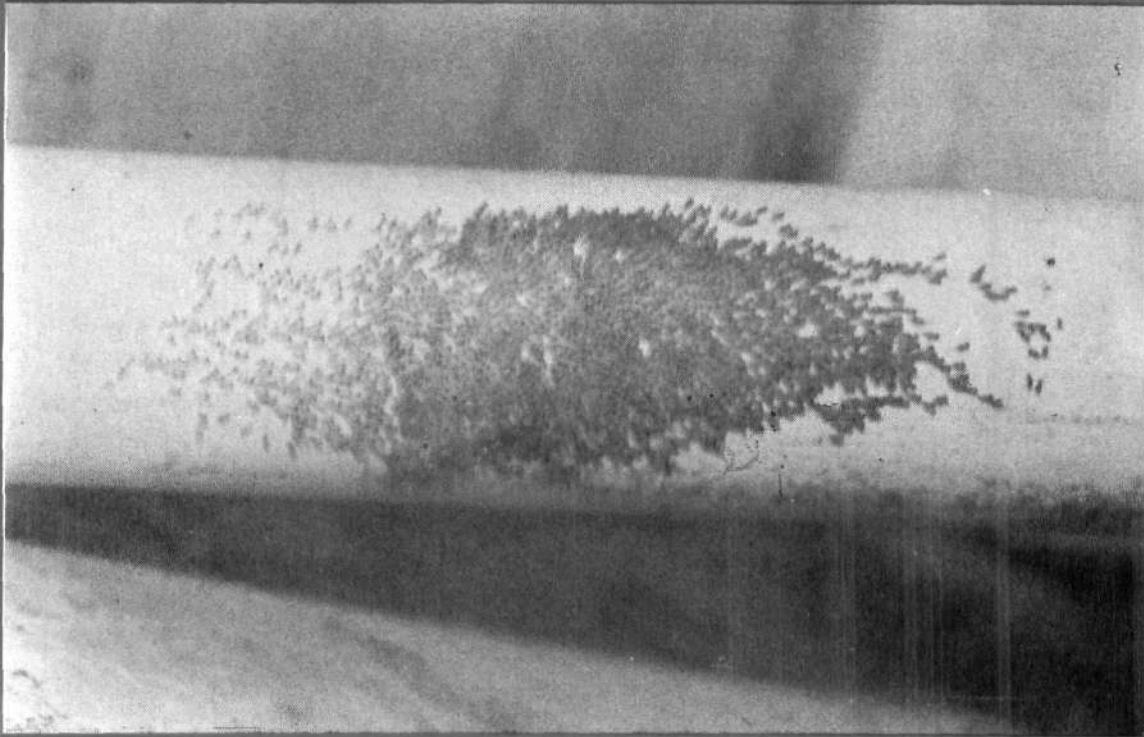




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INDIAN COUNCIL OF AGRICULTURAL RESEARCH

Introduction

'Dol' net is an indigenous bag net operated along the northwest coast of India. This is the gear mainly used in the Bombay duck fishery. Maharashtra and Gujarat are the states where the 'dol' nets are operated. The difference in the method of operation between these two states is in the method of anchoring. In Gujarat 'dol' nets are operated in three regions, namely Umbergaon to Kavi along the southern Gujarat, Siyalbet to Diu along the Saurashtra coast and Takkara to Modhwa in the Gulf of Kutch region. Among these three regions Saurashtra is the important region and the main fishing centres are Jaffarabad, Rajpara, Nawabunder and Goghla (Fig. 1). Out of this the first three centres are the most important with more than 200 'dol' netter units under operation.

In this communication an attempt has been made to give an overall view of the 'dol' net fishery of the Saurashtra Region of Gujarat. The method of 'dol' net operation, fishery, conditions and other factors prevailing in the three major landing centres namely Nawabunder, Rajpara and Jaffarabad are dealt with based on regular observations carried out during September 1995 to August 1997.

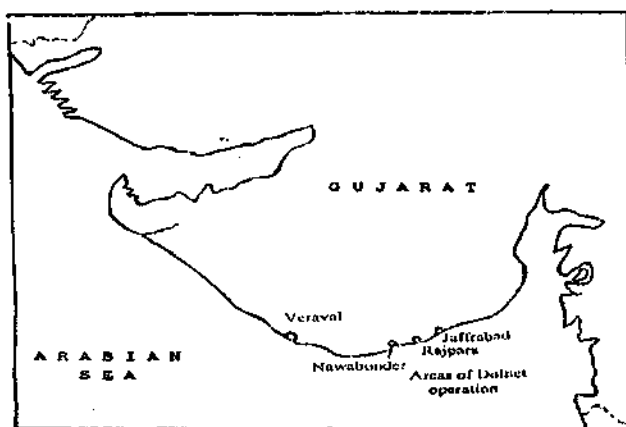


Fig. 1. Coastal map of Gujarat State.

'Dol' net operation

'Dol' nets are fixed bagnets which are tied to the poles or ropes anchored at the sea bottom and kept afloat by floats. In the Maharashtra region the anchoring is done on the poles fixed to the sea bottom whereas in the Saurashtra coast heaps of stones are used as anchors. 'Dol' nets are operated almost throughout the year, but the main season can be divided into two such as the first season from September to the middle of January and the second from February to May. This division is based on the shifting of the fishing grounds at all the three landing centres. During the first season the fishing ground is located in the southeast direction from all the three landing centres. Fishing is done from this ground till the middle of January and afterwards the ground shifts towards north of the existing ground. This shifting takes place in about 15 days and the next fishing starts in the beginning of February. It was observed that during this period the crew of the boat also changes. 'Dol' net being the fixed bag net the success of operation depends on the favourable currents, so the shifting of the ground must be associated with a change in the current patterns of the area.

The fishing ground is identified and stones are laid as marker for different 'dol' nets. The fishing season starts with the laying of stones. The stones are purchased from nearby quarries and taken to the fishing ground (Fig. 2). First a stone is laid with the rope followed by a number of stones through the attachment in the main rope. Two such stone heaps are made for each 'dol' net. A 'dol' net needs 50 to 60 stones. The 'dol' net operation in Saurashtra is confined to a depth ranging from 15 to 35 m. The anchor ropes are strongly based at the bottom with the help of these heaps. The other end of the rope is tied to the floats. Earlier floats were made of



Fig. 2. Stones used as anchors for 'dol' net waiting for transportation to fishing grounds from landing centre.

wooden barrels but now plastic cans and ready made floats are used for this purpose. The 'dol' nets are attached to these ropes. The mouth of the net is placed against the tidal current and before the current changes the net is hauled and after emptying the catch it is again put in the opposite direction. The number of hauls depend upon the season and number of nets carried in a boat. The four net units generally do single hauls only whereas two and three netters do two hauls.

The net is made up of HDPE with a codend mesh of 20 mm generally. The codend is generally double walled for extra protection. The length of the net varies from 40 to 80 m and costs around Rs.70,000 to 1,00,000. The ropes and net last for almost 10 years.

Fishing craft used for the 'dol' net operation varies from 10 to 15 m in length with tonnage varying from 5 to 20. Earlier the boats were with sails and were using wind power for propulsion. At present all the 'dol' net units are motorised with engine power varying from 20 to 88 HP. They also carry sails along with them to utilise the favourable wind.

According to the number of nets used by a single craft, the boats are classified as two net, three net and four net units. The two net units usually have 7 to 8 crew members whereas the three netters and four netters have more than 8. The season generally starts from September. The fishing ground is shifted towards the western side in all the major fishing centres during the middle of the season due to the change in the current pattern. This shifting requires the laying of another set of anchor stones in the new fishing ground mainly during January, and February.

TABLE 1. Major groups of fishes landed in 'dol' nets

Groups	Species	Uses
Bombay duck	<i>Harpodon nehereus</i>	Drying
Clupeids	<i>Coilia dussumieri</i>	Drying
	<i>Ilisha filigera</i>	Fresh and dry
	<i>Chirocentrus dorab</i>	Fresh
	<i>Thrissocles</i> sp.	Drying
Elasmobranchs	<i>Scoliodon</i> spp.	Fresh and dry
	<i>Carcharhinus</i> spp.	"
Catfishes	<i>Arius</i> spp.	"
	<i>Tachysurus</i> spp.	"
	<i>Osteogenus</i> spp.	"
Croackers	<i>Otolithus</i> spp.	"
	<i>Johnius</i> spp.	"
	<i>Protonibea diacanthus</i>	Fresh, frozen air bladder is exported.
Eels	<i>Muraenosox talabonoides</i>	"
Ribbon fishes	<i>Trichiurus lepturus</i>	Fresh and dry (exported)
Threadfins	<i>Polynemus heptadactylus</i> .	Fresh
	Pomfrets	<i>Pampus argentius</i>
<i>Formio niger</i>		(exported)
Flat fishes	<i>Cynoglossus</i> spp.	Fresh and dry
Penaeid shrimps	<i>Parapenaeopsis stylifera</i>	Fresh (exported)
	<i>Metapenaeus</i> spp.	"
Non penaeid shrimps	<i>Penaeus</i> spp.	"
	<i>Solenocera crassicornis</i>	"
	<i>Acetes</i> spp.	Drying
	<i>Nematopalaemon tenuipes</i>	Fresh and dry
Lobsters	<i>Exhippolysmata ensirostris</i>	"
	<i>Panulirus Polyphagus</i>	Fresh
	<i>Thenus orientalis</i>	(exported)

Fishery

Nawabunder

Nawabunder landing centre has a well constructed concrete jetty projecting into the sea. From here about 250 'dol' netters are operated. Out of the three centres the topography of the sea bottom off Nawabunder is highly sloppy and the fishing ground is comparatively nearer to the shore. The depth zone of 40 to 50 m is almost 10 km away from the shore and the 'dol' netters reach the ground within two to three hours. Out of the 250 'dol' netters only 50 numbers are three netter units and the rest are two netters. At the start of the season the depth of operation is around 50 m and in the second season the depth is about 40 m. At this centre fishermen from south Gujarat also operate their 'dol' netters.

The resident fishermen belonging to both Hindu and Muslim communities are almost in equal proportions. So fishing is carried out throughout the month without a break.

During 1995-'97 the data was regularly collected and estimated from these landing centres every month. The effort amounted to 15,262. The monthly average total catch of this centre during the period of study was

1,719.8t. But the catch rate was only 112.7kg. The variation in the total 'dol' net catch during the study period is represented in the Fig.3.

At this centre Bombay duck contributed 17,932.7t with an average catch per haul of 49 kg during the period. The average monthly catch was 49 kg. The percentage contribution of Bombay duck to the total 'dol' net catch was 42 % (Fig. 8). The catch per haul for Bombay duck ranged from 28.4kg during January '96 to 158.4kg during the start of monsoon in 1997. The peaks were observed during October to December and April-May in both the years. The cyclone and heavy rains experienced in this region during the monsoon of 1996 was followed by a bumper catch of Bombay duck in the beginning of the season. The highest catch of 2,501 t Bombay duck was reported during December '96.

Bombay duck was followed by non-penaeid shrimps in abundance during the post monsoon months of 1996. About 1,173.8 t of *Acetes* landed in December '96 (Fig. 6). This species formed about 15.31% of the total catch of the centre during this period. The average monthly catch was 263.3 t and the catch per haul 17.25 kg. Other non-penaeids such as *Exhippolysmata ensirostris* and *Nemato-*

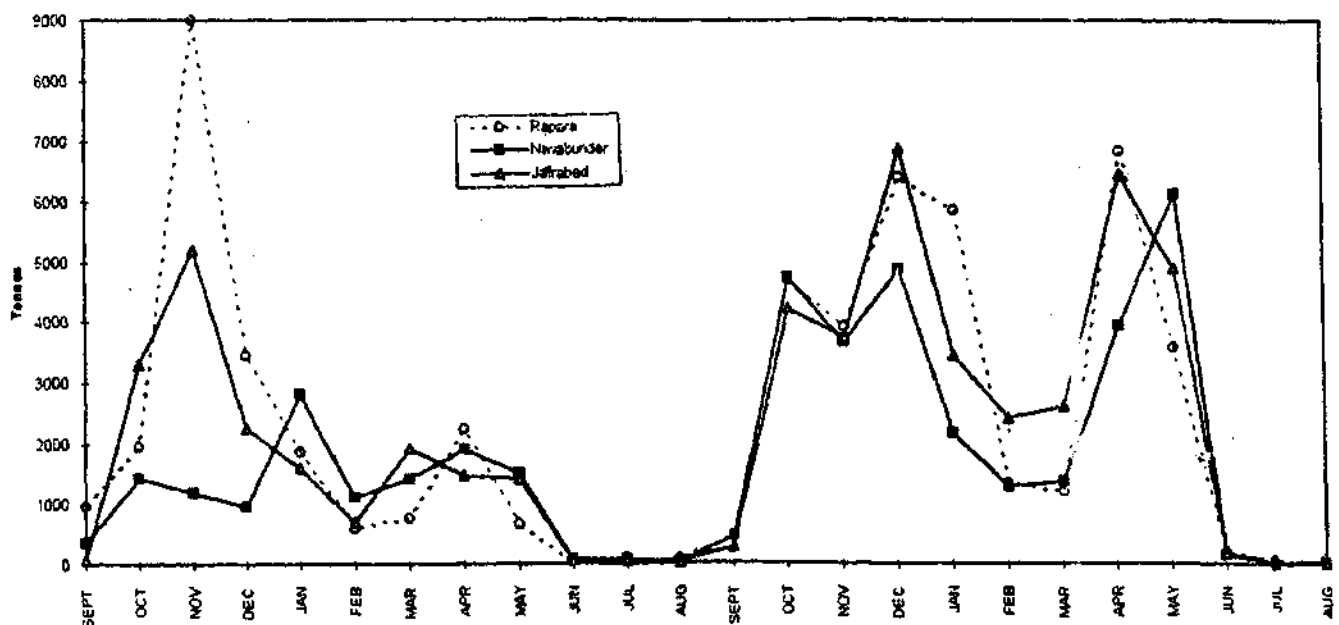


Fig. 3. Total 'dol' net landings at different landing centres (1995-'97).

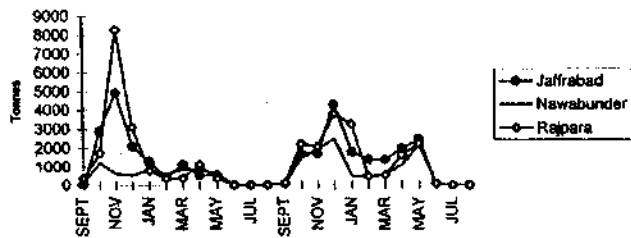


Fig. 4. Bombay duck landings at different 'dol' net centres 1995-'97).

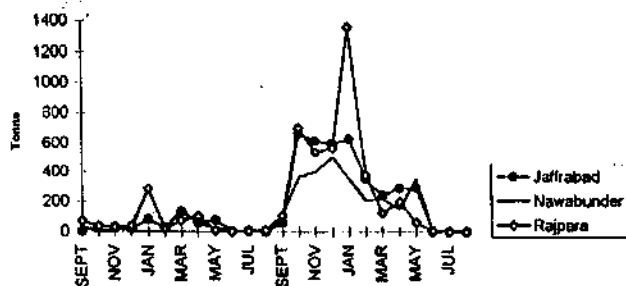


Fig. 5. *Coilia* landings at different 'dol' net centres (1995-'97)



Fig. 6. Unloading of catch at Rajpara landing centre.

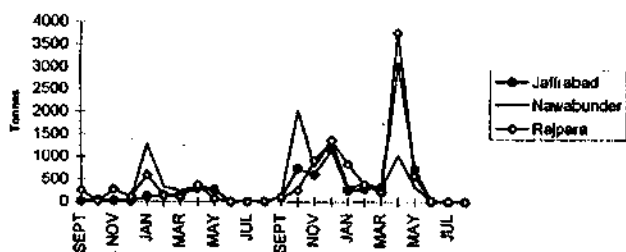


Fig. 7. Non-penaeid shrimps landings at different 'dol' net centres (1995-'97).

palaemon tenuipes formed 5.75 and 1.75 percentage of the catch respectively. The two main periods when non penaeid catch dominated were September-December and April-May. The catches were high during 1996 compared to 1995 (Fig. 6). Other important groups were *Coilia* (7.95 %), catfishes (6.74 %), ribbonfishes (4.596 %) and penaeid shrimps (9.7096 %) (Fig. 8).

Coilia dussumieri was a major constituent of the catch throughout the year. Maximum catch of this species was observed in December '96 followed by a peak during April-May 1997 (Fig. 5). Similar peaks were also observed during the corresponding months of the previous year but with a lesser intensity. The catch per haul ranged from 0.1 to 66.4 kg.

Catfishes were found throughout the year. The group was represented mainly by *Tachysurus* sp. The maximum catch was observed during May in both the years. Catfish landings also showed two peaks during these years. First in the beginning of the season and the next followed by the premonsoon.

The ribbonfishes are represented by *Trichiurus* spp. Maximum catch of ribbonfishes was observed during the premonsoon months of April and May. In this group also two conspicuous peaks were observed as in the case of catfishes. The catch per haul was maximum during May '97 (18.18 kg). Penaeid shrimps represented mainly by *Parapenaeopsis* spp. increased considerably from September 1996 reaching a peak of 597 t during May 1997. The catch showed a marked increase compared to the previous year. However, for both the years there were two peaks with one during the start of the season and another before the monsoon.

Rajpara

At Rajpara around 240 'dol' net units were under operation out of which 100 numbers were three netters and the rest two netters. The fishing depth is 24 to 40 m and it takes 3 to 4 hours to reach the fishing ground. Here

also the season starts from September and during February the fishing ground is shifted towards the west.

In the early years at Rajpara 'dol' netters from south Gujarat were also operated. But at present due to the lack of enough berthing facilities the 'dol' netters from outside are not allowed to operate from this centre. This landing centre is located in a small bay. A well constructed jetty is not available in this centre. Landing takes place all along the bay (Fig. 6) there is a concrete platform on one edge of the bay where some of the boats land the catch. The fishermen belong to the Hindu community and the 'patel' or the community leader has

great control over fishing.

During September 1995 to August 1997 an estimated catch of 55,891.5 t of fishes (Fig. 3) were landed at Rajpara by 69,906 'dol' net units in 5,04,939 hauls. Bombay duck formed 59.94 % of the total 'dol' net landings (Fig. 8). During the period of study the maximum catch of 8,274.7 t was landed in November '95 and the minimum catch was recorded in July '96 (8.2 t) (Fig. 4). Compared to 1995-'96 season the catch was less during 1996-'97. Overall catch per haul for the two year period was 66.34 kg. Catch per haul varied from 18.93 kg in June '96 to 162.82 kg in May '97.

Apart from Bombay duck the non-penaeid shrimps formed 18.7 % of the total catch. *Acetes* spp. formed 13.1 % followed by *E. ensirostris* (3.9 %) and *N. tenuipes* (1.8 %). The trend of fisheries was as seen in the Nawabunder centre. Non-penaeid shrimp catch was maximum during December 1996 (Fig. 5). *Coilia* spp. formed 8.4 % of the landings in this centre with the period of abundance between October and December during both the years (Fig. 5). Ribbon fishes constituted 6.3 % of the landings. During the period September 1996 to August 1997 the landings of ribbon fishes were very high. 110 kg per haul of ribbonfish was landed during May 1997. Penaeid shrimps also formed a considerable quantity of the total catch (2.7 %) (Fig. 8)

Jaffarabad

At Jaffarabad about 280 'dol' netters were under operation out of which 60 were four netters. Here the 'dol' net operation is about 25 to 40 km away from the coast and it takes 6 to 7 hours to reach the area of operation. The 'dol' netters from the nearby village Sialkot also operate from this centre.

During the period of study an estimated catch of 54,653.3 t were landed by 50,126 'dol' net units. Bombay duck formed 57.1 % of the total catch (Fig. 8). Overall catch per haul for the period of study was 117 kg. An estimated catch of 31,211.2 t of Bombay duck was landed during this period with an average catch per haul of 66.8 kg. The catch per haul varied

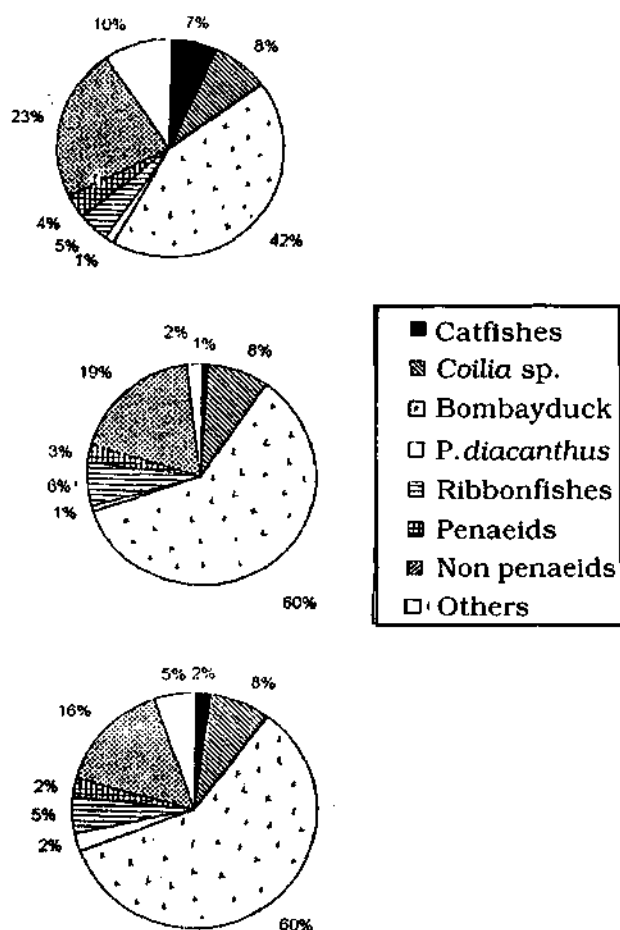


Fig. 8. Species composition the 'Dol' net landings (1995-'97). Top: Nawabunder, middle : Rajpara. Bottom : Jaffarabad.

from 40.2 kg (March 1996) to 172.4 kg (November 1995). The maximum catch of Bombay duck was observed during November 1995 followed by December 1996 (Fig. 4). During the monsoon months of July - August also 'dol' net operations are carried out but with a lesser magnitude. During July 1995 the catch per effort of 116 kg haul was obtained for the 99 units operated. The peak period of abundance was October to December 1995 and October 1996 to January 1997. Both these peaks were followed by a secondary peak in March 1996 and May 1997 respectively.

The total catch of Jaffarabad showed two conspicuous peaks in the fishery, one during October-December and the second during March-May in both the years. (Fig. 3).

Apart from Bombay duck, non-penaeids as a group formed 15.25 % of the total catch (Fig. 8). Among non-penaeids *Acetes* spp. formed 11.12 %, followed by *N. tenuipes* (2.73 %) and *E. ensirostris* (1.34 %). In non-penaeid shrimps a major peak was found between March and May in both the years. This peak is mainly due to the abundance of the *Acetes* spp. during the period. The other important constituents of the catch were *Coilia* spp. (7.7 %), ribbonfish (4.87 %), gholis (2.25 %), other croakers (4.74 %) and penaeid shrimps (4.87 %).

January to May was the period of abundance for *Coilia* spp. Another important species landed was *P. diacanthus*. Peak catch was observed in March 1996 (315.3 t) and January 1997 (324.9 t).

An estimated catch of 2,662 t of ribbonfishes was landed during the period, the primary season being April to May and the secondary October to December. The maximum catch of 622.6 t was observed during May 1997 with the catch per haul of 31.25 kg.

The period of abundance for the penaeid shrimps was October-November and there was a secondary peak during April-May. The total landing of penaeid shrimp for the period was 1286.3 t with an average catch per haul of 2.75 kg. Maximum catch of 287.9 t was observed

during April 1997 with an average catch per haul of 7.37 kg. The penaeid shrimps were represented by twelve species and the important genera were *Parapenaeopsis* and *Solenocera* in terms of abundance.

Catfishes and sciaenids other than *P. diacanthus* also contributed to the fish catch of the centre. Maximum catch of catfishes was during January-May. They formed 1.94 % of the catch. Small sciaenids formed 4.87 % of the total catch.

General remarks

One important feature observed in all the three landing centres was the dominance of Bombay duck in the catch (Fig. 9). This was the mainstay of 'dol' net fishery. Eventhough Bombay duck formed more than 50 % of the catch in all the three centres except in Nawabunder (44 %) (Fig. 8), there was a decrease in the percentage contribution of this species when compared to the values given by previous authors. Corresponding to the decrease in the percentage contribution of Bombay duck there was an increase in the next dominant group, the non-penaeids, which formed more than 15 % of the catch at all the centres. Among the non-penaeids, *Acetes* spp. was the dominant one. These species alone formed about 15 % at Nawabunder. At Rajpara this group formed about 13 % and at Jaffarabad about 11 %. The gold spotted anchovy (*Coilia dussumeri*) is also an important



Fig. 9. A portion of bumper catch.

group landed in 'dol' nets. This group formed around 8 % in the dol net catches at all the centres.

The peak season for Bombay duck was October to December at all landing centres and catches were poor during the monsoon months. Compared to 1996-'97 more Bombay duck was landed during 1995-'96 except in Nawabunder where the catches were more during 1996-97. But for non-penaeids and gold spotted anchovy the main season was March to May, and the catches were more during 1996-'97 than 1995-'96. The main season for the gold spotted anchovy was between December and March.

Eventhough there was an increase in the total fish landed by the 'dol' nets, compared to the previous year there was a decrease in the catch per haul for the total fish landed and also for the individual groups, the exception being non-penaeids especially the *Acetes* spp. So the increase in the catch was contributed mainly by the *Acetes* spp. which has a low economic value.

In all the three centres namely Nawabunder, Rajpara and Jaffarabad, fish drying is the major post harvest occupation. The fish is dried by hanging from ropes tied to the poles. There are several such rows in the drying yards of each centre (Fig.10). The dried products are transported to the centres throughout the country, mainly in the north eastern states. Bombay duck, *Coilia*, ribbon fish and small prawns are the main dried



Fig. 10. Sun drying of catch.

items. The high valued items such as bigger shrimp, lobsters, ghol, bigger ribbon fishes etc., are preserved with ice in the boat and is purchased by the exporters. The ghol, *Prototibea diacanthus* is priced about Rs. 90 per kg. The air bladder of the fish also fetches very good price. Some quantity of Bombay duck is consumed in the fresh form. Some of the processing plants in Veraval recently attempted export of Bombay duck in freeze dried form.

The interesting feature observed at all the landing centres was the involvement of women in the post harvest operations. The catch is purchased by women and they do the sorting, and the fish is then transported to the nearby drying yards in 'phut-phut' rickshaws (Fig.11). The costly varieties such as shrimps, pomfrets, lobsters, ghol etc. are purchased by the agents of exporters and transported to Veraval.

The trawl netters from Veraval occasionally land Bombay duck and other species usually appearing in the 'dol' nets, especially in the March-April months. This happens because at this period of the year some of the trawlers operate in the Bombay duck zone, but this was not found to have any effect in the 'dol' net catch.

It was observed that a large quantity of juveniles of the commercially important groups such as Bombay duck, penaeid shrimps, pomfrets, ribbonfish, ghol and other sciaenids



Fig. 11. Sorting and transportation of catch.

are caught in the 'dol' net. This must be due to the very small mesh size of the cod end. Water current of the sea has a very important role in

the success of 'dol' net operations and hence a detailed study of the oceanographic parameters is needed to understand the dynamics of this fishery.
