook rate was 12 percent and the fish were of good quality, species such as sailfish, tuna sharks and seer were caught. Subsequently, the North Star carried out trials by Roy Pyne with improved gear, the branched lines were set at 04 fathoms (= 8 meters). The baits used were cuttle fish and chubmackerel (kumbalawa). The catch varied from among trials and it varied from 0 to 180 lbs per 100 hooks. Thus, Medcoff (1963), based on the surveys from 1953 to 54 recommended that i. appropriate steps be taken to develop coastal long line fishery, ii. actions be taken to develop longline fishery near/ in the high seas.

One of the most common method of fishing for only surface pelagic predatory fish all over the world was trolling, which is nothing other than sailing a vessel or oru

each with multiple hooks, baited or lured fishing lines, that drag behind. The sailing usually lasted for a couple of hours. In Ceylon, the original sail oru with easy maneuverability was used with tied lines for trolling. However, the lines were just cotton/coir, therefore, did not last long. However, Colombo Plan obtained the services of Canadian experienced fishermen and captains to improve our trolling. Captain Homer, who was an experienced troller in Canada and the United States, was requested to undertake the trolling trials and he successfully did it. The results obtained using mechanized/ motorised and sailing (canoes) orus were encouraging (Table 4) to develop a trolling fishery.

**Table 4. Results of trolling surveys under Colombo Plan from 1953-55**

Details of trolling	Year		
	1953	1954	1955
Hours of Trolling	380.0	945.0	294.0
Total Catch (lbs)	3612.0	5415.0	2995.0
Catch/lure/hr (lbs,	1.1	0.9	2.5
Catch/lure/hr (lbs)	2.6	0.5	3.3

Thus, Colombo plan helped to improve the trolling method of fishing, which is an exceptionally efficient method of fishing for small varieties of schools at the surface.

The Canadian team recommended that: (i) encourage motorized crafts to take to trolling while the vessels are traveling to and from drift net operations fishing areas to obtain an additional income over and above target species that was fished within the day. (ii) make trolling spoons available to fishermen through fisheries stores and also, (iii) encourage commercial dealers to stock the appropriate fishing gears and (iv) carry out further trolling trials with indigenous troll fishery for better economic benefits.

All the above had contributed towards the development of trolling for surface and subsurface small tuna. Now there are various trolling gears developed with modern accessories like, line separators, line dips and multi colored artificial jigs etc and the fishery is mostly done in mechanized vessels but some sail orus(canoes) are also trolling, even in the high seas using nylon monofilament lines, which were introduced into Ceylon in the mid 50s.

Gulf of Mannar is the pearl oyster ground in the Island and it had been surveyed since 1922 (Pearson, 1929). Pear fishing in large scale was ended in 1925, however, small scale fishery existed even since then and oysters were sold in provincial markets almost up to 1961. Its latest survey had been by Munasinghe (1970) that showed very poor pearl oysters in periya paar and cheval paar. The most productive fishery survey and exploitation had been in 1958, about 10 years after independence. The most recent one had been in 1996, was for offshore large pelagic fish resource and some oceanographic factors like temperature and depth of thermocline had been found. Since independence, the fish surveys done by Medcof (1963) and Sivalingam (1964), especially on the demersal fish, is valuable. Survey of the distribution of flying fish along the East and Northeastern shores and along the southeastern shore of India was carried out from 1969 to 1972 and from 1979 to 1982 by Jinadasa (Jinadasa, 1991) had clearly shown the seasonal distribution of flying fish *H. coromandelensis* from around Pinnakuda on the East Coast and extending all the way even beyond Chennai (Madras) and traced the boundaries of the fishing ground. Shrimp surveys had been undertaken by de Bruin, who had reported the species composition and biology of shrimps on the continental shelf. Weerakoon (1964) discovered shrimp trawling grounds off Mullaitivu, Karukkupane (north of Chilaw). These shrimp ground are now exploited by local fishermen.

### **Fisheries research and the role of Universities**

Ceylon Fisheries research Station was the arm of the Department of Fisheries, its staff slowly expanded after independence. Scientists like Sivalingam, Medcof, Sivasubramanian, Bruin, Weerakoon, Mendis, Joseph and later by scientists (works are indicated in the text) of NARA in a small way, according to the available resources, helped to develop fishing industry. Fisheries Science was not taught at any Universities until 1966. Thus, the contribution made by the local Universities for the development of Fisheries Research was almost zero until then. The very first Fisheries Science course for undergraduate degree was taught at Vidyodaya University (now Sri Jayewardenepura) in 1966 and then it was developed gradually. Even the very first MS degree (by research) in Fisheries was produced by Vidyodaya University and the very first MS degree was awarded to J. Jinadasa in 1972. Subsequently, a number of Masters and PhD degrees were awarded by local Universities, especially, by the University of Kelaniya needed to be mentioned here. All the above work was due to untiring efforts made by Dr. Sivasubramanian

and late Professor Arthur Weerakoon. Their research brought a wealth of research information like the boundaries and extent of distribution of flying fish *H. coromandelensis* in the east coast of Sri Lanka up to Madras India. Sivasubramanian and Jinadasa successfully experimented with the same flying fish as a tuna long line bait fish to find a substitute for the then imported bait fish from Japan. Most other Universities soon incorporated fisheries to their undergraduate teaching curriculum. Subsequently, the very first Faculty of Fisheries was established by the UGC at the University of Ruhuna, it after 50 years of independence, what a great tragedy for an Island. A Fisheries University should have been established long before other Universities have been established in this Island.

The Fisheries Research Station established by the colonial masters was located at a tiny place at Galle Face with a few research scientists. However, it was shifted to new house at Crow Island Mattakkuliya, where fairly better facilities were made available. Besides, the number of Research Divisions were also increased. A research vessel too was acquired, but due high cost of management, it was discarded. Although the facilities were modernized and improved, the quality and quantity of research output was poor compares with that of pre independence. Actual quality work had been done during preindependence period, which is a severe blow to our scientists.

### **Oceanography of Ceylon Waters**

Understanding the marine environment is essential to understand the distribution of fish. Fish are normally associated with their preferred temperature salinity and currents. Temperature is one of the most important factors governing the distribution and most biological aspects of fish and shell fish (Bull, 1952, Hodder, 1965, Blasxter, 1965, Chervinski, 1984, Redfield, 1941, Jinadasa, 1991) Studies on sea surface currents are very important as these are directly responsible for the distribution of especially, commercially important fish such as tuna. They live in between currents that have specific oceanographic factors such as temperature, flow speed and salinity, which are conducive to tunas. It is also known that convergent areas are places where high concentration of fish are found and therefore, excellent areas for fishing (Uda, 1952, Sivasubramanian, 1965, Jinadasa, 1972, 1981). The Mixed Layer Depth (MLD) and the depth of the thermocline are immensely important to understand the distribution of fish. The nets and lines are always operated just above the thermocline because fish do not pierce the

thermocline, Besides the swimming layer of fish is always above the thermocline. Understanding these are important for proper operation of fishing nets (Jinadasa 1998). Majority of Fish always live within the mixed layer. Similarly, all properties of sea are directly responsible for the biology of fish. Therefore, these factors are very important in the commercial fishery. Unfortunately, sea around Ceylon was completely in dark even now with respect to oceanography is concerned. Understanding the nature of Sea bed is essential for fishing boats to navigate, information on this aspect, until late 1980s were obtained from British Admiralty charts. Fridtj of Nansen 1978, 1980 was fortunate enough to bring some basic information on this into the fishing industry, highlighting the bottom condition of the continental shelf, Sivasubramanian (1965) had studied the distribution of tuna and the monsoon currents and concluded that fish that were associated with north equatorial and equatorial counter currents disperse during the southwest monsoon due to destruction of these two currents. He had correctly shown that during Southwest Monsoon period the high fish catch is due to the above phenomena. Jinadasa had studied the sea surface temperature and salinity off Trincomale from 1969-72, Velvatithurei 1972, west coast in 1970, to a distance of about 30 km from the shore. Using his data he concluded correctly that flying fish approach the east coast every year for spawning primarily due to changes in the water mass properties in the east coast (1972). Fridtof Nansen had studied the depth of the thermocline around the Island in 1953, He also made a detail study of the temperature profile, of the coastal waters to locate the thermocline and also used echo graphs to locate schools of demersal fish (Blindheim, et al., 1979). Subsequently, resource surveys done under the direction of Sibasubramanian and Joseph 1997 had resulted the understanding of the depth of thermocline, which is important to understand the distribution of fish. Their surveys also highlighted the magnitude of the fish resource from Northwest to Northeastern waters except the war zone. At present, NARA had undertaken studies on bathymetry and mapping the sea bed around the Island. Besides, now NARA is mapping probable fishing ground using data obtained from satellites. The data so obtained is now made available to local and foreign funded tuna long line fisheries (Jeseph, personal communcation) It is also known that the thickness of the sediment around the Island had been studies for the benefit of the country. International bodies like the Indian Ocean Marine Affairs Coordinating Committe (IOMAC) had been in late 1970s, these had contributed along legal aspects for fishery development. But the

most important aspects like the temperature pattern and current patterns and their impacts on the distribution of fish are completely unknown for our waters, which is a severe set back to the develop the oceanic fishery. Besides, the sea ia a reservoir of chemicals, including manganese nodules (Gross 1978 and Garrison, 1977), gas and oils, their wealth is completely unknown to the people of Island Sri Lanka. This is primarily attributed to the inability of Oceanographers and fishery Scientists to venture into sea due to fear of sea or sea-phobia, although we are Islanders.

### **Development of Gillnet Fishery**

Gill net is an ancient but passive fish catching method (Radcliffe, 1921). But in Ceylon the used were made out of threads obtained from cotton or coir fibers, therefore did not stay long in the water. Besides weight was heavy too, at the same time the mesh sizes changed heavily with the absorption of water. Further, moulds etc set in and started to perish and therefore, nets, had to be continuously repalaced. Above all, these gears did not last long and needed continuous replacements, besides, economically not very profitable. These nets were set in the sea using traditional crafts like canoes, theppam, kattumaram, usually at night and hauled with the entangled fish early hours of the following morning. Therefore, this method of fishing was inactive form of fishing but caught many species of fish from different depth of the sea. However, the efficiency of the nets was poor as the nets were made out of coir ropes or cotton threads. Therefore, assistance of the Colombo Plan was sort to improve the methodology during early 1953. Initially, Babcock used gillnets, length 1200x18 feet with 6 "mesh. But as those were made out of tarred cotton nets, the efficiency was poor. The team leader, Bobcock was unhappy about the Canadian capital aid program, obtained nylon webbing and constructed experimental nylon fishing nets. The surveys with the synthetic nets were successful. Subsequently, according to Medcoffe, Barry, with long years of experience in gillnetting in the Canadian Atlantic Ocean was asked to conduct further experiments on gillnetting which he did on various other nets like trammel nets, a combination of two nets. Lampara nets were imported from Canada and used in the North Star by Mr. Pinchin (Medcoffe, 1963) and used in lift nets and purse seines; he carried out experimental fishing off Karaitivu Island at a depth of 5 fathoms and caught a school of queen fish (katta) each weighing 10 lbs. He also introduced the technique of fishing with night lamps etc. For this powerful buoyed lamps from Canada was ordered under Colombo Plan and experimental fishing were success, these methods

are now in use. Preliminary work on the mothership concept was also used by Dr. Jone of Canada using a motorized craft to pull a couple of theppams off Negombo, but the method was not a success. Therefore, his recommendation was that no further development of motherships. But the mother ships associated with small boats are in operation in most of the countries with developed fishing industries. It must be clearly noted that our fishermen resisted the introduction of nylon fishing nets based on two myths, namely. (i) fish caught in nylon nets decompose quickly, (ii) nylon nets distroy entire fish populations leading to extinction. However, soon our fishermen realized the reality of modern technologies and gradually took to nylon nets (Weerakoon, 1967 personal communication)

The above account testifies to ther initial actions taken since early 1950s by the Goverment of then Ceylon to develop various kinds of fishing gears, especially, net fishing, crafts and innovations in fishing all methods etc. The pioneer aid for the above development package came from Canada under Colombo Plan. Subsequently, all fishermen not only recognized but could not deviate from modern technologies. Fishing, methods like purse seines were used by fishing nations all over the world, and were introduced to Ceylon as well by aiding nations. However, partly due to ignorance, and partly due to lack of proper education, our fishermen fought against this very efficient fishing technique alleging that it destroys the fish stocks and more importantly, deprives the fish catch of small fishermen, without realizing that other fishing nations were using the same efficient method in the Indian Ocean at the doorstep. Our fishermen had no idea of mesh selection in gillnets or purse seines, where only mature fish is caught, without damaging the stocks. So, some of the scientific methods introduced by developed world had been rejected during the recent past mostly due to intervention of ignorant politicians, who just listen to fishermen and not to scientific findings.

The above account shows that the surveys of fish harvesting techniques had taken a major break through within the early part of 1950s, almost soon after independence due to international agencies like the Colombo Plan.

According to a recent study (Dayaratne and Joseph, 1993, Jinadasa 1995 and 2005), there are well over 13 species of small mammals, dolphins and small whales inhabiting Sri Lankan seas. The annual catch of these animals is in the region of 8000-10000 animals per year. However, initially only about 2-3 species have been reported by Lantz and Gunasekera (1955), the initial spade work for

the survey with the idea of developing a commercial fishery for marine mammals in our waters had been by Homer and Bobcock (according to Mudcoffe, 1963), who had seen skulls of dolphins in fishing communities and thought correctly that fishermen or people in their community do eat dolphins. With his experience in north Pacific, had decided to explore the possibility of developing a fishery. Harpoons, the killing gear of small whales and dolphins, were developed and these were deployed in north star and Seer, the boats belonging to the department of fisheries. The harpooning was combined with other types of fishing like netting and trolling. Trolling was stopped for a few hours and harpooning was practiced then for an hour or two (Mudcoffe, 1963). The small whale catches of 1953 were encouraging and therefore, further surveys were undertaken in 1954 as well. The total catch per day varied from 80 lbs to 3,260 lbs per day. These animals had been caught from the edge of the continental shelf off Trincomalee, Colombo, Negombo, Marawila. The skippers have reported that large schools of dolphins have been sighted in many places, mostly around Trincomalee. These surveys have indicated the direction of migration etc. Thus, based on the results of the Surveys, the steering Committee recommended that the department undertake further surveys and commercial fishery be developed.

### **Fish Productivity of Ceylon Waters.**

People who lived along the coastal belt had been making a living by catching fish; no one had an aorta of knowledge on the fish production capabilities of waters around the Island. According to principles of ecology, fish could be primary, secondary or tertiary consumers (Gross 2000, Tom Garrison 2005). Therefore, the amount of fish produced is primarily dependent on the primary productivity of oceans. According to Garrison 2005, the amount of carbon bound to carbohydrates in the ocean is about 35-50 billion metric tons of carbon and this amount would be producing about 350-500 billion tons of marine plants and plant like organisms. The amount of fish produced is dependent on the above amount. These amounts have been studied for Atlantic and even Pacific Oceans, but unfortunately, no work along this line had been done in the India Ocean up until recently, 1953. Prasad and Naidu imitated the spade work on the primary productivity of Indian Ocean and compared the relationship between the amounts of carbon fixed fish production. Their work was concentrated in the Indian waters, but there was no knowledge on the production capabilities of Ceylon waters. Under this scenario, Weerakoon (1965), based on the Indian results, estimated the total fish production

in Ceylon waters, around the Island to a depth of 7.5 fathoms, which is approximately equal to 15 m, as 260,000-382,000 Mt per year and 850,000 Mt per year (de Silva, 1964) Recently, Ranatunga (1999) based on primary production experiments carried out by him, had estimated that the fish production for the western coastal waters as 3.5 to 5.5 times the present total fish catch, however, the above study was a preliminary one. As Sri Lanka is a tiny Island, the results obtained at one area of the sea could be easily extrapolated to the entire coastal waters. Which means that our coastal waters have the potential to produce 3.5 to 5.5 times the present harvest? However, this amount is an estimate and could include all categories of fish from pelagic to demersal species of fish. As the demersal fish production or even their dominant commercial species have not been properly understood, although, R/V Dr. Fridtjof Nansen during 1978-80 highlighted the dominant species of demersal fish. Therefore, production increase could be achieved from the demersal categories, which include Lethrinidae, Serranidae, Lutjanidae, Sciaenidae and other minor categories of demersal fish. Also, species of squids and their production capabilities are in dark. Thus, the predicted increase in fish production may be able to realize from the demersal species of fish, which are grossly under explored yet.

### **Survey of Species Richness**

The amount of wild caught species of fish in the world oceans is about 100 million Mt in 2007 (FAO Reports). This included favorite and common species, which means that commercial harvest, is primarily dependent on species of fish and their ecological distribution. Therefore, the understanding of the species and their ecology is one of the primary important factors for their commercial exploitation. The very first species richness survey in Ceylon waters was carried out by Munro (1955), an Australian, who was a consultant to the Ministry of Industries and Fisheries from 1951 to 1955, under Colombo Plan. He collected specimens from around the Island, mostly from fishermen, but fish was never sampled scientifically by himself to cover all ecological habitats of sea around Ceylon. Therefore, the study was not a comprehensive one, but it laid a very good foundation for any one else to continue the work later, on the species richness and their importance for the commercial fishery of Ceylon. According to him, Ceylon water has 846 species of marine and freshwater fish. Subsequently, a few workers worked on species richness of different families and they found many more species in Ceylon waters

than the number reported by Munro. For example, Munro had reported only 3 species of flying fish in Ceylon waters, but when Jinadasa (1971) studied these fish around the Island and fishing at different parts of the Sea around Ceylon and had found 11 species of flying fish in the above waters and all of which were with high commercial value and the most common and dominant species was *Hirundichthys coromandelensis* (Hornell) and it alone produced above 300 mt of fish off Trincomalee. Another such example was that of pelagic sharks, Munro (1955) had reported only 22 species of sharks in our waters. However, subsequently a detailed study was made by and found that there are at least 48 species of pelagic and demersal sharks in our waters Jayasuriya (1999). Similarly, according to Munro (1995), there are only three species of Hammer head sharks in our waters but Gunawardene (1971), Jinadasa (1995) and Jayasuriya (1999) had found four species of which the major species with high commercial value was *Sphyrna lew.* Which formed about 10-12 percent of total shark caught in Sri Lanka. A recent study by De Bruin and Russell (1994) had shown that there are more commercially valuable species of fish in our waters, for e.g. there are 48 species of sharks alone and 19 species of flying fish in our waters, which is 16 species more than what had been reported by Munro. The above account reveals that much of the species richness surveys had been undertaken after mid 1950s, especially so after mid sixties, yet more to be surveyed.

### **Fish Resource Surveys**

According to Medcoff (1963) surveys of fish resources in Pedro Bank and Wadge Bank had initiated in 1907 by the trawler Violet, then a complete survey of all ground fish resource around then Ceylon was carried out in early 1920s by a trawler called Lilla. Wadge and Pedro Banks were discovered during early 1920s (1920-1923) after a survey of littoral waters around Ceylon by colonial British Government and she emphasized the development of bottom trawling as it a method much familiar to them. The other reason was that bottom trawling was very much popular among most fishing nations prior to Second World War. Then, fishing based on the surveys was carried out from 1928 to 1935. In 1957 Sivalingam and Mudcofe (1957) carried out a intensive study of Wadge Bank and highlighted its bottom configuration and production capabilities. Trawling in the two demersal fishing grounds, Pedro Bank and Wadge Banks went on until 1948 by private companies, then around 1961 a few more trawlers were added and by 1965, the trawler fleet owned by the Government rose to seven. Then, Mendis (1965), after

analyzing the trawler fish catch from Pedro Bank with an area of 1000 sq miles and Wadge Banks with an area of 3000 sq miles had estimated the potential of the two fishing grounds as 17-18,000 mt per year. Ceylon Govt had the monopoly of the Wadge Bank since 1920s and the Ceylon Fisheries Corporation had a fleet of six, 250GT, stern trawlers (trawl was operated from the rear end of the trawler) and produced about 700 mt of good quality fish by the Govt trawlers alone, leaving aside the privately owned trawlers. The Pedro Bank was commercially exploited until 1965 (Joseph, 1984) But, later Ceylon Govt exploited its resources, at the rate of about 250 mt a year until 1976 when Sri Lanka unilaterally declared the 200 mile Exclusive Economic Zone (EEZ). As a result of it, she lost the entire ownership of Wadge Bank and the northern half of Pedro Bank to India.

However, there were no surveys done on the coastal or Oceanic Pelagic resources almost until 1978, when the research vessel **Fridtjof Nansen** was employed under Norwegian Development Program. The vessel Fridtjof Nansen survey lasted from 1978 to 1980, with each survey confined to a few weeks to about 2 months. The survey covered the coastal waters from Mannar to Point Pedro including Pedro bank. The results indicated the nature of the sea bed on the continental shelf, its slope, whether, trawling could be carried out, and the potential yield of the shelf. Her studies on the sea bed of the continental shelf were fascinating and extremely useful for trawling. The survey of Mannar Bank, especially the deep waters around 200-350m was carried out by **Soviet vessel Optimist** in 1972 and reported good prospects for lobsters, prawns (shrimps) and other species of fish. Then a few years later, 1978 and 1979, Fridtjof Nansen did a similar survey and found even better hauls of lobster, prawns (shrimps) and fish. The Hambantota Bank was explored a couple of times, By R/V Fridtjof Nansen and other vessels funded by NORAD in 1979 and 1980 and found that it had a potential of 30-55,000 mt. This fishing ground was later explored in 1982 and 1984 as well. Pedro Bank is an extension of the continental shelf, has a fishing ground with an area of about 1000 (nm)<sup>2</sup> depth ranging from 10 to 100 fathoms (20-200m), its potential resource had been acoustically estimated as between 10-15,000mt by Fridtjof Nansen. Similarly, she had also assessed its potential using bottom trawling, but the estimate was slightly lower than that of acoustic survey. The purpose of utilizing bottom trawling was to compare the acoustic estimation as well as real quantity caught by trawlers. The potential that was estimated based on the above surveys was slightly less than what had exactly harvested from Pedro Bank (Mendis,

1965) Exploratory fishing for under utilized demersal fish had also been undertaken by the same Norwegian vessel. **R/V Dr. Fridtjof Nansen (NORAD of Norway) survey (1980) was the most important, comprehensive, and up to date survey carried out after independence.** It had studies the width and the nature of the continental shelf. According to it the continental shelf is narrow, rarely extends beyond 40 km, averaging 22 km. Its slope is steep; the shelf itself is very smooth and flat north of Trincomalee up to Pedro Bank, Negombo to Puttalam and south of Trincomalee is smooth and even, Negombo to Galle rough and uneven, Hambantota area is very rough. The hydrography of the shelf waters, its thermocline, currents, salinity and dissolved oxygen etc has been very well surveyed then. The demersal fish resource as demersal, semidemersal and pelagic has been surveyed very accurately. The behavior of fish, especially, their schooling behavior and the number per school had been very well surveyed and documented. The astonishing work was that the species composition of fish caught, their sizes etc have been studied, which are immense importance to understand the age structure, year-class strength, survival etc, which are important for stock assessment (Gulland, 1975). The above parameters would give sufficient information for future workers and planners to develop the fisheries in this country. The most common demersal fish found in our waters are snappers, groupers, breams, sweat lips, trevaliys, which are commonly considered as breams or "galmaalu" have been generally studied. The total fish resources around the island, leaving behind Palk Strait according to the survey had been calculated as 500,000 mt, which had been compartmentalized to survey areas. However, as one may expect, the biomass calculated, varied between the three surveys. Thus, the Fridjof Nansen survey was the best demersal fish resources survey done within the last three decades. Sivasubramanian (1978) had surveyed the skipjack resource using pole and line and drift net catches using chartered Japanese vesels "Kosei Maru" and Nichiro vesel and recommended that pole and line fishery is successful within 60miles from shore small scale pole and fishery be establish around Chilaw, Negombo, Colombo, Mullaitivu and Trincomale. The pole and line survey is one of the most efficient methods to harvest tuna and skipjack (kelawall and balaya) which is as usual a Japanese invention. For the operation of the above method, live bait fish (pana maalu) is essential, the species most commonly used is "hingura". It is caught from coastal waters where there are rock bottoms (**the author had the previlage to catch them in 1970 off Uppuweli, Trincomale along with fishermen there**)

This important live bait for pole and line fishery was surveyed by Pajot (1977) and recommended species and the areas most likely to catch live bait (personal communication with the author. **According to Sivasubramanian (personal communication 2009), unfortunately, once most efficient pole and line fishery in Sri Lanka is dying now due to lack of live bait source.**

### **Development of fishing boat building industry**

Traditional fishing crafts had been in use as far back as in the 230 BC century. These included dug out canoes, log rafts and wind driven large canoes. These crafts were operated in the near shore waters and some, the wind driven canoes, operated even in the waters of outer edge of the continental shelf, especially in Trincomalee area, where the continental shelf was narrow. By 1948, about 8000 of the traditional crafts operated in our waters (Annual Report of Director of Fisheries, 1953) and those crafts were responsible for harvesting the entire Ceylon waters up until late 1950s. The fish harvest at that time was about 10,000 mt. The mechanization of the above crafts had increased the fish production by about 6000 mt per year (Weerakoon, 1965) The number of mechanized crafts was zero in 1948. The Motorization (mechanization) program was initiated around 1950 and about 10 crafts were mechanized each year and by 1958, there were a total of 104 mechanized crafts and by 1963 the number rose to 861. At that phase of mechanization, one would have expected a very large number of mechanized traditional crafts by now (2008). However, the increase in numbers did not keep pace at the original phase and it slowed down and by mid 2006 there are only about 2250 traditional mechanical crafts. One may wonder as to why the initial increase in phase did not continue, it was attributed to the fact that then there were no alternatives such as light beach landing type crafts other than the traditional crafts. Around mid 1960s, (Joseph personal communication 2008), due to the development of fiber technology, fiber reinforced plastic boats were available in the world. It was introduced to Ceylon as well around mid 1960s and as the Fiber Reinforced Plastic Boats (FRPB) were very light and beach landing type, gained popularity among fishermen quickly and the FRPB number increased rapidly and now there are close to 12525 such boats, fitted with outboard motors. Thus, these boats proved to be a very successful alternative to wooden traditional crafts such as canoes, rafts (oru, theppam, vallum and kattumeran etc.) These FRP boats were able to handle with very little labor, beach landing type, without a need for

harbors and now very actively engaged in fishing in our coastal waters, especially for shore seine varieties and small pelagic fish. The fish production in our coastal waters is about 190,000 mt in 2008 (NARA, personal communication) well over 65 percent of the above amount is harvested by these FRP boats. At the same the Government of Ceylon took the initiative to introduce mechanized crafts, the so called 3 1/2 ton, E 26 or 26-30 footers, versatil boats was the pioneer inboard motorized boat introduced to Ceylon and there were 7 of those by 1957. The number rose to 1150 by 1963 (Administrative Report, Director of Fisheries, 1958-64) mechanized boats, the fish production then increased by 10,100 mt per year. The building of mechanized boats was initiated by Taos Company in Ceylon around late 1950s (Athula personal communication) The very first mechanized boat built was by Claude Gras, a French man. Initially, it had built two wooden boats and these were launched in Negombo and engaged in fishing, these two were later destroyed at Arugam Bay.

From 1960-1970, offshore fishing operations were just initiated and confinde to four tuna long liners owned by a private company operated jointly with Japanese Company. Also, a freezer trawler owned by a private company was operated in Wadge Bank. The Ceylon Fisheries Corporation (CFC) was established in mid 1960s, government of Ceylon stepped into fish catching business and by 1967, she introduced two oceanic tuna boats (315 GT) initially and four more later but soon faced problems with bait for her long liners, the bait Sauri (*Colalabes saira*) for tuna longliners were then imported from Penang. However an alternative local bait flying fish (*Hirundichthys coromandelensis*) was experimented in CFC's tuna long liners by Jinadasa (1972, 1995) under the instruction of Sivasubramanian found it to be very successful. The amount harvested annually was, 300mt off Trincomalee that too was sufficient to meet the bait requirement of the longliners, but the Ceylon Fisheries Corporation (CFC) never implemented the findings and didn't pay attention to the findings of Jinadasa and Sivasubramanian. At the same time, the tuna price too fell, as a result these tuna boats had been discontinued around mid 1970s. At the same time, CFC launged a project to exploit the ground fish resource of Wadge Bank, for this purpose CFC introduced 6 (250GT) in mid 1960. These vessels harvested about 700-800mt of fish per year until late 1970s when the ownership of Wadge Bank was lost to India due to implementation of 200 mile Exclusive Economic Zone (EEZ)

around Sri Lanka. At the same time CFC bought 40 of 11 ton metal boats (12.2m) in mid 1960s (Joseph, 1988) to expand the local fisheries to the offshore range, this was the first step in developing an off shore fleet, other than tuna long liners, to catch billfish and sharks as well. **(The author, under the instruction of Dr. Sivasubramanian, was one of the crew members in one of the above boats in 1970 during 6 fishing operations, the boats were operated from Mutwal harbor)** These boats were made of metal and therefore corroded quickly and also unstable out at sea and therefore had to be discarded-bad planning.

Around late 1970s a fleet of 30 multiday, 12.2m, /boats were introduced. These boats were equipped with Fiber Reinforced Plastic (FRP), insulated fish holds, crew accommodation, hydraulic net haulers and radio communication facilities and therefore, well suited for off-shore multiday fishing. However, those boats failed and the cooperation had to discard the project funded by ADB. But two of the boats were engaged in prawn trawling in Gulf of Mannar. By 1978, the coastal fishing fleet was 23,000 vessels of less than 32 feet, of which 30% of the vessels were, mechanized (Joseph, 1984)

During 1981-85, a fleet of 80 multiday, 11m class boats fitted with facilities needed for offshore multiday fishery was introduced and the boats were successful that led to subsequent introduction of there 9-10 m boats. At the same time as the offshore fishery was more profitable than inshore fishery, more people started to convert their 3.5 - 4 t inboard engine fishing boats, (9-10m) which are usually referred to as 3 and 1/2 ton or E 26 type boats into multiday boats by fixing insulating holding boxes. The conversion took place within four years after 1981 and 20-60 percent of 3.5 GT boats were converted into multiday fishing boats. According to Joseph (1988), there were 2000 offshore fishing boats were destroyed by the tsunami of 2004 and the replacement that came along foreign funding had increased the multiday boats to 3500 and the total fishing fleet to 43000, except the multiday boats the others are mostly for the exploitation of coastal waters and its far too much of an effort.

### The coastal fishing fleet in 1987

Inboard motorized boats .....	2,657
Outboard motorized crafts and motorized traditional crafts.....	10,543
Nonmotorised traditional crafts .....	13,865
<b>Total fishing fleet .....</b>	<b>27,065</b>

### The total fishing fleet in 2007

Inboard motorized one day boats	1,593
Inboard motorized multidayday boats	3,500
Fiber Reinforced Plastic Motorized	13,010*
Motorized Traditional crefts	2,760
None motorized traditional crafts	15,160
<b>Total</b>	<b>36,023*</b>

**\*\*Source, NARA, Socio Economic Division**

**\* The number of these boats had increased after tsunami and the total number of boats now stands at 43,000 (Nandasena, Dept of Fisheries, personal communication)**

Therefore, the mechanization process that initiated around 1950, two years after independence had grown to 25 percent by 1984 Joseph, (1984) and to 56.30 percent within 37 years. It is a slow process of development of the fleet. However, the motorization of small beach lending reinforced plastic boats had taken a great leap since its introduction around mid 1960s. The drawback is in the "large" multiday boats, which is attributed to insufficient fisherman who could afford to buy these boats; each is about a few million rupees, depending upon the size of boat, the cost is about 3-7 million, depending on size ranging from 35ft 55ft (according to Sivasubramanian's comments on the manuscript)

The oceanic fishery never got off the ground until 1967, when Ceylon Fisheries Corporation introduced two tuna vessels of 315GT, these two vessels were operated in the equatorial belt, but the project had to be abandoned by 1970 due to falling price of tuna as well as problems finding bait for tuna long operations. The bait saury (*Colalabes saira*) was initially imported from Penang, Malayasia, However, Jinadasa having worked for two years in the sea and experimenting with an alternative bait, flying fish *Hirundichthys coromandelensis*,

found that it was as good as improted saury recommended to CFC that flying fish be used instead of saury. But unfortunately the matter didn't get off the ground. Subsequently, 40, of 11 tom boats in mid 1960s and 12m long 30 boats in 1970 later from 1981 to 85, 80 boats of 11m class were added onto the fishing fleet. Thus, by 1986, the offshore fishing effort consisted of about 1200 boats, that's after 38 years after independence and it was not a satisfactory development considering the fact that Sri Lanka is an Island ideally located to harness the resources of entire Indian Ocean, even going south to Antarctic. According to Sivasubramanian there were factors that did not favor development of fisheries unfortunately by then a fair number of foreign gillnetters, tuna clippers, and tuna purse seiners and tuna long line some factory ships of former USSR were operated in our neighborhood (Joseph, 1988). There was a joint venture with a Japanese firm in early 1960s to import tuna long line vessels. The local company applied for permission from Govt. The Government at that time discarded the proposal and granted Ceylon Fisheries Corporation to import vessels and operate. The operation ran at a loss and soon abandoned (Sivsubramanian's comment). The inability of Govt. to do business.

During 1990s, the total number of new multiday fishing boats added to the existing offshore fishing fleet was about 230 bringing the total number to 1430 by the end of the century, or about 23 boat per year, which is not a satisfactory development for an Island that has the access to offshore waters from three directions during the last decade the number of multiday offshore boats was increased by about 400 boats or 40 boats per year and the total number about 3500 by the end of 2007. The total number of fishing crafts and vessels in Sri Lanka was 43000 (more boats were replaced than the amount destroyed due to tsunami) consisting of multiday boats, day boats, fiber reinforced plastic boats, motorized traditional crafts and none motorized. The percentage wise, 94 percent of the boats and traditional crafts operated are for coastal fishery, where as only 06 percent is operating in the offshore waters. Thus, there is a severe imbalance in the numbers of boats and crafts (effort) utilized in the exploitation of marine fish resources in seas around Sri Lanka. In any fishing nation, the coastal fishery (or fishery in the coastal waters) is the backbone of the fishing industry because; the resources on the continental shelf extend all the way from surface to bottom, fish belonging to all niches are found on the continental shelf. As the water is shallow, not exceeding 75-200m, the efficiency of exploitation is high too. The primary production too is

four times that of oceanic waters (Sverdup, et. al. 2006 and Gross and Gross, 1996) The primary production is 300mg/C/m<sup>2</sup>/year, which as in the open ocean its 75 mg/C/m<sup>2</sup>/year. According to oceanographers, the fish production in the coastal waters which forms only about 6.4 of the area of the oceans is 356 million tons/year. The fish production in the open ocean, beyond the continental shelf, which forms about 91.7 percent of the total area of oceans, is 817 million mt/year (Sverdrup et. al. 2006). More importantly, the continental shelf belong to the coastal nation, on the other hand the EEZ is in international waters and belonged to most countries of the world.

Based on the above concept, it's generally all right to employ more effort in the coastal waters, but not 94 percent of total effort to be concentrated on the continental shelf waters, where our continental shelf is relatively narrow averaging about 12 km from shore compared to that of North sea, averaging about 60 km from the shore. However, according to Sivasubramanian, the effort on the continental shelf cannot be controlled due to socio economic problems. As an Island, our emphasis should have been to develop the offshore fishing fleet above that of coastal. We are slowly moving along that direction with the open economy.

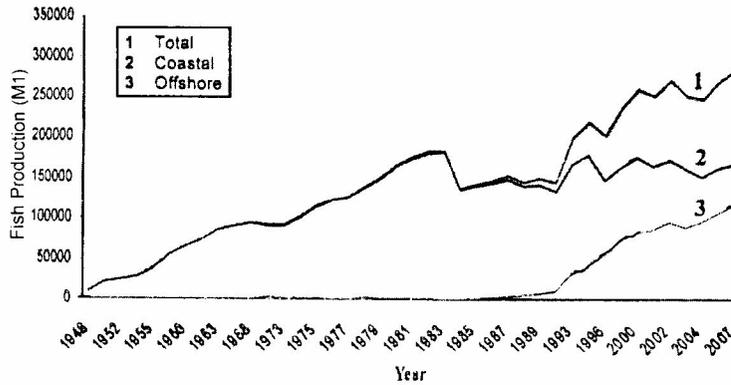
### **Marine Fish Production**

The marine fish production prior to independence was about 10,000mt, when our population in the country was 7 million people. Then the freshwater fish production was almost zero. The statistics on the fishery data was not, even now as good as they should be, prior 1951 they were of the most meager and only around 1952 statistics comparable to what we have now have come to published (Weerakoon, 1965). Marine fish harvesting was primarily in the hands of the traditional fisherman, who fished, mostly the coastal fish stocks, utilizing crafts powered by either human labor or wind power. These traditional crafts included small canoes (kuda oru) of about 6' long, where two people could sail into the sea. Their large version is called the canoes of about 15-20' long, these were powered by wind and leave the shore after midnight, mostly towards the morning hours, here too two to three people sail, these crafts sail at very high speed, even at 20-39 nautical miles per hour, these crafts engaged in fishing using almost any type of gear, namely gill nets, trolling, and hand lining. Also, another dugout wood canoe (Valluma), without an out trigger or one with a short one, these crafts mostly operated

gillnets and traps, in lagoons and estuaries. These crafts contributed well over 40 percent to the total fish catch of traditional crafts. One of the most common crafts was the small log raft (theppama), about 6' long and powered by a man sitting at the center of the raft, using a bamboo strip (una pathura). These crafts operated gillnets, hand lines in the coastal waters up to a distance of about 1-2 km. The bigger log raft (kattu maran) with a length of about 15-20 with sail was used to operate gillnets and hand lines, a slightly far away from shore, up a distance of about 3-5 km from shore. The biggest contributor of the fish production was the beach seine (maa dela), operated around the Island. Each beach seine (maa dela) was 550 fathoms (1100m) long with two wings and cod end and operated by about 30 men and operated a few times a day depending upon the arrival of schools of fish close to shore. These seines were operated only during the calm seasons. During southwest monsoon period, fishermen from south and North West usually migrated to north east and south east and operated their beach seines. There were about 5000-8000 of beach seines in the Island around 1948 (personal communication from fishermen). These seines were owned by a couple of people, who owned a crew paid by the owner, throughout the year. Most of them lived in thatched beach huts. Species such as anchovy, snake mackerels, woulf herrings, small trevalies (paraati), demersal fish like drummers (pannawa), groupers (kossa), slip mouths (karall) snappers, sweet lips uruhotas meevetiyas, skates rays and shrimps were dominant catch in the beach seine. Up to 1958 the total fish production and that of "maa del" was almost parallel and indicated that its contribution was significant to total fish production in Sri Lanka. All fishing gears such as nets, lines, traps etc up to 1958 were made of coir or cotton fibers. These soaked water and changed the consistency constantly changed the mesh sizes etc. Thus, were not efficient gears. Around 1958 nylon nets were introduced to the fishing industry. During 1958 maa del catch contributed 50.4 percent to total fish production and by 1963, it had declined to 23.9 percent, primarily due to introduction of nylon fishing nets (when these nets were first introduced, fishermen protested against and even dynamited to destroy the nets ignorantly alleging that nylon nets are destroying our fish stocks) Therefore, fishermen brought more fish than when they operated coir/cotton nets. However, thereafter it tends to run parallel to the production of small boats. Besides, a large proportion of the fish was also harvested by stilt fishermen (fishermen who climbed on to a pole planted close to the shore, where a depth of water was about 2-3m) These fishermen fished mostly during high tides

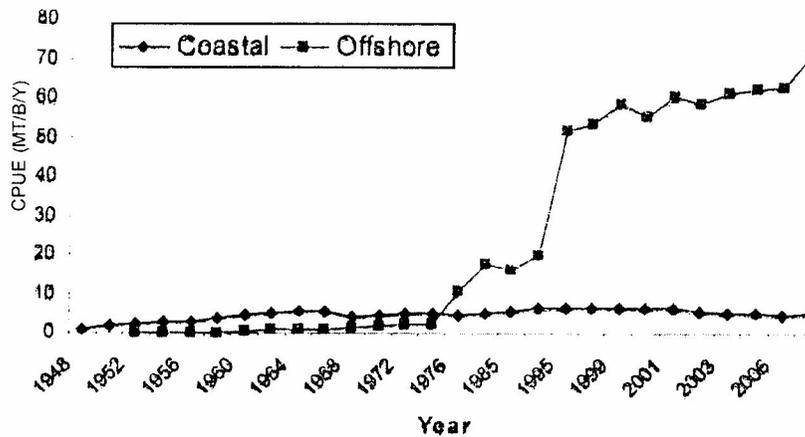
and the catch is sold around the region of operation, the fish was very fresh and most people liked it, high concentration of these fishermen was around south western corner of the Island. Even at present these fishermen are common around Induruwa but the numbers have dwindled.

The fish production in 1952 (statistics are available only since 1952) was 25.5 thousand metric tons and was 91.2 in 1963, an increase of 65.7 thousand metric tone within a period of 11 years, which is an increase of about 6000 mt a year. It was also seen that the total fish production around 1952 is almost parallel to coastal fish production (Weerakoon, 1964), or 86.8 percent of our fish production was coastal of the total, 15 percent was from beach seine ("maa del") 35 percent from non mechanized traditional crafts, 10 percent by mechanized traditional crafts (mechanization of TC was initiated after 1948 and there were 104 mechanized traditional crafts in 1958 and the number rose 861 by 1963), 04 percent by tuna calipers and 01 percent by the seven trawlers operated in the Wadge Bank (Wadge Bank was solely owned by Ceylon at that time until late 1970s when EEZ came into operation, when she lost the Wadge Bank completely). The high rate of increase in fish catch after 1952 had been attribute to (i), introduction of mortorisation program for traditional crafts like theppam, vallum kattumaram and canoes, (ii), introduction of mechanized small boats as well as introduction of two, three and half and four ton mechanized boats, in 1958, there were 07 of these, (iii) change over to nylon nets and lines from coir/cotton to use in MTC and mechanized boats, (iv) the number of traditional crafts too were increased in slow phase. (v) open economy. The coastal fish production was almost parallel to total fish production until 1960s, at the same time it was parallel to the maadel fish production (Weerakoon, 1965) and then started to deviate from the total creating a wider gap between the two, the maadel fishery declined rapidly. On the contrary, the deep sea fish catch started to increase from 2257 mt in 1972 to 11160mt in 1990 to 120,000mt in 2009, which is 3945 percent increase. The coastal fish production had increased during the same period from 91,000 to 134,000mt and finally to 171,000 mt, which is an 88 percent increase, indeed a very slow growth (Figure 1).



**Fig 1. Marine fish production in Sri Lanka since independence**

The above effect can further be explained when the catch per unit effort (cpue) as mt/boat/year is considered (Figure 2). It was not possible to separate the pelagic and demersal species separately as our data bank does not contain such information.



**Fig. 2. The catch per unit effort (cpue) as mt/boat/year of coastal and oceanic fish production since independence**

According to figure 2, the cpue of coastal fish production had kept more or less around 5 mt/b/y from mid 1960s to until of 2000 and the peak was around 1999. From 2001 onward the cpue had been decreasing implying that Sri Lanka is

exploiting the Maximum Sustainable Yield (MSY) from the coastal waters. The amount now harvesting is close to what Weerakoon (1965), and Ranatunga (1999) had calculated based on Prasad and Nair (1960) principle for our coastal waters. The difference between his estimate and the amount harvested at present could be attributed to low catch taken from demersal fish. The demersal fish resource is virtually unknown and a large number of species are both under exploited and explored.

The cpue in the deep sea (off-shore) fish production was zero initially, but after independence it had increased at a slow phase until late 1970s and increased rapidly and now increasing exponentially. At present the cpue is about 72 mt/b/y, where as it had been 51 mt/b/y in 1995 and had reached the present level within the last decade, a good sign of development.

The above findings clearly indicate that the future of fish production in Sri Lanka could be dependent on the demersal fish stocks on the continental shelf and its edge and oceanic fish, gear and crafts should be managed accordingly. The coastal pelagic fish production, according to available data, is at its maximum; there is no evidence to indicate expansion on small pelagic stocks. Besides, the effort employed in the coastal fish production, especially, the number of FRP boats, is far too much at present, as indicated by cpue, therefore, it should be reduced and effectively, managed. However, there is a possibility to increase the demersal fish production by adjusting pelagic fishing for demersal fishing. The future back bone of the fishing industry in this Island is nothing other than the oceanic fishery, mostly for large pelagic species or even small pelagic species. As of now, the harvested amount had exceeded all previous estimates (Sivasubramanian, 29,000 in 1978; FAO/ADB, 40,000mt) (Joseph 1988). Thus, effort must be adjusted accordingly, increasing the so called multiday boats or even larger boats, may be like purse seiners and tuna boats to venture into oceanic waters within the 200 mile EEZ or even to international waters.

### **Aquaculture and ornamental fish production**

Rice paddy farming is a well established industry in Sri Lanka from the time of Sri Lankan kings. However, it's unfortunate to note that there was no fishfarmer in this Island, although its surrounded by sea. It was primarily due to social hierarchy

existed in the Island. There is a popular saying that the Paddy farmer can even be the king and not the fish farmer.

Fish farming was news to people of this Island. In fact, up to 1952, there was almost no harvesting of fish from freshwater bodies. In 1952, the amount harvested was about 10mt. and in 1957, the freshwater production from the irrigation reservoirs was 102 and 463mt. in 1963 (Weerakoon, 1965) However, with the establishments of Dept of Inland Fisheries in early 1960s, fish breeding centers, releasing of fish fingerlings to manmade reservoirs etc got off the ground. The main contributing fish for the inland fish industry were Tilapia, Chinese and Indian major carps. The total inland and aquaculture fish production now had grown to about 40,000mt (2008). Similarly, the brackish water prawn farming started around 1972 had developed fast as it brought lucrative income for farmers. The total shrimp production is about 5000mt (2009). The bulk of the harvest was exported to the United States. Another important area was the ornamental fish industry, it started develop around mid 1950s with the export of marine ornamental fish by Johnklos, who is considered the father of marine ornamental fishing industry in Sri Lanka. Then freshwater ornamental fish industry took off around mid 1980s and breeding of various species of freshwater ornamental fish was started by private sector. The total value of fish exported from Sri Lanka varied from 136 to 120 million rupees and it was in the region of 1.9-2.1 of GNP.

### **Infrastructure Facilities**

Infrastructure facilities like, road, housing and ice plants etc have been developed since independence. The total number of ice plants was about 08 had now grown to 70, producing about 1325mt of ice per day. Thus, more fresh fish is made available to people now than 61 yrs back. The fish consumption was 30 lbs per person/year in 1952 (about 14kg/year). According to NARA, the present availability of fish person per year is about 18.5kg and the increase is not satisfactory due to increase in population in the Island.

**Post Independence progress of marine fisheries in Sri Lanka**

2000 s	Addition of Multiday boat	300,000 mt
	↑	
1990 s	Introduction of around 1000 Multiday boats (Total 1430) With navigational equipments, Freezer boxes, ice carrying facilities, facilities for crew	200,000 mt
1980 s	11M, 80 boats, more multiday boats	150,000 mt
	↑	
1970 s	12.2 M Boats (30) Multiday offshore boat with Insulated fish holds accommodation Hydrolic net haulers, declaration of 200 mile EEZ, loss of Wadge Bank and north half of Pedro Bank	100,000 mt
	↑	
Mid 1960 s	FRP Boats (OBM) Longliners (315GT) 6 trawlers (250Gt)wage bank 4 Tuna Long liners (private) 2 Tuna Long liners (CFC) FRPB	
	↑	
1948-1958	Mechanization of Traditional crafts Introduction of mechanized, 2,3 1/2 and 4 tonners, nylon nets	35 mt
	↑	
Pre 1948	Traditional crafts canoes, wood rafts, coir cotton and hemp nets	8 mt

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