The Validation of Potential Fishing Zone Advisories and Benefits in the Catch Per Unit Efforts (CPUE) Along the Coast of Raigad District, Maharashtra State

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Abstract:*The validation of Potential Fishing Zone (PFZ) advisories parallel with Ocean State Forecast (OSF) have been generated by the Indian National Centre for Ocean Information Services (INCOIS) using different media. The study carried out from within PFZ of 02 major fish landing centres of Raigad district coast gave positive relationship between PFZ and the abundance of pelagic. The data on feedback from fishermen consists of crafts and gears, fish catch, fishing lat. and long., distance from the coast, direction, depth of catch, major catch, fish quantity and variety. The Catch Per Unit Efforts (CPUE) was computed by dividing total fish catch (Kg) divided number of fishing hours. An analysis of fish catch data from fishing crafts within and outside PFZ revealed that CPUE was more in notified PFZ areas and it's validated in trawl than purse-seine net operations during 2021-2022.*

Keywords:PFZ-OSF, Fishing, Within and Outside PFZ.

I. INTRODUCTION

Raigad district coastline spanning about 240 km. The fishermen population is totally dependent on marine fishing activities for their living. Raigad is one of the major fish landing centre situated on the west coast of Maharashtra. About 80 fishermen co-operative societies and 01 district fisheries federation is in existence in Raigad district. The fishing fleet consists of 1,510 mechanized fishing vessels and 1,163 non-mechanized vessels and over 5,500 fisher are engaged in fishing industries. (Anon, 2018).

Catch Per Unit Effort data are typically analyzed in the form of catch-per-unit effort (CPUE), which expresses the quantity of fish caught (in weight) by a given amount of fishing effort. In general, CPUE is used as an index of abundance, meaning that a proportional change in CPUE is expected to represent the same proportional change in stock size (FAO, 1998 & 1999). In many instances catch per unit effort (CPUE) is taken as an estimate of stock size. The CPUE is especially useful if the relationship between catch and effort is linear through the origin (strict proportionality) (Gulland, 1954; 1964; Garrod, 1964; Ricker, 1975; Lima et al., 2000).

Satellite based sea surface temperature (SST) images are being used as an input for locating potential fishing zone of productivity and hence fish availability for commercial fishing operations. (Pillai, 2005). Ocean together with atmosphere is two components of the climate systems. The sea surface temperature (SST) is one of the important parameters that drive the tropical armosphere-ocean interaction (Pandey, et. al., 2008). Fishes are known to react to changes in the surrounding environmental conditions and migrate to areas where favourable environmental conditions in terms of seawater temperature, pH, dissolved oxygen etc. Availability of food is an important factor which control their occurrence, abundance and migration in the sea. PFZ advisories pertaining to these coastal states are being generated using the satellite data sets from NOAA AVHRR, IRS-P4 OCM and MODIS AQUA. SST and chlorophyll-a were restricted from the NOAA AVHRR and IRS P4 OCM/MODIS AQUA, respectively. Fish catch data pertaining to the PFZ advisories were collected both the vessels that are operating within PFZ location and the vessels that are operating outside PFZ location. In addition to the fish catch data, the economics operations have been collected (Solanki et al., 2001a & 2001b).

The PFZ information provided through the media by fax, telephone, prints and EDDB Electronic Digital Display Board has ensured that these advisories provided in the local languages for their socio-economic status. A reliable and timely forecast of PFZ of fish aggregation benefitted the fishermen community to reduce their time saved, fuel and effort spent in searching the fishing ground. It has been validated that the search time for fish has been reduced up to

30 % to 70 % due to usage of this advisories. (Radhakrishna, 2004). In the Potential Fishing Zone, the pelagic region has wide variety of fish species out of that more fish catch found in the pelagic operated by purse-seine net uses by PFZ, while trawl net comprises less catch in PFZ and outside PFZ areas.

II. MATERIALS AND METHODS

Potential fishing zone advisories are released by INCOIS thrice in a week (Monday, Wednesday and Friday) and cloud free months during non-monsoon and non-banned period were disseminated to active fishermen groups along the Raigad district coast. Depending on the exact location of PFZ by personal contact, fax or telephone messages and Digital Display Boards installed at major landing centres. The feedback data is gathered in the prescribed format immediately upon the vessel's arrival at the landing centre on completion of fishing activity. The following is the methodology adopted for the within PFZ and outside PFZ. Potential fishing zone advisories are released by INCOIS thrice in a week (Monday, Wednesday and Friday) and cloud free months during non-monsoon and non-banned period were disseminated to active fishermen groups along the Raigad district coast. Depending on the exact location of PFZ by personal contact, fax or telephone messages and Digital Display Boards installed at major landing centres. The feedback data is gathered in the prescribed format immediately upon the vessel's arrival at the landing centre on completion of fishing activity. The following is the methodology adopted for the within PFZ and outside PFZ.

The PFZ advisories reaching methodology amongst the fishermen for fishing.
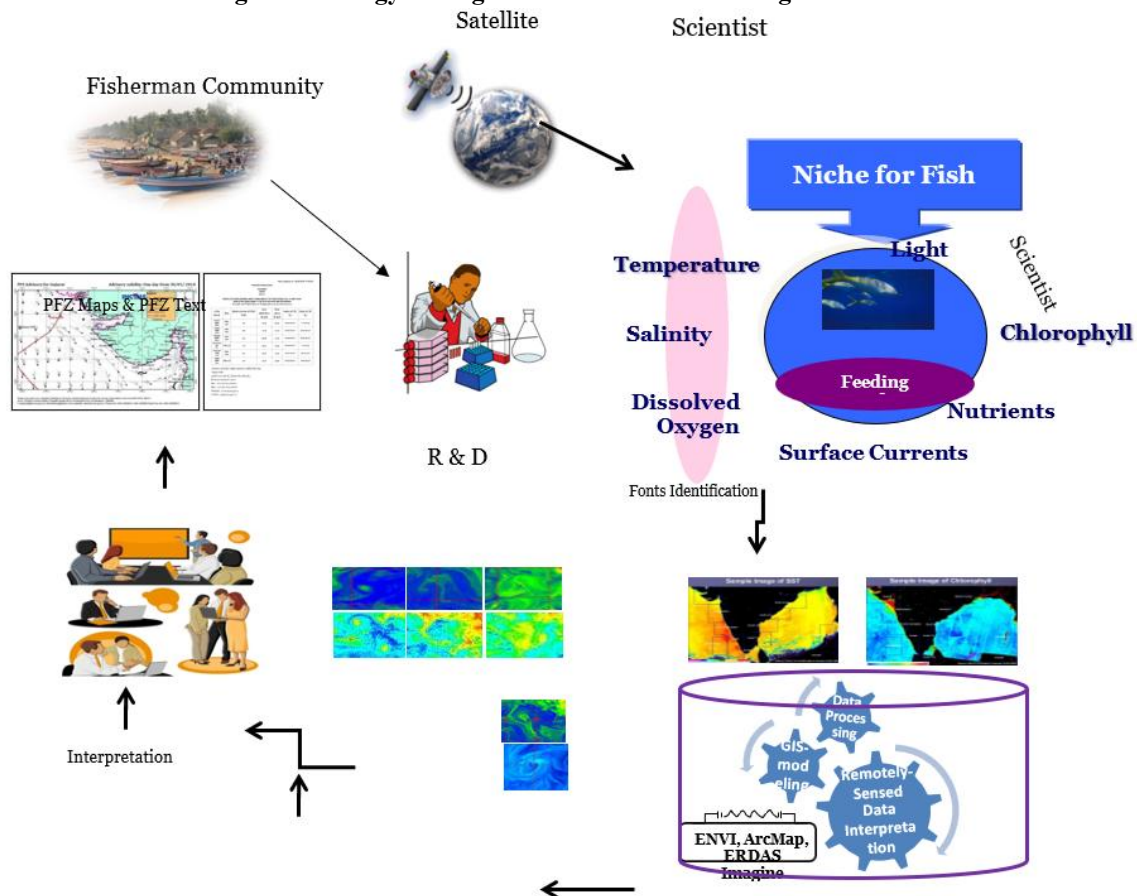
To conduct validation exercises by hiring a commercial fishing vessel, in order to obtain concurrent and quantitative feedback on the total catch (species-wise) obtained in the within PFZ and outside PFZ areas. A representative is also sent on board the hired vessel. Collect feedback data in a common feedback format developed by INCOIS for carrying out further quantitative analysis. On estimation of the PFZ advisories the increase in CPUE is recorded. The quality

(species-wise identification) as well as quantity (approximate) of fish catch is also reconfirmed by the enumerator on the spot (when the enumerator, invariably drawn from the fishermen community, visits the area of fishing activity onboard a hired vessel or at the landing centre). The consolidation of the data gathered from different landing centres is undertaken every month and average CPUE for different types of operation is calculated.

The vessels depart from the Murud and Srivardhan fish landing centre for the fishing, simultaneously outside PFZ experiment were conducted by purse-seine and trawl net. The Geographical Positioning System (GPS) location had been provided by INCOIS PFZ-Mission, in that PFZ location of the fish catch where the fishing boats operating the fishing nets. In addition to that after completion of the fishing experiment, the data collected in feedback format from within PFZ and outside PFZ vessels. Research experiment carried out in April-2021 to March-2022. In non-monsoon and non-banned period (PFZ vessels using INCOIS-PFZ advisories and outside PFZ vessels not using the INCOIS-PFZ advisories).

III. RESULTS AND DISCUSSION

Table. 1. Total no. of PFZ & OSF advisories validate

Total no. 1. of OSF advisories		
Year, 2021-22	**Received**	**Validated**
April	04	02
May	05	03
September	10	05
October	12	06
November	10	04
December	08	05
January	07	03
February	02	01
March	05	03
Total	63	32

Graph. 1. Total no. of PFZ & OSF advisories validate
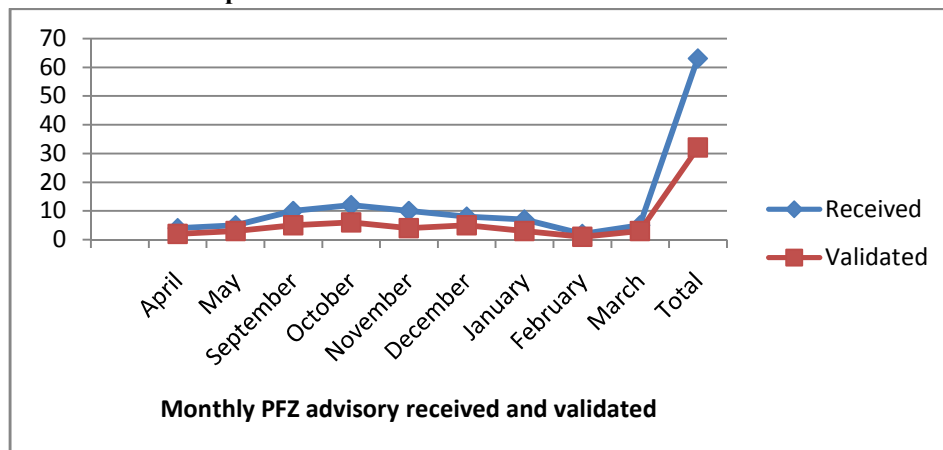
Total no. 2. of PFZ advisories received and validated in FLC

Total no. 2. of PFZ advisories						
Year, 2021-22	**Received**			**Validated**		
1	2	3		5	6	7
Month	Chl.	SST	Combined	Chl.	SST	Combined
April	04	02	06	01	01	02
May	05	05	10	01	01	02
Sept.	05	03	08	02	02	04
Oct.	07	07	14	05	05	10
Nov.	05	05	10	03	03	06
Dec.	08	06	14	04	03	07
Jan.	09	06	15	04	03	07
Feb.	03	01	04	01	01	02
Total	**46**	**35**	**81**	**21**	**19**	**39**

Catch Per Unit Effort (CPUE):

The CPUE was compared for each of the two major statistical Potential Fishing Zones and outside PFZ for trawl net and purse-seine fishing methods. The high CPUE indicate the most favourable oceanographic environment/conditions for PFZ resources accumulation and fishing operations. Which indicates the potentials of satellites to locate most favourable fishing zone. The catch is increased within PFZ and decreased in outside PFZ region during the study period.

CPUE (Kg/hr) in Murud and Srivardhan FLC in Trawl net during 2021-22:

At Harnai fish landing centre, total 09-month April, May, September, October, November, December, January, February and March in a month's PFZ validation conducted for experiment and data collected in prescribed feedback format and statistical analyses were made in CPUE from the PFZ users. In Murud CPUE was high 244.23 in months of December and low in March 140 inSrivardhan trawl net operation CPUE was more 378.46 in January and 42.43 in April within PFZ,

Table. 3. CPUE in Murud and Srivardhan trawl net FLC during 2021-22.

Months	Murud	Srivardhan
	Within PFZ	**Within PFZ**
April	160.20 ± 1.03	42.43 ± 0.52
May	174.66 ± 1.24	60.10 ± 4.08
Sept.	120.43 ± 3.153	340 ± 4.08
Oct.	178.11 ± 0.83	270 ± 2.44
Nov.	169.33 ± 3.299	131.66 ± 5.73
Dec.	244.23 ± 2.46	367 ± 1.33

Jan.	184.66 ± 3.39	378.46 ± 1.55
Feb.	145.21 ± 3.12	47 ± 0.71
March	140 ± 2.12	342 ± 1.22

Average values of three observations with ± S. D.

Graph. 2. CPUE in Murud and Srivardhan trawl net FLC during 2021-22
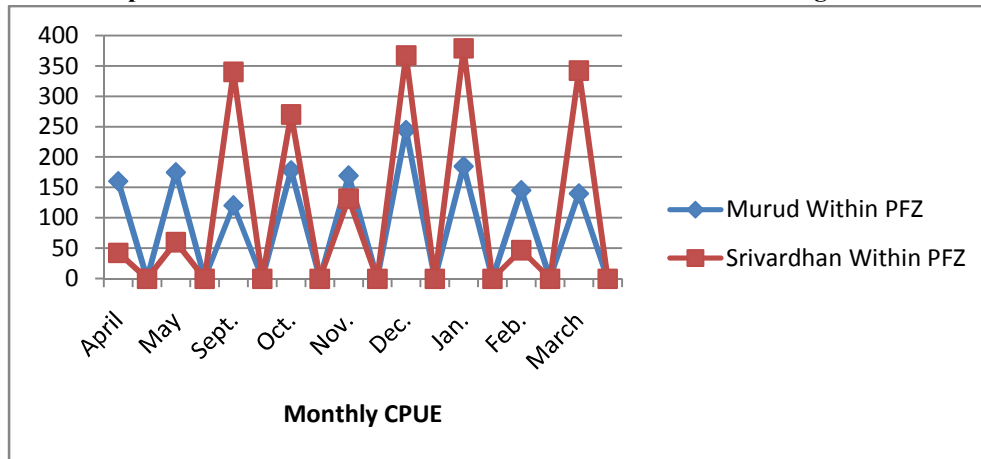
CPUE (Kg/hr) Murud and Srivardhan fish landing centre in Purse-seine during 2021-22:

In the Murud and Srivardhan fish landing centre study month are April, May, September, October, November, December, January, February and March. In Purse-seine net operation at Murud and Srivardhan, there are total 09 months of within PFZ fish catch data collected from the users for CPUE. The CPUE was more 582 in December and low on 140 in October within PFZ, while in Srivardhan FLC PFZ 541 more CPUE in April and low 176 in October, therefore it is indicated that the CPUE was more found in Murud PFZ areas within PFZ than Srivardhan PFZ.

Table. 4. CPUE (Kg/hr) in Murud and Srivardhan purse-seine during 2021-22.

Months	Murud	Srivardhan
April	343.10 ± 3.21	541.54 ± 1.05
May	190.11 ± 1.19	240.10 ± 1.01
Sept.	552 ± 0.41	311 ± 2.23
Oct.	140 ± 1.52	167 ± 1.53
Nov.	315.33 ± 2.05	259 ± 0.81
Dec.	582 ± 0.81	411 ± 3.26
Jan.	463 ± 2.44	203 ± 1.414
Feb.	310.22 ± 1.03	254 ± 0.60

March	313.22 ± 1.05	259 ± 0.81

Average values of three observations with ± S.D.

Graph. 3. CPUE (Kg/hr) in Murud and Srivardhan purse-seine during 2021-22.
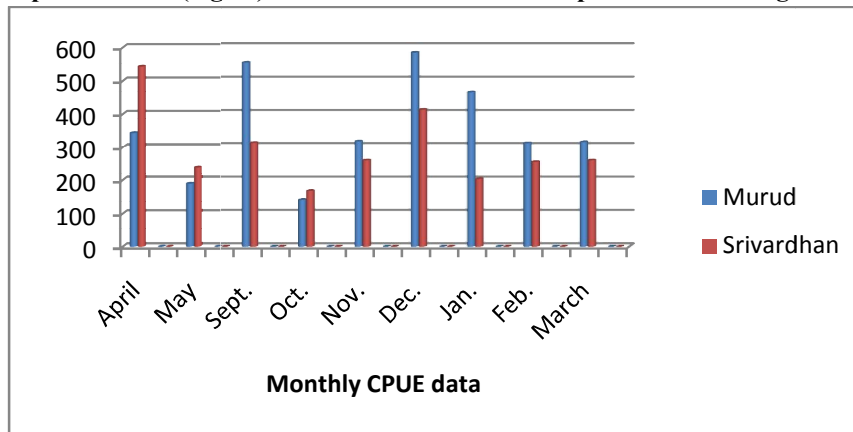
It is usually assumed that CPUE is directly proportional to abundance. For example, if a fisher in 2021 could catch 4 fishing per hour, but the same fisher in 2022, using the same gear and technique, could catch 2 fish per hour, it would be assumed that the abundance of fish in that area had decreased 50 percent from 2021 to 2022. CPUE is commonly used because it is a fishery-dependent indicator. In a few cases, the necessary data already exist, especially if local fisheries agencies require fisher to fill out logs, or record their landings. The CPUE also depends on the skill of the skipper, gear specifications, wind direction, sea state and bottom topography. (Solanki et. al., 2003) reported about 70% observations were positive in-depth zone 30-50m whereas 90% observations were positive in 50-100m depth zone. On an average 100% and 70% increase in catch at 40-50 m and 60-100 m respectively. The per cent increase in total catch was calculated from CPUE in PFZs as compared with mean CPUE of the month.

Catch and effort data are typically analysed in the form of catch per unit effort (CPUE), which expresses the quantity of fish caught (in numbers or weight) by a given amount of fishing effort. In general, CPUE is used as an index of abundance, meaning that a proportional change in CPUE is expected to represent the same proportional change in stock size Catch per unit effort (CPUE) data from fisheries have traditionally been used to measure change in relative abundance, but accumulated evidence indicates that interpreting CPUE data from commercial fisheries is difficult, particularly for pelagic fish, because commercial CPUE data are affected by changes in fishing efficiency (FAO, 1999). Fisheries researchers and managers commonly rely on measures of fish abundance based on catch per unit effort (CPUE) rather than on fish population estimates, because CPUE require less effort and expense (Harley et. al., 2001). However, repeated measures of CPUE may not accurately reflect population abundance (Beverton and Holt 1957). The CPUE is important to study the fishing activities specially in marine fishing in PFZ. The CPUE is calculated in PFZ after fishing operation and they know to fishermen the effort of fishing (CPUE kg/hour/haul/vessel).

According to (Shailesh Nayak et. al., 2003) stated that the development of fisheries depends upon availability of natural resources, climate, physical resources, adequate finance, suitable new technology, growth of fishing units, extension of fishing areas, Government policies, the modern technology, growth of fishing units, extension of fishing areas, Government policies, the modern technology and flow of the technical information to grass-root level. With the increase in fishing fleets, there is a tremendous pressure on the traditionally known fishing grounds, which lead to decline in CPUE (Catch Per Unit Effort). Hence, there is a need to divert some fishing efforts in other suitable potential fishing areas, which can be explored using remote sensing techniques.

The present study was taken up to understand the impacts of the satellite based PFZs forecast on economics of fishermen community and fishing industry. The cost of fishing, generation of PFZ charts as well as fish has been considered. In present study it is observed that the CPUE in Raigad district coast 40-50 m depth zone in 100% and 60-

100 m depth zone 80% observed in purse-seine and trawl net operation. The percent increase in total catch was calculated from CPUE in PFZs as compared with mean CPUE of outside PFZs. In Maharashtra state fisher use the PFZs forecast about 40% but in Raigad district fisher use the about 50% PFZs forecast and operate the purse-seine net and trawl net. The majority of active fishermen are using forecast for locating potential fishing grounds. Hence, fishermen are getting substantial benefits that are using PFZ. The present study indicates that catch per day (in kg) ranges from 180 kg to 280 kg within the period considered. However, in CPUE is calculated by gear and hauling wise within PFZ and outside PFZ. Total fishing effort (number of fishing days) effort increased in both the zones during the period of study.

IV. CONCLUSION

The CPUE in purse seine and trawl net calculated from the table 11 and 12 reveals that, i) The overall results shows that during study period the purse-seine fishing percentage is more benefitted than trawl netting. It means that the PFZ advisories are more benefitted within PFZ for pelagic fishing i.e., purse-seine. ii) The CPUE at three landing centres within PFZ is more than outside PFZ for different fishing gears. This indicates that, by using PFZ validations more catch with less consumptions of fuel and time is observed. It also supported to get more value to fish catch in an average 40 % fuel and time saved when the fishermen used the advisories.

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