Potential Fishing Zone Advisories and Ocean State Forecasts

S.S.C. Shenoi
Indian National Centre for Ocean Information Services (INCOIS)
Hyderabad - 500 055
## Marine Fisheries in India - some facts

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Area of country</strong></td>
<td>3.29 million sq. m</td>
</tr>
<tr>
<td><strong>Area of Exclusive Economic Zone (EEZ)</strong></td>
<td>2.02 million sq. m</td>
</tr>
<tr>
<td><strong>Length of coastline</strong></td>
<td>8130 km</td>
</tr>
<tr>
<td><strong>Fish production (Marine)</strong></td>
<td>2.8 million tonnes</td>
</tr>
<tr>
<td><strong>Estimated production</strong></td>
<td>3.9 million tonnes</td>
</tr>
<tr>
<td><strong>Contribution to GDP</strong></td>
<td>1.04 %</td>
</tr>
<tr>
<td><strong>Fishing villages</strong></td>
<td>3202</td>
</tr>
<tr>
<td><strong>Fish landing centers</strong></td>
<td>1332</td>
</tr>
<tr>
<td><strong>Fisherfolk families</strong></td>
<td>7.5 lakhs (approx)</td>
</tr>
<tr>
<td><strong>Fisherflok population</strong></td>
<td>35.0 lakhs (approx)</td>
</tr>
<tr>
<td><strong>Mechanised boats</strong></td>
<td>60000 (approx)</td>
</tr>
<tr>
<td><strong>Motorised boats</strong></td>
<td>75000 (approx)</td>
</tr>
<tr>
<td><strong>Non-motorised</strong></td>
<td>100000 (approx)</td>
</tr>
</tbody>
</table>
Traditional methods of locating the fishing grounds

- Bird Congregation
- Colour
- Bubbles breaking on Surface
- Muddy and oily water and calm Sea
- Reflection in the Night
- *Kaladu* (a kind of smell)

Fish

- Availability
- Type
- Quantity
Traditionally, the success of fishing trip depended on fisherman's keen sense of sight, smell and hearing.

Often, the fishing trips resulted in spending longer days at sea and returning with low or no catch.

A good catch was mostly ascribed to the 'luck of fisherman'!

It is necessary to examine the scientific data and device methods to pre-determine the locations of probable fishing grounds at sea so that the fishermen need not try out their luck or return empty handed.
Ariel surveys to locate the fishing grounds

- Visual fish spotting from aircraft was successfully demonstrated for locating a number of pelagic species such as anchovy, swordfish, menhaden and tuna in western countries.

- A trained observer acts as a “sensor”, spots the school of fish and communicates with the vessels in the area using radio link.

- The trained observer distinguishes the fish shoal based on their colour, behaviour and schooling patterns.

- But, use of aircrafts on a day-to-day basis over the vast areas would be prohibitively expensive and unviable.

- Use of satellite remote sensing could be the other alternative, but the direct detection of fish using remote sensing is not possible with the current levels of technology.
Indirect detection is possible by observing the associated sea surface phenomena.

Environmental factors:
- Temperature
- Salinity
- Dissolved Oxygen
- Surface Currents
- Wind
- Feeding
- Breeding
- Light
- Chlorophyll
- Nutrients
Remote sensing of sea surface parameters

Chlorophyll – biological productivity

SST – thermal fronts, upwelling

Eddies, meanders, upwelling fronts, rings, filaments, etc.
Use of remote sensing to identify the potential locations for fishing

- Evolved from the MRSIS programme of DOD in early 1990’s

- Used satellite derived SST for the demarcation of ‘potential shoals of fish aggregation’ in the Indian waters


- Disseminated through state fishery departments using FAX and TELEFAX

- Due to the usage of data from single satellite, at least 3 days data was required to cover the Indian coast and to generate the PFZ maps

Thus the PFZ advisory service was limited to twice a week.
Establishment of INCOIS and PFZ Mission

R&D Efforts, Modelling, Technology Development

Operational Generation
(SST, Chlorophyll)
3 per week

Dissemination
- Multi-lingual Delivery (Map, Text)
- Fax, Phone, News Paper,
- Internet, e-mail,
- Electronic Display Boards,
- Radio Broadcast
- Information Kiosks

Validation Feedback

Fishing Vessels

User Awareness
Establishment of INCOIS and PFZ Mission

Sea Surface Temperature

Chlorophyll Concentration

Gujarat
Maharashtra
Goa & Karnataka
W.B & Orissa
North A.P
North T.N
Andaman Is
Kerala
Lakshadweep Is
South T.N
Nicobar Is

Ban (East)
Ban (West)
PFZ (West)
PFZ (North)
PFZ (All India)

SW Monsoon
NE Monsoon

15 Apr 30 May Aug Mid Oct Late Nov 15 Apr

Three times a week (Mon, Wed, Fri) (non-cloudy, non-ban period)
PFZ map and text
PFZ advisories - weekly thrice to daily

Time line of the Operational Process before and after OceanSat-2 Ground station

Before

- 14 00 hrs
- 13 00 hrs
- 11 00 hrs
- 10 00 hrs
- 07 00 hrs

After

- 15 00 hrs
- 14 30 hrs
- 14 00 hrs
- 13 30 hrs
- 13 00 hrs

Multi-satellites
Oceansat-2, MODIS, METOP, NOAA-18 & 19) and GHRSSST)
<table>
<thead>
<tr>
<th>Details</th>
<th>PFZ</th>
<th>Non PFZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the Boat</td>
<td>MRR-8</td>
<td>MRR-10</td>
</tr>
<tr>
<td>Type of Boat</td>
<td>Mech. Ring Seine</td>
<td>Mech. Ring Seine</td>
</tr>
<tr>
<td>Duration of Total Trip</td>
<td>9 Hrs 30 Min</td>
<td>7 Hrs 15 Min</td>
</tr>
<tr>
<td>Number of fishing hours</td>
<td>01</td>
<td>01</td>
</tr>
<tr>
<td>Number of Hauls</td>
<td>01</td>
<td>01</td>
</tr>
<tr>
<td>Number of Fishermen Engaged</td>
<td>37</td>
<td>36</td>
</tr>
<tr>
<td>Total Catch (Kgs)</td>
<td>7200</td>
<td>1800</td>
</tr>
<tr>
<td>Major Species Caught</td>
<td>Carangids</td>
<td>Carangids</td>
</tr>
<tr>
<td>Approximate cost of total catch (Rs) (@ 50 Rs /Kg)</td>
<td>3, 60, 000</td>
<td>90, 000</td>
</tr>
<tr>
<td>Total Expenditure in Fishing Operation (Rs)</td>
<td>77, 600 (Fuel: 5, 400) (Wage:72, 000)</td>
<td>21, 440 (Fuel: 3, 240) (Wage:9, 000)</td>
</tr>
<tr>
<td>Net Profit</td>
<td>2, 82, 400</td>
<td>68, 560</td>
</tr>
</tbody>
</table>

PFZ Forecast based on SST
Issued: Dec 15, 2006
Valid up to: Dec 18, 2006

 Validation of Potential Fishing Zone advisories

Area: Kerala Sector

Details of Simultaneous Fishing Operation by
Two Vessels (PFZ & Non PFZ) on December 16, 2006
## Validation of Potential Fishing Zone advisories

### Area: Goa Sector

<table>
<thead>
<tr>
<th>Details</th>
<th>PFZ</th>
<th>Non PFZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name of the Boat</td>
<td>MDV</td>
<td>SLV</td>
</tr>
<tr>
<td>Type of Boat</td>
<td>Purse Seiner</td>
<td>Purse Seiner</td>
</tr>
<tr>
<td>Duration of Total Trip</td>
<td>24 Hrs</td>
<td>24 Hrs</td>
</tr>
<tr>
<td>Number of fishing hours</td>
<td>02</td>
<td>01</td>
</tr>
<tr>
<td>Number of Hauls</td>
<td>02</td>
<td>01</td>
</tr>
<tr>
<td>Number of Fishermen Engaged</td>
<td>23</td>
<td>23</td>
</tr>
<tr>
<td>Total Catch (Kgs)</td>
<td>12,193</td>
<td>4,000</td>
</tr>
<tr>
<td>Major Species Caught</td>
<td>Coastal Tuna</td>
<td>Pomfrets</td>
</tr>
<tr>
<td>Approximate cost of total catch (Rs)</td>
<td>12,00,000</td>
<td>6,00,000</td>
</tr>
<tr>
<td>Total Expenditure in Fishing Operation (Rs)</td>
<td>36,000 (Fuel: 10,000, Wage:20,000, Other: 6,000)</td>
<td>26,050 (Fuel:9,000, Wage:15,000, Other: 2,400)</td>
</tr>
<tr>
<td>Net Profit</td>
<td>11,64,000</td>
<td>5,73,950</td>
</tr>
</tbody>
</table>

PFZ Forecast based on SST/Chlorophyll image of 06-07 April 2006

Issued: April 08 2006 & Valid up to: April 11, 2006

Details of Simultaneous Fishing Operation by Two Vessels (PFZ & Non PFZ) on April 10, 2006
Validations of PFZ advisories using same type of fishing vessels and fishing gears

- 630 validations were carried out during 2007-2012
Cost - benefits

- On an average 50% reduction in search time indicates that annual savings on account of diesel consumption for
  - mechanised vessels is about Rs.6.0 lakhs (5500)
  - motorised boats is Rs.1.95 lakhs (14000)
  - small motorised boats is Rs. 1.65 lakhs (10000)

- Considering that 25% of the boat owners are using PFZ advisories this amounts to a saving of Rs. 163 crores for Kerala.

- If 100 % of the mechanized and motorized boats operating in Kerala use PFZ advisories, this will account for annual savings of about Rs. 600 crores just on account of diesel savings in addition to the valuable human effort.

- Extrapolation of the above results to the national scenario indicates a savings of Rs. 1351 crores for 25 % usage and Rs. 5000 crores for 100% usage.
Irrespective of the level of technology they would like to know 'how it is going to be out there when they are at sea'.

Numerical Models
Wave height and direction forecasts
Wave forecast for coastal states
Ocean State Forecast

Real time wave monitoring and validation for Wave Height

Karwar

Puduchery

Port Blair
Ocean State Forecast - ocean currents and temperature

INDIAN OCEAN SURFACE CURRENT (cm/s)
Forecast for: 1130IST of 18-08-2012  Issued on: 18-08-2012

INDIAN OCEAN SEA SURFACE TEMPERATURE (Deg. C)
Forecast for: 1130IST of 18-08-2012  Issued on: 18-08-2012
Ocean State Forecast – Mixed layer and thermocline

INDIAN OCEAN MIXED LAYER DEPTH (m)
Forecast for: 1800 IST of 18-08-2012 Issued on: 18-08-2012

DEPTH OF 20 DEG ISOThERM IN THE INDIAN OCEAN (m)
Forecast for: 1800 IST of 18-08-2012 Issued on: 18-08-2012
Ocean State Forecast - Mixed layer and thermocline

Chlorophyll-a  Sea Surface Temperature  Water clarity ($K_{d,490}$)

Depth of thermocline  Mixed Layer Depth  Wind Speed and Direction

42 Tuna Advisories during 2011-12

Sector Name: Gujarat, Maharashtra, Karnataka, Goa, Kerala, South TN, North TN, South AP, North AP, Orissa, West Bengal, Andaman Is., Nicobar Is., Lakshadweep Is.
Vertical migration of Tuna off Visakhapatnam

Depth (m) and Temperature (°C) for Tag 111704 (X-Tag)

- Depth (m) from 0 to 120
- Temperature (°C) indicated by varying markers
- Dates from 2/23/12 to 3/29/12

Legend:
- Archived Depth
- Real Time Depth
- Archived Temperature
- Real Time Temperature
High wave alerts for A & N and Cyclone Thane
## High Wave Alerts

**Forecast for 17.30 IST 29 DEC 2011**

**Notes:** PLEASE CONTINUE TO UPDATE US YOUR POSITION. REGARDS, DUTY FORECASTER.

### Wave Height and Direction

<table>
<thead>
<tr>
<th>Forecast Date</th>
<th>Significant Wave Height (m)</th>
<th>Wind Direction</th>
<th>Wind Speed</th>
<th>Wind Sea Height</th>
<th>Swell Height</th>
<th>Swell Period</th>
<th>Significant Wave Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>05-FEB-2012 12</td>
<td>57.20</td>
<td>ESE</td>
<td>9</td>
<td>1.14</td>
<td>ESE</td>
<td>1.63</td>
<td>7.92</td>
</tr>
<tr>
<td>05-FEB-2012 18</td>
<td>57.18</td>
<td>ENE</td>
<td>9</td>
<td>1.06</td>
<td>ESE</td>
<td>1.56</td>
<td>7.95</td>
</tr>
<tr>
<td>06-FEB-2012 00</td>
<td>57.17</td>
<td>ENE</td>
<td>6</td>
<td>0.95</td>
<td>SSE</td>
<td>1.51</td>
<td>7.84</td>
</tr>
<tr>
<td>06-FEB-2012 06</td>
<td>57.16</td>
<td>ESE</td>
<td>6</td>
<td>0.99</td>
<td>SSE</td>
<td>1.46</td>
<td>7.91</td>
</tr>
<tr>
<td>06-FEB-2012 12</td>
<td>57.15</td>
<td>NNE</td>
<td>4</td>
<td>0.80</td>
<td>SSE</td>
<td>1.42</td>
<td>7.75</td>
</tr>
<tr>
<td>06-FEB-2012 18</td>
<td>57.14</td>
<td>ENE</td>
<td>5</td>
<td>0.86</td>
<td>SSE</td>
<td>1.38</td>
<td>8.02</td>
</tr>
<tr>
<td>07-FEB-2012 00</td>
<td>57.12</td>
<td>NNE</td>
<td>3</td>
<td>0.71</td>
<td>SSE</td>
<td>1.34</td>
<td>7.72</td>
</tr>
<tr>
<td>07-FEB-2012 06</td>
<td>57.11</td>
<td>NNE</td>
<td>4</td>
<td>0.81</td>
<td>SSE</td>
<td>1.31</td>
<td>7.89</td>
</tr>
<tr>
<td>07-FEB-2012 12</td>
<td>57.10</td>
<td>ESE</td>
<td>2</td>
<td>0.80</td>
<td>SE</td>
<td>1.28</td>
<td>7.90</td>
</tr>
<tr>
<td>07-FEB-2012 18</td>
<td>57.09</td>
<td>ENE</td>
<td>3</td>
<td>0.79</td>
<td>SSE</td>
<td>1.27</td>
<td>7.80</td>
</tr>
<tr>
<td>08-FEB-2012 00</td>
<td>57.08</td>
<td>ENE</td>
<td>4</td>
<td>0.76</td>
<td>SSE</td>
<td>1.26</td>
<td>7.68</td>
</tr>
<tr>
<td>08-FEB-2012 06</td>
<td>57.06</td>
<td>ENE</td>
<td>5</td>
<td>0.67</td>
<td>SSE</td>
<td>1.27</td>
<td>7.52</td>
</tr>
</tbody>
</table>

Notes: Wind speeds are in Knots. Wave heights are in metres. The significant wave height is defined as the average of the highest 1/3rd of waves. The Maximum wave height is the average of the highest 1/3rd of waves. The Maximum wave height is the average of the highest 1/3rd of waves.
Prediction of tides along the Indian coast

Tide Predictions for Pondicherry (Long: 79.833E  Lat: 11.933N)

<table>
<thead>
<tr>
<th>Date</th>
<th>Time (IST)</th>
<th>High Tide</th>
<th>Low Tide</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Level (m)</td>
<td>Level (m)</td>
</tr>
<tr>
<td>09-10-2010</td>
<td>08:58 AM</td>
<td>1.34</td>
<td>0.41</td>
</tr>
<tr>
<td>08-10-2010</td>
<td>09:28 PM</td>
<td>1.41</td>
<td>0.26</td>
</tr>
<tr>
<td>10-10-2010</td>
<td>09:37 AM</td>
<td>1.29</td>
<td>0.43</td>
</tr>
<tr>
<td>10-10-2010</td>
<td>10:04 PM</td>
<td>1.37</td>
<td>0.51</td>
</tr>
<tr>
<td>11-10-2010</td>
<td>10:16 AM</td>
<td>1.23</td>
<td>0.48</td>
</tr>
<tr>
<td>11-10-2010</td>
<td>10:41 PM</td>
<td>1.31</td>
<td>0.38</td>
</tr>
<tr>
<td>12-10-2010</td>
<td>10:51 AM</td>
<td>1.15</td>
<td>0.56</td>
</tr>
<tr>
<td>12-10-2010</td>
<td>11:19 PM</td>
<td>1.22</td>
<td>0.46</td>
</tr>
<tr>
<td>13-10-2010</td>
<td>11:26 AM</td>
<td>1.07</td>
<td>0.65</td>
</tr>
<tr>
<td>13-10-2010</td>
<td>11:58 PM</td>
<td>1.14</td>
<td>0.55</td>
</tr>
</tbody>
</table>
Dissemination mechanisms

- Telephone / Fax
- Electronic Display Boards
- Emails
- Website
  - Text
  - Web GIS
- SMS
- Radio and Doordarshan
- Local News Papers
- Information Kiosks

Radio Benziger
mKRISHI – MOBILE APPLICATION (DISSEMINATION)

- Perceived as a large scale impact on fishing community safety, and livelihood.
- Clear impact on the environment.
- World bank found it effective & looking at scaling up.

Implementation: CMFRI-RC, Mumbai and TCS
Box 6: Technology helps deliver a big catch: *taking a chance on new information*

**Name:** A. Alphonse  
**Location:** Koyalam village (Pondicherry)  
**Segment:** Fibre Boat (small-medium fisherman)  
**Service:** Fisher friend

**Impact of mobile phone:**  
a) Revenue – increased catch  
b) Information sharing – ability to contact other fishermen from the sea

Evaluating sea conditions using traditional methods, the fishermen of this village judged that fishing would be poor on this day and did not venture out to sea.

One of the fishermen, who was part of the fisher friend programme, chose to rely on the optimal fishing zone information delivered to his mobile and discovered a large pool of fish. He immediately called a friend on land with his mobile and the news spread among the villagers. This prompted the fishermen to venture out to sea, resulting in an overall haul worth Rs.2500,000 for the village.

Information on Potential Fishing Zone, Wave height, Weather, Flash News, Government Schemes / announcements, Market, Rural Yellow Pages
Centralized Help Line (24x7)

INCOIS Services
- Early warning
- Potential Fishing Zone
- Ocean State Forecast

Queries from Fisher folks

INCOIS

Analysis

INCOIS-MSSRF

Knowledge Management System

Generic Fisheries related Queries
- Expert Consortium
  - CAS
  - CMFRI
  - Anna University
  - Fisheries Dep.
  - Individual experts
  - Academic Institutions

Tablet computing
PFZ – GIS
Ocean State Forecast models
Early Warning

Help-line No.: TN: 9282442311, 9282442312 & AP: 7569059856, 7569079047

FISHERMEN HELP-LINE (DISSEMINATION)
User Interaction Workshops

User Interaction in Danavaipet, E G Dist, Andhra Pradesh
Increasing user base

Total PFZ User Base as of 2011-12
Benefits from PFZ advisories and ocean state forecasts

Impact Assessment and Economic Benefits

- Identifications of PFZs as well as Ocean State forecast by INCOIS are found to be both timely, accurate and of significant value to the fishing community.
- The economic benefits resulting from identification of PFZ is estimated as:
  - If Only mechanized crafts adopt PFZ: contribution to national GDP can go up from 0.81 % to 1.47%.
  - If both mechanized and motorized crafts adopt PFZ: contribution can go to 1.58-2.00 % of national GDP
  - If all mechanized crafts, motorised crafts and traditional crafts adopt PFZ: contribution to national GDP would be ~ 2.04 %.
- Total Annual net income due to PFZ: `34,000 to 50,000 Crore’
- Catalytic roles by MS Swaminathan Research Foundation (MSSRF), Village Resource Centres (VRC) and Village Knowledge Centre (VKC) in raising awareness and facilitating the knowledge transfer
- The proactive role of INCOIS with the catalytic role of the partnering agency like MSSRF and NGOs could be major milestones in the road map for the progress

From the Executive Summary of a National survey by National Council of Applied Economic Research (NCAER)
Thank You