सत्यमेव जयते

Draft Report

11 Economic Valuation of Seasonal Fishing Ban on Marine Fisheries Services in Selected Maritime States of India

THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY-INDIA INITIATIVE

COASTAL AND MARINE ECOSYSTEMS

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THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY-INDIA INITIATIVE

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Economic Valuation of Seasonal Fishing Ban on Marine Fisheries Services in Selected Maritime States of India

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THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY-INDIA INITIATIVE

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning. TII targets action at the policy making levels, the business decision level and awareness of citizens. TII has prioritized its focus on three ecosystems - forests, inland wetlands, and coastal and marine ecosystems - to ensure that tangible outcomes can be integrated into policy and planning for these ecosystems based on recommendations emerging from TII.

In addition to the existing knowledge, TII envisions establishing new policy-relevant evidences for ecosystems values and their relation to human well-being through field-based primary case studies in each of the three ecosystems. In response to an open call for proposals for conducting field-based case studies in the context of relevant policy or management challenges for conservation and the sustainable use of biodiversity and ecosystem services, over 200 proposals were received. A Scientific and Technical Advisory Group (STAG), comprising eminent ecologists and economists, appraised the proposals and recommended 14 case studies for commissioning under TII.

These studies in forests deal with issues such as hidden ecosystem services of forests, conflicts between humans and wildlife, and the economic consequences of species decline. In wetlands, the studies draw lessons on water resources management, community stewardship and equity, and the economics of hydrological regime changes. In coastal and marine ecosystems, the studies explore the opportunities and economic efficiency of interventions such as eco-labelling, seasonal fishing bans, mangrove regeneration, and the challenge of bycatch in marine fisheries.

The reports of these 12 case studies have been published in this TII series.

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COASTAL AND MARINE ECOSYSTEMS

09 Valuation of Planted Mangroves
10 Assessment of Eco-labelling as Tool for Conservation and Sustainable Use of Biodiversity in Ashtamudi Lake, Kerala
11 Economic Valuation of Seasonal Fishing Ban on Marine Fisheries Services in Selected Maritime States of India
12 Economic Valuation of Biodiversity Loss: A Study of By-Catch from Marine Fisheries in Andhra Pradesh

KEY MESSAGES

Millions of fishers along India's vast coastline eke out a living, contribute to national development and are learning to cope up with conservation of marine resources. Seasonal Fishing Ban (SFB) has been followed since the late 80's to protect breeding fish population during peak spawning season. An economic valuation of SFB in five of the maritime states shows improved ecosystem services in the form of catch, fisher income, biodiversity, respite to the sea floor and reduced carbon emissions. These benefits outweigh the costs of a ban.

FINDINGS

- About **10.36 million** fishing hours are reduced due to SFB, equivalent to **408,000 tonnes** of CO2 emitted and a savings of **156.58 million** litres of diesel.
- In 2014, an amount of **₹8.3 billion** (**US$ 137m**) was saved on diesel during fishing ban.
- The estimated economic value (based on landing price) of the incremental growth of fish attained due to a fishing ban of **45-60 days** was a total of **₹1.07 billion** (**US$ 18m**) in the five states.
- The transaction cost, which includes information to fishermen and enforcement of the ban amounts to **₹45.78 million** (**US$ 0.76m**) in the five states.
- Estimated net social benefit due to SFB in five states was **₹1.09 million** (**US$ 18,167**).

RECOMMENDATIONS

- SFB may be strengthened to facilitate sustainability of resources, increase in catch and fisher income.
- Extend research to other maritime states not considered under this study.
- SFB should be combined with other management measures, such as an ecosystem-based approach, marine protected areas, no-take zones, regulated entry, catch quotas, certification, protection of endangered species, mesh size regulation and minimum legal size at capture.
- Create awareness among fisherfolk about sustainability.
- Regular monitoring and impact assessment.

Photo: R Narayan Kumar

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1. Introduction

Fishery resources are renewable natural resources but exhaustible if harvested indiscriminately. Many examples indicate that certain resources are commercially extinct due to unsustainable harvest. This emphasizes the need for proper management of resources. "Management of fisheries is not confined to management of stocks alone but it should consider all the stakeholders associated with the sector directly or indirectly such as fishers, traders, those involved in post-harvest operations and those who provide support services to the sector. Besides, fish stocks live in a highly variable and a complex ecosystem and are affected by human interventions and vagaries of nature, which emphasises the need for including risk and uncertainty factors in management strategies. In recent years, we are witnessing several conflicts among different stakeholders of the fisheries sector, which arise mostly due to sharing of limited resources and income disparities. Management measures adopted in temperate countries are not directly adoptable to the multi-species and multi-gear tropical fisheries of India. Hence we have to formulate fishery management policy considering domestic situations and promote sustainable fishing practices that will not decrease the stock level, but will ensure livelihood security, resource sustainability, economic efficiency and ecosystem integrity (Srinath and Pillai, 2008)."

Exclusive Economic Zone (EEZ) was declared in 1977 which empowered maritime countries the rights to explore, exploit and utilise the living and non-living resources available within a 200 nautical mile zone from the shore. In India, as development of marine fisheries in the territorial waters extending up to 12 nautical miles from the shore is a subject of maritime states, the states have formulated rules and regulations for management of the resources. The regulatory measures formulated under the above Acts and Regulations by and large cover prohibition of exploitation of resources by destructive gears, explosives and poison.

The management of fisheries in India is governed by rules and regulations formulated under the Indian Fisheries Act 1897. Various state governments have issued regulations under the Indian Fisheries Act 1897 for regulation and protection of fisheries. .The regulations concerning Indian marine fisheries are listed in Annexure-1. The other regulatory measures adopted are as follows:

1. Restriction of number of fishing boats
2. Restriction of number of fishing gears which exploit juveniles in the Backwaters, estuaries and shallow inshore waters
3. Mesh size regulation
4. Minimum legal length for capture
5. Seasonal ban on fishing
6. Restriction of fishing areas
7. Protection of endangered species
8. Marine Protected Areas

Although seasonal fishing ban (SFB) is just one of the many tools available for fisheries management, it is the only instrument which is being diligently followed in India. Maritime states along the west and east coasts of India are implementing closed seasons of 45 to 75 days for mechanised fishing vessels as a corollary to their Marine Fishing Regulation Acts. Earlier there was no uniformity of ban period, but after the intervention of the Ministry of Agriculture, Government of India, since 1998, the ban has been made uniform all along the west coast (June15 – July 31) and east coast (April 15 – May 31) states and Union Territories.

(From 2015, the ban period has been extended to 60 days in both the coasts i.e., from April 15 to June 14 in the east-coast and from June 1st to July 31st in west-coast)

Protecting spawners during peak spawning season, reducing fishing effort and giving respite to the

Seasonal fishing ban is the only fishery-management instrument which is being diligently followed in India. After several years of the ban, though, important questions remain about the ban's efficacy and implementation

benthic fauna from intense trawling and safety at sea (due to rough sea conditions, the lives of fishermen are at risk during monsoon)are major reasons for seasonal closure of fishing. However, SFB has been generating controversies since inception. There are questions about the effictiveness of SFB in long-term sustainability and enhancement of fish stocks and also loss of employment. After inception of the ban, in Kerala, several committees were formed to review the efficiency, period, duration and impact of the ban. Barring one or two, all committees have advocated continuation of the ban as a measure of conserving the fishery resources and to aim at sustainable harvest.

Since the inception of ban, the marine fisheries sector has undergone immense technological, economic and social change. However, even after several years of implementation of SFB, there are no specific answers to the following questions: Has the natural capital asset and its value increased? Has the ban improved marine ecosystem services? What is the management cost vis-à-vis benefits? How does each maritime state perform? Answers to these questions are needed to arrive at effective management decisions to sustain this important sector. With this background, an attempt has been made to find answers to some of these vital questions and infer the results to substantiate or recommend alternate/improved management measures to sustain marine fisheries.

2. Objectives

a) To evaluate whether the ban has improved ecosystem services and net social benefits
b) To evaluate the transaction costs vis-à-vis benefits
c) To suggest improved and acceptable fisheries management options

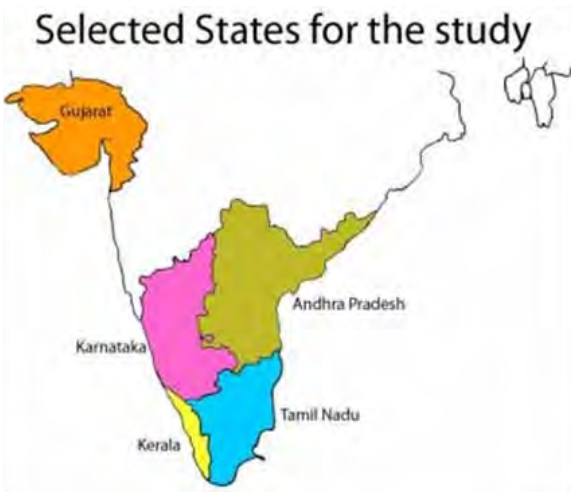
3. Approach

The coastal ecosystem provides a variety of services. Fisheries is an important provisioning service with supplements from supporting and cultural services. The approach of the present study is to quantify the following potential benefits due to implementation of SFB:

(i) Sustainable catch, which provides assured income to fishers.
(ii) Reduced fuel use, CO2 emission: SFB imposes restriction on fishing by mechanised vessels. In the Indian fisheries sector, mechanised crafts share 38 per cent of the total fishing fleet. Out of the total mechanised crafts, 50 per cent are trawlers, which consume substantial amount of fuel for fishing. Thus, the imposition of the ban stops mechanised fishing vessels for 45 to 60 days, thus reducing the use of fuel and CO2 emissions.
(iii) Impact on biodiversity: Due to reduction of effort of mechanised vessels, and subsequent reduction in fishing pressure, the fish stocks are expected to increase and consequently the biodiversity index will also increase.
(iv) Biodiversity was evaluated from the presence/ absence data of occurrence of major groups in the landings. Plymouth Routines for Multivariate Ecological Research (Primer 6), software normally employed for biodiversity research, was used to calculate changes in biodiversity index over the time period. The major fishery resource groups unique to each state recorded as "present/absent" in the landings during 1985- 2013, indicated biodiversity trends over the pre and post ban scenarios. Trophic level evaluation was made based on based on state-wise annual catch data (1985 to 2013) for 68 major groups / species using presence/ absence data. Trophic levels were classified into 3 broad categories comprising Category 1 (herbivore / detritivores with TL 2.0 –3.0); Category 2: Carnivores (TL 3.1 – 4.0) and Category 3: top predators (TL> 4.1) following Vivekanandan et al. (2011).

Rapid Stock Assessment (RSA) was done with a 3 point moving average of catch and compared with the historic maximum of time series catch data in which stocks were classified as Abundant (A), Less abundant (LA), Declining (D), Depleted (DEP) and Collapsed (C) (Mohamed et al., 2010). The average catch of 2011-13 was taken for the

Figure 1: Selected States for the study



evaluation.

4. Study area

Five maritime States namely Tamil Nadu, Andhra Pradesh, Kerala, Karnataka and Gujarat were selected for the study considering their importance in marine fisheries in India in terms of coastal length, share in country's total landings, number of marine fishing villages & landing centres and dependency on fisheries (Table 1 and Figure 1).

The marine fishery profile of the selected maritime states is given in Table 1.

Among the states, Gujarat has the longest coast length and also the maximum number of mechanised crafts. Kerala accounted for about 25% the total fish landings of the country followed by Gujarat and Tamil Nadu during 2011-13. However, in 2014, Gujarat (19.8%) stood first followed by Tamil Nadu (18.5%)

Table 1: Marine fishery profile of the selected maritime States

State	Coast line (km)	Average annual landngs 2011 -2013 (in tons)	Share of major resources (in %) in total fish landings	Number of marine fishing villages	Number of marine fish landing centres	Number of boats			Fisher folk popula-tion (in lakh)*
						Mecha-nised#	Motor-ised#	Non-mecha-nised#	
Andhra Pradesh	974	2,81,688 (10%)	PL-56 DM-29 CR-13	555	353	3,167	10,737	17,837	6.05
Tamil Nadu	1,076	6,54,569 (19%)	PL-61 DM-29 CR-6 ML-4	573	407	10,692	24,942	10,436	8.02
Kerala	590	7,51,223 (25%)	PL-73 DM-14 CR-6 ML-7	222	187	4,722	11,175	5,884	6.10
Karnataka	300	4,34,063 (12%)	PL-64 DM-24 CR-5 ML-7	144	96	3,643	7,518	2,862	1.67
Gujarat	1,600	7,20,591 (20%)	PL-36 DM-35 CR-21 ML-8	247	121	18,278	8,238	1,884	3.96

Note: Figures in brackets indicate the average share of the States in India's marine fish landings
PL-Pelagic resources; DM-Demersal resources; CR-Crustacean resources; ML-Molluscan resources
** National Marine Fisheries census, CMFRI, 2010*
 # Mechanised sector: Use engine power for cruise and fishing
Motorised sector: Use engine power for cruise and fishing done manually
Non-mechanised sector: Generally use manual labour for cruise and fishing

and Kerala (16%) (CMFRI 2015).

The response of fishing communities to SFB is different between the states depending on their literacy, awareness and social status as shown by our previous studies. Among the selected states, the literacy rate, awareness and social status of the fisher-folk in Kerala are better than in other states. Hence, expectations and societal response to the fishing ban are higher in Kerala. Kerala is highly fisheries-sensitive and in that respect, the challenges for fisheries administrators are also many. Andhra Pradesh and Tamil Nadu are implementing the ban since 2001 for 45 days from April 15 to May 31 and in general, there was an acceptance for the ban in light of the rejuvenation of the fish stocks though there were some reservations regarding the season of enforcement. In Gujarat, the literacy level of the fishers was 44 per cent (excluding children of below five years). The SFB is in force from 1998-99 onwards. It was found that historically in this State, the fishers were enforcing voluntary ban earlier. In Karnataka, fishers had a literacy level of 64% (excluding children below five years). The SFB is in force in the State since 1989. There is a marginal difference in the ban period between the two major fishing districts namely Dakshina Kannada and Uttara Kannada.

5. Data

The study involved the collection of both primary and secondary data. The details of the primary and secondary data collected are given below.

a) Primary data

The primary data was collected from fisher households to assess their socio-economic status and willingness to accept (WTA) and willingness to pay (WTP) for the imposition of the ban. The primary data collected included general particulars of the household, age, family composition, literacy level, occupation, income and fishing details during the year.

b) Secondary data

The secondary data on marine fish landings was collected from the National Marine Fish Landing Data Centre (NMFLDC) of CMFRI. The following time series data on resources landed along with the corresponding fishing effort [both in units and in hours (AFH)] was collected:

6. Enforcement of Seasonal Fishing Ban (SFB)

The enforcement of seasonal fishing ban commenced at various points of time and the duration also varied across the selected study States. The details of the enforcement of SFB in the selected States are given in Table 3.

7. Results

7.1 Impact of Seasonal Fishing Ban (SFB)

7.1.1. Quantification of Incremental Fish Biomass Due to SFB

The economic benefit of SFB was assessed by estimating the value of incremental growth of fish that was attained due to fishing ban, following Vivekanandan et al. (2010) as detailed below:

It is expected that the biomass of resources would have increased during the ban period. In order to

Table 2: Data collected from National Marine Fisheries Data Centre of CMFRI for analysis

State	Annual Landings	Annual Effort	Quarterly Landings	Quarterly effort	Monthly landings	Monthly effort
Gujarat (zw-sw)	1970-2013	1985-2013	1985-2013	1985-2013	2002-2013	2007-2013
Karnataka (zw-sw)	1970-2013	1985-2013	1985-2013	1985-2013	2002-2013	2007-2013
Kerala (zw-sw)	1970-2013	1985-2013	1985-2013	1985-2013	2002-2013	2007-2013
TN (zw-sw)	1970-2013	1985-2013	1985-2013	1985-2013	2002- 2013	2007-2013
AP (zw-sw)	1970-2013	1985-2013	1985-2013	1985-2013	2002-2013	2007-2013

(zw: Zone-wise; sw- Species-wise)

(The cells indicate the period for which the data were available and collected)

Table 3: Enforcement of SFB

State	Year of introduction	Period of notification*	Number of days	Type of fishing banned	Type of fishing permitted
Gujarat	1998-99	10 June to 15 August	67	All craft	NIL
Karnataka	1989	15 June -10 August	57	All crafts except motorised OBM/IBM vessels up to 25 hp engine	Motorised up to 25 hp engine
Kerala	1988	15 June -31st July	47	Mechanised vessels/ motorised crafts of >10 hp engine	All traditional /motorised crafts up to 10 hp engine
Tamil Nadu	2001	15 April to May 31	47	Mechanised fishing/ trawlers	All non-motorised and motorised crafts with less than 25 hp engine
Andhra Pradesh	2000	15 April to May 31	47	Trawlers and motorised crafts of >25 hp engine	Traditional/ motorised crafts with <25hp engine

Source: Policy Brief Seasonal Fishing Ban, CMFRI Spl. Publn. No.103, 2010

*Note: *The ban orders issued by the respective State Governments are given in Annexure-II.*

estimate the weight increment of important resources (which otherwise would have been exploited by the fishery), during the ban period, the following growth formula of von Bertalanffy (1936) was used:

$$Wti = W_{\infty i} (1\text{-}\exp^{(-kti))^3} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Where,

W^{ti} is the weight of fish at age t for the i^{th}resource,

k is the annual growth coefficient

$W\infty i$ is weight at L_∞ for the ith resource.

The k, Wt and W_∞ as well as the length-weight relationship of the major species representing the resources exploited by the mechanised gears were collected from a number of published sources and used to find out the weight increment. The increment factors were used to estimate total increment in the biomass of resources from the catch data of the previous month of ban.

7.1.1. Economic Valuation of the Incremental Growth

The economic benefit of SFB was assessed by estimating the value of incremental growth that was attained due to a fishing ban. The incremental weight (in tonnes) of each species was multiplied by the price/tonne (geometric mean of the last three years at the landing centre price level and retail price level; the price data was available with the Socioeconomics and Technology Transfer Division of CMFRI) of the respective species and the final value was estimated..The valuation of incremental growth was arrived at as follows:

$$I_v = \sum_{i=1}^{n} q_i p_i, \quad \ldots\ldots\ldots (2)$$

where,

I_v = incremental value during the ban period

q_i = incremental growth (biomass) of species

p_i, = price per kg of the species

i = species

The growth in biomass due to increase in body size of fishes during the ban period was computed using the VBGF and cumulated for all resources and the incremental growth was computed. The incremental benefit thus estimated was higher in west coast states (Kerala, Karnataka and Gujarat-9%) compared to Andhra Pradesh (5%) and Tamil Nadu (8%). (Table 4).

The value of the incremental catch captures the average price the fish had realized at the landing centre as well as retail market levels due to increase in body size for 45 – 60 days. The estimated value of the incremental biomass ranged from ₹1,266 lakhs in Andhra Pradesh to ₹2,809 lakhs in Tamil Nadu at landing centre price level (point of first sales) . At the retail market level (point of last sales), the estimated value ranged from ₹1,980 lakhs in Andhra Pradesh to ₹4,620 lakhs in Tamil Nadu (the average for the last three years) during 2013. This analysis indicates that the SFB has a positive impact on fish harvest as well as on realization of higher value.

Table 4: Incremental economic benefit due to SFB

Parameters	Kerala	Karnataka	Gujarat	Andhra Pradesh	Tamil Nadu
Catch (t) in 45-60days (if there is no fishing ban)	49,344	35,900	35,523	22,265	67,015
Estimated Catch (t) in 45-60 days	53,785	39,131	38,720	24,046	72,377
Increment in catch during ban period(t)	4,441	3,231	3,197	1,781	5,361
Increment rate (%)	9	9	9	5	8
Value of incremental catch estimated at landing centre price(₹ in lakhs)*	2,729	1,701	2129	1266	2,809
Value of incremental catch estimated at retail market price (₹. In lakhs)	4,053	3,781	2,897	1,980	4,620

7.1.2. Impact of SFB on Resource Group-wise and Sector-wise Marine Fish Landings

The impact of SFB was further assessed for assorted resources (fish species/ groups) as well as for different craft types. The craft type (sector) categorization assumes significance as the SFB applies to all mechanised boats, which operate trawls and gillnets, but only partially at varying proportions for motorised boats from which gears like seines are operated.

The methodology involves two approaches: (i) Regression approach aims at studying the dependence of landings and catch rates (catch per unit craft trip as well as per hour of actual fishing) upon effort (boat trips or actual fishing hours) and an indicator variable signalling the start of SFB in the state concerned. Those years post SFB introduction are given a dummy value of 1 and those prior to that were marked as 0. Here, the annual catch rates are calculated in two forms: one is standardised across various gears and other nominal which is the ratio of gear wise catch to effort are utilised. The idea behind this type of analysis is to isolate the SFB factor from major masquerading effects like total effort or standardised effort across various craft / gears and check whether that has a significant contribution to the catch rate variability. In other words if the coefficient associated with the SFB indicator in the analyses happens to be significantly different from zero ($p<0.05$) then it can be inferred that the introduction of SFB and what followed thereafter was effectively different from what preceded, thus meaning that SFB was influential.

(ii) The second approach was more general wherein the catch rates were taken up as a parameter of fishery health / wealth as well as fishers' success and its compound growth rate in the pre SFB and post SFB periods were computed using the semi logarithmic model (Power function). The significance of the individual growth rates and their relative performance in pre and post SFB periods were taken as a definitive lead towards assessing the impact of the SFB in the five study states. The results are discussed in section (iii) and (iv) in detail. In both the cases the time period considered was 1985-2013, which is sufficient for studying interventions and their impact.

The impact of the variables that influences the fish catch was studied through a series of regression analysis. The fish catch (tonnes) is regressed against standardized effort, catch per hour and SFB as a dummy variable. The fishing effort (in terms of Actual Fishing Hours) as a dependent variable was introduced to account for the expansion in the fishing grounds over the years.

The common regression model fitted is as follows:

$$ncr_{sybg}=\mu+a_1 fe_{syb}+a_2 ind_{sy}+e_{sybg} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where,

ncr_{sybg} is the nominal catch rate of gth group (groups being Cephalopods, Crustaceans, Large Pelagics, Small Pelagics and Demersal species) in bth sector (sectors being multiday trawl, other mechanised and motorised) for the yth year (year ranging from (1985 to 2013) of the sth state (Gujarat, Karnataka, Kerala, Tamil Nadu and Andhra Pradesh). It is computed based on nominal effort which is a non-standardised total absolute effort in suitable units expended by various gears which netted the resource under focus

μ is the general mean or the intercept.

fe_{syb} being the fishing effort (either in units or hours) of the bth sector for the yth year and sth state.

a_1 is the partial regression coefficient of

nominal catch rate on the effort..

ind_{sy} is the indicator variable (taking values 0 during the pre-ban era for the state concerned and 1 from the year regulations were introduced in the state concerned) for the bth sector in yth year.

a_2 is the partial regression coefficient of nominal catch rate on the indicator variable- significance of which may indicate tangible impact of the introduction of regulation for the sector-group concerned for the state.

e_{sybg} is the random error attributable to the g the group caught by bth sector during the yth year in the sth state.

The years when SFB was introduced in the states are listed in the previous section.

A detailed table containing the results of regression catch rates over SFB introduction and effort for different combinations of states, craft types and resource groupings is given in Annexure-III. In the subsequent section catch rate is the common term used to represent catch per boat trip (CPUE) as well as catch per unit hour of actual fishing (CPH).The units were catch in kilograms per boat trip or per hour as the case may be. The catch rates were computed in two formats; one standardized over various crafts / gears (standardized catch rates) and the other was computed taking into account the three special craft groups (sectors) viz. multi day mechanised, other mechanised and motorised. The multiday mechanised boats are larger in size with in-house engine, which operated mostly trawlers for 3 to 15 days per voyage. Other mechanised boats are those which operated either for a single-day per voyage or operated gillnets. Motorised boats are smaller ones, which had outboard motor and operated for 1 or 2 days per voyage.

In the east coast especially in Andhra Pradesh the results indicated that the SFB had a distinct influence on the nominal catch rates of crustaceans (like shrimps and crabs) from other mechanised sector. While considering the effort in terms of actual fishing hours, which is more precise in terms of offsetting reach to the fishing grounds and crew bias, the cephalopods (like squids, cuttlefish and octopus) landed by motorised sector; crustaceans landed by all the three sectors, demersal resources (like finfishes sciaenids, threadfin breams, perches etc.), landed by multiday sector (indicating very few targeted trips going by the state's craft profile) and the large pelagics (like the tunas, seerfish, barracudas etc.,) landed through motorised crafts, tunas are highly influenced by the SFB indicator, which is the dummy variable. In most cases the influence of increasing fishing effort was also significant. As the effort as well as the ban was significant it may be presumed that fishery development treaded a path of growth which was also influenced by the SFB. Tamil Nadu recorded overwhelming difference in patterns of pre and post ban scenarios in case of crustaceans, large pelagics and small pelagics targeted by motorised sector. The demersal catch rates per boat remained independent of the introduction of the ban. The catch per actual fishing hour based regression yielded a different result indicating that the pre and post ban eras differed significantly in almost all resources netted by all three sectors, although multi day efforts were quite rare in pre ban period. The large pelagics netted through the mechanised crafts had a very high level of dependence on the introduction of ban indicating a development of a new thriving fishery post ban. This attains importance as this mechanised sector (single day) has not shown much influence attributable to the regulation vis-à-vis, other resources like small pelagics, cephalopods and crustaceans.

The two east coast states showed a significant rise in catch rates since the introduction of trawl ban, but the results of the three west coast states showed a different picture. The north-western state of Gujarat, in general despite the fact that effort in units had an unusually significant role in explaining catch rates

The two east coast states showed a significant rise in catch rates since the introduction of trawl ban, but the results of the three west coast states showed a different picture

for a multiday trawling, the introduction of formal regulation had less impact. This could be because of the healthy self-control exercised by trawlers which are the mainstay of Gujarat fisheries since the 1960s. While the micro indicators of multi day efforts of trawlers have shown no significant dependence on the regulation, the other mechanised sector seems to have been influenced by the SFB milestone in case of capturing large pelagics, a group comprising highly migratory species, which is worth dwelling in detail.

The south-western constituents Karnataka and Kerala had a near similar status when it comes to the analysis of impact of SFB. One major reason could be that the number of years preceding the ban included in the analysis was far too less (three / four years) and could have had an impact on the results. Another significant factor is that the advent of one particular sector of craft types, namely the motorised sector (boats with outboard engines) too coincided with the SFB introduction. But the analyses using the catch rates per unit of time expended will take care of reach of the new introduction and would accordingly put the results on an even footing. The unit's effort based regression of the five groups landed in Karnataka with the seasonal fishing constraints of which the state was one of the earliest implementers, crustacean and small pelagics have shown influence in catch per boat performance after the introduction of ban in late eighties. The outboard sector, which started concurrently with the regulation in the state, had recorded very significant growth and substantial difference in the pre and post ban eras in case of large pelagics too. The CPH based analysis threw up more significant cases of dependence on the introduction of regulation in the state. Cephalopods, crustaceans through mechanised sector, crustaceans, demersal and large pelagics in the motorised sector have shown significant influence of the introduction of new regulation regime. The small pelagics which were showing significant dependence on units based catch rate analysis have shown no such explicit dependence on the dummy regressor, showing the fact that increase in catch per boat is more due to increase in spatial expanse of fishing rather than dramatic increase in resource density during the period under study. The Kerala scenario showed significant dependence on the introduction of regulation over the years in case of cephalopods targeted by mechanised units, predominantly single day trawlers, crustaceans again by the same sector and large pelagics, comprising sharks, landed by limited duration mechanised crafts. The demersal resources showed no change in pattern in terms of catch per unit effort (cpue) due to the introduction of regulation in late eighties. The more fine-tuned catch per hour (cph) analysis presents a scenario wherein mostly the motorised sector which co-initiated with a trawl ban, had significant performance in terms of catch rates. This was expected as the outboard concept was largely non-existent in the early parts of eighties. In such a scenario these two factors viz. trawl ban and motorization have confounding influence on the catch rates attributed to this sector.

The results shown by the standardized catch rate analysis which combined all mechanised crafts and gears after standardization also gave a similar picture. The SFB indicator has significant influence in the states of AP and TN, whereas Gujarat, Karnataka and Kerala have shown non-significant influence (7%, 74% and 54% respectively). Hence it can be concluded that the ban's introduction triggered better catch rates and hence better returns to east coast state fishermen under focus, whereas the same cannot be inferred about the west coast. But the fact that micro indicators of certain resource groups showed marked increase in catch rate regression over SFB in a couple of western states shows that some influence had been effected by the SFB in patches.

7.1.4. Impact of SFB on Sector-wise Marine Fish Landings-Compound Growth Rate

The annual compound growth rates (ACGR) visualized as an exponential regression here indicates the year over year increase in catches / catch rates over a time period, here pre and post SFB period. The model used to estimate this is as follows:

$$Yt = Y0\ (1+b)^{t} \quad \ldots\ldots (4)$$

Where Y_t is the catch rate of t th year and t is the number of years and Y_o is the initial year and b is the coefficient under focus, CAGR. This can be estimated using the log version of this which results in a linear form whose partial regression coefficient is the required growth rate. A significant b indicates tangible annual increase / decrease in catch rates equated for the time period. A comparison of pre and post ban periods indicates the trends and their portends. When it is mentioned pre and post ban period, it refers to the years before the introduction of SFB and after that. The figures subjected to regression were all summarised annually and the regressions were standardised.

The catch per hour (cph) was compared before and after the ban period. The comparison was made for the catch harvested by the mechanised and motorised crafts, which are banned during the SFB.

Table 5: Growth rate mechanised landings (catch rate) before and after the ban

States	Growth rate (pre ban)	Growth rate (post ban)	Remarks
Andhra Pradesh	-0.045727**	0.015376	Increase
Tamil Nadu	-0.032831**	0.084568**	Increase
Kerala	0.030474	-0.031091	Decrease
Karnataka	0.119550	0.015063	Decrease
Gujarat	0.027794	-0.012509	Decrease

The comparative growth rate of mechanised catch rate before and after the ban across the study states was assessed and is presented in Table 5.

The growth rate of the mechanised craft catch per hour increased after the ban period in Andhra Pradesh and Tamil Nadu while it showed a declining trend in the remaining three States namely Kerala, Karnataka and Gujarat.

In case of the catch rate of the motorised landings, except in Tamil Nadu and Kerala, the post-ban growth rate was positive and increasing in the States of Andhra Pradesh, Karnataka and Gujarat. (Table 6)

7.1.5. Impact of SFB on Resource Group-wise (species-wise) Marine Fish Landings: Compound Growth Rate

The various species that are caught are grouped into five major groups' namely small pelagics, large pelagics, demersal fin fishes, crustaceans and cephalopods. The growth rate of these groups before and after the ban period was assessed and presented in Tables 7 to 11.

The species-wise comparison indicated that in Andhra Pradesh (Table 7), all the resource groups showed a positive trend after the ban while in Tamil Nadu, except crustaceans, all the other resource groups exhibited a positive trend after the ban period (Table 8). In Kerala (Table 9), small pelagics and cephalopods showed a declining trend after the ban period while in Karnataka (Table 10), the large pelagics and demersal fin fishes alone showed a positive trend post-ban period. In Gujarat (Table 11), only demersal finfishes showed a positive trend after the ban and all the remaining showed a declining trend. Overall across the States, there has been an increase in the post-ban growth rate of the resource groups.

As the results indicate, the post ban growth rates differ on varying scales from pre ban growth rates, but the most telling latent featureof these results is the fact that the ACGRs which were relatively less significant or insignificant have become definitively significant in the most of the groups of the east coast states of TN and

Table 6: Growth rate of motorised landings (catch rate) before and after the ban

States	Growth rate (pre ban)	Growth rate (post ban)	Remarks
Andhra Pradesh	-0.00507	0.00366	Increase
Tamil Nadu	0.00059	0.00051	Decrease
Kerala	0.01254	-0.00057	Decrease
Karnataka	-0.34187*	0.00284	Increase
Gujarat	0.00157	0.00197	Increase

Table 7: Growth rate of catches of fish groups along Andhra Pradesh

Resource Groups	Growth rate pre ban	p value	Growth rate post ban	p- value	Remarks
Small pelagics	0.13009	0.07407	0.14712	7.83553E-05	Increase
Large pelagics	0.08939	0.6579832	0.17838	2.84256E-05	Increase
Demersal fin fishes	0.00315	1.66449E-08	0.17597	3.51618E-06	Increase
Crustaceans	0.08596	4.25074E-05	0.09242	0.00036	Increase
Cephalopods	0.04884	5.8455E-06	0.2282	0.000212717	Increase

Table 8: Growth rate of catches of fish groups along Tamil Nadu

Resource Groups	Growth rate pre ban	p- value	Growth rate post ban	p- value	Remarks
Small pelagics	0.10457	0.04944062	0.24271	2.58993E-06	Increase
Large pelagics	0.00801	0.130860053	0.15504	0.569882916	Increase
Demersal fin fishes	-0.00889	7.67928E-08	0.10015	6.49004E-06	Increase
Crustaceans	0.05256	0.000311326	0.0523	0.010176695	Decrease
Cephalopods	0.10919	0.743423176	0.14745	0.00083349	Increase

Table 9: Growth rate of catches of fish groups along Kerala

Resource Groups	Growth rate pre ban	p- value	Growth rate post ban	p- value	Remarks
Small pelagics	0.15754	0.304849985	0.06605	1.26279E-05	Decrease
Large pelagics	-0.13791	0.450218808	0.16004	1.64361E-05	Increase
Demersal fin fishes	-0.02497	0.674121261	0.06486	0.69261979	Increase
Crustaceans	-0.00941	0.39165967	0.03376	0.053486356	Increase
Cephalopods	0.30657	0.030224098	0.06196	0.000484585	Decrease

Table 10: Growth rate of catches of fish groups along Karnataka

Resource Groups	Growth rate pre ban	p- value	Growth rate post ban	p- value	Remarks
Small pelagics	0.04369	0.330067198	0.03122	3.39971E-06	Decrease
Large pelagics	-0.16801	0.48625568	0.04609	0.12361398	Increase
Demersal fin fishes	0.00008	0.879847085	0.16149	1.46468E-10	Increase
Crustaceans	0.09181	0.48625568	0.01646	0.12361398	Decrease
Cephalopods	0.27768	0.549531537	0.1268	1.99441E-06	Decrease

Table 11: Growth rate of catches of fish groups along Gujarat

Resource Groups	Growth rate pre ban	p- value	Growth rate post ban	p- value	Remarks
Small pelagics	0.07943	0.023721505	0.03393	0.000876881	Decrease
Large pelagics	0.13656	0.000751356	0.01501	0.193149725	Decrease
Demersal fin fishes	0.06366	0.000510909	0.07001	0.008316789	Increase
Crustaceans	0.10049	1.16372E-05	0.03765	0.00520517	Decrease
Cephalopods	0.11223	2.9551E-05	-0.01836	7.05011E-05	Decrease

AP. In case of west coast states the post ban growth rates followed similar suit as their pre ban counterparts viz., those which had significant ACGAR before SFB also had the same post SFB. This too buttresses the findings recorded in section (i) wherein the significant impact of the SFB intervention was established in the eastern states while Gujarat, Karnataka and Goa had no such telling difference in performance.

7.2. Impact of SFB: Environmental Benefits and Net Social Benefits

The significant impact of SFB on ecosystem services is increase in fish catch, in addition to environmental benefits such as reduction in carbon emission and respite to the sea floor. The increase in catch or growth

Figure 2: Boats anchored during SFB-BV Palem, AP

Figure 3: Sail boats operating during SFB- Vizag, AP

is discussed in the previous section. In this section, the reduction in carbon emission and the fuel saved (in money terms) is presented. The respite to the ocean floor has been estimated based on a few earlier studies.

7.2.1. Estimated Reduction in Carbon Emission and Money Saved

During the ban period, as the vessels do not go for fishing,there is no usage of diesel and hence there is no carbon-dioxide (CO_2) emission. The amount of fuel used during fishing operations of different craft type was taken from Vivekanandan et al., (2013). The reduction in carbon emission was estimated as the difference between the estimated carbon emission for the 12 month period and carbon emitted during the actual 10 to 10.5 months of fishing (Table 12).

The reduction in fishing effort (actual fishing hours) because of SFB in all the five selected States worked out to 103.61 lakh hours , thereby saving of 1565.8 lakh litres of diesel. This is equivalent to reduction of 4.08 lakh tonnes of CO_2 emission. This reduction in fuel consumption has resulted in a savings of ₹82,988.94 lakh during 2014. The SFB has helped saving foreign exchange and reducing the greenhouse effect due to reduction in use of diesel.The amount of carbon emission reduced and the diesel saved may be treated as positive externalities of the SFB to the ecosystem and to the country.

7.2.2. Damage Avoidance

One of purposes of SFB was to prevent damage to the fishing craft that venture into the sea. This purpose is more relevant to west coast states as the SFB is during the southwest monsoon when the sea is rough. Along the east coast, the ban is during summer, when the sea is relatively calm. However considering the damage that occurred during the 1996 cyclones in east coast a probability of around 1.23 per cent of damage (for the whole year) (Compiled from a paper in FAO, 1999) is assumed to the crafts. This proportion (1.23%) is reduced to the ban period of 45 days and the number of boats that might have been damaged was arrived at. From this figure, the damage avoidance cost of the

Table 12: Estimated reduction in CO_2 emission and savings in diesel due to SFB in the Study States, 2014

State	Reduction in annual fishing effort (hours)	Diesel saved (lakhlitres)*	Money saved (₹ in lakhs)	Reduction in Co2 emission(tonnes)*
Andhra Pradesh	16,18,076	297.38	15,761.38	77,646.12
Gujarat	35,40,974	514.61	27,274.28	1,34,362.67
Karnataka	7,00,365	157.35	8,339.54	41,083.48
Kerala	13,14,008	243.77	12,919.94	63,648.16
Tamil Nadu	31,87,707	352.71	1693.80	92, 092.22
Total (for the five States)	103,61,130	1,565.83	82,988.94	4,08,832.64

** Conversion of diesel burnt to CO2 emission after Vivekanandan etal. (2013)*

Table 13: Estimated Damage avoidance due to SFB, 2014

STATES	No. of mechanised crafts*	Probable number of crafts damaged @0.16%	Investment per craft (in lakhs)**	Cost of damage averted (₹ In lakhs)
Andhra Pradesh	827	5	26.11	132.32
Tamil Nadu	2,799	17	26.18	447.84
Kerala	1,657	8	35.09	265.12
Karnataka	1,048	6	28.77	167.68
Gujarat	4,754	29	26.01	760.64
			Total	1773.6

*Note: * The damage avoidance was worked out for mechanised crafts only as they are completely banned during the SFB*
*** SEETT Division, CMFRI, Annual Report, 2014-15*

crafts was estimated and presented in Table 13.

The damage avoidance cost due to SFB was estimated at ₹1,773 lakhs as this amount could have been the loss incurred had these crafts were deployed in the seas for fishing during the ban period

7.2.3. Social Cost of SFB

The social cost or the damage avoidance cost is considered to be equivalent to the claims given to the accident relief to the fishermen families. However this accident relief scheme is applicable to all sorts of accidents in the sea during the whole year. The premium for such claims is paid to FISHCOFED (with Centre and State sharing 50:50). The claims are paid by FISHCOFED to the registered fishers. In Tamilnadu, during 2013-14 an amount of ₹143 lakhs has been paid to 153 families and the total members enrolled was 6,51,111.

In Karnatka, during 2013-14, an allocation of ₹25.00 lakhs was made and ₹24.00 lakhs has been paid to FISHCOFED, New Delhi towards premium by the State Government. There was 32 cases claiming an insurance of ₹31.00 lakhs during 2013-14. During 2014-15, an allocation of ₹26.25 lakh is made for this purpose and premium amount has been paid for insuring 2,04,689 fishers.The Government of Andhra Pradesh has released ₹35.00 Lakhs duly revalidating the amount which was released during 2008-09 in the last week of March,09. Thus the government both Central and State are allocating funds under the Fishermen Welfare Scheme to compensate the loss of life during fishing accidents but this is again for the period of whole year and under the centrally sponsored fund with an equal amount of State contribution. This should be viewed only from fishermen welfare point of view and not in terms of the benefit-either annual or incremental-which

Figure 4: Mechanised boats anchored during SFB, Kerala

Figure 5: Motorised boats anchored in Uppada, AP

otherwise will defeat the purpose of such schemes.

7.3. Estimation of Net Social Benefits

The net social benefit is the incremental value minus the transaction cost. For the present analysis, transaction cost was estimated as below:

7.3.1. Estimation of Transaction Cost of Implementation of Seasonal Fishing Ban

The transaction cost refers to the costs involved in implementation and enforcement of management measures or acts or legislation. This includes the expenditure incurred by the Government in implementing the regulation.

Transaction cost primarily involves,

(i) Search and information costs – This includes cost of educating the stakeholders, getting information and related costs

(ii) Bargaining and decision costs - This includes cost of arriving at a particular decision or programme for implementation of fishing ban

(iii) Policing and enforcement costs – This includes cost of enforcing a particular decision or program: The cost of enforcing the SFB.

In this study, the cost incurred by the government to implement the SFB is arrived at by computing the cost incurred in notification of the SFB, conducting awareness campaigns, inspections by the Fisheries Development Officials, and other expenses associated with the enforcement of the ban individually and adding them. The estimate of the transaction costs in the study States are given below.

The data for estimation of the transaction cost was collected from the State Fisheries Department of the selected States using the pre-tested questionnaire (Enclosed as Annex 4)

(i) Kerala

The estimated transaction cost in the implementation of SFB in Kerala is given in Table 14

The transaction cost is divided into major heads namely information cost, enforcement cost and compensation cost. The information cost relates to the expenses incurred in the information exchange on the ban to the masses either through audio or visual media like Radio, Newspaper, TV ,print Notices/ Others including awareness campaigns. The enforcement costs include the expenses computed for enforcing the ban across the coast by way of involving official sin the enforcement from the department of fisheries, police force and the coast guard patrol. Also cost is computed for the hiring changes of the patrol boat and its Petrol and oil expense (POL) expenses .The Compensation cost includes incentives and compensation paid during the ban which free rations and cash allowance paid to the fishers in lump sum or with sharing from the Central and State government during the ban period. But it is to be noted that compensation cost is not a part of transaction cost.

The total transaction cost in 2014 was ₹248.14 lakhs out of which the information costs accounted for a major share of ₹210 lakhs (84.63%) followed by the enforcement cost, ₹38.14 lakhs (15.37%). The awareness about SFB is created through various channels of communication like personal, electronic, print media and also through small publications.The expenses incurred to advertise in media, publication of notices and awareness campaigns were computed as information costs. Besides the above transaction cost, the government also gives compensation to the fishermen during the fishing ban period. It includes cash allowance and free rations. The total compensation paid to the fishers of Kerala is presented in Table 15.

The total compensation cost was ₹5,802.38 lakhs out of which the free ration shares ₹1,392.38 lakhs (24%) followed by cash allowance, ₹4,410 lakh (74%).

(ii) Andhra Pradesh

Table 14: Estimation of transaction cost in Kerala, 2014

Sl.No	Components of transaction cost	Amount (in ₹ Lakhs)	% share to total
(A)	Information Cost	210.00	84.63
(B)	Enforcement cost		
	Salary of government staff	13.63	5.49
	Patrolling	21.71	8.75
	Fuel	2.80	1.13
	Total enforcement cost	38.14	15.37
(C)	Total transaction cost	248.14	100.00

The estimated social benefit due to SFB was worked out for the states and it was found to be positive for all the states. The net social benefit in the Study States ranged from ₹1,097.42 lakhs in Andhra Pradesh to ₹2, 879.76 lakhs in Gujarat

The estimate of the transaction cost in Andhra Pradesh is given in Table 16.

The total transaction cost worked out to ₹172.52 lakhs out of which the enforcement costs accounted for a major share of ₹168.58 lakhs (97.71%) followed by the information cost, ₹3.95lakhs (2.29%). The awareness about SFB is created through various channels of communication like personal, electronic, print media.

(iii) Tamil Nadu

In Tamil Nadu the ban is implemented for a period of 45 days from the 15th April to the 29th May of every year along the entire East coast of the State starting from Thiruvallur Revenue District to Kanyakumari Town in Kanyakumari District and from the 15th June to the 29th July of every year along the west coast portion of the State in the Kanyakumari district from Kanyakumari to Neerodi village limit. The government of Tamil Nadu do not make any public announcements through media regarding the enforcement of seasonal fishing ban. The announcements on the ban are made through media. However instructions are given to authorized officers through Office memorandum. Further, notice is issued through newspapers as Press Release and no cost is involved

The enforcement is done with the help of the Department of Fisheries officials which includes Joint Director, Deputy Director, Assistant Director, Fisheries Inspectors, Fisheries officers, Sea guards. Patrolling is carried out in Kanyakumari District using fishing boats of local fishermen with 2 patrolling trips with 2 boats per week for 6 weeks during east coast ban period (i.e. 4 x 6 = 24 boat trips) and 2 patrolling trips with 2 boats per week for 6 weeks during west coast ban period.(i.e. 4 x 6 = 24 boat trips). There are no hiring charges for patrolling boat; however 200 litres per boat per trip is provided for all the 48 trips which require a diesel requirement of 9600 litres valued at ₹1.50 lakh during 2013-14. However, the cost of overall patrolling worked out to be 11.49 lakhs for the 100 odd coastal

Table 15: Compensation allowances paid to fishers during SFB, Kerala

Components of Compensation cost	Amount (₹ In lakhs)	Per cent to total compensation cost
Free ration	1392.38	24.00
Cash allowance	4410.00	76.00
Total Compensation cost	5802.38	100.00

Table 16: Estimation of transaction cost in Andhra Pradesh

Sl.No	Components of transaction cost	Amount (in ₹ Lakhs)	% share to total
(A)	Information Cost	3.95*	2.29
(B)	Enforcement cost		
(i)	Salary – Department of Fisheries	141.88	
(ii)	Salary – Police officials	26.71	
(iii)	Total enforcement cost	168.58	97.71

*Note: * This cost was incurred by Reliance Foundation on their own. Reliance India Limited initiated a programme to connect farmers and fishermen as a part of their expansion programme. Since this exercise aimed at creating awareness about SFB, the cost incurred by them is taken as information cost (as a proxy to the expenses incurred by the Government of AP).*

Table 17: Estimated Net Social benefit due to SFB

Sl.No.	State	Incremental benefit (₹ In lakhs)*	Transaction cost (₹ In lakhs)	Net social benefit (₹ In lakhs)
1	Andhra Pradesh	1,266	168.58	1,097.42
2	Tamil Nadu	2,809	12.99**	2,796.01
3	Kerala	2,729	248.14	2,480.86
4	Karnataka	1,701	10.92**	1,690.08
5	Gujarat	2,897	17.24**	2,879.76

*Note * At landing centre level estimate*

*** In these states, enforcement of SFB is being taken care by the Coast guard, whose salary is apportioned as costs of enforcement*

guards who spent their time in implementing the ban as an enforcement cost.In this state, the compensation is paid to the 1,49,855 fishermen families (2014) was 30,01,59,565, which included the allowance of ₹2,000 per family and a contingency expenditure of ₹3 per family.

(iv) Karnataka

Announcements regarding the ban are made through newspapers as news item. Hence no cost is involved. No officials are specifically engaged for enforcement of closed fishing season. The staff members involved in management of fishing harbours/ fish landing centres is responsible for enforcement of closed fishing season without any additional cost. Patrolling during SFB is done by coast guard. . The cost of patrolling worked out to 10.92 lakh s for the 75 odd coastal guard who spent their time in implementing the ban as an enforcement cost. In this State, compensation is paid to 43,000 fishermen under centrally sponsored "Saving cum Relief Scheme." Under this scheme ₹900 is contributed by the beneficiary and ₹900 each by state and central governments .Total ₹2,700/- is paid during the ban period. The total compensation paid was ₹11.61 crores.

(v) Gujarat

In Gujarat, the enforcement is taken care by the coast guard as a part of their duty. The ban is complied with by the fishermen. Hence no separate costs of enforcement are incurred. There is no specific compensation cost paid during this period.But the compensation given through the Centrally Sponsored scheme is provided. The cost of patrolling worked out to 17.24 lakh s for the 100 odd coastal guards who spent their time in implementing the ban as an enforcement cost

7.3.2. Estimation of state-wise net social benefit

The estimated net social benefit for the study states is given in Table 17.

The estimated social benefit due to SFB was worked out for the states as the additional incremental benefit minus the transaction cost and it was found that it was positive for all the state. The net social benefit in the Study States ranged from ₹1,097.42 lakhs in Andhra Pradesh to ₹2, 879.76 lakhs in Gujarat. Hence it can be concluded that there is a substantial positive net social benefit due to enforcement of Seasonal Fishing Ban in the selected States. However if the compensation costs are included in this analysis (which are not a part of the transaction cost), there will not be monetary benefit due to Seasonal Fishing ban.

7.3.3. Compensation paid to fishermen community

Compensation is given during the ban period by the concerned state governments availing the Centrally Sponsored Scheme and adding their own share. The compensation amount is being given by the Central and State Governments from the public fund through the regular budget allocations. This is not a part of the transaction cost and this is a part of the Welfare Scheme of the Government for the fishermen community, most of them belonging to traditional and motorised category. This assistance is mainly provided to the fishermen community to maintain their livelihood and sustain the fishery (a situation similar to granting subsidies).Hence this amount was not deducted from the incremental benefit to estimate the net social benefit.

The amount of compensation varies from State to State. In Tamilnadu ₹4,000 per month per fishermen household is given as compensation during the ban period while it is ₹2,700 per house hold in Karnataka. This includes the savings component of the individual fishermen household during the year with which an equal contribution of the Central and State governments is added and above all in some states they add a few thousand rupees more.

8. Impact of SFB on Stock Status and Biodiversity

The Indian Fisheries Sector is a muti-gear multi-species fishery.In the year 2013, about 670 species were landed along the Indian coast of which only 15 species were present in all states and 254 were represented in only one of the states/UTs (CMFRI, 2014) indicating that there are strong regional distribution of fish diversity, unique to each ecosystem.The number of species recorded in 2013 in various states were Gujarat (192), Kerala (308), Tamil Nadu (328), AP (236) and Karnataka (173) which could be categorised under 68 major groups. The stock status of major targetted fishery resources is estimated on an annual basis and based on the catch estimates obtained through CMFRI's multistage Stratified Random Sampling technique. The Rapid Stock Status Assesment (RSA) is calculated using historic landings data and compared with the current year's catch levels in various states, which are classified according to a fixed criteria (Mohamed et al., 2010). Results indicate the possible impact a SFB will deliver on these fished stocks (Table 18).

RSA indicates that in Andhra Pradesh, Mullets (Declining) and Hilsa shad (Collapsed) are the two stocks causing concern.These stocks are affected by fishing pressure as well as environmental factors during spawning runs and in breeding grounds etc. It has been suggested that to revive Hilsa fishery of Andhra Pradesh minimum discharge volumes from rivers to sea should be ensured, otherwise the spawning runs of this anadromous species which migrates upstream will get disrupted and recruitment to the fishery of this highly valued food fish of the region will be adversely affected (Ghosh et al., 2014). Environment may also be playing an important role in increasing fish catches as the fish catches across all categories, from the lower trophic level herbivorous fishes and shellfishes to top predators like tunas, billfishes, large carangid are showing increase. Although the shark catch trends are showing decline, the volume of other high unit value large predatory species has increased. Seerfish in Andhra Pradesh indicates a declining status. It has been mentioned that the large scale seasonal capture of juveniles of seerfishes, mackerels, anchovies in shoreseines that regularly occur during April-May months (monsoon ban period) are of concern (Rao et al., 2008). As these fishes have the potential for fast growth and within two to three months attain larger size and recruit to the fishery, they need to be conserved and SFB may help to achieve this. Monetary compensation for abstaining from harmful fishing by traditional gears currently not prohibited during the SFB combined with creation of awareness to protect fish juveniles among the traditional shore seine fishermen can be considered to discourage harmful fishing practices during the ban period.

In Kerala it is observed that the trophic category 1 comprising species low in the food chain have shown increase. The probable effect of high fishing pressure on the top predators in recent years (fishing down the food web phenomenon) as well as favorable environmental factors that favor production of high volume catches of oil sardine that belongs to the lowest trophic level may be responsible for this phenomenon. The RSA indicated that nearly 11 stocks were declining, and mostly comprised of species belonging to trophic category 1 (herbivores/detritivores) and trophic category 2 (carnivores). A major resource the penaeid prawns, are showing "less abundant" status while mullets are showing "declining" status. Species such as mullets, penaeid prawns etc belonging to trophic category 1 are speciose groups and the penaeid prawns such as Penaeus indicus, Metapenaeus spp. are commercially important and in high demand even in export and domestic markets respectively. They are mainly caught in mechanised gears like trawl nets where any reduction in fishing effort would assist in ensuring sustainability of the resource. They also have a significant portion of their life cycles in coastal waters and estuaries. Hence, habitat stress and recruitment loss due to pollution (dumping of plastic waste, discharge of untreated wastes from fish processing units, destruction of mangrove habitats) are major issues here which have to be looked into besides the fishing effort on their targetted exploitation concerning their declining catches. The collapse of the catfish stock was due to large scale destruction of spawners due to fishing using large seines. These can be expected to benefit from the fishing ban to a greater extent in the future as catches are showing recovery recently. Goatfish was another resource that showed "collapse". Considerable landing of juvenile goatfish in the trawl by-catch has been reported and is of concern considering that these fishes are important in the food chain.

In Tamil Nadu, there are 9 stocks which are showing declining trends and no "collapsed" stock. The traditional gear category indigenous trawl net Thallumadi is operated in estuarine areas for the prawn P. indicus and the prawns like P. semisulcatus and also catch other juvenile prawns, crabs and cephalopods. The main catches are during May, when trawl ban is in vogue (Sarada and James, 2014). Although volume of catches compared to trawl nets are quite low, the

Table 18: Present Stock status of various resources exploited (based on Rapid Stock Assessment)

	AndhraPradesh	Tamil Nadu	Kerala	Karnataka	Gujarat
Hilsa shad					
Mullets					
Oil sardine					
Penaeid prawns					
Non-penaeid prawns					
Crabs					
Stomatopods					
Lesser sardines					
Silverbellies					
Anchovies					
Whitefish					
BlackPomfret					
Rock cods					
Lobsters					
Mackerel					
Soles					
Sciaenids					
Catfishes					
Threadfin breams					
Goatfishes					
Pigface breams					
Scads					
Sharks					
Cephalopods					
Bombay duck					
Other carangids					
Lizardfishes					
Ribbonfishes					
Horse mackerel					
Seerfishes					
Coastal tunas					
Billfishes					
Barracudas					

Colour code	Status
Green	Abundant – Less abundant
Orange	Declining -Depleted
Red	Collapsed
No colour	Not a major fishery resource in concerned state

*Note * At landing centre level estimate*

*** In these states, enforcement of SFB is being taken care by the Coast guard, whose salary is apportioned as costs of enforcement*

damage to sea grass beds which are nursery areas for a diverse group of shrimps by the use of these nets is quite high. Considering that the catch is mainly composed of very small sized juveniles it is apparent that even if the catch volumes are low, a large number of individuals are destroyed thereby affecting recruitment to the fishery in the coming months. Alternate livelihood options and incentives to divert such fishing to more sustainable methods are hence suggested.

The total marine fish landing trends of Karnataka are showing a sustained increase with catches of the trophic category 2, mainly composed of mid-level and top-level carnivores, which are showing the highest increase. Stomatopods which are an important component of the trawl by-catch are critical in maintaining the food web dynamics, being a major food item of marine fishes. Hence, any reduction of fishing pressure is expected to benefit. Non-selective gears like trawl nets and purseseines in Karnataka catch large number of juvenile fishes, causing an economic loss to the fishery; but the monsoon fishing ban on such fishing positively impacts the spawning and recruitment process as reported for the commercially important fishes like the threadfin breams (N.japonicus, N. randalli), lizardfish Saurida tumbil and the penaeid prawn Metapenaeus monoceros (Thomas and Dineshbabu, 2014). The stocks of all these demersal fishes mainly caught by trawlers are of "abundant" status presently and a SFB can further ensure sustainability of the stocks by giving sufficent protection to spawning fish and fish eggs/larvae due to a respite in fishing effort during the ban period.

Gujarat has the longest coastline among all maritime states of India, with a comparatively broader shelf region from where a large number of mechanised fishing effort is concentrated. Silverbellies and Seerfishes are the two stocks of concern and any effort regulation through SFB or mesh regulations is expected to have a positive impact on the stocks.

It is concluded that post the fishing ban there has been an overall increase in the volume of fish catches as well as their species diversity across all states. The "miscellaneous" component of the catch which usually includes all kinds of by-catch and non-edible biota in trawls is showing an increasing trend across all states. Since these non-edible biota play a significant role in maintaining the food web, a reduction of fishing caused mortality/destruction due to a SFB will create a favourable environment for impacted fish stocks to revive in the various states.

9. Socio-economic Impact of SFB

The data on the socio-economic impact of the SFB was collected from sample respondents in the study states which include Tamil Nadu, Andhra Pradesh, Kerala and Gujarat. The respondents were grouped under the following categories:

- Mechanised craft owners
- Crew working in mechanised crafts (Trawler labourers)
- Motorised craft owners
- Traditional craft owners

The data was collected on family details, education, occupation, income, consumption & expenditure, indebtedness; fishing details such as seasons of fishing, fishing hours per trip, average costs & revenue per trip, major species caught. In connection

Figure 6: By-catch component of trawl net

Figure 7: Juveniles of threadfin breams landed by trawlers

with SFB, the details on their awareness about the SFB, ban duration, who are all banned, employment during ban period, benefits or support provided by the Government during this period, any alternate livelihood tried during the ban period, the problems encountered during the ban period and finally their willingness to accept (WTA) for the ban (in case of mechanised craft owners/labourers) and willingness to pay (WTP) for the ban (in case of traditional/motorised boat owners) were collected. From the collected information the analysis of WTP and WTA were performed.

The Willingness to pay (WTP) is set for the trawl labourers and the trawl owners who are denied fishing on account of ban. They will have willingness to accept the ban with some compensation. Similarly the traditional and a few categories of motorised boat owners are allowed to fish during the ban. Hence, they could be enquired of their willingness to pay for getting additional income during ban.

9.1. Socio-economic Characteristics of Sample Respondents

The general particulars of the respondents such as age distribution, size of family, dependency ratio, male-female ratio, adult and child, occupation and related information are given in Annex 7 to serve as background information.

9.2. Assessment of Willingness to Accept and Pay for Implementation of SFB

The contingent valuation method was used to assess the willingness to accept (WTA) and willingness to pay (WTP) for the ban period. Two types of schedules were prepared and the data was collected from different stakeholders namely trawl owners, trawl labourers, motorised boat owners and non-motorised boat owners.

The sample size annd sample centres are given below.

The willingness to pay data was collected from trawl labourers (24), trawl owners (6). The willingness to accept data was collected from motorised craft owners (30) and traditional craft owners (30). The schedules used for the data collection are given in Annex 5 and Annex 6.

In addition to their willingness to pay or accept, other related information like the number of days unemployed, the major problems during the ban, the support from the family, alternate livelihood solutions and related aspects were also gathered.

9.2.1. Willingness to Accept (WTA) for SFB: Incentive Based Approach

An incentive based interview in which the amount they were willing to accept for ban days ranging from 30 to 120 days in favour of ban was asked and conclusions were arrived at. The incentive they were willing to accept increased according to number ban days is given in the Table 20(a) and 20(b).Since this is a choice experiment, for computing the willingness to pay was made up to that level, which is based on few feedbacks from the stakeholders' meeting conducted at earlier occasions on this issue.

It is seen from the table that, trawl owners in Rameswaram were willing to accept the ban for ₹34,167 for 30 days and ₹1,43,333 for a period of 120 days and trawl labourers were willing to accept the same for ₹11,817 to ₹79,067 . In Kakinada, mechanised trawl owners were not willing to accept any amount except for 45 day period which was ₹10,050.Whereas trawl labourers were willing to accept an amount of ₹2970 to ₹8659 for a period up to 90 days. In Nizampatanam, respondents of all the sectors were ready to accept the 45 days ban period and the amount ranged between ₹9,265 among trawl to ₹38,200 among mechanised

Table 19: The sample size and sample centres are given below.

Sl. No.	State	Selected Centres	Sample size
1	`Kerala	Alapuzha	90
2	Karnataka	Mangalore	90
3	Gujarat	Veraval	90
5	Andhra Pradesh	Kakinada	90
		Nizamapatnam	90
6	Tamil Nadu	Chennai	90
		Rameswaram	90
		Kanyakaumari	90

trawl net. Similar conclusions are drawn for Chennai and Nizampatnam too where different categories were willing to accept only for 45 days period. In Chennai, only mechanised trawl crew was willing to accept an amount for 30-120 days that ranged between ₹1,170 (for 30 days)-₹7,920 (45 days). In Kanyakumari they were willing to accept a sum of money only for 45 days which was ranged between ₹9250 (by non-mechanised labour) and ₹13880 (by motorised owner) across various categories. The willingness to accept increases as the number of days of the fishing ban increases as it might affect their livelihoods.

9.2.2 Community's Perception on Various Aspects of SFB with Respect of WTA

9.2.2.1. Number of Days Unemployed

The unemployed days of fishermen in the study areas varied between 45 and 48 days during ban except in Mangalore and Veraval. In Veraval unemployed days during the ban was found to be 100 days, whereas in Mangalore it was nil.

9.2.2.2. Mitigation Measures During Ban Days

Information on different mitigation measures was also collected to find the source of support during trawl ban period, mainly support from cooperatives, government support, support from family members etc. The major source of support that the respondents avail during the ban period across different centres was found to be cooperatives (39.5%), followed by government (32.8%) and family members (31.6%). Most of the respondents

Table 20(a): Willingness to accept for SFB

	Rameswaram		Chennai					Kanyakumari				
Ban Days	Trawl owners	Trawl Labors	Mechanised trawl Owner	MechGillnet Owner	MechTrawlcrew	Mech Gillnet crew	Mech Owner	Mechlabor	Motorised Owner	Motorised Labor	Non mech Owner	Non MechLabor
30	34167	11817	(NA)	NA	1170	NA	11187	5333*	8174**	4444***	7409* *	1875***
45	49167	20950	591667	88333	7920	11500	15417	11694	13880	11111	13330	9250
60	73333	33433	NA	NA	5760	NA	NA	NA	NA	NA	NA	NA
90	105000	52867	NA	NA	4200	NA	NA	NA	NA	NA	NA	NA
120	143333	79067	NA	NA	5000	NA	NA	NA	NA	NA	NA	NA

NA refers to not acceptable

Table 20(b) Willingness to accept for SFB—Contd...

	Kakinada		Nizampatnam				Mangalore	
Ban days	Non-Mechanised	Mechanised	Mechanised Trawlnet	Motorised gillnet	Mot Mini Trawl net	Labours	Motorised gillnet Boat owner	Non Motorised Boat Owner
30	2970	NA)	NA	NA	NA	7000	NA	NA
45	8659	10050	38200	11708	10400	9265	5500	NA
60	6333	(NA)	NA	NA	NA	NA	15000	1333
90	4848	NA	NA	NA	NA	NA	4663	1430
120	NA	NA	NA	NA	NA	NA	NA	3000

(80 per cent each) of Kanyakumari and Chennai centres depend mainly on Government support during the ban period. Since Self-help Groups are more popular in Kerala and Andhra Pradesh, 61.54 per cent and 89.39 per cent of the respondents of Alappuzha and Kakinada centres respectively availed support from cooperatives (mainly from SHGs) during the ban period.

However, dependence on alternative livelihoods options among the total respondents (1.23%) was observed to be very minimal and only available in Nizampatanam (1.64 %) and Veraval (12.50 per cent). Unlike other states the only mitigation measure available to Karnataka was support from family members where 95 per cent were said to be beneficiaries.

9.2.2.3. Income Source During Ban

Most of the fishermen (56.97%) remained jobless during ban days. Chennai and Kanyakumari fishers were the most badly hit, where 96 per cent and 93 per cent respectively had no earnings during the ban; followed by Andhra Pradesh which constituted around 86 per cent. Only fishers from Rameswaram went for alternate jobs. 82 per cent of fishers in Nizampatnam survived with their savings, while fishers in Chennai, Kanyakumari and Karnataka reported that they did not use any savings. In Karnataka most of the support (80%) for fishers came from their own family. The centrally sponsored schemes provide minimum support to fishers during the ban period.

9.2.2.4. Alternate Livelihood Options (ALO)

Most of the respondents of Chennai (100%), Rameswaram (94.44%) and Veraval (90.63%) expressed that availing alternate avocations during the ban period was too hard. According to respondents from Kakinada (87.88%), Kanyakumari (74.00%) and Mangalore (76.36%) centres the availability of alternate avocations was found to be easy in their locality.

9.2.2.5. Fisherwomen support

The income support of fisherwomen during SFB would help the family in meeting daily errands of their family. Many fisherwomen belonging to fishing community were gainfully employed which served as a great support to fishers during the ban. Women from Nizampatnam were in the forefront in labour force, where 95 per cent of them were actively and fully employed and hence their role in income generation during ban period was found to be of great significance. Women were mainly engaged in assisting trawl net mending and non-motorised fishing. In Rameswaram, 44 per cent received their support, in which 25 per cent each indulged in crab peeling, dry fish business and seaweed farming whereas 13 and 12 per cent indulged in ornamental mollusc and tailoring respectively. In Andhra Pradesh 27 per cent received assistance from fisherwomen in which 5 per cent were in tailoring, 39 per cent in fish business and 56 per cent in SHGs. Unlike other centres fisherwomen's support received in Chennai was negligible, where only 17 per cent women were engaged in fish marketing. Only women from Kanyakumari and Andhra Pradesh were in various SHGs.

9.2.2.6. Inclusion of Non-mechanised Sectors in Trawl Ban

More than 25 per cent of the total respondents stand for ban of trawl operation alone across different centres. Interestingly all respondents stood for ban of trawl operations in Karnataka and Kerala, whereas all in Nizampatnam were against banning trawl operations alone. Half of the interviewees in Rameswaram opined that it is not just the trawl operations but also motorised, shore-seine, gillnet, pair trawling and purse seine to be brought under the ban purview. In Chennai more than 90 per cent opined that all fishing boats accept traditional (non- motorised) should also be brought under the ban and in Kanyakumari 3 per cent opined that motorised and shore seine should be included in the ban. In Karnataka, they also suggested that non-motorised and gillnet boats also may be banned. Remarkably a small segment of respondents were of the opinion that fishing can be allowed for motorised and non-mechanised craft within 8 nautical miles or the same should be allowed for 5 hrs a day for motorised and non-mechanised during ban period.

9.2.2.7. Community Perception on Increasing Ban Days

In Veraval, 97 per cent of the respondents favoured the need for increasing the ban days, followed by Chennai (73.30%), Mangalore (52.72%) and Rameswaram (44.44%).Only 21.21 % respondents in Kakinada and 30.76 % in Kerala favoured increase in ban days, whereas in Nizampatnam none of respondents supported the same.

9.2.2.8. Resource Conservation and SFB: Community Perception

All the respondents of Rameswaram, Chennai, Nizampatnam and Mangalore were of the opinion that SFB has helped fishery resource conservation and hence they could observe an increase in fish landings after the ban period. In other centres too, majority were

Figure 8: Net mending during SFB-Kakinada, AP

Figure 9: Net mending during SFB- Munambam, Kerala

of the opinion that fish landings have increased due to the trawl ban. However 78 % of the respondents of Kakinada were in disagreement with the relationship between trawl ban and resource conservation.

9.2.2.9. Increased catch in post ban period: Community Perception

About 85 % of the respondents experienced increase in fish catch after introduction of trawl ban. All the respondents of Nizampatanam and Mangalore expressed that the fish catch has substantially increased in the post ban period. Majority of the respondents of Kanyakumari (93%), Chennai (97%) ,Veraval (97%) , Alappuzha (92.3%) and Kakinada (71%) expressed that their catch has improved immediately after the trawl ban period. However, Rameswaram respondent sdid not record any increase in fish catch during the post ban period.

9.3. Willingness to Pay (WTP) for SFB: Incentive Based Approach

Data on willingness to pay (WTP) for seasonal fishing ban was collected from the motorised and traditional craft owners who are allowed to operate during the ban period under some conditions like use of low horsepower in motorised crafts. Opinions of traditional and motorised craft owners are discussed below. About 53 per cent of respondents were willing to pay for the ban either by cash (83.04%) or in kind (19.96%). While none of the respondents of Chennai, Nizampatanam, and Mangalore (except a very few) were willing to pay in favour of trawl ban. All the respondents of Kerala were willing to pay in cash in favour of trawl ban. The details of the willingness to pay for SFB are given in Table 20.

Chennai and Nizampatnam fishers were not willing to pay a fee for any of the ban days (30 to 120). In Rameswaram, the traditional fishers were willing to pay a fee ranging from ₹333 for 30 day ban to ₹1,725 for 120 days ban. In the same centre, the motorised boat owners were willing to pay from ₹652 for 30 day ban to ₹3,352 for a 120 days ban period. In Kakinadathe WTP of the motorised craft owners on an average ranged from ₹175 for 30 day SFB to ₹6,177 for 120 days ban.

In Mangalore, most of the individuals were not willing to pay a fee. Only two mechanised purse-seiners were willing to pay ₹1, 500 for 45 days and one owner from a total of 5, was ready to pay ₹9,000 for 90 days. Only two trawl boat owners were willing to pay ₹23,500 (which include the WTP in kind, converted into value) for 45 days 6 and one owner ready to pay ₹10,000 for 90 days ban. Among mechanised trawl boat labourers only 13 were ready to pay ₹2,692 for 45 days, for respondents, ₹4,500 for 60 days and only one expressed that he will be willing to pay ₹1,000 for 90 days ban.

9.3.1. Community's Perception on Various Aspects of SFB with Respect of WTP

9.3.1.1. Allowed to Fish and Satisfaction During the Ban Period

Of the total 263 respondents, 206 are allowed to fish during the ban period. This is because, in states like Kerala, the restriction on the horse power of the engine for motorised crafts is in place during SFB. In Rameswaram, Chennai and Nizampatnam fishers of non-motorised sector are allowed to fish during the ban period. In Kakinada and Alappuzha majority are from motorised sector and hence less than 35 per cent of the respondents are allowed to fish during the ban

Table 21: Willingness to pay for SFB

Centres/ Ban days	Rameswaram		Chennai		Kakinada	Nizampatnam	Mangalore		
	Traditional (in ₹)	Motorised (in ₹)	Motorised Boat Owner (in ₹)	Motorised Boat Crew(in ₹)	Motorised (in ₹)	Non-motorised (in ₹)	Mech Purse-seiners (in ₹)	Trawl Boat owner (in ₹)	Trawl boat labourer (in ₹)
30	333	652	Not Willing(NW)	Not Willing(NW)	175	Not Willing(NW)	NW	NW	NW
45	606	1.265	NW	NW	281	NW	1,500*	23,500*	2,692
60	976	1.838	NW	NW	484	NW	NW	NW	4,500
90	1,278	2,394	NW	NW	5.678	NW	9000	10000	1000
120	1.725	3.352	NW	NW	6,177	NW	NW	NW	NW

*Note: * A few number of respondents only expressed to pay that amount, as mentioned in text*

period. More than 90 per cent of the fisher-folk from Rameswaram, Chennai and Nizampatnam are happy to fish during the ban period.

9.3.1.2. Alternate Livelihood Options (ALO)

About 42 per cent of the respondents are not aware of any alternative avocations if they are not allowed to fish during the ban period, whereas 23 per cent opt for going for other non-fishing jobs and 22 per cent will not go for fishing or other jobs. Only 11 per cent of the respondents choose inland fishing as an alternative source. It was found that for trawl labourers with good experience in trawling operations, it was difficult to find other skilled jobs. Alternate livelihood in repair and maintenance of fishing equipment and in the processing sector may be created for protecting livelihood security of mechanised workers.

The crew working in fishery sector normally are not involved much in non-fishery activities during the ban period. They resort to repairing and overhauling fishing equipment during this period. Respondents from Kakinada and Mangalore opt for non-fishing jobs to a greater extent, during the SFB.

9.3.1.3. Benefits of Trawl Ban

Most (about 60%) of the traditional fishers were very much aware of the benefits of the trawl ban, such as increased catch, better income, better price, and increased fishing days for them. The ban on bottom-trawling, has contributed to an increase in incomes for traditional fishermen.

About 60 per cent of the fisher folk are aware of getting more income due to the ban on bottom-trawling. i.e. getting income at the cost of others.

10. Relative performance of SFB across the Study States

The relative performance of the SFB across the study states was assessed by ranking the values in four major indicators namely, economic value of the incremental biomass (in ₹), net social benefit (in ₹), carbon (in lakh tonnes) and fuel saved (in lakh litres), is shown in Table 22.

Gujarat, Tamil Nadu and Kerala have first three positions among all states, in all the four indicators selected for comparison except for Kerala, which is next to Andhra Pradesh in the amount of carbon emitted and fuel saved. Apart from this difference, the performance of seasonal fishing ban varies across the States and the ranking will be Gujarat, Tamil Nadu, Kerala, Andhra Pradesh and Karnataka. But it is important to note that the period of ban in Gujarat and Karnataka are different from that of the remaining three states and this ranking has to be viewed in this background. It is also important to note that in spite of the extended duration of the ban, the fishermen in Gujarat and Karnataka have accepted the orders of respective state governments, though they are different from the central government notification, which shows their commitment towards the conservation of the marine fishery resources.

11. Conclusions

Fishery resources are renewable but exhaustible. Many fishery regulation measures, both input and output have been tried to bring in sustainable management of marine fishery resources in the country. Among them the seasonal fishing ban (SFB) was found to be one of the effective tools but the SFB will be more effective if used in combination with a few other regulation

Table 22: Comparative performance of SFB across the study states

State	Economic value of the incremental biomass (in ₹ lakhs.)*	Net social benefit (in ₹ In lakhs)*	Carbon emission reduced (in lakh tonnes*	Diesel saved (in lakh litres)*
Gujarat	2,897.00	2,897.00	1.35	514.61
Tamil Nadu	2.809.00	2.809.00	0.92	352.70
Kerala	2,729.00	2,480.00	0.65	243.77
Andhra Pradesh	1,266.00	1097.00	0.41	297.38
Karnataka	1,701.00	1,701.00	0.77	157.35

**Source: From previous tables*

measures. The SFB is introduced with the major aim of conservation of resources to ensure the sustainable management of marine fishery resources and to address sea safety issues. However, an almost uniform ban period is in practice since 1998 in the maritime states with the period differing in the east (April 15 to May 31) and west coasts (June 15 to July 31).

The analysis on incremental benefits indicates, that the SFB has a positive impact on the fish harvest after the ban and hence, can be continued as a tool for sustainable marine fisheries management.

The catch per hour of mechanised crafts increased after the ban period in Andhra Pradesh and Tamil Nadu while it showed a declining trend in the remaining three States namely Kerala, Karnataka and Gujarat. In case of the catch rate of the motorised landings, except in Tamil Nadu and Kerala, the post-ban growth rate was positive and increased in the States of Andhra Pradesh, Karnataka and Gujarat.

The impact of SFB on resource-groups (specie-wise comparison) indicated that across the states, there has been an increase in the post-ban growth rate of the resource groups. In Andhra Pradesh, all the resource groups showed a positive trend after the ban while in Tamil Nadu, except crustaceans, all the other resource groups exhibited a positive trend after the ban period. In Kerala small pelagics and cephalopods showed a declining trend after the ban period while in Karnataka, the large pelagics and demersal fin fishes alone showed a positive trend in the post-ban period. In Gujarat only demersal finfishes showed a positive trend after the ban and all the remaining showed a declining trend.

The SFB has led to reduction of carbon emission due to the absence of mechanised and motorised fishing during the period. About 103.61 lakh fishing hours (fishing effort) is reduced due to SFB, which is equivalent to 4.08 lakh tonnes of CO2 emitted and savings of 1,565.83 lakh litres of diesel. This indicates that an amount of ₹82, 988.94 lakhs is saved (which otherwise would have been spent on diesel) during 2014 fishing ban. This indicated that the SFB had helped in reducing carbon emission and also lead to considerable savings in foreign exchange due to reduction in use of diesel

It was also found that, the net social benefit was positive in all States. In the remaining States there is no exclusive enforcement wing in the fisheries department and assuming the average enforcement costs in the States of Kerala and Andhra Pradesh, the net social benefit will be positive in the remaining States. Hence, it can be concluded that there is a substantial positive net social benefit due to enforcement of SFB in the selected States and can be recommended to continue.

Post fishing ban there has been an overall increase in the volume of fish catches across all states. Stock status also indicates that states with a higher level of mechanisation such as Karnataka and Gujarat have higher percentages of exploited stocks that are seriously depleted and require attention to rejuvenate the stocks than states like Andhra Pradesh and Tamil Nadu.

The fishermen in the mechanised sectors were willing to accept an amount for the enforcement of the ban. It varied across centres and across the duration of ban which was simulated from 30 days to 120 days.

The attitude of the fishermen (motorised and traditional sector) towards willingness to pay (WTP) evinced mixed response. In Chennai and Nizampatnam fishers were not willing to pay fee for any of the ban days (30 to 120). In Rameswaram, the traditional fishers were willing to pay a fee ranging from ₹333 for 30 day ban to ₹1,725 for 120 days ban. In the same centre, the motorised boat owners were willing to pay from ₹652 for a 30 day ban to ₹3,352 for a 120 days ban period. In Kakinadathe WTP of the motorised craft owners on an average ranged from ₹175 for 30 day SFB to ₹6,177 for 120 days ban. In Mangalore most of

the individuals were not willing to pay a fee. Only two mechanised purse-seiners were willing to pay ₹1, 500 for 45 days and one owner was ready to pay ₹9,000 for 90 days ban. Hence, most of the fishers were not willing to pay to pay for the ban and only a few are ready, that too for a long duration only.

The relative performance of the seasonal fishing ban varies across the study States and the ranking is Gujarat, Tamil Nadu, Kerala, Andhra Pradesh and Karnataka in that order. But it is important to note that the period of ban in Gujarat and Karnataka are different from that of the remaining three states and as such this ranking has to be viewed in this background.

The above findings indicate that the SFB is predominantly having a positive impact on the resources and the fishers who are dependent on the sector for their livelihood. The net positive social benefit from a sample study State also helps to substantiate the continuation of the SFB.

12. Recommendations

SFB has resulted in a positive net social benefit in the study states. This indicated that the enforcement of SFB can be continued, which will facilitate sustaining the resources as well as an increase in the catch and income to the fishers. Besides, SFB should be combined with other management measures, such as ecosystem approach, marine protected areas, no-take zone, regulated entry, catch quotas, certification, protection of endangered species, mesh size regulation, and minimum legal size at capture

13. SFB: An epilogue

This section includes the limitations of this study. The study recommends continuation of SFB because of the positive effects. However, it is important to note that SFB alone cannot be taken as a stand-alone measure for achieving sustainable development or conservation of resources. There are many other related management measures that need to be implemented along with SFB. A combination of several other regulatory measures such as minimum/maximum legal size at capture, mesh size regulation, licensing of boats, regulation of operation of motorised boats and capping the number of boats, catch quota, no-take zone, certification, Ecosystem Approach to Fisheries Management and co-management are necessary along with seasonal closure for effective replenishment of fish stocks.

The expertise of the study Institute, CMFRI in addressing the issues related to SFB has revealed various important guidelines, which is worth mentioning in this epilogue.

1. Seasonal ban helps the fish to grow, thereby improving their price and value.
2. Boats with outboard motors with different engine capacity have become dominant in the fishery all along the Indian coast. When the ban exists for larger boats, removal of large quantities of spawners of small pelagics by motorised craft is evident. Proper regulation of these boats is important.
3. There is an improvement in recruitment of dominant demersal species into the fishery immediately after the ban, but for a short duration of one to two months.
4. Several rounds of meetings with stakeholders across maritime States showed differing views between fisher-folk of maritime states; and among mechanised, motorised and artisanal sectors. In general, the mechanised sector wants the ban to be removed (showing that some shrimps, which are abundant during the ban period are not harvested); the motorised sector wants to not only increase the ban duration on the mechanised sector to 90 days, but also wants an exemption of motorised boats from ban.
5. Most of the employees get engaged in fishing-related or un-related jobs during the ban period, but this does not provide a sustainable income and hence, they drop out. However, they demand government support during the period of closure.
6. Increased awareness among the fisher-folk towards issues of sustainability is evident. If convinced, they are willing to listen to and comply with fisheries regulatory measures.
7. Considering the changing fisheries scenario, regular monitoring and impact assessments are imperative to suggest timely management measures.

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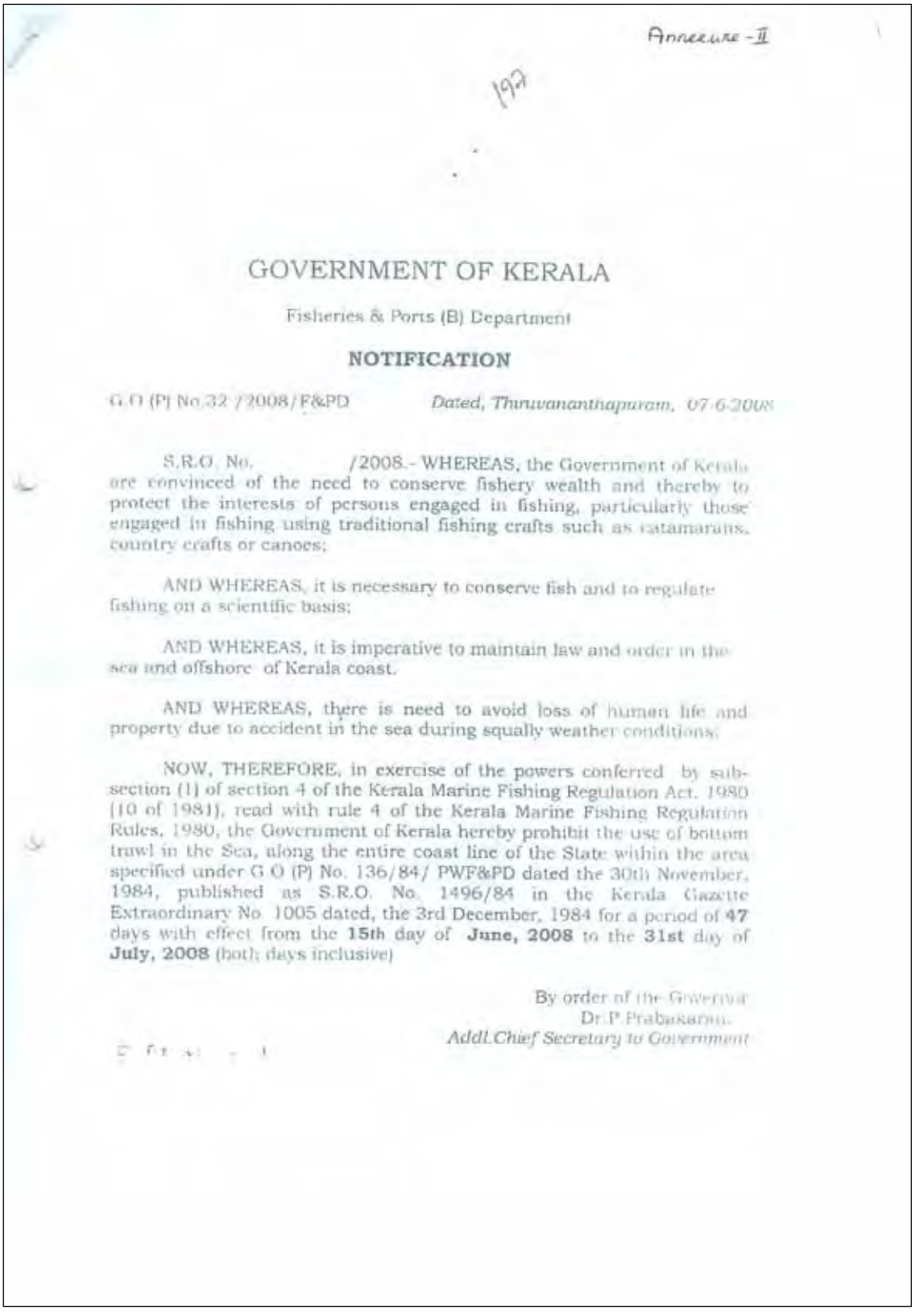
Annexes

Annex 1

List of regulations concerning Indian marine fisheries

1. The Indian Fisheries Act, No. IV of 1897, Government of India
2. The Indian Fisheries Act as adopted and applied by the State of Saurashtra, 1897
3. The Mysore Game and Fish Preservation Act 2 of 1901, Government of Mysore
4. The Game and Fish Protection Regulation Act 12 of 1914, Government of Travancore (1914)(modified 1921)
5. Cochin Fisheries Act 3 of 1917 (modified 1921), Government of Cochin
6. Andaman and Nicobar Islands Fisheries Regulation 1 of 1938
7. The United Provinces Fisheries Act 45 of 1948
8. Government of Travancore-Cochin Fisheries Act 34 of 1950
9. The Maharashtra Fisheries Act 1960 (modified 1962), Government of Maharashtra
10. The Indian Fisheries (Pondicherry Amendment) Act 18 of 1965
11. The Indian Wildlife Act 1972. 2lb-The territorial waters, continental shelf, EEZ and other maritime zones Act 1972
12. The Marine Products Export Development Authority Act 1972
13. The Maritime Zones of India (Regulation of fishing by foreign vessels) Act 1981
14. The Kerala Marine Fishing Regulation Act and Rules 1980 (Act 10 of 1981)
15. The Goa Marine Fishing Regulation Act, 1980
16. The Maharashtra Marine Fishing Regulation Act 1981, Government of Maharashtra
17. The Orissa Marine Fishing Regulation Act 981 (Orissa Act 10 of 1982) and the Orissa Marine Fishing Regulation Rules 1983
18. The Tamil Nadu Marine Fishing Regulation Rules 1983
19. The Karnataka Marine Fishing Regulation Act, 1986
20. The Andhra Pradesh Marine Fishing Regulation Act, 1994
21. Lakshadweep Marine Fishing Regulation Act, 2000
22. The Gujarat Fisheries Act, 2003
23. Andaman and Nicobar Marine Fishing Regulation Act, 2003

Annex 2



Annexure -II

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GOVERNMENT OF KERALA

Fisheries & Ports (B) Department

NOTIFICATION

G.O (P) No.32 /2008/F&PD *Dated, Thiruvananthapuram, 07-6-2008*

S.R.O. No. /2008.- WHEREAS, the Government of Kerala are convinced of the need to conserve fishery wealth and thereby to protect the interests of persons engaged in fishing, particularly those engaged in fishing using traditional fishing crafts such as catamarans, country crafts or canoes;

AND WHEREAS, it is necessary to conserve fish and to regulate fishing on a scientific basis;

AND WHEREAS, it is imperative to maintain law and order in the sea and offshore of Kerala coast.

AND WHEREAS, there is need to avoid loss of human life and property due to accident in the sea during squally weather conditions;

NOW, THEREFORE, in exercise of the powers conferred by sub-section (1) of section 4 of the Kerala Marine Fishing Regulation Act, 1980 (10 of 1981), read with rule 4 of the Kerala Marine Fishing Regulation Rules, 1980, the Government of Kerala hereby prohibit the use of bottom trawl in the Sea, along the entire coast line of the State within the area specified under G.O (P) No. 136/84/ PWF&PD dated the 30th November, 1984, published as S.R.O. No. 1496/84 in the Kerala Gazette Extraordinary No. 1005 dated, the 3rd December, 1984 for a period of **47** days with effect from the **15th** day of **June, 2008** to the **31st** day of **July, 2008** (both days inclusive)

By order of the Governor
Dr. P. Prabakaran,
Addl.Chief Secretary to Government

Annex 3

Regression summary of state-wise resource-wise craft type-wise of significance of effort and SFB indicator upon catch rates-catch per boat trip (CPUE)

State	Resource groups	Gear	Coefficient of Effort in boat trips ± SE (no. of units)		t-value (effort)	Significance (p of Effort)	Coefficient of Dummy Variable (DV) of SFB ± SE		t-value (DV)	Significance (p of DV)
Andhra Pradesh	Cephalopods	Multi-day trawls	5.7906	0.2391	24.2150	0.0000	0.5768	5.6074	0.1029	0.9189
Andhra Pradesh	Cephalopods	Other Mechanised	-0.7564	1.7773	-0.4256	0.6739	-60.3329	84.4900	-0.7141	0.4815
Andhra Pradesh	Cephalopods	Motorised	0.1094	0.1088	1.0057	0.3238	12.3905	9.6378	1.2856	0.2099
Andhra Pradesh	Crustaceans	Multi-day trawls	5.4510	0.1857	29.3498	0.0000	2.7116	4.3550	0.6226	0.5390
Andhra Pradesh	Crustaceans	Other Mechanised	1.6309	1.9518	0.8356	0.4110	-251.0473	92.7834	-2.7057	0.0119
Andhra Pradesh	Crustaceans	Motorised	2.8921	0.7763	3.7256	0.0010	48.3197	68.7630	0.7027	0.4885
Andhra Pradesh	Demersal	Multi-day trawls	4.7893	1.0651	4.4965	0.0001	7.0163	24.9754	0.2809	0.7810
Andhra Pradesh	Demersal	Other Mechanised	4.5991	1.3126	3.5039	0.0017	6.1986	62.3958	0.0993	0.9216
Andhra Pradesh	Demersal	Motorised	2.2931	0.4072	5.6317	0.0000	75.7816	36.0688	2.1010	0.0455
Andhra Pradesh	Large Pelagics	Multi-day trawls	2.2042	0.9413	2.3416	0.0271	6.9285	22.0730	0.3139	0.7561
Andhra Pradesh	Large Pelagics	Other Mechanised	0.5923	1.1333	0.5227	0.6056	51.1000	53.8730	0.9485	0.3516
Andhra Pradesh	Large Pelagics	Motorised	2.8285	0.7812	3.6208	0.0012	-51.8057	69.1977	-0.7487	0.4608
Andhra Pradesh	Small Pelagics	Multi-day trawls	6.6933	0.2945	22.7295	0.0000	2.9064	6.9051	0.4209	0.6773
Andhra Pradesh	Small Pelagics	Other Mechanised	-1.3791	2.1372	-0.6453	0.5244	-75.9232	101.5963	-0.7473	0.4616
Andhra Pradesh	Small Pelagics	Motorised	4.0023	0.8052	4.9706	0.0000	-1.3593	71.3248	-0.0191	0.9849
Gujarat	Cephalopods	Multi-day trawls	4.6666	0.1888	24.7141	0.0000	0.2162	5.8787	0.0368	0.9709
Gujarat	Cephalopods	Other Mechanised	0.7431	1.8021	0.4124	0.6835	172.9334	100.2417	1.7252	0.0964
Gujarat	Cephalopods	Motorised	0.1797	0.1860	0.9660	0.3430	32.4604	11.8504	2.7392	0.0110
Gujarat	Crustaceans	Multi-day trawls	4.5331	0.3517	12.8881	0.0000	9.2053	10.9504	0.8406	0.4082
Gujarat	Crustaceans	Other Mechanised	-0.5394	1.3648	-0.3952	0.6959	-25.2985	75.9147	-0.3332	0.7416
Gujarat	Crustaceans	Motorised	1.0664	1.0365	1.0289	0.3130	173.9820	66.0285	2.6350	0.0140

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State	Resource groups	Gear	Coefficient of Effort in boat trips ± SE (no. of units)		t-value (effort)	Significance (p of Effort)	Coefficient of Dummy Variable (DV) of SFB ± SE		t-value (DV)	Significance (p of DV)
Gujarat	Demersal	Multi-day trawls	0.8230	0.3324	2.4762	0.0201	12.8218	10.3477	1.2391	0.2264
Gujarat	Demersal	Other Mechanised	-0.4160	1.5017	-0.2770	0.7840	-20.4472	83.5308	-0.2448	0.8085
Gujarat	Demersal	Motorised	4.3303	0.7090	6.1077	0.0000	4.5978	45.1635	0.1018	0.9197
Gujarat	Large Pelagics	Multi-day trawls	0.9208	0.5809	1.5851	0.1250	11.2186	18.0845	0.6203	0.5404
Gujarat	Large Pelagics	Other Mechanised	-1.9177	1.2048	-1.5917	0.1235	-114.9089	67.0168	-1.7146	0.0983
Gujarat	Large Pelagics	Motorised	3.4406	0.7187	4.7872	0.0001	-40.1576	45.7831	-0.8771	0.3885
Gujarat	Small Pelagics	Multi-day trawls	1.9176	0.8476	2.2625	0.0323	16.2124	26.3881	0.6144	0.5443
Gujarat	Small Pelagics	Other Mechanised	-2.2953	0.9197	-2.4958	0.0192	-23.8723	51.1564	-0.4667	0.6446
Gujarat	Small Pelagics	Motorised	3.7065	0.7678	4.8278	0.0001	44.2422	48.9072	0.9046	0.3740
Karnataka	Cephalopods	Multi-day trawls	5.4244	0.9151	5.9278	0.0000	12.5631	21.6154	0.5812	0.5661
Karnataka	Cephalopods	Other Mechanised	4.0546	2.3036	1.7601	0.0902	-20.9229	123.8918	-0.1689	0.8672
Karnataka	Cephalopods	Motorised	-0.0491	0.2098	-0.2339	0.8169	27.0505	22.7881	1.1870	0.2459
Karnataka	Crustaceans	Multi-day trawls	2.8218	0.3801	7.4232	0.0000	4.8761	8.9794	0.5430	0.5917
Karnataka	Crustaceans	Other Mechanised	-3.1670	2.2734	-1.3931	0.1754	-341.0730	122.2683	-2.7895	0.0097
Karnataka	Crustaceans	Motorised	-0.4275	0.7967	-0.5366	0.5961	264.3081	86.5390	3.0542	0.0052
Karnataka	Demersal	Multi-day trawls	3.6730	0.3186	11.5278	0.0000	1.6377	7.5263	0.2176	0.8294
Karnataka	Demersal	Other Mechanised	-5.4544	2.2640	-2.4092	0.0234	-219.3515	121.7591	-1.8015	0.0832
Karnataka	Demersal	Motorised	0.4523	0.5849	0.7733	0.4463	92.7769	63.5283	1.4604	0.1562
Karnataka	Large Pelagics	Multi-day trawls	2.8400	0.3933	7.2205	0.0000	3.7948	9.2909	0.4084	0.6863
Karnataka	Large Pelagics	Other Mechanised	2.2989	1.2285	1.8712	0.0726	-54.8663	66.0733	-0.8304	0.4139
Karnataka	Large Pelagics	Motorised	1.1088	0.4351	2.5483	0.0171	260.6664	47.2610	5.5155	0.0000
Karnataka	Small Pelagics	Multi-day trawls	3.8783	0.6386	6.0730	0.0000	3.8797	15.0849	0.2572	0.7991
Karnataka	Small Pelagics	Other Mechanised	-4.7773	0.6037	-7.9129	0.0000	-109.5019	32.4697	-3.3724	0.0023
Karnataka	Small Pelagics	Motorised	0.5876	0.5441	1.0800	0.2901	140.0254	59.0965	2.3694	0.0255
Kerala	Cephalopods	Multi-day trawls	1.8431	0.7486	2.4620	0.0208	17.9354	13.3184	1.3467	0.1897
Kerala	Cephalopods	Other Mechanised	2.9490	1.1907	2.4767	0.0201	341.4668	98.3383	3.4724	0.0018
Kerala	Cephalopods	Motorised	0.1934	0.8056	0.2400	0.8122	128.6601	77.4743	1.6607	0.1088
Kerala	Crustaceans	Multi-day trawls	1.7680	0.7401	2.3887	0.0245	18.6324	13.1680	1.4150	0.1689
Kerala	Crustaceans	Other Mechanised	-2.7916	1.5938	-1.7515	0.0916	-350.1031	131.6311	-2.6597	0.0132

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State	Resource groups	Gear	Coefficient of Effort in boat trips ± SE (no. of units)		t-value (effort)	Significance (p of Effort)	Coefficient of Dummy Variable (DV) of SFB ± SE		t-value (DV)	Significance (p of DV)
Kerala	Crustaceans	Motorised	1.7967	0.8707	2.0634	0.0492	201.2973	83.7343	2.4040	0.0236
Kerala	Demersal	Multi-day trawls	3.8411	1.4944	2.5704	0.0162	37.5063	26.5867	1.4107	0.1702
Kerala	Demersal	Other Mechanised	-4.1574	1.3609	-3.0549	0.0051	-148.2479	112.3928	-1.3190	0.1987
Kerala	Demersal	Motorised	0.7410	0.8787	0.8433	0.4067	107.6155	84.5021	1.2735	0.2141
Kerala	Large Pelagics	Multi-day trawls	3.5099	1.2660	2.7725	0.0101	32.2537	22.5231	1.4320	0.1640
Kerala	Large Pelagics	Other Mechanised	-3.3444	0.3195	-10.4665	0.0000	99.4572	26.3894	3.7688	0.0009
Kerala	Large Pelagics	Motorised	-0.0701	0.7659	-0.0915	0.9278	-11.5255	73.6529	-0.1565	0.8769
Kerala	Small Pelagics	Multi-day trawls	3.0104	1.2668	2.3765	0.0251	29.6218	22.5371	1.3144	0.2002
Kerala	Small Pelagics	Other Mechanised	2.1581	1.4632	1.4749	0.1522	42.0207	120.8424	0.3477	0.7308
Kerala	Small Pelagics	Motorised	-0.6129	0.2498	-2.4533	0.0212	-18.6910	24.0265	-0.7779	0.4436
Tamil Nadu	Cephalopods	Multi-day trawls	1.6505	0.7346	2.2468	0.0334	26.9947	14.4240	1.8715	0.0726
Tamil Nadu	Cephalopods	Other Mechanised	-0.0595	0.9589	-0.0621	0.9510	11.7177	78.5358	0.1492	0.8825
Tamil Nadu	Cephalopods	Motorised	0.3550	0.4107	0.8643	0.3953	87.1447	26.3587	3.3061	0.0028
Tamil Nadu	Crustaceans	Multi-day trawls	0.4751	1.2496	0.3802	0.7069	61.1237	24.5355	2.4912	0.0194
Tamil Nadu	Crustaceans	Other Mechanised	0.7177	0.4280	1.6769	0.1055	136.7580	35.0514	3.9016	0.0006
Tamil Nadu	Crustaceans	Motorised	0.7860	0.4239	1.8542	0.0751	277.1521	27.2095	10.1859	0.0000
Tamil Nadu	Demersal	Multi-day trawls	3.1565	0.7452	4.2357	0.0003	28.8404	14.6326	1.9710	0.0595
Tamil Nadu	Demersal	Other Mechanised	-1.7092	0.9650	-1.7712	0.0883	-23.6758	79.0319	-0.2996	0.7669
Tamil Nadu	Demersal	Motorised	2.9161	1.2592	2.3158	0.0287	74.3222	80.8238	0.9196	0.3663
Tamil Nadu	Large Pelagics	Multi-day trawls	4.5870	0.6390	7.1784	0.0000	12.6516	12.5471	1.0083	0.3226
Tamil Nadu	Large Pelagics	Other Mechanised	-0.4604	0.4758	-0.9678	0.3421	321.5781	38.9642	8.2532	0.0000
Tamil Nadu	Large Pelagics	Motorised	2.4475	1.0057	2.4335	0.0221	274.2555	64.5547	4.2484	0.0002
Tamil Nadu	Small Pelagics	Multi-day trawls	3.1402	0.9138	3.4364	0.0020	27.1144	17.9430	1.5111	0.1428
Tamil Nadu	Small Pelagics	Other Mechanised	0.2817	0.5994	0.4700	0.6423	35.6850	49.0931	0.7269	0.4738
Tamil Nadu	Small Pelagics	Motorised	2.7119	0.6949	3.9022	0.0006	139.4307	44.6058	3.1258	0.0043

State	Resource groups	Gear	Coefficient of Effort in hrs. ± SE (actual fishing hours)		t-value (effort)	Significance (p of Effort)	Coefficient of Dummy Variable (DV) of SFB ± SE		t-value (DV)	Significance (p of DV)
Andhra Pradesh	Cephalopods	Multi-day trawls	0.1212	0.0401	3.0214	0.0056	1.7445	1.0808	1.6141	0.1186
Andhra Pradesh	Cephalopods	Other Mechanised	0.0390	0.0807	0.4837	0.6326	5.6428	6.0839	0.9275	0.3622
Andhra Pradesh	Cephalopods	Motorised	0.1484	0.1274	1.1650	0.2546	17.3697	8.0637	2.1541	0.0407
Andhra Pradesh	Crustaceans	Multi-day trawls	3.6230	0.5929	6.1109	0.0000	37.3372	15.9687	2.3382	0.0273
Andhra Pradesh	Crustaceans	Other Mechanised	1.6668	0.7357	2.2657	0.0320	-123.4796	55.4537	-2.2267	0.0348
Andhra Pradesh	Crustaceans	Motorised	0.8366	0.3712	2.2537	0.0329	78.7012	23.4958	3.3496	0.0025
Andhra Pradesh	Demersal	Multi-day trawls	4.0249	0.8557	4.7038	0.0001	44.3044	23.0463	1.9224	0.0656
Andhra Pradesh	Demersal	Other Mechanised	1.4513	1.0254	1.4154	0.1688	6.3433	77.2931	0.0821	0.9352
Andhra Pradesh	Demersal	Motorised	2.7572	0.8011	3.4417	0.0020	240.7325	50.7057	4.7476	0.0001
Andhra Pradesh	Large Pelagics	Multi-day trawls	1.0139	0.2447	4.1436	0.0003	2.1684	6.5902	0.3290	0.7448
Andhra Pradesh	Large Pelagics	Other Mechanised	-1.1932	0.8124	-1.4687	0.1539	102.2123	61.2376	1.6691	0.1071
Andhra Pradesh	Large Pelagics	Motorised	4.8600	0.6519	7.4553	0.0000	168.7570	41.2602	4.0901	0.0004
Andhra Pradesh	Small Pelagics	Multi-day trawls	4.2460	0.7088	5.9904	0.0000	33.3431	19.0904	1.7466	0.0925
Andhra Pradesh	Small Pelagics	Other Mechanised	-0.0333	1.0418	-0.0320	0.9747	-90.2939	78.5311	-1.1498	0.2607
Andhra Pradesh	Small Pelagics	Motorised	2.6595	1.2720	2.0907	0.0465	84.0910	80.5126	1.0444	0.3059
Gujarat	Cephalopods	Multi-day trawls	3.5175	0.5416	6.4940	0.0000	13.6190	16.8201	0.8097	0.4255
Gujarat	Cephalopods	Other Mechanised	-0.5930	0.8822	-0.6722	0.5074	-46.2948	73.8474	-0.6269	0.5362
Gujarat	Cephalopods	Motorised	0.1060	0.1644	0.6445	0.5249	22.5768	10.2628	2.1999	0.0369
Gujarat	Crustaceans	Multi-day trawls	2.6282	0.6213	4.2300	0.0003	22.9274	19.2946	1.1883	0.2455
Gujarat	Crustaceans	Other Mechanised	-1.1906	0.8432	-1.4119	0.1698	5.1264	70.5878	0.0726	0.9427
Gujarat	Crustaceans	Motorised	0.5741	0.2520	2.2782	0.0312	50.3201	15.7285	3.1993	0.0036
Gujarat	Demersal	Multi-day trawls	2.1187	0.5206	4.0696	0.0004	31.1510	16.1675	1.9268	0.0650
Gujarat	Demersal	Other Mechanised	-0.2141	1.1205	-0.1911	0.8499	28.4764	93.7973	0.3036	0.7639

Contd...

State	Resource groups	Gear	Coefficient of Effort in hrs. ± SE (actual fishing hours)		t-value (effort)	Significance (p of Effort)	Coefficient of Dummy Variable (DV) of SFB ± SE		t-value (DV)	Significance (p of DV)
Gujarat	Demersal	Motorised	4.0203	0.9497	4.2331	0.0003	-32.5423	59.2748	-0.5490	0.5877
Gujarat	Large Pelagics	Multi-day trawls	1.0492	0.2275	4.6119	0.0001	3.0270	7.0646	0.4285	0.6718
Gujarat	Large Pelagics	Other Mechanised	0.0980	0.6546	0.1498	0.8821	-168.9497	54.7976	-3.0832	0.0048
Gujarat	Large Pelagics	Motorised	2.6263	0.9432	2.7844	0.0099	-80.6470	58.8691	-1.3699	0.1824
Gujarat	Small Pelagics	Multi-day trawls	1.0521	0.5530	1.9024	0.0682	32.3266	17.1734	1.8824	0.0710
Gujarat	Small Pelagics	Other Mechanised	0.3701	0.3609	1.0255	0.3146	-39.7950	30.2112	-1.3172	0.1993
Gujarat	Small Pelagics	Motorised	2.7375	1.0623	2.5769	0.0160	45.4371	66.3013	0.6853	0.4992
Karnataka	Cephalopods	Multi-day trawls	6.3255	0.5609	11.2781	0.0000	9.0968	13.3370	0.6821	0.5012
Karnataka	Cephalopods	Other Mechanised	-2.4816	0.8222	-3.0181	0.0056	338.0723	85.5395	3.9522	0.0005
Karnataka	Cephalopods	Motorised	0.1798	0.3179	0.5655	0.5766	19.9157	35.2345	0.5652	0.5768
Karnataka	Crustaceans	Multi-day trawls	3.0835	0.6852	4.5000	0.0001	10.1291	16.2945	0.6216	0.5396
Karnataka	Crustaceans	Other Mechanised	-0.9222	0.9186	-1.0039	0.3247	195.6374	95.5641	2.0472	0.0509
Karnataka	Crustaceans	Motorised	0.4530	0.5641	0.8031	0.4292	150.6026	62.5223	2.4088	0.0234
Karnataka	Demersal	Multi-day trawls	4.2754	0.4238	10.0882	0.0000	6.2628	10.0777	0.6215	0.5397
Karnataka	Demersal	Other Mechanised	-1.2535	1.0116	-1.2390	0.2264	177.3365	105.2448	1.6850	0.1040
Karnataka	Demersal	Motorised	0.8255	0.5923	1.3937	0.1752	216.6079	65.6540	3.2992	0.0028
Karnataka	Large Pelagics	Multi-day trawls	3.4621	0.3252	10.6463	0.0000	-0.8735	7.7329	-0.1130	0.9109
Karnataka	Large Pelagics	Other Mechanised	1.5504	0.8130	1.9071	0.0676	-125.6515	84.5752	-1.4857	0.1494
Karnataka	Large Pelagics	Motorised	0.1009	0.4872	0.2071	0.8375	411.8720	54.0058	7.6264	0.0000
Karnataka	Small Pelagics	Multi-day trawls	5.3568	0.6167	8.6869	0.0000	5.5799	14.6637	0.3805	0.7066
Karnataka	Small Pelagics	Other Mechanised	-0.6796	0.7616	-0.8924	0.3804	-137.3648	79.2304	-1.7337	0.0948
Karnataka	Small Pelagics	Motorised	2.0022	0.5321	3.7632	0.0009	49.9596	58.9744	0.8471	0.4046
Kerala	Cephalopods	Multi-day trawls	7.7240	0.6946	11.1199	0.0000	10.2467	15.7507	0.6506	0.5210
Kerala	Cephalopods	Other Mechanised	6.7497	1.2223	5.5222	0.0000	-138.1376	73.7688	-1.8726	0.0724
Kerala	Cephalopods	Motorised	-1.1566	0.5878	-1.9675	0.0599	86.2336	32.1823	2.6795	0.0126
Kerala	Crustaceans	Multi-day trawls	7.0226	0.7798	9.0053	0.0000	8.8084	17.6829	0.4981	0.6226
Kerala	Crustaceans	Other Mechanised	-4.9000	1.0892	-4.4986	0.0001	62.5835	65.7369	0.9520	0.3498
0 Kerala	Crustaceans	Motorised	0.7359	0.7673	0.9591	0.3463	-58.9208	42.0072	-1.4026	0.1726
Kerala	Demersal	Multi-day trawls	3.9439	0.3012	13.0931	0.0000	4.1943	6.8303	0.6141	0.5445

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State	Resource groups	Gear	Coefficient of Effort in hrs. ± SE (actual fishing hours)		t-value (effort)	Significance (p of Effort)	Coefficient of Dummy Variable (DV) of SFB ± SE		t-value (DV)	Significance (p of DV)
Kerala	Demersal	Other Mechanised	-0.9486	1.3027	-0.7282	0.4730	-55.9957	78.6193	-0.7122	0.4827
Kerala	Demersal	Motorised	-0.7576	0.8455	-0.8960	0.3785	-91.4611	46.2876	-1.9759	0.0589
Kerala	Large Pelagics	Multi-day trawls	1.3555	0.3570	3.7967	0.0008	3.4489	8.0954	0.4260	0.6736
Kerala	Large Pelagics	Other Mechanised	-2.3315	0.3810	-6.1188	0.0000	38.9053	22.9971	1.6917	0.1026
Kerala	Large Pelagics	Motorised	-1.3607	0.7897	-1.7230	0.0968	-7.2604	43.2352	-0.1679	0.8679
Kerala	Small Pelagics	Multi-day trawls	4.8592	0.9167	5.3005	0.0000	9.3592	20.7873	0.4502	0.6563
Kerala	Small Pelagics	Other Mechanised	-3.3702	1.4801	-2.2770	0.0313	-104.5067	89.3283	-1.1699	0.2526
Kerala	Small Pelagics	Motorised	-0.7103	0.5863	-1.2116	0.2366	36.2435	32.0957	1.1292	0.2691
Tamil Nadu	Cephalopods	Multi-day trawls	-0.3951	1.5086	-0.2619	0.7954	43.3749	13.9259	3.1147	0.0044
Tamil Nadu	Cephalopods	Other Mechanised	-0.3038	0.8421	-0.3608	0.7212	202.0985	52.5825	3.8435	0.0007
Tamil Nadu	Cephalopods	Motorised	0.1428	0.1150	1.2414	0.2256	50.6574	11.4118	4.4391	0.0001
Tamil Nadu	Crustaceans	Multi-day trawls	6.6611	1.7624	3.7796	0.0008	58.0008	16.2691	3.5651	0.0014
Tamil Nadu	Crustaceans	Other Mechanised	0.1218	0.2546	0.4786	0.6362	24.3659	15.8980	1.5326	0.1374
Tamil Nadu	Crustaceans	Motorised	0.4108	0.1427	2.8795	0.0079	69.8405	14.1516	4.9352	0.0000
Tamil Nadu	Demersal	Multi-day trawls	2.5255	1.1930	2.1169	0.0440	37.1182	11.0130	3.3704	0.0024
Tamil Nadu	Demersal	Other Mechanised	-1.4193	1.1383	-1.2468	0.2236	-66.7619	71.0842	-0.9392	0.3563
Tamil Nadu	Demersal	Motorised	0.9587	0.3077	3.1155	0.0044	39.5658	30.5252	1.2962	0.2063
Tamil Nadu	Large Pelagics	Multi-day trawls	0.2186	1.6608	0.1316	0.8963	45.8704	15.3312	2.9920	0.0060
Tamil Nadu	Large Pelagics	Other Mechanised	-0.7401	0.6629	-1.1163	0.2745	209.3083	41.3979	5.0560	0.0000
Tamil Nadu	Large Pelagics	Motorised	1.6193	0.3774	4.2908	0.0002	16.3272	37.4336	0.4362	0.6663
Tamil Nadu	Small Pelagics	Multi-day trawls	9.6150	1.2931	7.4356	0.0000	34.2393	11.9369	2.8683	0.0081
Tamil Nadu	Small Pelagics	Other Mechanised	-0.0902	0.5211	-0.1731	0.8639	-48.0060	32.5375	-1.4754	0.1521
Tamil Nadu	Small Pelagics	Motorised	2.1206	0.6999	3.0300	0.0055	197.9260	69.4214	2.8511	0.0084

Annex 4

Central Marine Fisheries Research Institute
Socio-economic Evaluation and Technology Transfer Division

Economic Evaluation of Seasonal Fishing Ban in selected maritime States in India

Questionnaire for Collection of transaction cost details

1. Name of the State

2. Ban duration : .....days Period: April-May (or) June-July

3. Information costs
   a. Whether announcements regarding the ban are made through media Yes/No
   b. If Yes, what are the media through which announcements made
   i. Radio// Newspaper /TV /Notices/ Others

Expensed incurred for announcement of ban in the media

Media	Radio	TV	Print	Printing of Notices	Awareness campaigns	Other sources
Expense (in ₹)						

4. Enforcement costs

a. Number of officials involved in enforcement

Sl. No.	Designation of officials involved in enforcement	Monthly pay	Time spent for enforcement (%)	Remarks
1	Joint Director			
2	Deputy Director			
3	Assistant Director			
4	Fisheries Officers			
5	Fisheries Inspectors			
6	Sea guards			
7	Any other office / contractual staff engaged			

b. Number of patrolling boats involved : .....(Numbers)
c. Hiring charges per patrolling boat : .....(₹/day/hour)
d. Fuel charges (if paid separately) : .....(₹)
e. Other expenses (if any) involved in enforcement : (₹)

5. Compensation paid during the ban period

a. Free ration

i. Rice : .....(kg per family) Value: ..... (₹)
ii. Kerosene : .....(litres /family) Value: .....(₹)
b. Cash allowance : From government: ₹.....: Contribution from fishers: ₹
c. Any other forms of allowance paid (in cash or kind) : ₹.....

6. Remarks /Observations /Comments :

Annex 5

Schedule to collect data on Willingness to Accept (WTA)

1. Number of unemployment days during the ban period _____

2. What are the major problems associated with trawl ban

Sl. No	Reason	Rank(Based on the severity)
1.	Poverty	
2.	Non availability of credit	
3.	Unemployment	
4.	Lack of governmental support	
5.		
6.		
7.		
8.		

3. What are the different measures of mitigation carried out?

Support from co-operatives b) Governmental support c) Other alternative avocations available d) Support from the family members

4. What is your major source of income during the trawl ban period

a) No income, b) alternate jobs, c) income from other family members, d) Government support, e) Savings

5. Do you find it difficult to get alternate employment during the ban period Yes /No

6. What are the alternate avocations available during the ban period

7. Is there any additional support from fisherwomen for the family Yes / No

8. If Yes how_____

9. Do you think that the trawl operation alone should be banned during trawl period? Yes/No

10. If no, who all should be included in the trawl ban?

11. Is there any increase in fish landing consequent to fish landing? Yes/No

12. Do you support the need of increase in number of fishing ban days? Yes/ No

13. Has your catch increased during the post ban period? Yes /No

14. In the event of an incentive based approach, how much amount you are willing to accept in favouring ban?

Sl No	Ban days	Amount required to accept
1.	30	
2.	45	
3.	60	
4.	90	
5.	120	

Annex 6

Schedule to collect data on Willingness to Pay (WTP)

1) Are you allowed to fish during the ban period Yes /No

2) Are you happy as a traditional fisher folk being allowed to fish during this period, what you will do Yes/ No

3) Do you think that motorised fishing operation also having negative impact on fishery resources?
a) No b) Little c) High

4) What are the major problems you experienced during the ban period?

Sl. No	Problems	(Rank based on the severity) Rank
1.	No Market	
2.	Risk at sea	
3.	Others	

5) If you are not allowed to fish during this period ,what you will do
a) Won't go for fishing b) inland fishing c) Non fishing jobs b) d) don't know

6) What are the benefits you enjoy for fishing during the trawl ban period
a) Increased catch b) better prices c) Better income d) Increased fishing days

7) Are you aware that you are getting more income at the cost of others (absence of competitors) Yes / No

8) Are you willing to pay fee for allowing you to fish during this period?
If yes Cash / in kind

9) In the event of an incentive based approach, how much amount you are willing to pay in favouring ban?

Sl. No	Ban days	Amount required to pay	
		Cash (Rest.)	Kind(Percentage of catch)
1.	30		
2.	45		
3.	60		
4.	90		
5.	120		
6.			

Remarks of the enumerator –_____
_____
_____
_____
_____

Place:
Date: Signature of the Enumerator:

Name of the Enumerator:

Annex 7

Socio-economic characteristics of the sample respondents

The general particulars of the respondents such as age distribution, size of family, dependency ratio, male female ratio adult and child, occupation and related information were given in Annexure- VII to serve as background information.

Age distribution

Table 1 Age distribution of sample respondents (years)

	<30 yrs (nos)	30-60 yrs	>60 yrs	Total
Rameswaram	20(20.83)	72(75.00)	4(4.17)	96(100)
Kanyakumari	2(2)	95(95)	3(3)	100(100)
Chennai	13(14.44)	76(84.44)	1(1.11)	90(100.00)
Kakinada	15(15.63)	80(83.33)	1(1.04)	96(100.00)
Nizampatnam1	8(8.89)	82(83.33)	0(0.00)	90(100.00)
Manglore	9(10)	80(88.89)	1(1.11)	90(100)
Alapuzha	8(8.99)	76(85.39)	5(5.62)	89(100.00)
Veraval	3(9.38)	28(87.50)	1(313)	32(100.00)
Total	78(11.42)	589(86.24)	16(2.30)	683(100.00)

Figures in parenthesis indicate percentage to total

Age distribution of the population was mainly categorized into sub groups viz., young (less than 30), middle (30 to 60) and old (> 60). Most of the respondent fisher folk across different centers represent the middle age group of 30-60 across different coastal states of India and constituted 86 percent of the total respondents followed younger group (11 %).The elder fishermen represented the least in the study .Interestingly a significant number of younger respondents represented (more than 20%) in Rameswaram district indicate the popularity of fishing business among the younger generation of Rameswaram District.

Male:Female ratio

The male-female ratio of respondents among adults (above 15 years) and children (less than 15 years) is given the Table 2

Table 2 Male-female ratio of the respondents' fisher

	Adults		Child		Male -female Ratio
	Male	Female	Male	Female	
Rameswaram	154	163	59	69	0.92
Nizampatnam	164	123	43	49	1.20
Chennai	157	151	40	28	1.10
Kakinada	251	166	126	97	1.43
Karnataka	251	157	101	102	1.36
Kanyakumari	139	153	115	108	0.97
Alappuzha	129	75	74	39	1.00
Veraval	81	89	85	77	1.03
Total	1326	1077	643	569	1.20

The male- female ratio of the total respondents across different centers of the coastal sates of India was found to be 1.20:1.00.Male outnumber the female in all centers except in Rameswaram and Kanayakumaricentres justifying usual trend in male preference over female .In Alappuzha centre male female ratio was found to be one.

Dependency ratio

The dependency ratio refers to how many individuals depend on the earning members in the family. The dependency ratio of respondent fishers; house hold across different centresalong the Indian coastal states is given in Table 3

Table 3 Dependency ratio

Sl. No.	Centres	Dependency Ratio
1.	Rameswaram	2.48
2.	Nizampatnam	3.12
3.	Chennai	4.53
4.	Kakinada	1.87
5.	Manglore	2.01
6.	Kanyakumari	1.3
7.	Alapuzha	1.05
8.	Veraval	2.24
9.	Total	1.98

It was found to be 1.98 for the total sample and it ranged from 1.05 in Alappuzha centre to 4.43 in Chennai Centre. In Nizampatnam the same was arrived at 3.12 where as in Rameshwaram and AndhraPradesh it was 2.48, 1.87 respectively. Though Andhra Pradesh records highest male female ratio, the dependency ratio was found lower.

Occupation

The occupation pattern of respondent fisher folk is shown in Table 4

Table 4 Occupational profile of respondents

Centres	Occupation (Nos)		
	Primary (Fishing)	Secondary (Fishery related)	Male -female Ratio Tertiary(Supporting to fisheries)
Rameswaram	96(100.00)	0(0.00)	0(0.00)
Kanyakumari	100(100.00)	0(0.00)	0(0.00)
Chennai	88(100.00)	0(0.00)	0(0.00)
Kakinada	74(77.08)	22(22.92)	0(0.00)
Nizamptanam	33(100.00)	0(0.00)	0(0.00)
Manglore	90(100.00)	0(0.00)	0(0.00)
Alappuzha	15(71.43)	6(28.57)	0(0.00)
Veraval	21(100.00)	0(0.00)	0(0.00)

Figures in brackets indicate per cent to the total

Most of the fisher folks across all centres except Alapuzha and Kakinada centre belong to primary occupation. About 29% of respondents in Alappuzha and 23% in Kakinada were working in secondary sector respectively. None of the respondents were found in tertiary sector in any of the centers.

Experience in Fishing

The details of the fishing experience of the respondent fishers across different centre of coastal India is depicted in Table 5

Table 5 Fishing Experience

Centres	Experience (No. of respondents)		
	<20 years	>=20years	Nil
Rameswaram	51(53.13)	45(45.86)	0(0.00)
Kanyakumari	19(19.00)	79(79.00)	2(2.00)
Chennai	35(38.89)	44(46.86)	11(11.37)
Kakinada	26(27.08)	70(72.10)	0.00
Nizampatnam	21(23.33)	67(72.56)	2(2.04)
Manglore	22(24.44)	68(73.56)	0(0.00)
Alappuzha	3(9.38)	17(44.30)	12(18.27)
Veraval	7(29.17)	17(36.82)	0(0.00)

More than 70 percent of the respondents of Kanyakumari centre of Tamil Nadu, Kakinadaand Nizampatanamand Kakinada of Andhra Pradesh and Mangloreof Karnataka had more than 20 years of experience. New entrants was found only in Kanyakumari (2%) ,Chennai ,Nizampattanam(2%) and Alapuzhacenters and significant number of freshers were representing only Alappuzha center (18.27%) and Chennai (11.27) centre. In Rameswaramcentre most of the respondents possess less than 20 years of experience. The experience years for the total individuals ranged from 3 to 65 in general..

Education profile- Literacy

Table 6 Literacy level

	Primary (in %)	Secondary (in %)	Higher secondary (in %)	Illiterate (in %)	Literacy rate (in %)
Rameswaram	60.40	39.60	0	0	100
Kanyakumari	28.00	52.00	20.00	19.00	100
Chennai	68.89	17.78	4.44	8.89	91.11
Kakinada	84	10	1	5	95
Nizampatnam	13.33	1.11	0	85.86	14.44
Manglore	46	31	20	3	97
Alappuzha	59.09	18.18	22.72	0	99.99
Veraval	15.39	25.87	55.93	2.80	97.19

The respondents inRameswaram and Kanyakumari had cent per centliteracy level either primary or secondary education, or respondents of all other centres except Nizhampatanam (14.44%) had a literacy rate of more than 90%. The highest number of respondents having higher secondary education was found in Veraval(55.93%) followed by Alappuzha centre (22.72%) Kanyakumari and Mangalore center (20%) respectively

Income and Expenditure

The income profiling of the respondents are analysed using monthly expenditure and income patterns , savings and indebtedness levels, and their sources of income across the different landings are given below .The expenditure pattern for the concerned states were analyzed using the data collected from expenditure on food, clothing, fuel, medical expenses, education, entertainment and others. The following are the results obtained.

1. Rameswaram

Rameswaram	Income	Expenses	Savings (current)	Debt (current)
Trawl Owners	42833	34583	15000	5417
Trawl Labourers	13900	10865	1399	50
Traditional	7967	7272	887	38
Motorised	9617	9103	1230	63

Income source of all respondents belonging to various sectors in Rameshwaram were totally from fishing occupation which included mechanised, traditional and motorised. Among the fisher category, trawl labourers earned the highest monthly savings which accounted to about 13900. Trawl owners average income was ₹ 42833, motorised earned an income of ₹9617 and traditional fishers income came to an average of ₹7967.

In Rameswaram highest expenditure on an average was spent on food (44%) followed by education (26%), medical expense (11%), clothing (10%), fuel (6%) and entertainment (3%). The monthly expense as a whole for trawl owners was ₹34583, trawls labourers ₹10865, traditional ₹7275 and for motorised ₹9103.

2. Kanyakumari

Kanyakumari	Income		Expenses	Savings(cy)	Debt
	Fishing	Non-fishing			
Mechanised Owners	67500	6867*	27738	252625	91875
Mechanised Labour	22900		14030	12200	12900
Motorised Owner	29000		16367	26271	8525
MotorisedLabor	14000		11740	6670	2300
Non mechanised Owner	14750		13385	7800	1558
Non mechanised Labour	7988		10381	6000**	7200**

** non fishing only 5 out of 24*

*** debt and savings only 1 reported out of 8*

In Kanyakumari Mechanised owners earned the highest income which came to about ₹67500 per month. Out of 24 respondents in Mechanised, only 5 were reported to have earned income from other than fishing which was estimated at ₹6867

1. Nizamaptanam

Nizamaptanam	Income		Expenses	Savings (current)	Debt (current)
	Fishing	Non-fishing			
Mechanised Trawl net	80000	20000	39600	3360000	545000
Motorised Gillnet	27375	8950	14058	27375	1250
Motorised Mini Trawlnnet	10200	6200	10760	239000	0
Labors	20143	15320	13678	218750	4444.44
Nonmotorised	12914	4000	8619	72964	33688

In Nizampatnam, the income source of respondents included both fisheries and non-fisheries sector. More than 70% of their income was from fishing only. Non fisheries sector mainly comprised of labours, hotels, packing and other services. The income from fishing sector is as follows.Mechanised trawl net earned ₹80000, Motorised Gill net and Motorised mini trawl net earnings were ₹27375 and ₹10200 respectively. The labours earned ₹20143 and non-motorised ₹12914. The variation in their non-fishing income was estimated to be around ₹11106

In Nizampatnam, 26% of their income was spent on food, 20% on fuel, 15% on entertainment, 13% for other purposes, 11% for education, 9 % for clothing and 6% for medical purpose. Mechanised trawl net group expenditure was on high which accounts to ₹39600, then motorised gill net ₹14058, next labourers ₹13678, then mini trawlers ₹10760 and non-motorised ₹8619. We can see that though mechanised trawl net earned more, their spending were also high. Also illiterates were found more in Nizampatnam in coastal area according to the data obtained may be due to their unwillingness to spend much on education which was only 11%. Compared to all other states entertainment expenditure was also high in Nizampatnam.

4. Chennai

Chennai	Income		Expenses	Savings	Debt
	Fishing	Non-fishing			
Mechanised Trawl Owner	47143	25000	19757.14	nil	157857
Mechanised Gillnet owner	91667	nil	26000	nil	200000
Mechanised Trawler Crew	21240	11700	11858	nil	47181
Mechanised Gillnet crew	23556	nil	10688.89	nil	33500
Motorised Boat Crew	8914	1114	8031	nil	28971
Motorised Boat Owner	15700	nil	9195	nil	28500

In Chennai also the income of the respondents included both fishing and non-fishing sources in which fishing sector accounted for more than 80% of the total income. Among the mechanised sector, the gillnet owners earned the highest which was ₹91667, followed by trawl owners ₹47,143, gillnet crew ₹23556 and trawler crew ₹21240. In motorised, boat owners earned an average of 15700 whereas boar crew earned an 8914. From the non-fishing sector, the deviation in income earnings was found to be ₹4891 which was much less when compared to Nizampatnam. It was found that most of these earnings came from private sector. Their preference for private sector job can be due to

easy availability of jobs and flexibility in work timings when compared to public sector.

Chennai more than half percentage of the expenditure goes for food which accounts to 55% followed by 12% for clothing. For other purposes, entertainment, education, fuel and medical expenses the amount spent are 1%, 7%, 6%, 5% and 4% respectively. It is among the mechanised trawl owner the expenses are very which is ₹19757 and for trawl crew it is ₹11858. Mechanised gillnet owner and gillnet crew spends around ₹26000 and ₹10689 whereas for motorised boat owners and boat crew it comes around ₹9195 and ₹8031 respectively.

5. Kakinada

Kakinada	Income	Expenses	Savings	Debt
Motorised	13303	19803	11236	131939
Non-mechanised	8970	6844	4545	28000
Mechanised	35067	29900	7317	96933

Kakinada had no other income source other than fishing in which the highest income was from mechanised sector. Fishers from mechanised earned on an average ₹35067 per month, motorised ₹13303 and non-mechanised ₹8970.

Kakinada the highest percentage is spent for fuel unlike other areas which came to around 51%. Remaining 25%, 5%, 8%, 8% and 3% is spent on food, clothing, medical, education and entertainment respectively. For mechanised the average expense comes to around ₹29900, motorised spent ₹19803 and non-mechanised spent ₹6844

6. Mangalore

Mangalore	Income		Expenses	Savings	Debt
	Fishing	Non-fishing			
Mechanised Purse-seiner	26600	nil	21660	17200	15lakh *
Non- Motorised Boat owner	11257	7083**	7624	25167**	13200
TrawlerBoat owner	90000		14267	40000***	6.25lakh***
Mechanised Trawl boat Labour	31750	15875* *	66827	68412* *	27500* *
Motorised Gillnet Boat owner	38080	9508* * *	9456	48333* * *	50000* * *

** 15 lakh (1 out of 5)*

*** non fishing y only 6 reported out of 25, savings only 12, current debt only 5*

**** savings only 3 from 6 and debt only 2.*

** *15875 only 8 out of 24, savings only 17 , current debt only 2,*

** * *9508 only 13 out of 30, savings only 18, debt only 1*

In Karnataka fishing income came highest for Trawl boat owners which was approximately ₹90000.Income from sources other than fishing across each categories was also less in which only a very few respondents were found to be non-fishing income earners. For Non-Motorised Boat owner only 6 from 25 men earned non fishing income which was about ₹7083. Among Mechanised trawl boat labour non fishing income source for about 8 respondents from a total of 24 was estimated to be ₹15875 and among Motorised gillnet owners only 13 from a total of 30 earned about ₹9508 from alternate occupation

7. Veraval

Veraval	Income		Expenses	Savings(cy)	Debt
	Fishing	Non-fishing			
Mechanised Owners	67500	6867*	27738	252625	91875
Mechanised Labour	22900		14030	12200	12900
Motorised Owner	29000		16367	26271	8525
MotorisedLabor	14000		11740	6670	2300
Non mechanised Owner	14750		13385	7800	1558
Non mechanised Labor	7988		10381	6000**	7200**

8. Alapuzha

Alapuzha	Income		Expenses	Savings(cy)	Debt
	Fishing	Non-fishing			
Mechanised Owners	52500	1500	62300	Nil	147500
Mechanised Labour (crew) CHECK 0	8000	1900	190060		161000
Motorised Owner	102950	724230			3735000
Non-MotorisedLabour	48900	175740			395000

Non fisheries sector provided fishers an alternative reliable income source which might have encouraged them to work in various occupations like labour services, hotels, private sector etc. In Rameswaram and Nizampatnam there was not any single respondent involved in non-fishing activities.

Savings & indebtedness

Savings of Rameswaram was estimated at ₹2036. 96 % of the respondents had savings.For trawl owners it was calculated to be ₹15000 per month, for trawl labourers around 1400 for motorised ₹1230 and for traditional ₹887. On total the average savings of Rameswaram came to about ₹2036.

In Nazampatnam also around 92% had savings which came to an average of ₹405277. the savings was highest among mechanised trawl net (₹3360000)followed by motorised mini trawl ₹239000, labours ₹218750, motorised gillnet ₹27375 and non-motorised ₹75964.

Chennai none of the respondents had any savings. Kanyakumari also depicted a similar situation where only one respondent reported to have savings of about ₹6000.

Kainada only 29% of the respondents had savings which amount to ₹7711 on an average. Motorised sector savings amount to ₹11236, non-mechanised ₹4545 and Mechanised ₹7317.

In Mangalore for mechanised Purse-seiners the savings was about ₹17200. Only 12 non-motorised boat owners from a total of 25 had savings for about ₹25167. Similarly only half of the trawl boat owner's savings was ₹40,000.Majority had no savings.

Indebtedness

Lack of savings and more spending often lead to debt. The results indicated that only 15% had debt in Rameshwaram which accounted to a minimum of ₹386 per person.In Kanyakumari most of the respondents were debt free in which only one reported to have current debt of about ₹7200. In Nizampatnam nearly half of the respondents were in debt and the amount to be repaid is estimated at around ₹117311. Highest debt accrued to Chennai where 85% of the respondents were indebted and the total amount to be repaid came to about to ₹20812 per person. This could be the reason why they had no savings. The major share of the amount was taken for house purpose and the rest for boat repair. In Kakinada, 75% were in debt which was mainly taken for boat purpose, net repair and house maintenance where ₹87,118 was owed. In Mangalore we find that the number of people who were reported to be in debt was very few from each categories(just one or two men).So as a whole most of the had no debt at present.

Ownership of assets

The assets of fishers was analyzed in terms of housing (kutcha or pucca), vechicle, craft, gear and others particulars they possessed. In Rameswaram 46% of respondents owned pucca house and remaining 54% owned kutcha house. 38% owned two-wheeler, 1 % had four- wheeler and remaining was without any vehicles. 30% each had traditional a motorised craft, 6 % mechanised and 30% did not had any craft. Similarly 63% used bottom gillnet gear, 31% were without any gear and remaining trawl net.

Nizampatnam 60% had concrete houses, 19% lived in hut. Only 23% possessed vehicle all two wheelers. In case of craft, 27% used fireboat, 31% used wood boat and a very small per cent used craft. In gear use, 58% were gillnetting users, a 10% trawl net and remaining no gear.

Chennai 17% lived in concrete houses, 52% rented house, and 26% government houses. 84% had vehicles, 10% reported to have all crafts and gears.

Andhra Pradesh 47 % live in pucca house, 30% in semi-pucca, 20% in hut and remaining 2% in kutcha. 50% possessed 2 wheeler, 46% no vehicles and 3% owned auto. 25% possessed mechanised craft, 12% motorised, 22% other crafts like fibre boat, non- motorised etc., 36% were trawl net users and another 22% gillnet and net

Fishing details

A detailed analysis is also done regarding the catch of fish during four seasons which was categorized as pre-monsoon, monsoon, and post monsoon and ban period. Number of trips per month, fishing days per week, hours of fishing per trip, quantity of catch in kg per week, major species got their revenue, coat and profit sector wise are also calculated.

During Pre monsoon, in Rameswaram single day fishing is undertaken by trawl owners, labourers, traditional and motorised fishers. Their number of trip per month on an average varies from 10 to 26.Whereas traditional goes for fishing 6 days each for 6 hours per week, Trawl owners and labourers fish for 3 days hours varying from 22 to 24.Quantity per catch in week ranges from 1947 kg to 11 kg on an average. The major species include sardine, crab, and barracuda. Total revenue, cost a profit obtained is highest for trawl owners a lowest for traditional fisher. In Nizampatnam both multi day and single day fishing is undertaken in which number of trips per month is highest for non-motorised which is 81 permonth.But motorised min trawl net has not recorded any trips during permission. But more hours of fishing and largest quantity is caught by mechanised trawl net .So their profits is also high when compared to other categories in Nizampatnam.In Chennai only mechanised trawl owners and gillnet owners go to sea during pre-monsoon. 4-5 trips, multiday on an average are noted.Quantity obtained to a maximum of 3500 kg.MostlyTunas, seerfish, cephalopods.prawns, goatfish forms their major catch share.Highest profit is obtained for mechanised gillnet owners which is much high when compared to trawl groups. In AP mechanised crew attains highest profit more than thrice to motorised though they races high in terms of catch rate.

Monsoon

During monsoon period the number of trips and fishing days are similar in Rameshwaram to that of premonsoon. But fishing hours and also the quantity caught is less which is due to unfavourable weather. As a result there is a remarkable decline in revenue and profits. In Nizampatnam number of trips recorded is high during monsoon than pre-monsoon for all categories. The quantum of fish and also profits earned is high contrary to Rameshwaram. In Chennai the total quantity is slightly less leading to a decline both in revenue and profits. In AndhraPradesh we can see that profit is on high during monsoon than pre-monsoon..

Post-monsoon

During post monsoon in Rameswaram a larger quantity is caught but profits is only slightly higher when compared to pre-monsoon. In Nizampatnam also a similar result can be found in post monsoon compared to pre-monsoon. In Chennai the profit, revenue obtained in post monsoon is found very less when compared to other periods though there is not much change in quantity obtained. In AndhraPradesh the total catch is much higher during post monsoon followed by higher percentage increase both in revenue and profits.

Ban period

During ban period traditional and motorised were out for fishing. Their number of trips ranges from 26 to 29 in

which almost all the days in a week they will be sea for about 8-10 hours per trip. The quantum of fish varies from 23 to 58 kg in which the species include crab, sardine, great barracuda, hilsa shad, needle fish etc. Revenue obtained to a maximum of ₹5033, cost 3245 and their profits 1788. In Nizampatnam none of the fishers were reported to go to sea during ban. In Chennai motorised owners fish all days, 3 hours per trip in which their catch will be 11000kg. Revenue comes to a total of ₹3000. In AP motorised fish during ban days in which their total catch comes to around 3968, their revenue ₹46629 and profit of ₹20639.

Awareness about trawl ban

Cent per cent awareness was found for all fishers across concerned areas but government support differed in each centres. In Rameshwaram I trawl period was said to be from April 15 to May 29. Motorised, Shore-seines and traditional were allowed in sea and they used to fish during ban days in which their catch and fishing details during ban days are already stated. Each family received an amount of ₹2000 as relief assistance from government. Nizampatnam also fishers also were fully aware about ban days which run from April 15 to June end. Only non -motorised were allowed to fish. Among those who were not permitted, only 56% received benefit in kind in form of food grains (rice). Remaining 44% were reported to have received no such benefits. In Chennai 20% did not receive any benefits but remaining were given an amount of ₹2,000 as relief. In AP the same run April 15 to May 29.68% received rice (10kg), 6% received ₹2000 as relief fund and 26% did not receive any benefit.

In Rameswaram more than 65% stated that trawl ban benefits them in many ways. 42% stated there was an increase in catch during ban, 21% said it was easy to avail loans, 25% said savings went high. 19% stated they were unemployed, 14% said interests went high and 3% said there was fall in catch. In Nizampatnam, 50% said they were benefitted via increase in catch rate and an equal percentage was against ban as unemployment went high. In Chennai 43 percent said it benefitted them only for few months, 55% there was an increase in catch 2% said they were not benefited through ban. 47% said poverty and debt were the main aftermath of ban and remaining was silent on pitfalls. In AP 97% said there was an increase in fish during ban. 31% said there was non-availability of credit during ban; an equal amount said interest rate went high which led to indebtedness and another 31% sad there was financial breakdown and unemployment.

List of Acronyms

ACGR	Annual Compound Growth Rates
ALO	Alternate Livelihood Options
CPH	Catch per hour
CPUE	Catch per Unit Effort
EEZ	Exclusive Economic Zone
NMFLDC	National Marine Fish Landing Data Centre
POL	Petrol Oil and Lubricants
PRIMER	Plymouth Routines for Multivariate Ecological Research
RSA	Rapid Stock Assessment
SFB	Seasonal Fishing Ban
WTA	Willingness to Accept
WTP	Willingness to pay

India a biodiversity hotspot

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