

# Prospects of Fisheries Development in Goa

A. H. Parulekar and S. G. Dole  
National Institute of Oceanography  
Barrage Ponda, Goa-403004

## Abstract

Marine fisheries of Goa with an annual catch of over 40,000 tonnes have developed considerably since 1965. The trend projection for production indicates that the annual marine production from shelf region can be increased to one lakh tonnes by 1981. In view of the low productivity and the high-cost technology involved, the economic viability of deep sea fishing would be highly questionable. Based on the technical and economic feasibility studies, possibilities of large scale coastal aquaculture in different aquatic ecosystems of Goa have been indicated, for increasing the fish production, substantially.

## Introduction

As elsewhere, research and management has greatly helped in the development of Indian fisheries. Fishery development is the application of scientific knowledge concerning the dynamics of fish population, their environment and their responses to variations in their environment, exploitation by man. Fishery, unlike any other natural resource

like petroleum, coal, minerals, etc. is of self-generating type and, therefore, the resource being renewable, can be developed for maximum exploitation. Like any other living resource, the fisheries also have seasonal variations, due to natural or man-made changes and hence, unlike industrial growth, the development of fishing industry cannot be forecasted with a great degree of accuracy. Any projection about the potential fishery resources needs baseline information about the present level of exploitation, the magnitude of the resource and the details of new fishery grounds or techniques developed in the recent past.

## Present Status:

Goa, with a coastline of 104 km. lies on the central west coast of India. The Goa coast is full of creeks, estuaries and backwaters formed by the seven rivers (Fig. 1). Since the liberation in 1961, the development in fisheries has taken place at a rapid pace, resulting in almost doubling the annual yield which on an average (1965—76) is 24,000 tonnes.

The Marine fisheries of Goa, as seen from the production figures,

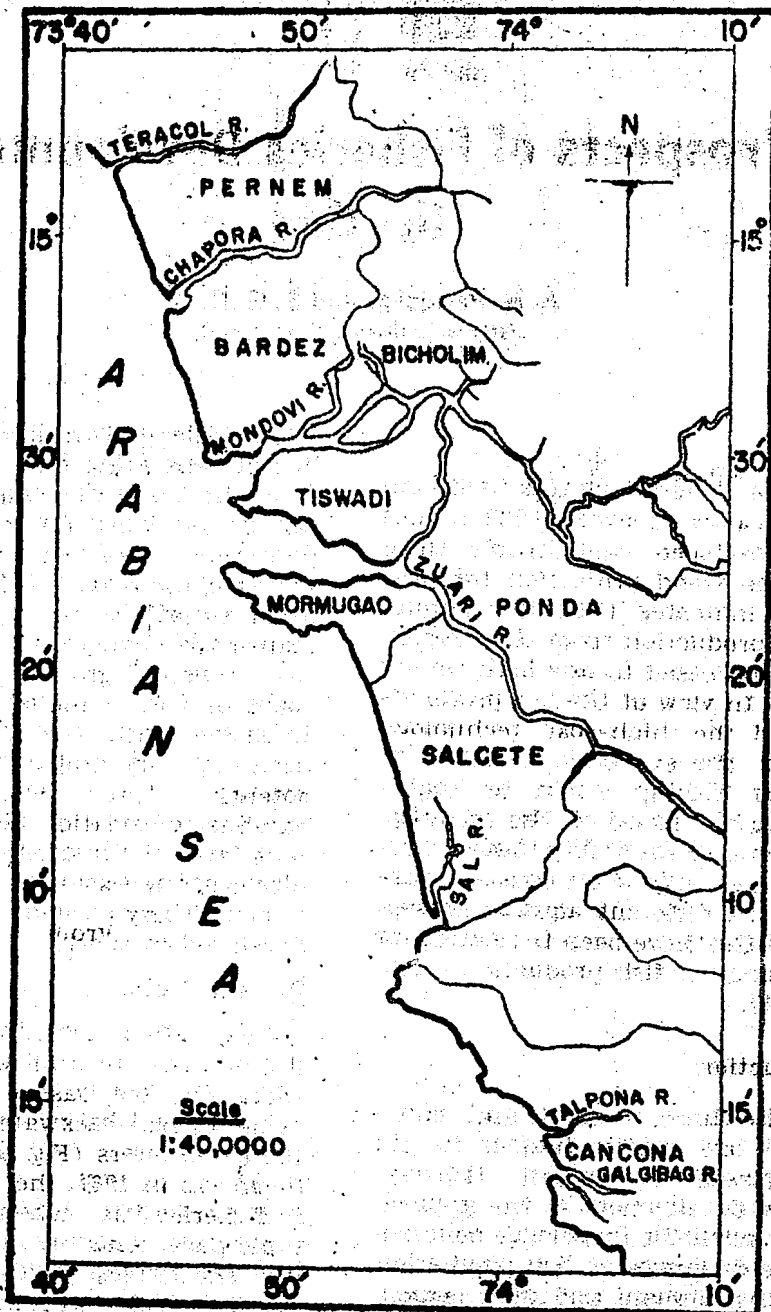


Fig. 1

available since 1965, are dominated by pelagic fishes (fig. 2), like mackerel and sardine which contribute 71.83% of the total (Shastri 1977). An analysis of yearly catch data, for the last 12 years from 1965, indicates that there are wide fluctuations in the pelagic catches and the abundance of mackerel and sardine, exhibit an inverse relationship (Fig. 3). The demersal catch which contributes 28.17% is represented by shrimps and other varieties, like butter fish, promfrets, sciaenids, etc. The demersal catches in contrast to pelagic stock, show less seasonal variations (Fig. 3) and from 1971 onwards, there is a steady increase which is a reflection of the increase in mechanised fishing.

In spite of increasing mechanisation, at present, the fishing in Goa is mainly done by non-mechanised boats using traditional gear. Though the number of mechanised boats has gone from about 10 in 1963-64 to 300 in 1977, non-mechanised fishing contributes to about 70% of the total annual fish landing. Most of the mechanised boats are less than 45 ft. in length and hence their range of operation is restricted within the 40 metre depth zone.

Besides the marine fish, on an average of about 1400 tonnes of finfish and shellfish is harvested from estuaries and freshwaters of Goa.

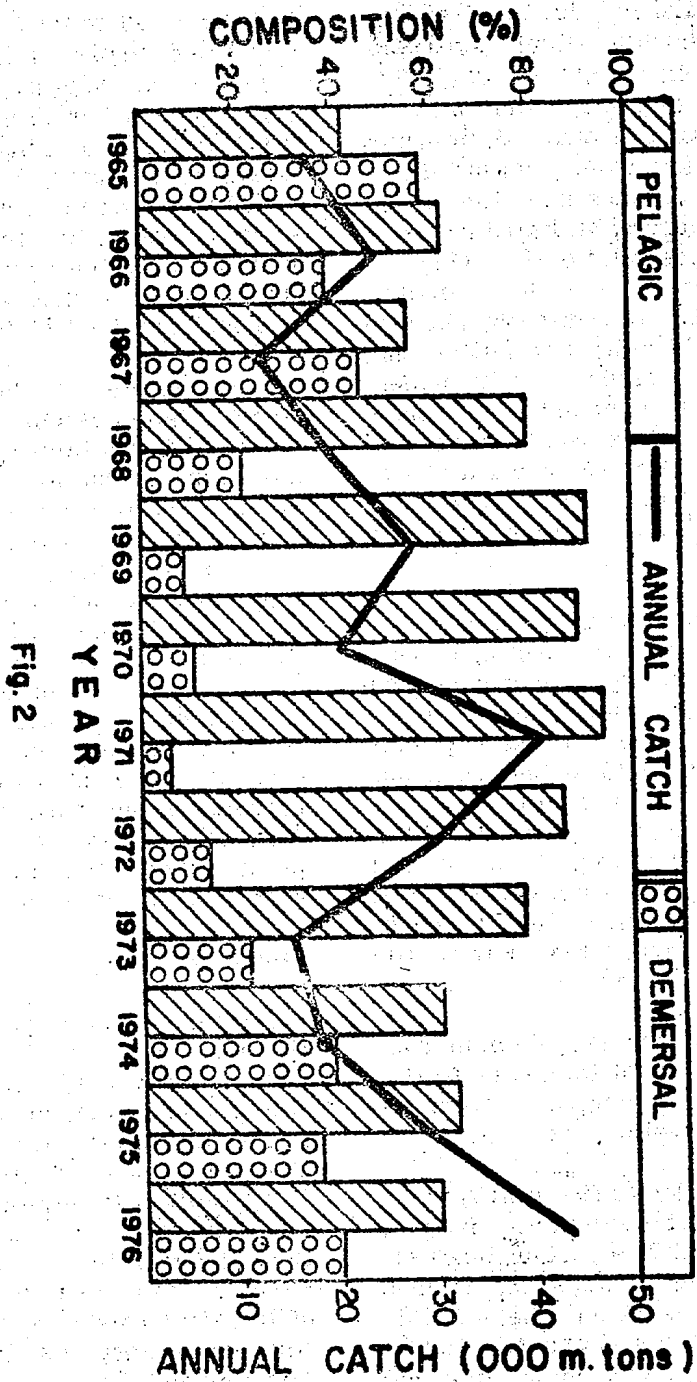
The utilisation of fish is 81% fresh, 90% sundried, 5% salted and 5% manuring. Since 1967, a part of the catch, mainly, frozen shrimps and canned fish, is being exported. The quantum of export which was about 60 tonnes in 1967 had rapidly gone upto 663

tonnes in 1973 followed by a sharp decline of 10 tonnes in 1974. Since then, the export is showing slow progress. On the basis of export earnings, it can be surmised that the average annual earnings are Rs. 35 lakhs. These earnings are subjected to a high degree of fluctuations, not only due to fall in annual fish landings but also due to vagaries of demand and price offered in the international market.

Thus, at present, the annual marine fish landings which have reached above 40,000 tonnes, mainly come from non-mechanised fishing which is restricted to a narrow belt within the continental shelf (up to a depth of 40 metres) measuring less than 2000 km<sup>2</sup>. Increase in mechanisation has shown its impact in considerable rise in annual fish landings. However, a large part of potential fishing grounds upto 200 metre depth zone remains, unexploited. Similarly, specialised ecosystems like estuaries, backwaters, mangrove vegetation and freshwater ponds which have high productivity potentials are, at present, very meagerly utilised.

#### Prospects:

Several estimates of fish production for different parts of the Indian Ocean are available (Ryther, 1969; Gulland, 1971; Prasad and Nair, 1973; Jones and Banerji, 1973; Krey, 1973; Cushing, 1973 and Qasim, 1974 & 1977). Most of these resources assessment figures are based on computations from primary production or from the calculated potential yield of different categories of fish or on the exploratory fishing survey in different areas.



Since 1971, the National Institute of Oceanography, Goa, has been collecting data on biological production at different trophic levels, in Goa waters. So far, we have processed, analysed and published the data on primary, secondary and tertiary levels of production in estuaries, continental shelf and oceanic regions of Goa. Earlier, Rao and Dorairaj (1968), based on exploratory demersal fishery survey undertaken in 1967-68, have also indicated the potential sustainable yield from the shelf upto 70 metres depth. Using the baseline data from different sources like primary productivity values, exploratory surveys and an analysis of the annual fish catch from 1965-76, estimates and projection trends have been attempted, here.

As shown in Table I, the estimated potential and sustainable yield for the Goa waters as computed from primary production, is 69,000 and 41,760 tonnes, respectively. These estimates can only be considered valid with certain reservations for resource of pelagic fishes like mackerels, sardines, tunas, seer fishes, etc. which are essentially surface feeders in habit.

The demersal resources, assessed from the available data (Table 2), show variations from 19.3 kg/ha (Jones and Banerji 1973) to 47.8 kg/ha (Prabhu and Dhawan, 1972). Moreover, as there is no comparable data in respect of area of operation, season of survey, gear used and duration of survey, it is rather difficult to arrive at any realistic inference regarding potential demersal yield. However, the results presented by Rao and Dorairaj (1968) appear to

be more realistic as they cover wider area of continental shelf, use of standard gear and a statistically valid sampling technique, viz. the "sweep" method. Accordingly, the potential demersal yield for the entire area of 15,798 km upto 70 metre depth at the rate of 30.10 kg/ha will be 47,558 tonnes and of this at 60% exploitation level, the annual sustainable yield will be 28,535 tonnes. Thus, the total annual sustainable yield from both pelagic and demersal resources will be about 70,000 tonnes

In order to test the validity of the estimate of fish production calculated from primary productivity and exploratory demersal fishery survey, an attempt has been made here to draw production projection (but Not predictions) from the available annual fish catch data for the last 12 years (1965-76). The production potentials have their inherent limitations, arising out of factors like changes in Government policies, technological innovations, prevailing prices in inland and export market, etc. In the case of fisheries, changing economics of operations, over exploitation of inshore waters, availability of new but unconventional resources in deeper waters, availability of bigger vessels to operate in offshore regions, etc. are some of the other factors having direct bearing on future fish production. In view of the above mentioned constraints, it was thought proper to restrict to only trend projections rather than attempting for statistical projection models.

As seen from Figs. 3 & 4, the Fisheries of Goa during the last 4 years (1973-76) have shown an overall increasing trend as compared to the

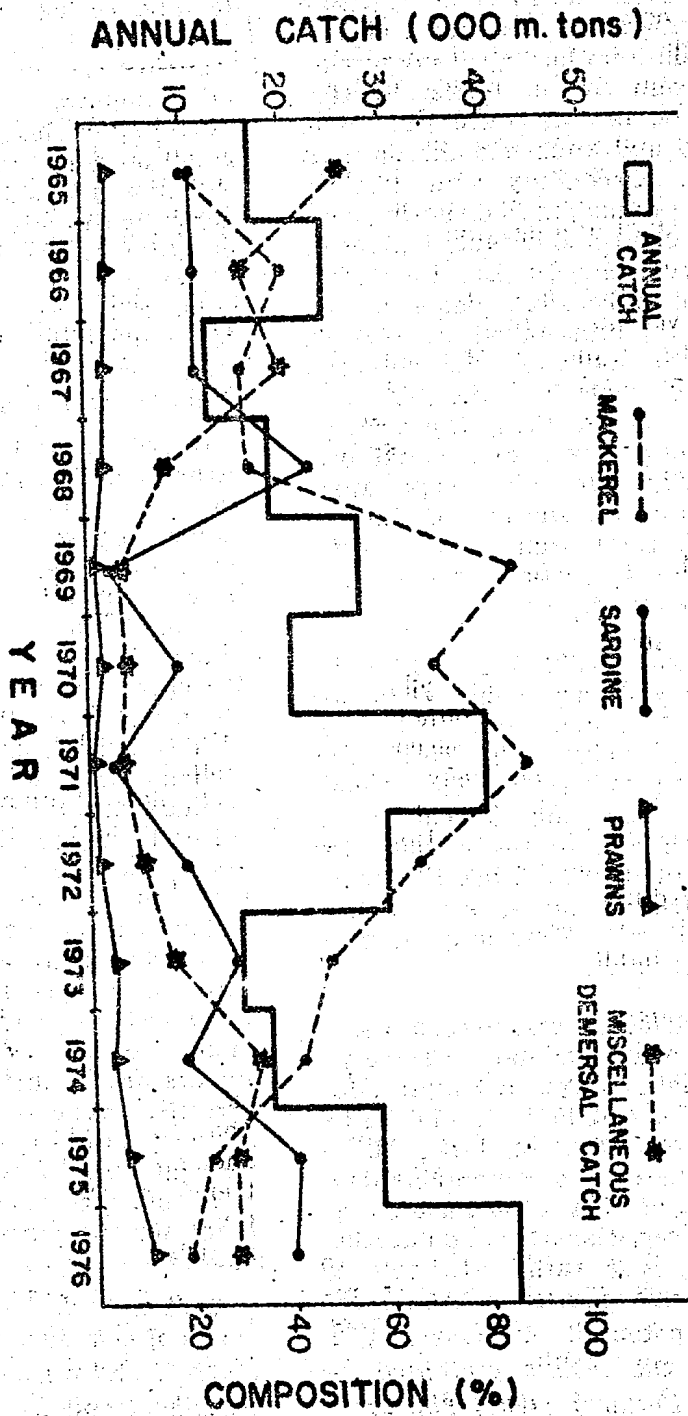


Fig. 3

period from 1965 to 1972. This may be due to less fluctuations in pelagic resources which usually exhibit wide variations (Shastri, 1977). After duly considering all the above mentioned facts, the available production data was fitted in the Linear and Modified Pearl Reed Curved, for projecting the production of the next few years.

A linear model ( $Y = a + bx$ ) as it indicates changes in absolute terms was found to be not very appropriate to project the trends of production.

Moreover, after examining the patterns of expenditure by Government of fisheries development and the consequent increase in production, during the last 4 years (1973-76), it was found that there is a direct correlation between expenditure and production. The expenditure pattern has been found to follow a growth rate which more appropriately can be expressed by a modified Pearl Reed Curve than a Linear model. Accordingly, the projected production, as shown in Table 3, varies from 50,875 tonnes in 1977 to 1,12,036 tonnes in 1981.

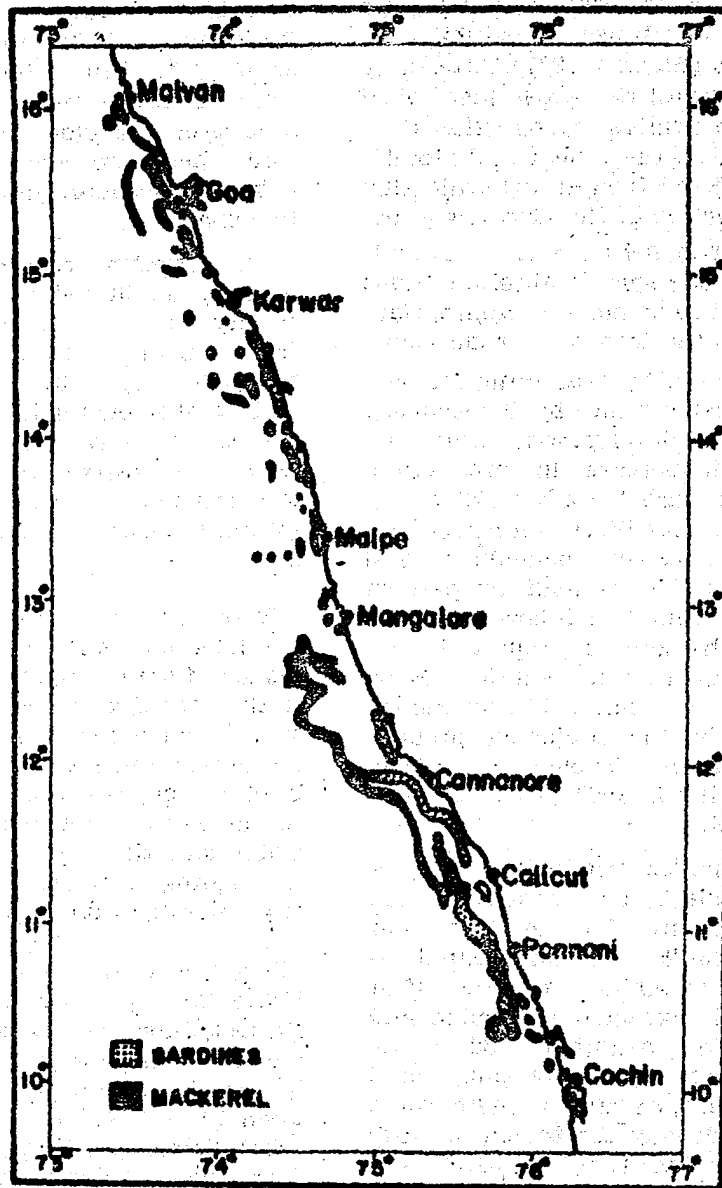
The yearwise production projections (Table 3) are based on fish landings figures for the last four years (1973-76). The anticipated increase is maximum in 1978 after which it is expected to decline and will remain constant in 1982-83. After the year 1983, procedure used here may not be valid as there would be upward changes in expenditure on fisheries in the VII Five Year Plan.

The projections are comparable with the estimated potential yield computed from primary productivity studies and exploratory demersal fishery survey. The estimated sus-

tainable yield is 70,000 tonnes for the year 1978 whereas the production projection is 68,359 tonnes for the same year. Thus, the potential resource is much more than the present level of exploitation and therefore, there are good prospects of fisheries development in the years to come.

The estimates, especially based on primary productivity data, are far fishery survey. The estimated sustainment is realistic, as rightly pointed out by Qasim (1977 b) and therefore, instead of solely relying on such estimates, we have used exploratory survey and yearwise fish catch data for arriving at a reasonably reliable estimate about the potential resources.

The recent findings (Qasim, 1977 b) indicate that from the traditional inshore fishing grounds an increase in the fishing effort will not result in substantial increase in the catch of mackerels and sardines. It has long been suspected that the pelagic resources will be available in appreciable quantity beyond the traditional fishing grounds. The results of the investigations by aerial and acoustic surveys (Fig. 4) conducted along the west coast of India by UNDP/FAO sponsored pelagic Fishery Project, have confirmed that both mackerel and sardine shoals occur in neritic waters, particularly between 19 and 40 fathoms (Annon, 1973). These resources off Goa (Fig. 4) can very well be exploited by using relatively small-sized vessels that at present, are used for trawling in the inshore waters upto 20 fathoms. These newly reported fishing grounds can be exploited throughout the year but the maximum abundan-



Sardine and Mackerel schools along the west coast of India observed by aerial survey during September - October 1973 (after UNDP/FAO Pelagic Fishery Project (IND/593) Progress Report No. 8).

Fig. 4



ce will be prior to the outbreak of southwest monsoon (Annon op. cit).

While we have reasonably good information about the resource potential of the continental shelf, the extensive offshore areas accounting for more than 90% of the total sea floor are scientifically little known. The available information on primary productivity (Prasad and Nair, 1973; Qasim, 1977 a and b; Radhakrishna 1978 Radhakrishna et al., 1978) and benthic production (Neymann, 1966 and Parulekar and Nair, 1977) indicates that in general, the areas beyond the continental shelf are 80% less productive than the in-shore waters (Cushing, 1973). These observations necessitate a close scrutiny of any proposal for deep-sea fishing which involves large inputs and low returns.

#### **Aquaculture:**

Any programme for the overall development of fishing industry needs diversification and exploration of new avenues. At present, there is a worldwide trend for the development of aquaculture of fish farming which basically involves the application of the principles of animal husbandry (Qasim, 1975).

In a developing country like India, the necessity for implementing large scale aquaculture programme arises from the following factors.

- i) aquatic organisms attain high growth rates in warm waters;
- ii) to produce a high quality animal protein at a reasonable price for supplementing the protein deficient diet;

- iii) abundant availability of relatively cheap and unskilled manpower;
- iv) proper utilisation of vast wetlands for generating more fish food resources;
- v) creating more vocational opportunities for rural population, and
- vi) production of choicest varieties of quality table fish for export.

Besides the above mentioned points, aquaculture also aims at monitoring the environment so as to control the quality and yield of the desired product.

Studies on technical and economic feasibility of farming of different aquatic organisms in Goa waters have yielded very promising results (Table 4) and the production figures alongwith the rate of return on investment are comparable and even higher than reported from the developed countries (Shepherd, 1974). The technique so far developed are indigenous, low cost and most practicable.

Aquaculture in a traditional way has been practised in Goa from times immemorial (Parulekar and Verlenkar, 1977). The success, so far achieved, clearly indicates the greater possibilities of fish farming on commercial scale (Parulekar and Dalal, 1978). A survey of suitable areas (Table 5) for undertaking aquaculture of commercially important species indicated that there are 4,500 hectares of area readily available in different ecosystems of Goa. Besides these areas, a large part of the open sea can also be brought under cultivation

for raft culture of pearl oysters, edible oysters and mussels; cage or pen culture of lobster and other pelagic and demersal fishes; rope culture of seaweeds etc. At present, fish farming in Goa which engages about 300 part-time and about 100 fulltime persons contribute for about 0.1% of the annual fish production (Parulekar and Verlencar op. cit). This production, by traditional methods, involves less than 80 hectares. With the introduction of scientific management technique which assure round the year production at high rate of returns, an appreciable increase can very well be achieved.

An analysis of the available data clearly indicates that the potentials for fisheries development in Goa are very high. The marine catches are subjected to unanticipated vagaries but due to increase in mechanisation, the catches are likely to increase. Moreover, the recent discovery of exploitable shoals of mackerels and

oil sardines off Goa is bound to increase the annual yield, substantially. A large part of this increase should come from the shelf waters. Any largescale investments in deep sea fishing beyond the shelf has to be undertaken with a great degree of caution. In view of the low productivity and the high-cost technology involved in deep sea fishing, the economic viability of such fishing operations would be highly questionable.

New avenues of increasing the fish production are to be explored by undertaking large scale fish farming programmes. The feasibility studies have indicated high yields at low cost and all the other associated benefits like high rate of returns, utilisation of wet lands, pollution control, employment in the rural sector, etc. are in favour. At a conservative estimate, an increase, of 5,000 tonnes of choicest varieties like shrimps, fin fishes can be expected.

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**Table 1. Annual primary productivity and estimated potential and sustainable yield of Pelagic fishes in Goa waters**

Depth zone (m)	Area (km <sup>2</sup> )	Average daily Production (g m <sup>-2</sup> day <sup>-1</sup> )	Annual Production <sup>a</sup> (tonnes C/year)	Estimated Potential Yield (t/yr)	Estimated Sustainable Yield (tonnes/yr)
< 50	2,849	0.70	7 × 10 <sup>5</sup>		
50-200	7,135	6.37	9 × 10 <sup>5</sup>	6,96.00	41760
>200	8,98,560	0.21	6 × 10 <sup>7</sup>		
<b>Total</b>	<b>9,08,544</b>		<b>6.9 10<sup>6</sup></b>		

\* Values by Radhakrishna et al (1978)

**Table 2. Annual estimated potential and sustainable yield of Demersal Fishes in Goa waters**

Depth zone (m)	Area (Km <sup>2</sup> )	Catch (Kg/Km <sup>2</sup> )	Potential Yield (tonnes)	Sustainable Yield (tonnes)	Source	
< 50	2,849	1930-00	5498.57	33,00	Jones & Banerji (1973)	
0-70	15,798	3010-43	47,558.81	28,535	Rao & Dorairaj (1968)	
Depth zone (m)	Area (Km <sup>2</sup> )	Catch (Kg/day)	Catch (Kg/Km <sup>2</sup> )	Potential Yield (tonnes)	Sustainable Yield (tonnes)	Source
< 4	2,280	484.35	4776.00	10889.28	6533.65	Prabhu & Dhawan* (1972)

\* The original values of Kg/boat/day have been converted to Kg/ha and Kg/Km<sup>2</sup> by integrating the area up to 40 meter depth zone.

Table 3. Projection of Fish Production in Goa (1977-81)

S. No.	Year	Projected Production (tons)	Anticipated Increase (%)	Coefficient of Determination ( $r^2$ )	Methodology Details
1.	1977	50,875	18		<p>Modified Pearal Reed Curve</p> $y^{-1} = c + e^{bx}$ <p>where</p> <p>y is production</p> <p>e is Neperian base (2.718)</p> <p>c &amp; b are constant</p> <p>x is Variable (Year)</p>
2.	1978	68,359	34		
3.	1979	89,358	30	0.98	
4.	1980	1,08,539	21.4		
5.	1981	1,12,036	3.2		

Table 4. Fish Farming in Goa - Details of species, annual yield economics etc.

Sl. No.	Species	Type of Environment	Location & System	Annual Yield ( Kg/ha )	Rate of Return (%)	Source
1.	Green mussels ("Shivan")	Brackishwater/ Marine	Dona Paula & Caranzalem Bay/ Rope Culture on Floating Raft	4,80,000	181	Qasim, Parulekar, Harkantra, Ansari & Nair (1977)
2.	Mulletts ("Sevto") Pearl spot ("Kalundra") & Prawns ("Sungta")	Brackishwater	Orda, Ribandar & Mashem/Traditional Fish Farms, Paddy Field Culture & Salt Pan-cum Fish Culture-Natural Stocking	1,060	100	Parulekar & Verlekar (1977)
3.	Mulletts ("Sevto") & Pearl spot ("Kalundra")	Brackishwater	Siridaon/Specially designed fish farm where Scientific Stocking was done	1,700	205	Prabhu Matondkar (1978)

**Table 5. Fish Farming in Goa-Potentials**

Sl. No.	Type of Ecosystem	Area (approx.) (hectares)	Species Suitable for Cultivation
1.	Coastal bay, Coves, Sandplats rock pools etc.	2,200	Green mussels, Oysters, Wedge clams, hard clams, Ladys fish, shrimps, Lobsters & Seaweeds.
2.	Estuarine embouchers, bays mudflats, etc.	900	Mulletts, pearl spot, milk fish, bhekti, Shrimps, Crabs, Green mussels, Oysters & Clams.
3.	Mangrove vegetation	500	Mulletts, pearl spot, milk fish, bhekti, Shrimps Crabs, Oysters, etc. especially for developing nurseries.
4.	Estuarine fish farms, Salt pans, Paddy fields and "Khar" lands.	725	- do -
5.	Shall tanks, lakes, ponds and river bed.	100	Indian and Exotic Carps, Tilapia, Eels, Murrels, Macrobrachium prawn, Black clam & Freshwater Mussels.