Research Papers

VALIDATION OF PFZ ADVISORIES –A CASE STUDY ALONG GANJAM COAST OF ODISHA, EAST COAST OF INDIA

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ABSTRACT :

The potential fishing zone (PFZ) advisories received from Indian National Centre for Ocean Information Services (INCOIS), Hyderabad from November 2003 to February 2005 was validated along the Ganjam coast. Feedback was collected for both the PFZ and Non-PFZ locations in the prescribed format of INCOIS. The feedback contains the date of fish catch, time of hauling, geolocation, name of the ship or boat, type of net used, depth of catch, distance from the coast, direction, catch in kg, major catch in kg, and major variety of fish. The catch per unit effort (CPUE) was computed by dividing total fish catch by the number of hours of actual fishing per haul. The CPUE data were then compared for both PFZ and non-PFZ areas. The results revealed that the CPUE was more in boats operated in PFZ areas than non-PFZ areas in all the sectors of the Ganjam coast. In Rushikulya base, the CPUE was more in February 2005 followed by December 2004. At Gopalpur and Sonepur sector, CPUE was maximum during January 2005. The average catch per unit vessel in PFZ areas showed a similar trend in all the stations with the maximum at Gopalpur. The search time analysis for boats operated in notified and non-notified areas revealed that the search time was less where the PFZ advisories were utilized. The study confirms that satellite-based PFZ advisories help significantly in the reduction of search time, fuel cost and yield better catch.

KEYWORDS : *Remote Sensing; CPUE; Search Time; Socioeconomic; Chlorophyll.*

INTRODUCTION

India is a maritime country of the Asian continent comprising of its two coasts: the east coast (the Bay of Bengal) and west coast (the Arabian Sea). In terms of the marine environment, India is having a wide coastline of about 8,000 sq. km, an Exclusive Economic Zone (EEZ), and a very wide range of coastal ecosystems (Venkatraman et al., 2005). Both, these coasts are endowed with extensive areas of estuaries, brackish water lagoons, mangroves, coral beds, seaweed beds, and rocky, sandy, and muddy inter-tidal regions providing an excellent opportunity for colonization of a great variety of flora and fauna. The EEZ has been estimated at about 2 million sq. km accounting for about 66% of the total land area. From time immemorial fishery has been accepted as a way of livelihood by coastal area people.

The Odisha state, on the east coast, has 480 km of long coastline extending from Patisonapur beach at the south to Digha beach at the north. The width of the shelf decreases from south to north with continental shelf bounding in an area of 2430 sq. km. The deepwater fishing grounds bordering this state is about 6000 sq. km. The area remains largely underexploited due to the lack of fishing fields operating from this coast. Fishery data reveal the country has around 6 million fishermen. Of this, full-time fishery-dependent are 2.4 million, part-time are at 1.45 million and the remained are termed occasional (Jayashree and Arunachalam, 2000). Statistics on craft reveals traditional; 2,20,000, traditional motorized: 40,000 and mechanized boats around 52,000 are in use by the fishermen in the Indian waters. However, to get a good catch of pelagic and demersal fishes, the fishermen use a variety of fishing gears (INCOIS, 2009). The upper layer of the ocean normally contains pelagic fishes and the ocean bottom is dominated by the demersal fishes (Hobday et al., 2009).

Our nation has been contemplating how to progress in the area of fishery sector by utilizing the operational satellite technology. In this regard, the Indian National Centre for Ocean Information Services (INCOIS) has achieved a milestone in providing satellite-based the potential fishing zone (PFZ) advisories to different nodes of the country for their best possible utilization. By this means, India in the present scenario is striving to improve food security in the marine sector by enhancing fish production and their export. It is estimated that India’s fish production per year goes to ~3 million tones include 52% of pelagic and the rest is of demersal species. There are nearly 1570 species of finfishes and around 1000 species of shellfishes known from the seas surrounding our subcontinent some of which are having a high commercial value (James et al., 1987). The orthodox fishers rely on their traditional methods of locating potential fishing grounds.

In order to locate fish congregation, the traditional fishers use their techniques such as gathering of birds, ocean water colour, smell, the collapse of huge bubbles at the surface, calm sea superposed with muddy and oily water and reflection in the night. The marine fishery sector is one of the vital areas for better improvement in the socio-economic conditions of the fishermen community. Millions of livelihood and living standards of the fishermen community depend upon the abundance of fishery stocks (The World Bank Report, 2004). A more challenging aspect for the fishermen today is to identify the accurate location and catch the fish school, as the fish stock itself is mobile and moves further offshore when the vessel approaches the stock. This results in an increase in search time, cost, and effort. Identification of potential fishing grounds using the advanced technology of remote sensing earned an excellent result for the fishermen reducing search time, fuel, and manpower in getting a better catch. It is well known that the adaptation of fish surrounding the marine environment is controlled by important physical, chemical, and biological factors.

Ocean current boundaries with sharp horizontal temperature gradients provide one of the best possible clues for identifying the fish school. Conventional spatial monitoring of such processes including the related ocean bio-physical parameters are very expensive and time-consuming. Hence, satellite remote sensing is the present state of the art technology, which made it possible to provide real-time data on spatio-temporal scale. The important parameters extracted with high temporal resolution and large synoptic coverage from satellite imagery are sea surface temperature and phytoplankton pigments (chlorophyll-*a*). Chlorophyll-*a* is the suitable index of phytoplankton biomass. It represents the base of the food chain. Earlier PFZ advisories were prepared based on one parameter i.e. Sea Surface Temperature (SST) retrieved from the NOAA-AVHRR thermal infrared band. But due to the advances in sensor technology, scientific methodologies and model developments, scientists are able to prepare more reliable advisories based on a composite image of SST and chlorophyll-*a*. The potential fishing grounds are located by identifying oceanic physical features such as; temperature fronts, meanders, eddies, rings, and upwelling areas (Chen et al., 2005; Fielder and Bernad, 1987; Laurs et al., 1984; Solanki et al., 1998, 2003a,b; Nayak, 2003).

The improved PFZ forecasts based on the SST and chlorophyll-*a* (Arone et al, 1987; Solanki et al, 1998; Nath et al, 1991; Solanki et al, 2000; Silas and Pillai ,1982) provides locations of oceanic features which are likely areas of fish congregation especially tuna spies of skipjack and yellowfin (Zainuddin et al, 2004). Validation exercise of PFZ advisories along the eastern coastal India reveal an increase in the order of 2-3 fold fish catch.

INCOIS generated advisories for PFZ based on satellite-derived chlorophyll-*a* and SST. The advisories were then disseminated to the fisherman community by various modes. The objective of the present paper is to validate the PFZ advisories, provided by INCOIS, along the Ganjam coast of Odisha, using ground truth data. An attempt was also made to evaluate the advisories in notified (PFZ) and non-notified (non-PFZ) areas based on Catch Per Unit Effort (CPUE).

STUDY AREA

The study area covers the entire Ganjam coast (19° 5’-19° 25’ N and 84° 30’-85° 5’ E) covering the southern part of Odisha. Its coastline is about 60 km (Fig. 1). There are about 28 fishermen villages adjacent to the coastal area of this district. For the present study, 16 villages of four blocks *viz*., Ganjam, Chatrapur, Rangeilunda and Chikiti were taken into account. Towards the northern part of the coast, Rushikulya rookery near Purunabandh village is famous for mass nesting of Olive Ridley (*Lepidochelys olivacea*) sea turtles. The Rushikulya rookery is spread over 6 km and has two permanent fisherfolk settlements: Gokharkuda and Kantiagada villages. Gopalpur Harbour (under Rangeilunda block) facilitates regular fishing activities.

Figure 1: Image showing the map of the study area with blocks and landing centres

RESULTS AND DISCUSSION

Primary information

Before the study as pilot basis, primary and important investigations was made to extract information about the total blocks that come under the Ganjam district, fish landing centres present in each block, total number of households, block-wise population of total fishermen community, and fishermen engaged in fishing out of the total population (Table-1).

Table 1: Table showing block-wise marine fishing landing centres

Sl. No	Blocks	Name of the Landing centres	No. of House holds	Total Fishermen population	Total Fishermen engaged in fishing
1	Ganjam	Prayagi Kantiagarh Gokharakuda Rushikulya Base	818	3949	1100
2	Chatrapur	Nolianuagaon Sana Aryapalli Bada Aryapalli Rev Koturu	2320	14137	2891
3	Rangeilunda	Gopalpur New Boxipalli Golabandha Garampeta Markandi	3410	14088	2550
4	Chikiti	Patisonapur Sonapur Ramayapatana	2107	11733	1648
Total:			8655	43907	8189

Rangeilunda block was having five fish landing centres, which was the highest in the Ganjam district. Though the total number of households was more in Rangeilunda block, the fishermen population was highest in Chatrapur block. Information pertaining to the assets of the fisherman community was also investigated during the pilot study (Table-2). A total number of 358 motorized and 1652 non-motorized found to be engaged in fishing. During the study period, the information drawn that a total number of 7733 nets were used for fishing purposes. The highest numbers (135) of motorized boats were being operated in the Sana Aryapalli landing centre of Chatrapur block compared to others. The highest numbers of non-motorized crafts i.e 275 and 12 number of motorized crafts were found to be operated in the Noliyanuagaon landing centre of the same block. This difference was due to the poor socio-economic condition of the inhabitants.

Table 2: Table showing boats and gears used

Block	Landing Centres	Boats		Total no of Gears
		Motorised	Non-motorized	
Ganjam	Prayagi	--	94	165
	Kantagada	23	85	550
	Gokharkuda	27	41	365
	Rushikulya Base	--	105	150
Chatrapur	Nolianuagaon	12	275	940
	Sana Aryapalli	135	129	1050
	Bada Aryapalli	7	95	350
	Rev Katuru	76	136	293
Rangeilunda	Gopalpur	2	120	448
	New Boxipalli	5	137	365
	Golabandha	9	135	430
	Garampeta	--	82	219
Chikiti	Markandi	38	8	720
	Rameya Patana	--	70	620
	Sonapur	20	54	925
	Patisonapur	4	86	143
Total:		358	1652	7733

PFZ Data

PFZ advisories, derived from satellite-based SST and chlorophyll-*a* for the whole Indian coastal region are generated by INCOIS and are supplied to different nodes all over the country. For the Ganjam coastal area, the PFZ message is being received through an electronic display board (EDB) installed at Gopalpur and fax at Berhampur University. The message indicates the distance and direction from the major fish landing centres at Gopalpur, Ganjam, and Eksingi along with water depth and corresponding geolocation (latitude and longitude). This information is elaborately explained and transformed to regional language (Oriya) while disseminating to the users.

There were in total 14 messages received from INCOIS from November 2003 to February 2005. All the messages were systematically disseminated and explained to the fishermen in their villages and sometimes at fish landing centres during PFZ awareness campaigning programmes. It may be noted that the fishermen appreciated the very usefulness of PFZ advisories and exploited their benefit out of it. As the coastal stretch of Ganjam is very long and it is not possible for all the fishermen to access the message from the electronic digital board, the project personnel disseminated the PFZ advisories to the users at different landing centres from time to time. To ensure the fishing operation in the PFZ forecast region, validation campaigns were undertaken periodically along the Ganjam coast. After dissemination of the PFZ message, feedbacks were collected from different landing centres in the prescribed formats provided by the INCOIS for both the PFZ and non-PFZ locations.

Data Dissemination

For timely and effective dissemination of the PFZ advisories, Electronic Display Board (EBD) is established at the Gopalpur-on-Sea area. The forecast is being updated thrice a week directly from INCOIS. Under the pilot project on Satellite Audio Broadcasting, World Space Radio receiver was installed and demonstrated to the fishers on a boat at Arjipalli. An user-interaction workshop was conducted at Gopalpur. Results of validation exercises indicate a reduction in searching time varying from 30% to 70% (referred from INCOIS official website) while using PFZ advisories than that of traditional fishing. Feedback results indicate a reduction in fuel consumption and valuable human effort. The dataset indicates improvement in CPUE.

Validation

Data obtained from the feedback collected against PFZ message dissemination and the validation campaigns conducted by Berhampur University was analyzed. Calculations were made using the known formula: total fish catch / number of hours of actual fishing per haul. A comparative study on CPUE for both PFZ and non-PFZ locations was done. The average fish catch obtained from the boats operated in the PFZ area is illustrated as Figure-2. Sector-wise CPUE is provided in Figures 3-6.

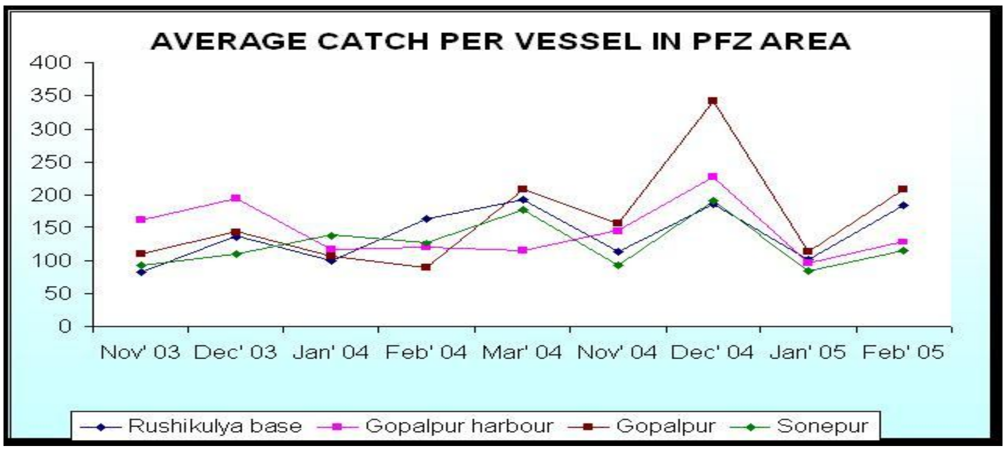

Figure 2: Image showing sector wise Catch Per Unit Effort

Figures reveals that the CPUE was more in boats operated in PFZ areas than non-PFZ areas in all the sectors of the Ganjam coast. In Rushikulya base, the CPUE was more in February 2004 followed by December 2004. The CPUE was higher in January 2004 in Gopalpur Harbour, Gopalpur, and Sonepur sectors. The higher CPUE might be due to the fact of good phytoplankton production and quite a favourable sea state for fishing during this period. The graphical representation of CPUE for PFZ and non-PFZ areas of all the sectors are shown in Figures 2-5.

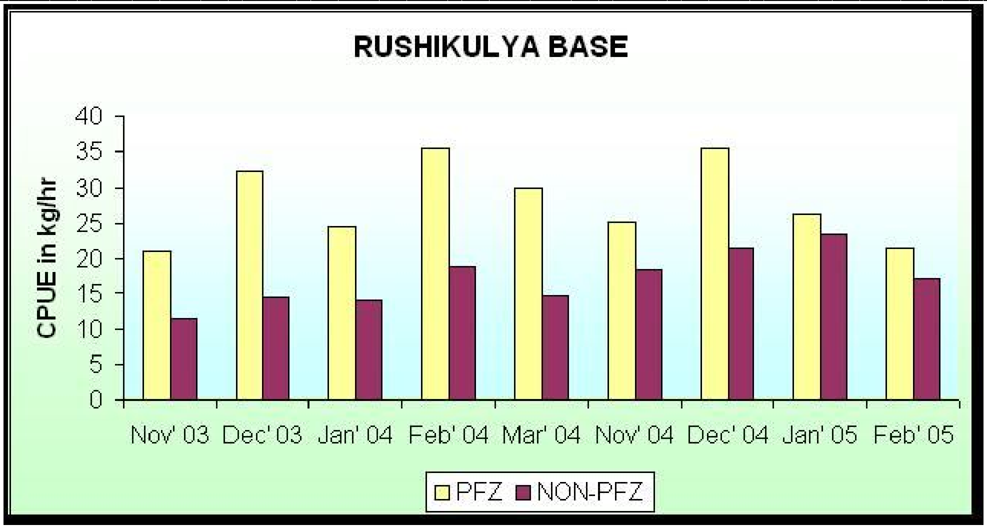

Figure 3: Image showing histogram of CPUE at Rushikulya Base landing centre

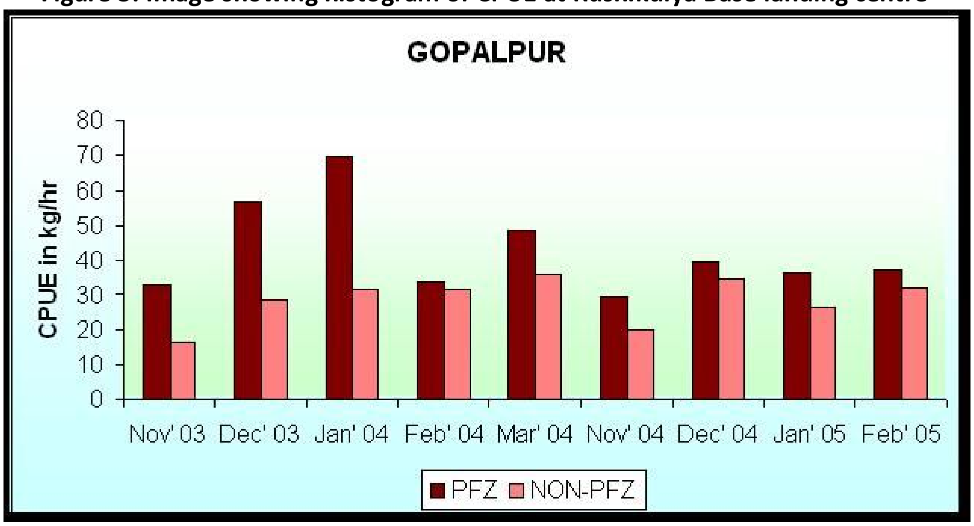

Figure 4: Image showing histogram of CPUE at Gopalpur landing centre

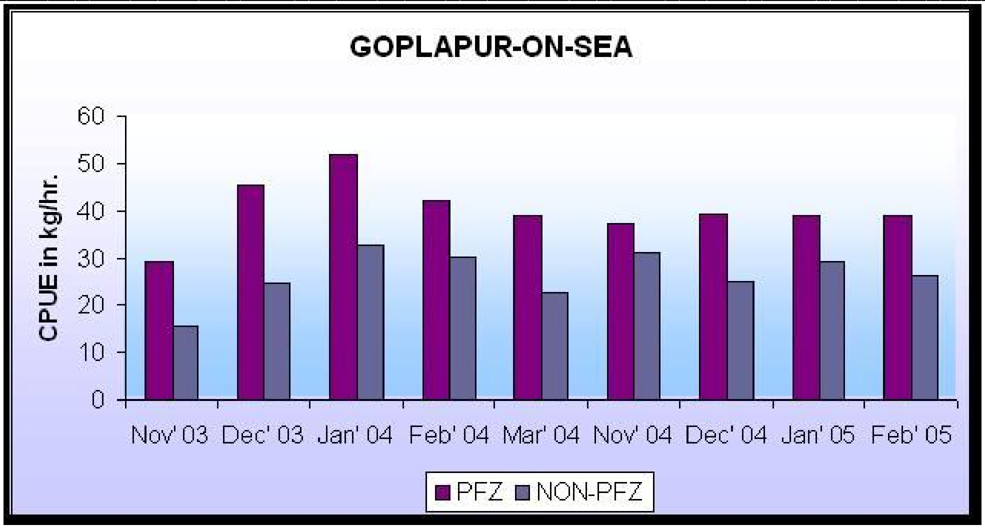

Figure 5: Image showing histogram of CPUE at Gopalpur-on-sea landing centre

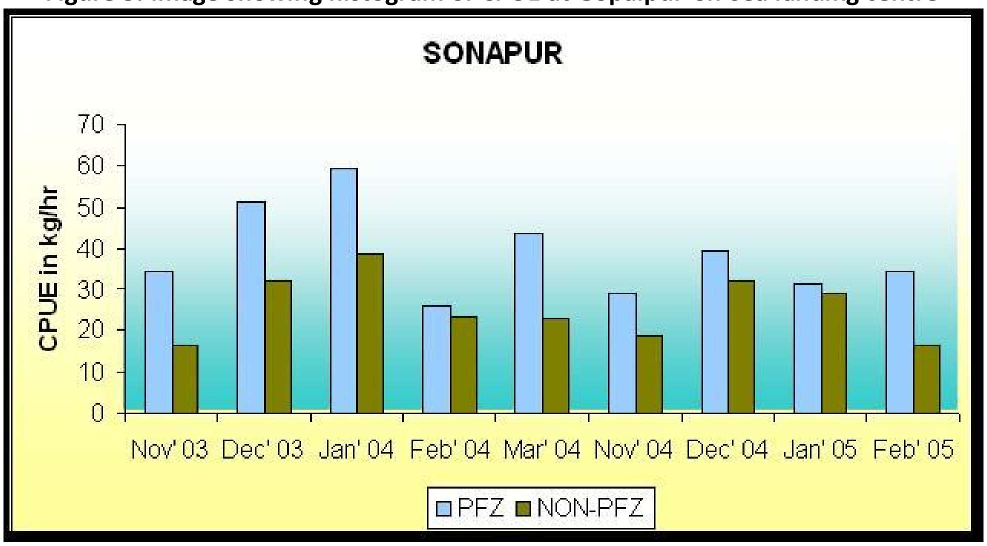

Figure 6: Image showing histogram of CPUE at Sonapur landing centre

Search Time Analysis

From the feedback data, a general statistics was obtained for the search time to locate the fishing ground, the number of fishing hours and average fish catch for both PFZ and non-PFZ areas (Figure 7-9 and Table-3). The present study reveals that the time taken to search the PFZ locations was less where the PFZ advisories utilization was made. Hence, it is concluded that the fishermen who did not utilize the PFZ advisories took more time to reach the PFZ locations or even not able to reach by following their own conventional methods. In fact, for boats operating outside of the PFZ, the fishing time was accompanied by a decrease in the catch.

Table 3: Table showing details of search time, fishing hours and average fish catch

Month	Search time		Fishing Hour		Average fish catch	
	PFZ	NON-PFZ	PFZ	NON-PFZ	PFZ	NON-PFZ
Nov' 03	2	7	2	4	112	57
Dec' 03	5	6	2	3	146	79
Jan' 04	4	9	2	2	115	64
Feb' 04	3	8	3	2	125	94.5
Mar' 04	4	6	3	4	173	103
Nov' 04	3	4	1.5	4	127	93
Dec' 04	5	6	2	3	237	174
Jan' 04	3	7	2	4	98	80
Feb' 04	2	4	2	3	159	110

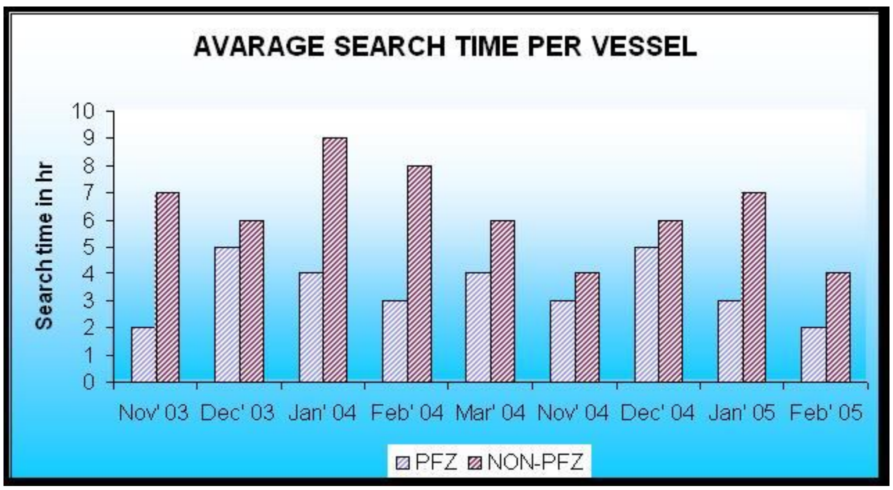

Figure 7: Image showing average search time per vessel

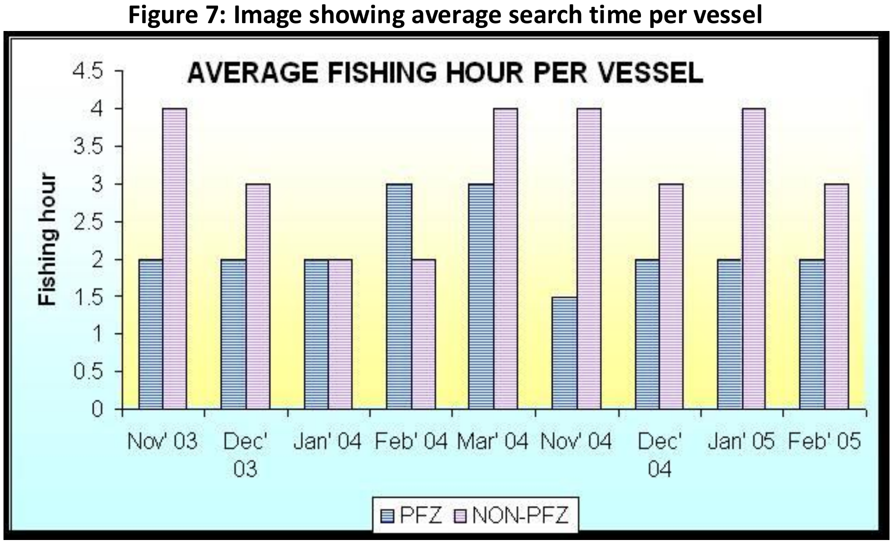

Figure 8: Image showing average fishing hour per vessel

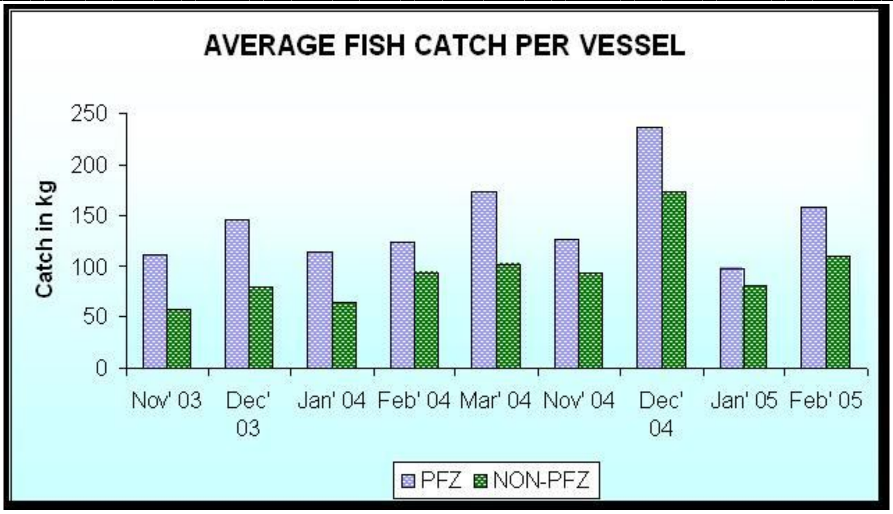

Figure 9: Image showing average fish catch per vessel

CONCLUSION

The coastal fishermen community is an underprivileged one in our country. Their source of income can be enhanced if they get good catch by employing less effort and search time. Due to the advancement of sensor technology, models of high resolution, and methodologies, composite images containing the oceanic features are provided to the fishing community across the country to easily locate the potential fishing grounds. In this study, we attempted to validate the satellite-based PFZ advisories by engaging boats in PFZ and non-PFZ areas. The present study concludes that the fish catch found to be more intense in boats operated in PFZ areas than non-PFZ areas in the study regions of the Ganjam coast. In fact, the fishermen took more time to search the fish school without following the PFZ advisories. The hour of fishing was also more followed by less catch for boats operated in the non-PFZ areas. The satellite advisories are now improved with the recent use of the current vector along with the SST and chlorophyll-*a*. In the Indian context, the INCOIS generates the PFZ advisories using NOAA-AVHRR, OCEANSAT, and MODIS satellite data and disseminate nationwide for its use to get a better catch.

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