Note

A case study on *dol* net fishing operation and its economic analysis off Gujarat, north-west coast of India

K. M. SIKOTARIA[1], G. S. TEMKAR[1], P. ABDUL AZEEZ[*2] AND K. L. MATHEW[1]
[1]College of Fisheries Science, Junagadh Agricultural University (JAU), Veraval - 362 265, Gujarat, India
[2]ICAR-Central Marine Fisheries Research Institute, Veraval Regional Centre, Bhidiya Plot, Veraval - 362 269
Gujarat, India
e-mail: azeez.cr7@gmail.com

ABSTRACT

Dol net is traditionally used for fishing along the north-west coast of India. In this study, the operational as well as economic aspects of *dol* net operation off Navabandar, Gujarat was studied. *Dol* nets operations from mechanised boats locally called as *Van* along Navabandar coast were considered for the present study. The overall length (OAL) of the mechanised vessels were in the range, 10-12.8 m with 2.4-3.6 m breadth and 1-1.8 m height. The total capacity of vessels was in the range 15-20 t and average fish holding capacity was 2.5 t. The fishing vessels had six cylinder engines of 87 to 105 hp. Fishermen themselves fabricated the nets for the *dol* net, which had seven different parts with various lengths. *Kaba-sus* system using steel pipes was the method of *dol* net fishing off Navabandar. They were locally known as *Bochi*, *Patiya*, *Aor*, *Trijo*, *Bangu*, *Chothi* and *Jalo*. The study indicated that the profit of a *dolnetter* at Navabandar in a year was ₹2,88,122.

Keywords: *Dol* net, Economic analysis, Navabandar coast, Passive fishing

Dol netting is a very popular passive technique of fishing practiced along the north-west coast of India. It is one of the traditional fishing gears of India, especially in Gujarat and Maharashtra. This net is an indigenous version of bag net. Various studies have been conducted on the structure and operation of this net (Setna, 1931; Rammurthy and Muthu, 1969; Khan, 1986; Khan, 1987). However, the first report on the operation of *dol* net was from Maharashtra, wherein details about fixing of *dol* net was described (Setna, 1949). Raje and Deshmukh (1989) reported on details about fixing up of wooden poles based on the principles of hydrodynamics (Setna, 1949).

Dol net (set bag net) is a fixed tapering bag net, resembling a trawl net, set in tidal streams by attaching it to anchors for holding the net in place. The success of operation depends on favourable currents. Tapering of the net from mouth to the cod end is achieved by gradually reducing the size and number of meshes. The nets are hand braided and made mainly of nylon multi-filament for netting and other synthetic materials for framing lines. The traditional netting may also have a mixture of polyamide (PA), polyethylene (PE) and polypropylene (PP). *Dol* net catches the species of fish, which drift with the current or do not swim fast enough to stem the current and maintain a fixed position in relation to seabed (Akerman, 1986).

After few hours of shooting the net, it is hauled onboard and the catches are removed.

Dol nets are classified on the basis of the method and depth of their operation. The simplicity of its design, construction, operation and low investment has made this gear very popular among small-scale fishermen. *Dol* nets are operated by traditional, motorised as well as mechanised boats. *Dol* net can be efficiently operated at any depth in the water column and the gear is operated almost throughout the year, but the main season of operation is divided into two; the first season from September to the middle of January and the second from February to May. Gujarat and Maharashtra are the major states where the *dol* nets are operated. The difference in the method of operation between these two states is in the method of anchoring. Smaller bag nets are operated along other parts of the Indian coast, but mainly in estuaries and creeks. The dominating species of *dol* net catch along the north-west coast include Bombayduck, clupeids, elasmobranchs, catfishes, croakers, eels, ribbonfishes, threadfins, pomfrets, flat fishes, penaeid shrimps, non-penaeid shrimps and lobsters (Sehara and Karbhari, 1987).

Navabandar in Gujarat is one of the important marine fish landing centre, which has contributed 10634 t (1.54%)

towards fish production in 2010-11 (Anon., 2012). About 1395 fishermen families are engaged in fishing and fishery allied activities in the area (CMFRI, 2010). Though information exists on operation of *dol* nets from other areas, no information is available for Navabandar. Hence this work was undertaken to study the operational as well as economic aspects of *dol* net operation off Navabandar, Gujarat.

The study was conducted in Navabandar fishing village (20° 44' 13.0632'' N; 71° 4' 28.0056'' E), Gir Somnath District of Gujarat (Fig. 1). The village is the hub for *dolnet* fisheries of north-west coast of India. The major groups of fishes landed are Bombayduck, pomfrets, clupeids, sciaenids, thread fins, ribbonfishes, tuna, grouper, penaeid and non-penaeid shrimps and crabs (Anon., 2016). The information regarding catch composition and fishing operations were collected from 20 *dolnetters* at fortnightly intervals from randomly selected fishermen of Navabandar landing centre during August 2012 to April 2013. A structured interview schedule was formulated to collect data required for the present study with due care given to collection of all relevant information.

Vessel, engine and gear specification of *dolnetters* such as overall length (OAL) of vessel (m), breadth of vessel (m), depth of operation, tonnage capacity (t), base harbour, engine specification and accessories of vessel, total length of net (m), breadth of net (m), mesh size (mm), number of meshes and accessories of *dol* net were measured/counted and recorded to meet the objectives of the study (Sreekrishna and Shenoy, 2001).

The measurements of 50 *dol* nets used by the *dolnetters* along the coast of Navabandar taluka were recorded to determine their average values. Details of length, breadth, number of mesh and mesh size at each section of *dol* nets were recorded. The recorded data were analysed separately for each aspect.

Economic analysis of *dol* net operation was done by calculating capital cost, variable cost, fixed cost, total project cost, total cost and the total revenue (Snedecor and Cochran, 1967; Dewey, 1975; Rao and Bindu, 1976; Halcrow, 1981; Datta and Dan, 1988; Raje and Rammurthy, 1990; Sehara *et al.*, 1992). Capital cost included the costs of vessel, engine, net and other miscellaneous items, which have more than one year durability, whereas total variable cost is the part of the total cost that does change as the rate of output changes (Dewey, 1975). The day-to-day expenses incurred for the operation of boat was termed as the variable cost or the operating cost. It included the costs of fuel, ice, lubricant, wages as well as the cost of repair and maintenance. Total cost was calculated by adding capital cost and variable cost.

Total fixed cost is the part of the total cost that does not change as the rate of output changes (Dewey, 1975). Fixed cost in the case of *dolnetters* includes the depreciation, interest and insurance. Depreciation was calculated on the basis of expected life, *i.e.*, ratio of purchase cost of an item divided by its expected durability in years. The total cost per annum of *dolnetter* operation was calculated by adding the fixed cost and variable cost (Halcrow, 1981).

The total revenue was calculated from the prices of different species of fish per kilogram at the landing centre and multiplying them with the quantity of each category of fish landed by *dolnetters*. Finally the annual profit of

Fig. 1. Location of the study site in Navabandar Village, Gir Somnath, Gujarat (Source: Google Map)

dolnetters operation was obtained by subtracting the total expenditure from the revenue of a unit in a year.

Mechanised dolnetter: The overall length (OAL) of mechanised vessel at Navabandar was 10-12.8 m with 2.4-3.6 m breadth and 1-1.8 m height. The total tonnage capacity of the vessel was found to be 15-20 with an average fish holding capacity of 2.5 t Table 1. Most of the *dolnetters* used IBM for their vessels fitted with Ashok Leyland engine. Informations on the engine *viz.,* make, power and the number of cylinders are provided in Table 1. Vessels were fitted with six cylinder engines having different horsepower capacities ranging from 87 to 105.

Table 1. Vessel and engine specifications of crafts used by *dolnetters* at Navabandar

Specification	Minimum	Maximum
Overall length (m)	10	12.8
Breadth (m)	2.4	3.6
Height (m)	1	1.8
Tonnage (t)	15	20
Fish hold (Number and capacity in kg)	No 1. & 1200	Nos. 2. & 2500
Voyage time (Days)	8	8
Crew member	8	10
Depth of operation (m)	40	60
Engine power (Hp)	87	105
Engine make	Ashok Leyland	
Number of cylinders	6	6

Earlier studies have revealed that size of the fishing vessels used for *dol* net fishing operation varied with coast such as the *dolnetters* at Kodinar, Saurashtra ranged from 6.5 to 8 feet length (Pillai, 1948), whereas elsewhere in Saurashtra the length was 13 m (Gokhale, 1957), 9.5 to more than 12 m at Versova landing center (Rao and Bindu, 1976), 11 to 16 m at Sonadia along Bangladesh coast (Akerman, 1986), 9 to 14 m at Navedar-Navgaon, 8.5 to 12.8 m at Madh, 10 to 12.8 m at Navabandar (Sehara and Karbhari, 1987), 6.5 to 8 m, 10 to 13 m, 13 to 17 m with 5 to 25, 30 to 35, 50 to 100 hp respectively at Versova landing center (Raje and Deshmukh, 1989), 7.5 to 12 m at Versova (Raje and Rammurthy, 1990), 10 to 15 m with 20 to 88 hp along the Saurashtra coast (Manojkumar and Dineshbabu, 1999), 12 to 16 m along the north-west coast of India (Kunjipalu, 2001), 10 to 12.5 m fitted with inboard engine at Gorai, Greater Mumbai (Jadhav, 2003) and 15 m fitted with 90 hp engine at Bassien Koliwada (Jaydev *et al.*, 2007). The size of *dolnetter* in Navabandar coast was similar in length as reported earlier whereas the capacity of engine was higher as compared to the other parts of the country.

The gear (*dol* net) was fabricated by fisherman in their houses as per the individual requirement of fisherman and local practices, by following standard design and specifications. Thus, the design pattern and rigging practices were dissimilar from net to net. *Dol* nets used by fishermen at Navabandar were of two seams with 60-90 m length, 28-36 m breadth and 14-15 m height. The net tapered from mouth to cod end, usually from 130 to 10 mm mesh size. The materials used were HDPE (nylon), PP (polypropylene) and PA (polyamide). *Dol* net consisted of seven parts with mesh size 130 mm at mouth and gradually tapering to 10 mm at cod end (Table 2). The different parts of *dol* net were locally termed as *Bochi*, *Patiya*, *Aor*, *Trijo*, *Bangu*, *Chothi* and *Jalo* having different lengths.

Table 2. Gear specifications for *dolnetters* operated at Navabandar

Specification	Measurements	
Overall length (m)	60-90	
Height (m)	14-15	
Breadth (m)	28-36	
Types of material	HDPE, PP, PA	
Parts of net	Length (m)	Mesh size (mm)
Bochi	14.0-18.0	110-130
Patiya	12.0-14.0	100-110
Aor	16.7-22.0	70-90
Trijo	09.0-14.0	45-70
Bangu	03.0-05.6	30-45
Chothi	02.4-04.6	15-20
Jalo	03.0-05.5	10-15

The *dol* nets operated along Saurashtra coast measured 150 feet with 50 to 60 feet height and 5 to 120 mm mesh size (Gokhale, 1957); whereas it has been reported as 45 to 75 m with a mesh size of 15 cm at mouth and 1.25 cm at the cod end at Versova (Rao and Bindu, 1976). The nets operated along the Bangladesh coast measured 30.5 to 46 m, 18.5 to 30.4 m, 9.0 to 18.4 m with 20 to 40 mm mesh size (Akerman, 1986), while at Versova landing centre (Raje and Deshmukh, 1989) *dol* nets of 70 m length with 30 to 350 mm mesh size was reported, along with nets of 7.5 to 9 m (small), 9.3 to 12 m (medium) and over 12 m (large) length at the same landing center (Raje and Rammurthy, 1990). The nets used along South Konkan had mesh sizes from 280 to 12 mm from mouth to cod end (Raje, 1991) and 40 to 60 m length from mouth to cod end (Kunjipalu, 2001). The *dol* nets operated from Navabandar coast have more length and breadth while their mesh size was smaller compared to other areas; such modification mainly done to increase catch as much as possible including small fishes and shrimps such as *Acetes* spp.

The *dol* nets operating along the coast of Maharashtra are reported to have six segments of *dol* known as *Mohar* (8.5-10.7 m), *Chirate* (6.7-11.0 m), *Katra* (11.0-15.0 m), *Manjuwala* (9.8-13.7 m), *Munj* (4.8-8.5 m) and *Khola* (4.5-7.6 m) starting from the opening to the cod end (Sehara and Karbhari, 1987). However, Raje and Deshmukh (1989) reported that along Versova, Mumbai, Maharashtra *dol* nets have seven parts in the net *viz., Mohor* (11 m), *Chirat* (13 m), *Katra* (13 m), *Mazvala* (16.5 m), *Khola* (5.5 m), *Par* (5.5 m) and *Ambadpar* (5.5 m). The *dol* nets of Saurashtra were larger sized as well known to have eight sections locally termed as *Bochi* (1.2-1.5 m), *Mathadu* (12.0-13.7 m), *Malkhadu* (2.4-3.6 m), *Oar* (16.7-20.0 m), *Trijo* (9.0-12.0 m), *Bangu* (3.0-4.6 m), *Chothi* (2.4-4.6 m) and *Jalo* (3.0-5.5 m; Sehara and Karbhari, 1987). Thus the number of sections in a *dol* net showed regional variation possibly due to variations in the geography, catch type and operation.

Mesh size of *dol* nets measured during this study showed a gradual decrease from the mouth (130 mm) to cod end (10 mm). The size was 110-130 mm for *Bochi*, 100-110 mm for *Patiya*, 70-90 mm for *Aor*, 45-70 mm for *Trijo*, 30-45 mm for *Bangu*, 15-20 mm for *Chothi* and 10-15 mm for *Jalo* (Table 2). However in Versova, Mumbai the *dol* net mesh sizes were relatively larger in their different sections (Raje and Deshmukh, 1989).

The system practiced for *dol* fishing operation is locally termed as *kaba-sus*, where ten steel pipes tied with ropes were placed at the bottom floor. There were two main bridles used for single net operation and number is changed according to number of nets in operation. The free end of anchor rope was connected to the main bridle. One bridle was connected to the two corners of the net and *vice versa*. Each pole measured about 4.5 m in length. The sinker lines on the inner side of steel pipes were tied to the stone sinkers. Opposite to the sinker's end, floats were attached, on the upper pole using thermocole. The period of operation of the net was about 4 to 4.5 h. If anchors were set for low tide operation, then the arrangement continued for at least a fortnight. If operation was during high tide, then the whole unit was arranged in the reverse direction of ebb tide. The depth of fishing operation was from 40 to 60 m. The operation of *dol* net depended on high and low levels of tides and on favourable waters current. In Navabandar, *dol* net was operated from the eleventh day of Gujarati month *Akadashi* to the fifth day of Gujarati month *Panchmi*. During this period, water level and water current are favourable for *dol* net operation. After *panchmi*, fishermen waited for the next *Akadashi* of the same month because during this period, tide and currents were low which were not suitable for *dol* net operation.

Two types of *dol* net operations are known; "*Sus* fishery" and "*Khunt* fishery". These methods are followed from Kathiawar in the north to Versova and Revadanda in the south, respectively, where the depth of operation ranged from 6-8, 12-14 and 18-20 fathoms (Rao and Bindu, 1976). Sankolli *et al.* (1993) reported that *dol* net was operated right from Dahanu in the northern part to Jambhari in southern part of Konkan from shallow water of 5 fathoms to deeper waters of 20 to 25 fathoms depth in Satpati. The depth of operation of *dol* net along Saurashtra coast is reported to be 15 to 35 m (Manojkumar and Dineshbabu, 1999). Mechanisation of fishing vessel led to an increase in the depth of operation at Versova and Satpati up to 40 m in Bassein and Arnala up to 20 m and in Saurashtra waters upto 20 to 40 m (Kunjipalu, 2001), upto 35 to 40 m at Bassein Koliwada (Chavan *et al.*, 2004) and upto 24 to 26 m at a distance of 40-50 km from the shore from Bassein Koliwada (Umesh and Sujit, 2007). The depths of operation that are reported from Jaffrabad, Rajapara and Nawabunder have been 10 to 50, 10 to 50 and 30 to 40 m respectively (Nair *et al.*, 2007). The depth and methods of operation observed during the present study are quite similar to those reported from the other parts of the region.

Capital cost, variable cost, fixed cost, total expenditure, revenue generated and net profit were the major components considered for the economic analysis of *dolnetter* units operating from Navabandar fishing village (Table 3).

Capital cost: The cost of vessel, engine, net and other miscellaneous items with more than one year life span were considered to calculate the average capital cost of *dolnetters*. The capital investment was ₹25,54,800 for a *dolnetter*. In a *dolnetter* unit, the cost of vessel alone came to about 59% of the total capital cost. The cost of engine and gear amounted to 17 and 16% respectively. The other accessories like navigational equipments (GPS, compass and wireless set), anchor, battery, diesel tank, water tank, floats and ropes constituted about 8% of a *dolnetter* unit cost (Table 3). Economics of *dolnetters* of different sizes worked out in different years ranged from ₹24,150 to 1,14,700 for *dolnetters* operating along the Versova coast during 1983-86 (Raje and Rammurthy, 1990) and ₹2,30,000 for dolnetter units operating from Sasoon Dock coast during 1990-91 (Sehara *et al.*, 1992). The investment requirement has remained higher for *khamba* system as compared to *sus*-system that operated from Maharashtra and Gujarat coasts (Sehara and Karbhari, 1987). The average initial investment requirement in the mechanised sector has reached about ₹89,500 at Frasergunj and ₹1,05,000 at Bakkhali in West Bengal whereas in the non-mechanised sector that has amounted to ₹39,000

Table 3. Economics of *dolnetters* operated along Navabandar fishing village during August 2012 to April 2013

Items	Amount (₹)
Capital cost	
1. Cost of vessel	1500000
2. Cost of engine including gear box	350000
3. Propeller and propeller shaft	45000
4. Cost of nets (5 x 80,000)	400000
5. Winch drum and winch wire	50000
6. Navigational equipments	
➢ GPS	35000
➢ Compass	1800
➢ Wire less	20000
7. Accessories	
➢ Steel pole	25000
➢ Hammer	12000
➢ Anchor	6000
➢ Diesel tank	12000
➢ Water storage tank	5000
➢ Batteries	35000
➢ Electric fitting	5000
➢ Water pump	5000
➢ Floats	11000
➢ Rope	17000
8. Others	
➢ Life jackets	5000
➢ Crates	4000
➢ Tyre fenders	1000
➢ Miscellaneous	10000
A. Total capital cost	2554800
Variable cost (per fishing trip of 9-10 days)	
➢ Diesel 350 l @ ₹ 45	15750
➢ Salary of 7 crew members	30666
➢ Ices No. 36 of slide at ₹120	4320
➢ Grocery	3000
➢ Maintenance of engine and net	2500
➢ Fees prorate on annual basis	1000
➢ Miscellaneous	1000
Average variable cost per fishing trip	58236
B. Total variable cost of 9 months (27 fishing trips)	1572372
C. Total project cost (A+ B)	4127172
(Capital cost + Variable cost)	
Fixed cost	
1. Depreciation	
➢ Vessel @ 7.5%	200000
➢ Engine @ 10%	44500
➢ Accessories @ 10%	20980
➢ Net cost @ 20%	40000
2. Interest and insurance	56000
D. Total fixed cost	325480
E. Total cost (B+D)	1897852
(Variable cost + Fixed cost)	
F. Total revenue	
Average revenue of one trip	80962
Total revenue of 9 months (Total 27 trips)	2185974
G. Profits	288122
Gross profit per fishing trip	10671.20

at Frasergunj and ₹52,000 at Bakkhali (Datta and Dan, 1988). At Jumboo Island and Jaldah, the cost has reached ₹1,67,000 and ₹1,80,090 respectively during 1983-84. The total capital requirement of *dolnetters* was highly variable in different parts of the country. These variations found between the years is due to the differences in price index whereas the variation in the total capital cost in different parts of the country in the same year is due to the variations in the cost of raw materials and cost of labour involved in construction in the respective places. The present study revealed that the capital cost of *dolnetter* at Navabandar was higher as compared to that reported from earlier studies. The higher capital cost observed in the present study is due to the increase in prices of raw materials.

Variable cost: The total variable cost was estimated considering expenses on fuel, ice, wages, fees as well as repair and maintenance. The estimated annual variable cost was ₹15,72,372 for 27 fishing trips of *dolnetters*. The expenditure on wages formed the major share of 53%. Fuel cost was the second major expenditure contributing about 27%. Ice, grocery, port fees and repair and maintenance also contributed about 20%. Sharing system was followed to calculate the crew salary (Table 3). The variable cost estimated for Sasoon Dock amounted to ₹1,11,410 during 1990-91 (Sehara *et al*., 1992). The variable cost ranged from ₹22,203 to 1,11,678 at Versova coast during 1983-86 (Raje and Rammurthy, 1990). In the fishing villages of West Bengal *viz*., Frasergunj, Bakkhali, Jumboo and Jaldah it was ₹57,436; ₹ 54,634; ₹68,425 and ₹65,039 respectively during 1983-84 (Datta and Dan, 1988). The variable cost amounted to ₹79,275; ₹1,05,605 and ₹1,12,500 in Navedar-Navgaon, Madh and Navabandar respectively, in Maharashtra and Gujarat. The charges for labour formed about 37-43% of the variable cost whereas fuel, the second major operating expenditure has constituted about 30-36% (Sehara and Karbhari, 1987). It is obvious from all the studies that the major variable coast was due to wages and fuel. We concluded that the charges of labour and fuel have been the same at Navabandar as in other parts of Indian coast. However, as compared to the results of other places along the Indian coastline, the variable cost has remained high at Navabandar.

Profit distribution system: The crew members of *dolnetters* at Navabandar always preferred wage system rather than sharing system. Crew members are locally known as *Khalasi*. They were contracted for one fishing season and paid in advance. At Navabandar fishing village, the crew were paid up to ₹8,000-10,000 per month and for *Tandel* it was about ₹ 20,000-22,000 per month. All the catch profit goes to the owner and there were no shares for *Tandel* and *Khalasi*.

Total project cost: The estimated project cost for *dolnetter* was ₹41,27,172, which was the total of capital cost and variable cost.

Total fixed cost: Depreciation was included in the fixed cost. The estimated fixed cost was ₹3,25,480 for a *dolnetter* unit. For calculating the fixed cost, the average life considered were 15 years for vessel, 10 years for engine and accessories and 5 years for gear. At Versova coast, the fixed cost amounted to ₹7,156 and ₹ 29,915 for small and medium sized *dolnetters* respectively during 1983-86 (Raje and Rammurthy, 1990). In West Bengal it amounted to ₹13,675 in Frasergunj, ₹16,605 in Bakkhali, ₹26,200 in Jumboo and ₹ 26,950 in Jaldah during 1983-84 (Datta and Dan, 1988). The fixed cost was more in Navgaon in comparison to Madh and Navabandar (Sehara and Karbhari, 1987).

Total cost and revenue: The total cost is the sum of total variable cost (₹15,72,372) and total fixed cost (₹3, 25,480). The total cost for *dolnetter* was ₹18,97,852 (Table 3). The revenue calculated per fishing trip of *dolnetter* along Navabandar cost was ₹80,962. Fishing period consisted of nine months with a total 27 fishing trips. The total calculated revenue generation for the whole year was ` 21,85,974 (Table 3).

Profit: The net profit worked out for a *dolnetter* was ₹2,88,122 after deducting all the operational costs with wages of crew members from the total profit of nine months with 27 fishing trips (Table 3). Thus the *dol* net operation unit of Navabandar coast was profitable during the study period. The annual net profit of a *dol* unit was ₹18,623 during 1990-91 at Sasoon Dock (Sehara *et al*., 1992). At Versova, the net profit ranged from ₹16,988 to 23,411 for small and ₹10,094 to 32,897 for medium size *dolnetters* during 1983-86 (Raje and Rammurthy, 1990). The net profit realised in different villages of West Bengal ranged from ₹14,571 in Frasergunj, ₹9,221 in Bakkhali, ₹12,904 in Jumboo and ₹19,903 in Jaldah during 1983-84 (Datta and Dan, 1988). The net profit per operating day was more for *sus* system (₹81-88) than *khamba* (₹75; Sehara and Karbhari, 1987).

The quality and quantity of species landed were important as they determine the revenue generated, which determines the net profit. In addition to these, the expenditure towards labour was the major variable cost, which directly reflected on the net profit of *dolnetter* operation. The *dolnetter* units in Navabandar fishing village were found to be profitable during the study period.

The initial investment such as the construction of vessel, engine and net material were the major investments in *dol* net operation, which could be recovered by the profit from initial years. After paying back the capital cost, the operation becomes a profitable venture.

Acknowledgements

References

Akerman, S. E. 1986. *The coastal set bag net fishery of Bangladesh - trials and investigations.* Bay of Bengal Programme, BOBP/REP/34(FAO),GCP/RAS/040/AWS.

Anon. 2012. *Gujarat fisheries statistics 2010-2011.* Commissioner of Fisheries, Govt. of Gujarat, Gandhinagar.

Anon. 2016. *REIA study for development of fishery harbour at Navabandar, District Gir Somnath, Gujarat*. Commissioner of Fisheries, Government of Gujarat, WAPCOS Ltd., 64 pp.

CMFRI 2010. *Marine fisheries census 2010 Gujarat*. Central Marine Fisheries Research Institute, Kochi, p. 19-22.

Chavan, B. B, Waghmare, K. B. and Umesh, H. R. 2004. Unusual landing of silver pomfret, *Pampus argenteus* by karali *dol* net at Bassein Kolliwada (Vasai) Landing Center, Thane District, Maharashtra. *Mar. Fish. Infor. Serv. T&E Ser.,* 180: 20.

Datta, K. K. and Dan, S. S. 1988. Comparative efficiency of different types of bag net (Behundi Jal) units of West Bengal. *Seafood Export J.,* 20: 5-14.

Dewey, D. 1975. Production. In: *Microeconomics - The analysis of prices in markets*. Oxford University Press, 65 pp.

Gokhale, S. V. 1957. Operation of *'Dol'* net off Saurashtra coast. *J. Bombay. Nat. Hist. Soc.,* 54: 714-725.

Halcrow, H. G. 1981. Production functions and cost. In: *Economics of agriculture,* International student edn. McGraw Hill International Book Company, 105 pp.

Jadhav, D. G. 2003. Unusual landing of *Arius* by *dol* net at Gorai, Greater Mumbai. *Bull. Cent. Mar. Fish. Res. Inst.,* 175: 13.

Jaydev, H., Sujit, S., Josekutty, C. G., Jadhav, D. G. and Thakurdas, U. H. R. 2007. A note on the recurring heavy catch of 'Ghol' *Protonibea diacanthus* by dol net at Bassien koliwada, Maharashtra. *Bull. Cent. Mar. Fish. Res. Inst.,* 191: 24-25.

Khan, Z. M. 1986. *Dol* net fishery off Nawabunder (Gujarat). *Fishery Technol.,* 23: 92-99.

Khan, Z. M. 1987. A note on the dol net fishery of Jaffarabad (Gujarat) with special reference to Bombayduck from 1979-80 to 1981-82. *Indian J. Fish.,* 34: 188-192.

Kunjipalu, K. K. 2001. The '*dol*' nets of India. *INFOFISH Int.,* 4: 65-67.

Manojkumar, B. and Dineshbabu, A. P. 1999. *Dol* net fisheries of the Saurashtra coast. *Bull. Cent. Mar. Fish. Res. Inst.,* 161: 1-8.

Nair, K. V. S., Chakraborty, R. D., Savaria, Y. D., Polara, J. P., Dhokia, H. K. and Thumber, B. P. 2007. Catfish fishery by dolnetters along the Saurashtra coast. *Mar. Fish. Infor. Serv. T&E Ser.,* 193:

Pillai, T. V. R. 1948. Marine fisheries of Kodinar in Kathiawar. *J. Bombay Nat. Hist. Soc.,* 48: 47-61.

Raje, S. G. and Deshmukh, S. D. 1989. On the *dol* net operation at Versova, Mumbai. *Indian J. Fish.*, 36: 239-248.

Raje, S. G. and Rammurthy, S. 1990. Cost and earning of two different sized *'Dol'* net boats at Versova (Bombay). *Bull. Cent. Mar. Fish. Res. Inst.,* 104: 6-8.

Raje, S. G. 1991. Disposal of catch from 'Dol' net at Versova, Bombay. *Bull. Cent. Mar. Fish. Res. Inst.,* 113: 18-20.

Rammurthy, S. and Muthu, M. S. 1969. Prawn fishing methods. *Bull. Cent. Mar. Fish. Res. Inst.,* 14: 235-272.

Rao, P. S. and Bindu, S. T. 1976. Costs and earning of *dol* net operation at Versova during peak season. *J. Indian Fish. Ass.,* 6: 38-48.

Sankolli, K. N., Patil, S. W. and Shenoy, S. 1993. Low energy fishing technology of the Konkan. *Fishery Technol.,* 30: 141-144.

Sehara, D. B. S. and Karbhari, J. P. 1987. A study on 'Dol' net fishery at selected centers in north-west coast with special reference to costs and retunes. *Bull. Cent. Mar. Fish. Res. Inst.,* 78: 1-15.

Sehara, D. B. S, Mestry, A. Y. and Salini, K. P. 1992. A research note on economic performance of *dol* at Sasoon Dock. *Bull. Cent. Mar. Fish. Res. Inst.,* 118: 14-15.

Setna, S. B. 1931. Fishing for 'Bombayduck' (*Harpodon nehereus*), Destructive netting methods. *J. Bombay. Nat. Hist. Soc.,* 35: 867-879.

Setna, S. B. 1949. Bombay fishermen's ingenuity-Age-old methods of capture not yet out dated. *J. Bombay. Nat. Hist. Soc.,* 48: 444-453.

Snedecor, G. W. and Cochran, W. G. 1967. *Statistical methods*, 6th edn. Oxford and IBM Publishing Co., New Delhi, 593 pp.

Sreekrishna, Y. and Shenoy, L. 2001. *Fishing gear and craft technology*. Directorate of Information and Publications of Agriculture, Indian Council of Agricultural Research, Krishi Anusandhan Bhavan, New Delhi, 342 pp.

Umesh, R. and Sujit, S. 2007. Unusual landings of *Arius dussumieri* by Karli *dol* net at Bassien Koliwada. *Bull. Cent. Mar. Fish. Res. Inst.,* 191: 26-27.