Table 2. Antimicrobial resistance patterns of *E. coli* isolates to third generation cephalosporins

Resistant type	No. of resistant strains
CAZ	4
CZX	2
CTX	3
CTR	3
CPM	5
CAZ - CTR	3
CAZ- CTX	3
CAZ- CZX	2
CTR- CTX	3
CTR- CZX	2
CTX- CZX	2
CAZ - CTR- CTX	3
CAZ- CTX- CZX	2
CTR- CTX-CZX	2
CAZ - CTR- CTX- CZX	2
CAZ - CTR- CTX- CZX- CPM	2

incidence and the spread of highly resistant *E. coli* strains. It is further suggested that the strict hygienic practices such Hazard Analysis Critical Control Point (HACCP), Good Hygienic Practices (GHP) and Good Manufacturing Practices (GMP) are to be followed during the entire chain of seafood processing in order to produce wholesome seafood.

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Fishermen preferences towards gear-based fish conservation technologies in Sindhudurg district, Maharashtra

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Sindhudurg district, located at the southern tip of Maharashtra is endowed with a coastline of 121 kilometers. There are 526 mechanized vessels in the district, engaged in fishing operations (ICAR-CMFRI, 2010) and total trawlers operating are 317. In order to reduce the negative impact of trawling

and to achieve sustainable fish production, different conservation policies had been enforced by Maharashtra government such as seasonal trawl ban, ban on night trawling etc. Recently ICAR-CIFT has made different technology interventions for conserving fishery resources in Sindhudurg district under a GOI-UNDP-GEF Project. The present study tried to explore preferences of fishers towards different gear based fisheries conservation technologies in Sindhudurg district.

The study was undertaken in three major fishing centres in Sindhudurg district *viz*; Devgad, Malvan and Vengurla. Twenty fishermen and three net makers from these fishing centres were interviewed using structured interview schedule covering socio-economic status of the respondents, technology use details and awareness and adoption level related to different technologies.

Details of usage of technologies by fishers

Wooden trawlers of varying lengths (28-55 feet L_{OA}) were being used by the fishermen in Sindhudurg district for trawling operations. Recently construction of Fibre Reinforced Plastic (FRP) vessels for trawling operations are also being taking place especially in Devgad which has an FRP boat building yard also (Fig. 1). The engine power (HP) of mechanized trawlers ranged between 87-99 HP. Two types of trawl nets are being used for fishing *viz*; shrimp trawl and fish trawl (locally known as *Chaalu* and *Disco jaals*, respectively) with codend mesh size ranging between 20-30 mm. Shrimp trawl is mainly operated during November to May and fish trawl during August to October. Duration of fishing trips varied from single day up to five days and fishing is carried out in the depth of around 50-60 m. Otter boards made of wood are exclusively used as sheer devices (Fig. 2).

Fig. 1. FRP boat building yard at Devgad

Fig. 2. Wooden otter boards used in Vengurla

Awareness and adoption of gear-based conservation technologies

As a part of the GOI-UNDP-GEF project, several gear-based conservation technologies developed by ICAR-CIFT were demonstrated to the trawl fishermen of Sindhudurg district. Demonstrated technologies included CIFT-Semi Pelagic Trawl System (CIFT-SPTS), CIFT-Juvenile Excluder cum Shrimp Sorting Device (CIFT-JESSD), CIFT-Turtle Excluder Device (CIFT-TED) and use of square mesh codend in trawls. The level of awareness and adoption of these technologies are indicated in Fig. 3.

High level of awareness was observed in case of use of square mesh codend in trawls (100.00

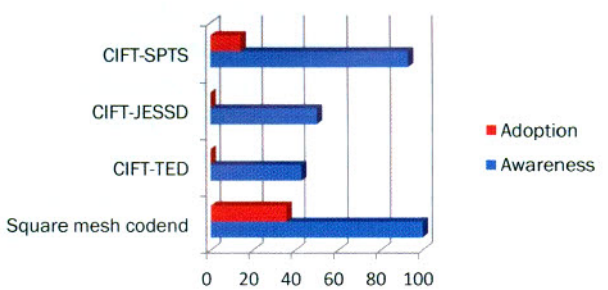

Fig. 3. Awareness and adoption of gear-based fish conservation technologies in Sindhudurg

per cent) and CIFT-SPTS (92.86%). In addition to having high awareness level, majority of the respondents had undergone field trial using the square mesh codend. Complete adoption of the technology was observed in case of 37.50% of the respondents. Adoption of CIFT-SPTS was mainly observed in Vengurla Taluka of Sindhudurg district. Since turtles are not a major problem in the region, the fishermen were not using CIFT-TED. Also, adoption was not found in the case of CIFT-JESSD.

Fishermen's perception about advantages and disadvantages of square mesh codend technology were further explored to understand the reason for adoption/non-adoption of the technology. The results are indicated in Figure 4.

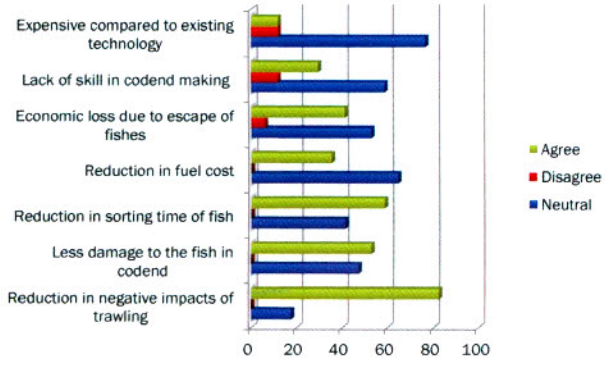

Fig. 4. Perceived advantages and disadvantages of use of square mesh codend

Fifty nine per cent of the fishermen agreed that there was reduction in sorting time by using square mesh codend in trawls and they were satisfied with the availability of cleaner catch in codend through efficient filtering of debris from the codend. Due to less drag of the net, 35.29% of the fishermen felt that there is a reduction in fuel cost. Majority of the fishermen (82.35%) agreed that this technology will help to reduce the negative impacts of trawling. One of the disadvantages perceived by fishermen in using the square mesh codend is the escape of small sized fishes, which finally constitute the bycatch, which also give them a revenue.

Adaptation of the technology in local context

A major problem faced by Sindhudurg fishermen during fish trawling was the attack by ribbonfish and subsequent damage to the fishing net. In order to reduce the damage to the codend and to avoid escapement of fishes, fishermen generally use a cover codend. At the initial stages, the fishermen were using square mesh codend with 1.25 mm diameter and later, taking into account the damage by the ribbonfish, the fishermen in consultation with ICAR-CIFT, started designing their own codends with 2.5 mm diameter twines which was found to have multiple benefits *viz*; less damage to net due to ribbonfish attack and cleaner catch in the codend.

Major constraints for adoption of technology

Even though there is gradual trickling down of square mesh codend technology to fishermen, they expressed few constraints in adopting the technology. They are:

- Lack of uniform policy across different states (Problem of inter-territorial conflicts)
- Use of high power Chinese engines in fishing vessels of neighboring state
- Lack of proper monitoring mechanism for law enforcement

According to Rogers Innovation Decision Process (Rogers, 2003), adoption decision of any technology undergo five stages *viz*; knowledge, persuasion, decision, implementation and confirmation. In case of technologies intended for natural resource conservation, as the benefits are indirect and time consuming, implementation of proper supporting policies are essential. In case of square mesh codend technology intervention in Sindhudurg district, GOI-UNDP-GEF project has initiated steps to supply square mesh codends to all 317 trawlers operating in the region, which will be a major boost for adoption of this technology. In addition, proper institutional mechanism by the government can help to ensure the continued adoption of the technology by all trawl fishermen.

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Study on drying of fishes using CIFT dryers

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Drying preserves fish from decay by removal of moisture from fish, thereby arresting the growth of bacteria, action of enzymes and chemical oxidation of the fat. Open yard drying of fish was an age old practice, known for higher microbial load, lower product quality and longer drying time. In addition, traditional method of fish drying may add up impurities like dust, sand, insects and bird waste in the dried product, thereby lowering market price (Yusuf and Agarwal, 1989). Use of solar dryer helps not only to reduce losses and maintain the quality of the product but also helps in conserving the conventional energy sources (Sablani *et al.*, 2003). ICAR-CIFT have developed different types of solar dryers for hygienic and effective drying of fish and fishery products.

Atmospheric parameters like temperature, relative humidity and solar radiation were recorded at one hour interval. Relative humidity varied from 69.4 to 85.4%, solar radiation varied from 125 to 1257 w/m^2 and ambient temperature varied from 29.6 to 34.4°C during drying operation. Solar - electrical hybrid dryer was used for drying of Mackerel' and 'Nandan' fish. The dryer showed excellent heat sealing property by attaining 65 °C within 8 minutes under no load conditions. The initial moisture contents of Mackerel and Nandan fish were 80% and 77%, respectively. For both types of fishes, maximum amount of water was removed during first two hours of drying *i.e.* till 40-50% moisture content (Fig 1). Thereafter, the drying rate was reduced and the similar trend was continued till 8 hrs of drying for Nandan fish and 12 hrs of drying for Mackerel fish. Final moisture content attained in dried Mackerel and Nandan fish were 14.5% and 14% respectively. Time taken for drying of Mackerel was 15 hours and Nandan was 10 hours. The result of sensory analysis of dried fish was observed to be within the acceptable limit. The observed water activity for dried Mackerel and Nandan fish was 0.78 and 0.76, respectively which indicates quality dried product. Similar results were also reported by Sapkale *et al.* (2003) for solar dried Mackerel fishes.

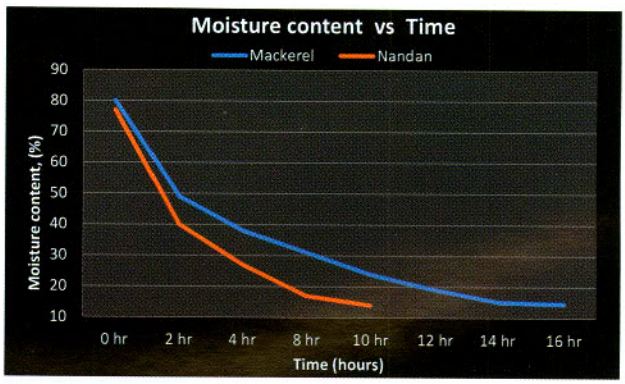

Fig. 1. Drying curve for Mackerel and Nandan fish

Drying of sole fish in solar cabinet dryer with electrical back up was carried out. The initial moisture content of salted fish was observed to be lower than fresh fish. Till first 6 hrs of drying, moisture content of fish decreased linearly with time. However after 6 hrs, the drying rate came down and the moisture removal from material was almost observed to be zero, implying materials equilibrium with the drying conditions (Fig 2). Totally it has consumed 8 hours to reach 18-20% moisture content with the water activity value of 0.70 for salted fish and 0.74 for fresh fish. The results revealed that salted fish consumed more time than fresh to attain almost similar final moisture contents. Joshi *et al.* (2014) noticed same trend for drying of fishes in improved solar