SUSTAINABLE DEVELOPMENT GOALS

Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development

'Life below Water'

By

Ramachandra Bhatta
Lead Author
Former ICAR-Emeritus Scientist
Former Division Chair and Scientist G
NCSCM (MOEF &CC) GOI, Chennai
rcbhat@gmail.com

to

DEPARTMENT OF
PLANNING, PROGRAM MONITORING AND STATISTICS
GOVERNMENT OF KARNATAKA
BENGALURU 560001

MAY, 2019

Acknowledgments

This report is result of a collective effort. In fact, it has been written with contributions from many experts and administrators who have reviewed and suggested modifications with their common concern to conserve and sustainably develop Karnataka coastal/marine resources. The report also show that there exists alternatives to achieve growth and these alternatives are currently unfolding – through community action although in many cases they remain invisible to us. This report brings together facts explaining the negatives and positives of development processes coastal development and social realities in multiple ways. In this sense, this report does not intend to present an aspirational view but rather hard realities of future.

We are grateful to the Chief Secretary Sri.T.M.Vijaya Bhaskar, IAS, for initiating the exercise and the support extended to the Working Committee. We are thankful to Smt. Shalini Rajaneesh IAS, Principal Secretary Planning, Programme Monitoring and Statistics Department for constantly guiding and monitoring the work. We are also grateful to Sri. Mohan Chakravarthy IAS former Secretary, Planning, Programme Monitoring and Statistics Department, for good support and active participation in completing this report.

We are also thankful to the Dr. K. Narayana Director of Planning, Programme Monitoring and Statistics Department, Government of Karnataka for associating with this exercise and also facilitating data collection on key dimensions of sustainable development. We profusely thank all the directors and officers of the line departments such as Director of Fisheries, Secretary, Department of Ecology and Environment, Agriculture, and Karnataka State Pollution Control Board, Bangalore.

We gratefully acknowledge the support extended by Ms. Roopa, Lead Consultant, in coordinating the team, facilitating the data collection and report writing.

The entire exercise was undertaken by the Working Committee with members draw from different areas of expertise under the leadership of Sri. Rudra Gangadharan IAS, former Secretary, Every member of the Committee on Goal 14 has played a distinctive role by participating in the discussion and supplementing the information. Special thanks to Dr. Paul Pandyan, Commissioner of Fisheries, Government of India, Delhi who reviewed the earlier version of this report and suggested many points which were incorporated in this report.

TABLE OF CONTENTS

Executive Summary

The Karnataka coast with 300 km of coast boasts of high marine productivity with a fisheries resource potential of 4.25 lakh metric tons, of which 2.25 lakh metric tons from inshore areas up to a depth of 70 m and remaining 2.0 lakh metric tons from the off shore/deep sea zone. During the last 20 years the fishing technology has undergone large scale mechanization enabling the fishing fleets to expand their fishing ground into deeper waters with fast imported moving engines with Hp ranging from 300-500 capacity. Karnataka Coast has also been a hub of anthropogenic activities attracting huge investments in oil & petroleum, shipping, thermal power station, fertilizer cement, caustic soda and ash industry, ship breaking yard, naval ports, jetties and salt producing sectors– all influence the coastal land and marine area overlapping with the limits of 12 nautical mines. In particular, the stretch between Mangalore and Udupi, is an area of intensive maritime activity characterized by single buoy moorings (SBMs), oil handling jetties, thermal power in addition to many source effluent outlets originating from the nearby small scale industries and urban sewage treatment plants.

The anthropogenic activities put immense pressure on natural ecosystems and the SDG 14 suggests that all development programs should consider the threats to natural capital such as coastal and marine ecosystems in the process of achieving economic development. The report delineates the benefits and costs of co-existence of ecological and economic hotspots in order to develop action plan within the existing legal framework. This report presents an assessment of the utilization of coastal and marine ecosystem goods and services by the fishing units, industries and tourism and other stakeholders to survive together is presented in the context of Karnataka coast.

It is suggested that the interstate and international marine biodiversity threats should be one of the main agenda during the periodic meetings of the coastal states and it should suggest biodiversity conservation measures. Notification of 8500 acres of naval sea bird coastal/marine areas as marine sanctuary, research on linking production of coastal fish species with cumulative impact of pollution, implementing progressive fuel subsidy, infrastructure and drinking water supply to fisheries harbours, provision of space for women processors within the port area,

Steps should be taken to establishment of a SDG Cell within existing line departments to achieve targets set under SDG 14. Such an action plan should incorporate conservation, restoration, and promote nutrition-rich sustainable consumption practices. Marine and coastal ecosystem goods and services should be incorporated into state/national accounting. The access and benefit sharing rules under the Biological Diversity Act 2002 should be extended to the utilization of marine biological resources and the benefits arising from commercial utilization of marine

biological resources must be shared with the local community. Women could be empowered to ensure their effective role in sustainable livelihood programmes such as fish curing, marketing and value added products should be protected while implementing any development programs. Effective monitoring the factors responsible for climate change should be given priority. The data collection system on marine landings should be strengthened by involving all stakeholders which is a pre-requisite for effective policy implementation. The budgetary allocation for SDG 14 related suggested work plan and schemes should be prioritised and the entire budgetary resources of the state fisheries, ports, ecology and environment, should be revised by developing schemes related with the SDG 14 action plan.

I BACKGROUND AND CONTEXT

1.1 Introduction

The maritime state of Karnataka state consisting of three districts with 300 km coastal length has 35, 507 active marine fishers and 11, 884 numbers of total fishing crafts (CMFRI, 2016). According to Government of Karnataka (2018) 75% per cent of the total fishers are small-scale fishers contributing only 15% of the total marine fish production. In 2017-18, 14 per cent of the total Indian fish catch was landed in Karnataka which is third largest producing state in the country. The inherent rich inland waters and rivers at the foot of the Western Ghats, with shallow continental shelf area contribute to the rich productivity of the marine fisheries. Karnataka has a share of 87000 sq. Km out of Indian Exclusive Economic Zone (EEZ) of 2.02 million sq km. The marine fisheries resource potential of the State is estimated at 4.25 lakh metric tons, of which 2.25 lakh metric tons from inshore areas up to a depth of 70 m and remaining 2.0 lakh metric tons from the off shore/deep sea zone. Karnataka coast has 162 fishing villages constituting 4.60 per cent of the country and one village for every 2.00 km of the coastline. The total landing fluctuate around 5.5-6.00 lakh tons/year with 66% from marine sector 34% from Inland sector. The fish production per fishing unit is around 20 tons/year which is above the national average of around 15tons (GOI 2016).

Coastal ecosystem of Karnataka is a mosaic of monsoon wetlands, beaches and mountains, some as high as 2000 meters, stretched along its 300 km long shoreline. The coastal eco-region of the state is separated by Western Ghats connected by a number of rivers that form vast estuaries. There is a narrow strip of coastal plains with varying width between the mountain and the Arabian Sea, the average width being about 20 km. The average height of the hinterland is 70 - 75 meters, but in some places it can be as high as 150 meters. Fourteen rivers originate in the Western Ghats and their tributaries flow through three coastal districts into the Arabian Sea, forming a mosaic of more than 8,000 ha of estuaries along the coast and render the inshore area rich in nutrients (Bhatta, Rao & Nayak 2003). The state has 5.60 lakh ha of inland water resources, consisting of tanks, reservoirs, rivers, canals and fish culture ponds.

The development of modern marine fisheries in Karnataka has been traced to the launching of Indo-Norwegian project for the mechanisation of the fishing craft in 1966. From 1980 to 2016 the number of trawlers grew from 1833 to 3071 and motorised boats increased from 974 in 1990 to 11884 in 2016 representing more than 10 times increase. In recent years, the deep-sea fishing is being developed with the help of imported speed engines and has reduced the number of days of fishing trips from 15-20 days to 3-5 days. Rapid growth of population, increase in fishing capacity, international trade in fish products and, increase in per capita income have caused transformation of fisheries during the past two decades. Several factors such as, drive to export shrimp, and state sponsored modernisation programme through co-operatives and banks influenced the growth of marine fishing in Karnataka since early 1960s.

During the last 15 years the fishing technology has undergone large scale mechanization enabling the fishing fleets to expand their fishing ground into deeper waters with fast imported moving engines with Hp ranging from 300-500 capacity. The enactment of Karnataka Marine Fisheries (Regulation) Act 1986 empowered the Fisheries Department to regulate the entry of fishing vessels by licensing a standard policy instrument. However, strict implementation of limited entry regulation with high levels of unemployment, community attachment and restricted geographic mobility of small scale fishers has prevented the state from implementing the restrictions. The 1980s and early 90s were a time of ambitious industrialization programs in many states. The emphasis of the policy was to increase fish production for domestic consumption and export. This was sought through various devices such as motorisation, mechanization, port development and introduction of new technologies and fuel subsidies. During the 80s and 90s the fish catch increased at a record rate. The state Fisheries Department first reported symptoms of over fishing in shrimp and other high value fishes. The modern marine fisheries sector characterized by declining resources due to over exploitation, increasing fishing capacity (powerful engines, vessel size and mechanization of fishing operations) and harvesting costs and declining per capita fishing output. The increasing fish prices, diversified more efficient gears and capital and operational subsidies have made fishing still profitable leading to increasing fishing effort over the years. The Government of India (2011, 2012) has reported that overall there is excess capacity of 125 percent and 40328 vessels in absolute

number. More than 75 per cent of the commercial fish catch is dependent on estuaries, mangroves and coastal wetlands for part of their life cycle (Bhatta & Bhat 1998). Sand bars have been developed in most of the estuaries. Karnataka has a monsoon tropical climate with bulk of rainfall being received during southwest monsoon period. All these natural phenomena create conducive conditions that attract fish and other marine organisms to inshore waters. A shallow continental shelf, wet lands and mangroves provide rich breeding and feeding grounds for fish and other marine species.

1.2 Industrialization in the Coastal Karnataka

The coastal zone in the district, between Mangalore and Surathkal is an industrialised zone. Kulai is a major industrial town which is situated between Surathkal and New Mangalore Harbour. (Shirodkar, Mesquita, Pradhan, Verlekar, Babu & Vetthamony 2009). There are 22 large scale and medium scale industries and 18,009 small scale industries in the district. The Mangalore Refinery and Petro Chemicals ltd. (MRPL), Mangalore Chemicals and Fertilizers (MCF), BASF, Kudremukh Iron and Steel Company are the major large scale industries. District has a dense network of six rivers and estuaries that have contributed to a strong fisheries sector.

The Environmental Master Plan Study (EMPS) and Environmental Management Plan and Action Plans for Dakshina Kannada District was a Denmark-India Government Cooperation carried out by a Danish Joint Venture (consisting of COWI consult, RH&H Consult, Carl Bro International, Water Quality Institute and Management Services Group) for the DFEE, GoK, on the Govt of India's request. The report (1994-95) spells out specific actions to be taken by local and state institutions through 21 interventions to ensure that district (undivided DK & Udupi) development proceeds in a sustainable manner. Consideration of a huge industrial SEZ with refinery, aromatics and olefins complex, together with general multi-purpose industries, power plant, etc needs to be preceded by the implementation of the recommendations from the EMPS. The petrochemical complex's proximity to ecologically sensitive areas, location within the siting of Industry exclusion zone in relation to the major settlements in the area and factors such as toxicants, salinity and eutrophication (excess nutrients) that are likely to influence the aquatic plants (sea grasses), mangroves, phytoplankton and fisheries are a matter of great concern. It is important to quantify the existing total level of effluents released into the sea and the existing

biological carrying capacity of the system. What would be the incremental effluents and nutrient-releases which could affect the marine life and aquatic plants through algae-bloom which has been substantially researched in similar ecosystems here and elsewhere (Nayar et al. 2004; 2005). Most of the impact of hydrocarbons would be direct and indirect. The direct impacts would be toxicity resulting in mortality of aquatic plants and animals. The indirect would be through food webs of basic physiological aspects or due to environmental change. Secondly most of these direct and indirect impacts could be chronic and acute. Chronic would be very long term impacts and acute could be very short run varying from a few hours to a few days.

1.3 Socioeconomic Background

Karnataka state covers an area of 191,976 square kilometres (74,122 sq mi), or 5.83 percent of the total geographical area of India. It is the seventh largest Indian state by area. With 61,130,704 inhabitants at the 2011 census, Karnataka is the eighth largest state by population, comprising 30 districts. Dakshina Kannada, Udupi, and Uttara Kannada are the three coastal districts of the state. According to 2011 census the state has a total population of 6, 11, 30, 704 (5.05 per cent of the total population of the country) and occupies ninth place in terms of population. The density of population stands at 319 persons per square km. Out of which 61.43 per cent live in rural area and rest in urban area. The literacy rate is 75.60 per cent, which is higher than the national average of 74.04 per cent (GOI 2011). With a surface water potential of about 102 cubic kilo-meters, Karnataka accounts for about six per cent of the country's surface water resources. Around 60 per cent of this is provided by the west flowing rivers while the remaining comes from the east flowing rivers. The Karnataka State Disaster Plan Report (2018) states that 287 grama panchyats with a total population of 28.53 lakh population are vulnerable to cyclone risks out of which 42 percent are BPL population.

Dakshina Kannada (D.K) district continues to be the second densely populated district in the state after Bangalore Urban. It ranks first in the state in terms of literacy rate (88.62 per cent), with 93.31 per cent literacy among men and 84.04 per cent literacy among women. The district has one airport, one all weather port and one fisheries harbour. The per capita GDP of the D.K district is Rs.52391 (at constant 2004-2005 prices) which is third highest in the state (GOK

2010). Udupi district has 13 large and medium scale industrial units employing about 45,612 people (GOK 2010). The recently launched coal based thermal power plant- Udupi Power Corporation is one of them. The per capita GDP of the district is Rs. 42,341(at constant 2004-2005 prices) for the year 2007-08. Udupi ranks 3rd in the state in Human Development Index. The important indicators of socioeconomic profile of D.K and Udupi districts are presented in Table 1.

Table 1.1 Socioeconomic profiles of the coastal districts of Karnataka

Details	**State**	**D.K**	**Udupi**	**U.K**
Total population (lakhs)	611.31	20.85	11. 78	14.40
Decadal population growth rate (per cent)	15.67	9.80	5.90	9.20
Area (in sq. km)	1, 91,791	4,866	3,575	10,291
Density of population (persons per sq. km)	319	457	287	240
Literacy level (per cent)	75.60	88.62	86.29	70
Percentage of workers to total population	44.3	50.0	44.0	40
Net District total income 2007-08 (in lakh) at current price	2,11,66,253	9,69,984	4,73,922	56,0503
Per capita income (in Rs.)2017-2018 (at constant price 1999-2000)	36,945	47,151	39,307	36,243
Rank based on Human Development Index	7	2	3	5
Net district income from fishing 2017-18 (in Rs. lakhs) at constant price	79, 773	22, 534	20, 529	19743
Percentage contribution of fishing to total income	0.38	2.32	4.33	4.2

Source**:** 1.GOK (2018). Karnataka at a Glance. Bangalore: Directorate of Economic and Statistics.
2. GOI (2011). Census of India 2011, Provisional population totals. Bangalore: Directorate of Census Operations.

Although the contribution of fisheries at the state level is only at 0.38 per cent to the state GDP, the two selected coastal districts contribute much higher. It is observed that, the industrial growth in the two coastal districts during 1990s and 2000 have reduced the share of fisheries. However, in absolute values fisheries still contribute substantially to income and employment.

1.4 Macro Economic Changes in Coastal/Marine Economy

The 14th sustainable goal spelt out in the UNDP sustainable development goals (SDGs) is to Conserve and sustainably use the Oceans, Seas and Marine Resources for Sustainable Development. The macroeconomic profile of the coastal region of Karnataka and changes in the coastal fish production and income based on the data analysis collected from different secondary sources such as Directorate of Economics and Statistics, Government of Karnataka and Central Statistical Organization is presented in this section. The CSO provides data on the NDDP (net district domestic product) and Gross Value Added in various sectors of the economy in current prices, from which we can get the nominal Gross Value Added in the sector "Agriculture, Forestry and Fishing, and Mining and Quarrying". The CSO also provides data on the "real" gross value added in this sector, by deflating the nominal gross value added with a price index of which does give us any idea of the living standards of the people engaged in this sector.

Table 1. 2 Net income (NDDP) from Fishing (Rs. Lakhs)

Fishing			
Year	D.K	Udupi	Uttara Kannada
2004-05	18241	12616	6833
2005-06	17571	8720	5488
2006-07	12281	9318	3838
2007-08	12433	11383	4261
2008-09	16284	18018	7714
2009-10	14304	15998	11264
2010-11	21131	19220	17884
2011-12	20071	18082	21109
2012-13	19743	18049	14986

Source: Directorate of Economics and Statistics Karnataka

The net district product (at constant prices 2004-05) from fishing presented in Table 1.2 shows that there was a marginal decline of income from 2011-12 onwards indicating stagnation of real income. In addition to this stagnation the inequity in the distribution of the net income has increased due to the introduction of deep sea fishing vessels which harvest almost 10 times larger catch compared to small-scale fishing units. The average catch of a small scale fishing unit per

trip was estimated to be around 0.5 tons (single day) compared to 6.00 tons per trip (3-4 days) of a fishing vessels with greater than 300 hp engine.

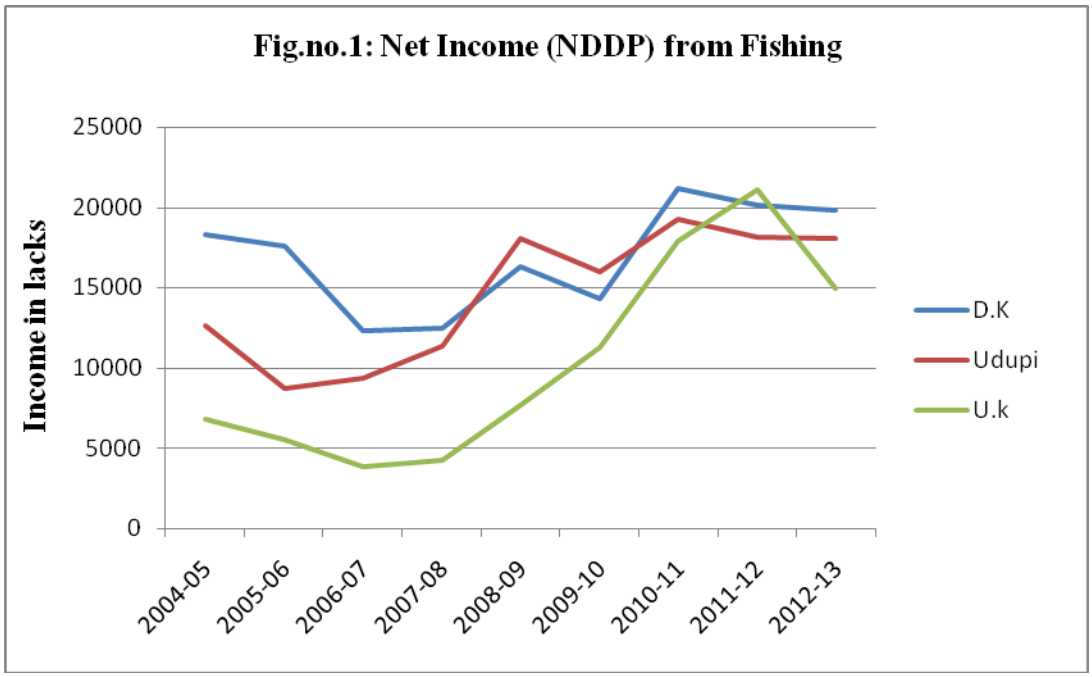


Table 1. 3 Per-Capita NDDP

Per capita NDDP (in Rs.)			
Year	D.K	Udupi	U.K
2004-05	42701	22775	22599
2005-06	43660	29975	24219
2006-07	44925	33214	27390
2007-08	47646	38171	27849
2008-09	51259	43280	29037
2009-10	54443	40510	25167
2010-11	59429	46822	32214
2011-12	56818	48930	31575
2012-13	59047	47715	36243

Note: NDDP: Net District Domestic Product (constant prices 2004-05)
Source: Directorate of Economics and Statistics Karnataka

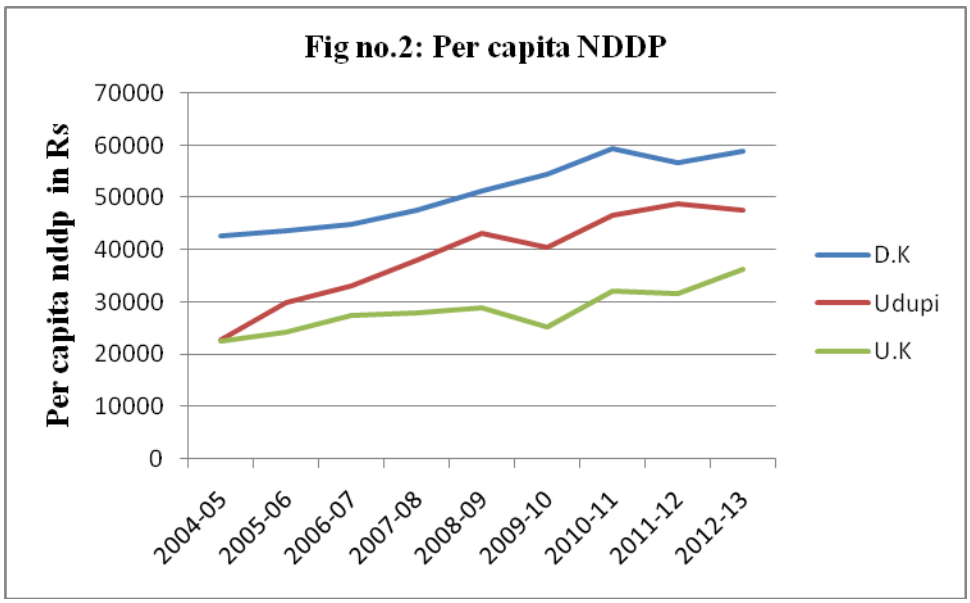


Table 1. 4 per-capita farm and fishing Income of Dakshina Kannada (Rs. Lakhs)

Year	Agricultural Income	Total families	Per capita	Fishing Income	Total families	Per capita
2004-05	84848	41033	2.07	18241	3686	4.95
2005-06	99632	42661	2.34	17571	3833	4.58
2006-07	96209	44289	2.17	12281	3980	3.09
2007-08	94796	45916	2.06	12433	4127	3.01
2008-09	83163	40137	2.07	16284	4274	3.81
2009-10	74836	40978	1.83	14304	4421	3.24
2010-11	88664	41819	2.12	21131	4570	4.62
2011-12	59597	40978	1.45	20071	4717	4.26
2012-13	100146	40137	2.5	19743	4864	4.06

Source: Directorate of Economics and Statistics Karnataka

Table 1. 5 Per-capita farm and fishing Income of Udupi (Rs. Lakhs)

Year	Agricultural Income	Total families	Per capita	Fishing Income	Total families	Per capita
2004-05	52830	38898	1.36	12616	10143	1.24
2005-06	57649	39480	1.46	8720	10297	0.85
2006-07	57478	39603	1.45	9318	10219	0.91
2007-08	54139	39727	1.36	11383	10141	1.12
2008-09	51802	39850	1.30	18018	10063	1.79

2009-10	49112	39973	1.23	15998	9985	1.60
2010-11	55163	40097	1.38	19220	9907	1.94
2011-12	45670	40220	1.14	18082	9829	1.84
2012-13	46914	40344	1.16	18049	9751	1.85

Table 1. 6 Per-capita farm and fishing Income of Uttara Kannada **(Rs. Lakhs)**

Year	Agricultural Income	Total families	Per capita	Fishing Income	Total families	Per capita
2004-05	42647	34729	1.23	6833	16008	0.43
2005-06	52089	35174	1.48	5488	16046	0.34
2006-07	54411	35852	1.52	3838	16084	0.24
2007-08	54802	36530	1.50	4261	16122	0.26
2008-09	45948	37208	1.23	7714	16160	0.48
2009-10	48177	37886	1.27	11264	16198	0.70
2010-11	57726	38564	1.50	17884	16236	1.10
2011-12	40305	39242	1.03	21109	16274	1.30
2012-13	70911	39920	1.78	14986	16312	0.92

Source: Directorate of Economics and Statistics Karnataka

The district-wise increase in the per-capita income from fisheries was presented in table 1.4, 1.5 and 1.6 for DK, Udupi and Uttara Kannada respectively. The average per capita income of the fishers is only half of their counterparts in the farming sector and the variation of the annual income is very high among fishers and thus is subjected to higher social and economic risks. The overall scenario that emerges from the analysis is that the fishers are more vulnerable to production and climatic risks affecting their socioeconomic status compared to the agriculture, and other services.

The overall net income of the three coastal districts has substantially increased during 2005-2013 although the share of the coastal region has been in the range of 10-12 percent of the state. Further, the declining share of primary sector in the total income of the three coastal districts has been compensated by increased income from the tertiary sector.

II. REVIEW OF GLOBAL AND NATIONAL EFFORTS

2.1 Introduction

In September 2015, the world leaders of 193 countries adopted the 2030 Agenda for Sustainable Development with a set of 17 Sustainable Development Goals (SDGs) and 169 associated targets. These goals and targets are universal, integrated and indivisible; and balance the three dimensions of sustainable development: economic, social and environment. The SDGs mirror India's own development initiatives that are robustly on track to fulfil the aspirations of inclusive and sustainable development. The SDGs are basically developed as a follow-up action of Millennium Development Goals of the United Nations. The SDGs are comprehensive and covers interconnected but separate goals integrating economic growth and environmental quality. The 17 identified targets have to be achieved by 2030. The FAO (2018) observed that in order to achieve SDGs there is a need to increase the contributions of fisheries and aquaculture towards food and nutritional security. FAO data (2018) on global production reveal that during 2011 the marine capture fisheries production was 81.5 million tons constituting 52% of the total production has further reduced to 90.90 million tons in 2016 constituting 50% of the global production. The GDP from fisheries sector has increased from 13.4 billion in 1994-95 to 413.60 billion in 2014-15. The total first sale value of fisheries and aquaculture production in 2016 was estimated at USD 362 billion of which USD 232 billion was from aquaculture production. With capture fishery production relatively static since the late 1980s, aquaculture has been responsible for the continuing impressive growth in the supply of fish for human consumption.

Blue Economy covers a wide range of interlinked established and emerging sectors such as fisheries, aquaculture, fish processing industry, ports, ports and ship building/repair, coastal tourism; marine extraction of oil and gas and maritime transport. Under the emerging sectors, we also include desalination, coastal and environmental protection; offshore wind energy; ocean energy; and biotechnology. The "blue economy" concept seeks to promote economic growth, social inclusion, and preservation or improvement of livelihoods while at the same time ensuring environmental sustainability. At its core it refers to the decoupling of socioeconomic

development through oceans-related sectors and activities from environmental and ecosystems degradation

The blue economy has diverse components, including established traditional ocean industries such as fisheries, tourism, and maritime transport, but also new and emerging activities, such as offshore renewable energy, aquaculture, seabed extractive activities, and marine biotechnology and bio-prospecting.

A number of services provided by ocean ecosystems, and for which markets do not exist, also contribute significantly to economic and other human activity such as carbon sequestration, coastal protection, waste disposal and the existence of biodiversity.

Figure 2. 1 Level and progress towards goals by country

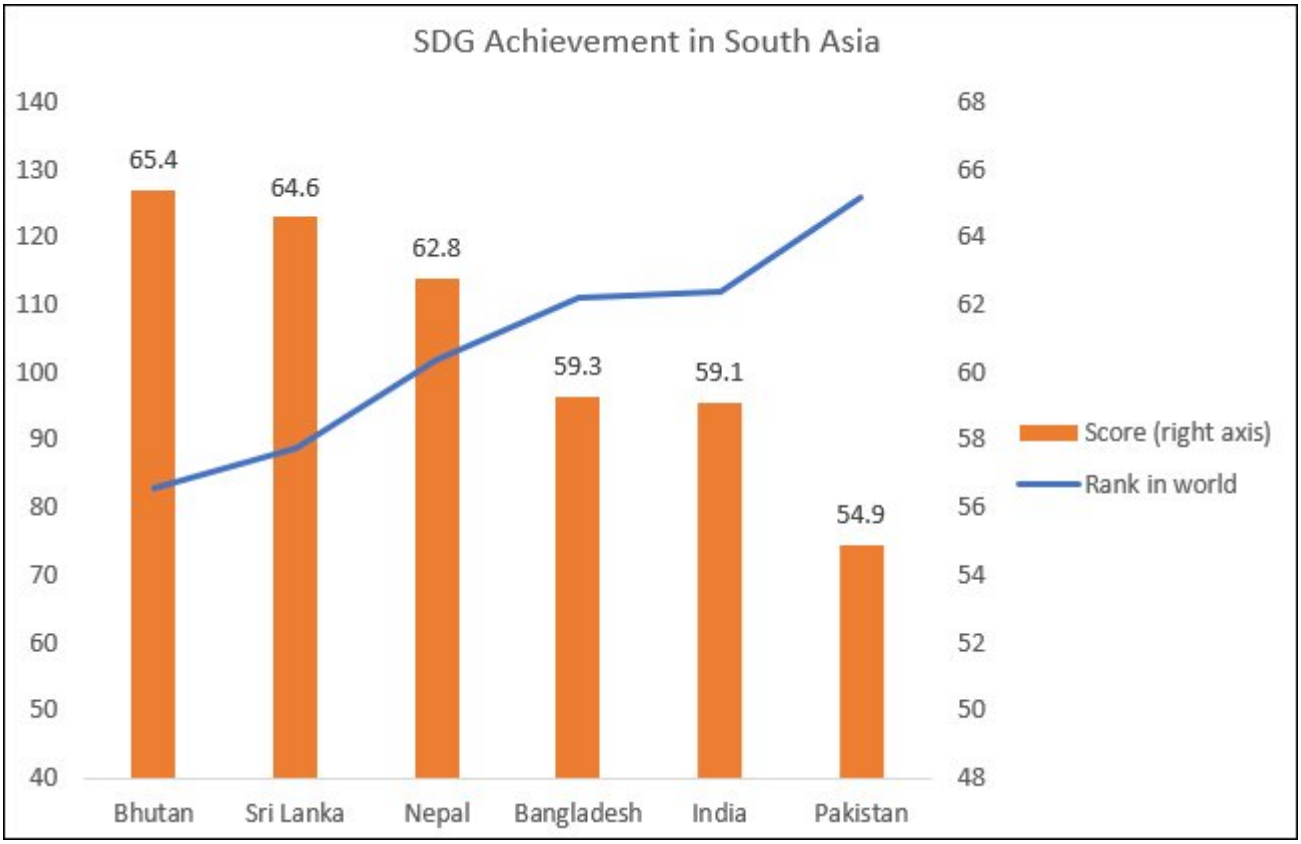


Table 2.1 Level and progress towards goals by in South Asia

SDGs	Bhutan	**Sri Lanka**	**Nepal**	**Bangladesh**	**India**	**Pakistan**
No Poverty	Good, On track	Good, On track	Moderate, On track	Moderate, On track	Moderate, On track	Moderate, On track
Zero Hunger	Poor, improving	Poor, improving	Poor, improving	Moderately Poor, improving	Poor, improving	Poor, Improving
Good Health and Well being	Poor, improving	Poor, improving	Poor, improving	Moderately Poor, improving	Poor, improving	Poor, Stagnating
Quality Education	Moderate, maintaining	Poor, improving	Insufficient data	Insufficient data	Insufficient data	Poor, Stagnating
Gender Equality	Poor, improving	Poor, Stagnating	Poor, improving	Moderately Poor, Improving	Moderately Poor, Stagnating	Poor, Stagnating
Clean Water and Sanitation	Insufficient data	Good, On track	Insufficient data	Insufficient data	Poor, improving	Insufficient data
Affordable and Clean Energy	Insufficient data	Poor, Stagnating	Poor, improving	Moderately Poor, improving	Poor, Stagnating	Poor, improving
Decent Work and Economic Growth	Insufficient data	Good, On track	Poor, improving	Poor, Stagnating	Moderate, On track	Poor, improving
Industry Innovation and Infrastructure	Insufficient data	Poor, improving	Poor, improving	Moderately Poor, improving	Poor, improving	Poor, improving
Reduced Inequalities	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
Sustainable Cities and Communities	Insufficient data	Poor, Stagnating	Poor, Stagnating	Poor, Stagnating	Poor, Stagnating	Poor, Worsening
Responsible Consumption and Production	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data	Insufficient data
Climate Action	Good, Maintaining	Good, Maintaining	Moderate, stagnating	Poor, Stagnating	Poor, Stagnating	Moderate, stagnating
Life Below Water	Insufficient data	Poor, improving	Insufficient data	Poor, Stagnating	Poor, improving	Poor, Stagnating
Life on Land	Poor, maintaining	Poor, improving	Poor, Stagnating	Very Poor, worsening	Poor, Stagnating	Poor, Worsening
Peace Justice and Strong Institutions	Insufficient data	Poor, Worsening	Poor, Stagnating	Poor, stagnating	Poor, Stagnating	Poor, Stagnating
Partnerships for Goals	Poor, maintaining	Poor, Worsening	Poor, improving	Poor, stagnating	Poor, Stagnating	Insufficient data

Source: SDG Index and Dashboards Report 2018

Performance on the SDGs is being measured by one effort that scores countries out of 100 (as the target or best possible outcome to be on track to meeting the SDGs) and currently Sweden

performed with best with a score of 85. Figure 1 shows that South Asian countries are well below that, with even the best performing of them (Bhutan) scoring below the global median of 66.2. Both performance and progress towards these goals appears to have little to do with levels of per capita income or degree of development. India, which is not only the largest and most diversified economy in the region but also prides itself on rapid income growth rates and hopes to emerge as a potential leader of the world economy, performs very poorly even in relation to other South Asian countries. Bhutan and Nepal – both landlocked countries at lower levels of development – show better ranks and significantly higher scores. It could be that at least some of the answer lies in the goal for which all countries show "insufficient data" to allow for assessment: that of reducing inequalities. The absence of statistical indicators imposes severe constraints in measuring the progress in the social sector. This in turns highlights the significance of political processes and the orientation of governments: those governments that have been more explicitly concerned with reducing inequalities in practice have been more effective in ensuring better performance to several other goals and targets.

Essentially SDGs address input-product- market conditions. The SDG 1-5 (no-poverty, zero hunger, good health and well being, quality of education, are closely related to the parameters that improve labour market conditions. At the same time SDG 8-9 (decent work and economic growth, infrastructure) are related with output markets. SDG 14 and 15 (life below the water and land) talk of natural capital while SDG 10 and 16 (reduced inequality, peace and social justice to reduce the possibilities of social conflicts (Ghosh 2019).

2.2 Literature Review

The Goal 14 is to Conserve and sustainably use oceans, seas and marine resources for sustainable development. The UN General Assembly adopted resolution 70/226 on December 22, 2015 in which it was decided to "convene the high level United Nations Conference to Support the Implementation of Sustainable Development Goal 14. The 21st century has been defined by threats of marine and nutrient pollution, resource depletion and climate change; all of which are primarily caused by human actions. To address the adverse effects of overfishing, acidification and pollution, and to achieve Sustainable Development Goals, it is imperative that we develop a holistic strategy. It has been well established that the overexploitation of coastal/marine

resources are increasingly threatening the world's marine capture fisheries (Myers and Worm 2003) and increasing use of ocean as a sink (public-bad) has been damaging marine ecosystems. This has posed major dilemmas for the 200 million or so fishers and others employed in fish supply chains that, along with their families, depend directly on them for their livelihood (Grafton 2010). Further, common property resources such as marine fisheries generate wide variety of economic benefits to the society. The human wellbeing places strains on the natural environment and on the sustainability of a range of ecosystems. The dependence of coastal communities on diverse coastal ecosystems is acute in most of the developing countries and erosion of the capacity of these resources would setback the prospects of tackling poverty. The Daniel Pauly and J. Alder 2005 (MA 2005) pointed out that degradation of coastal ecosystems could have uneven impacts on poor communities. As per the 2016 Marine Census data it was estimated that 47 percent of about 40 million fishers in India are living below the poverty line and most of them are traditional fishers. Thus any decline in the share of fish produced by them would lead to further impoverishment of these people. The social wellbeing approach for developing coastal management plan involves three main components namely meeting basic human needs, freedom and quality of life. Amaratya Sen (1999) illustrates the social wellbeing by using capacity approach which indicates that communities accept particular socioeconomic status involuntarily due to either lack of availability or accessibility. Hence the coastal planners have to consider the differential impact on different stakeholder groups while executing the management plan. The significant increase in coastal population, infrastructure development attracting settlements along the shoreline, rising fishing assets, fishing intensity, income and tourism development are some of the factors causing concern on its likely impact on coastal ecosystem goods and services. It was observed by the fishing community representatives that there have been shrinking physical space for the traditional fishing and fishery related activities on the coast and also with emerging dominant stakeholders there have been changes in the governing system. There has been enormous increase in human activity attracted by the free availability of coastal common resources which is presenting a case of free rider problem.

Many studies have tried to establish the relationship between the successful implementation of development and welfare-oriented programmes with or without the focus on social capital. Most

of the development projects in the marine fisheries sector have tried to concentrate on infrastructure development such as fisheries harbours, landing centers, cold-chain system, markets and subsidized supply of inputs to encourage fisheries modernization. The state policy considered that such investment, like in other sectors, would bring the required economic growth. However, it overlooked the importance of property rights and social capital in the sustainable development process of the industry. With the result the marine fisheries with the characteristic of common property started experiencing excess capacity, declining per capita output and overcapitalization. The social capital, which was strong and dynamic in transforming rules and regulations for sustainable development in traditional governance process, did not find a place in the fishery modernization policy of the state. The World Bank Social Capital Initiative studies and many others (*e.g.,* Putnam, 1993; Coleman 1988; Grootaert 1998; Fukuyama 1995) started stressing the importance of incorporating social capital in all development projects. However, in reality, very few have recognized it in the implementation process, its impact on conservation and sustainability of marine resources.

In response to the overexploitation of commercial fisheries, many countries have adopted policies that restrict the numbers and size of fishing vessels. However, limiting the fishing effort or capacity has been a controversial subject since this policy appears to cause unemployment in fishing communities. Fishery agencies are grappling with a policy dilemma: while effort reduction policies could increase biological stocks and fishery profits, the same could jeopardize fishery labor community as well as other sections of a regional economy. The adverse impacts that fishery policies inflict on the regional economy have received very little attention by economists.

2.3 Eco-Restoration and Sustainable Development

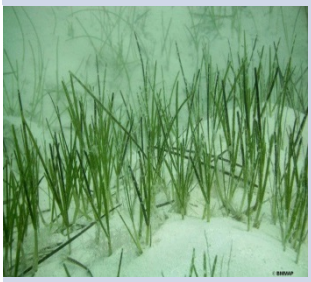
The United Nations' Food and Agriculture Organisation reported in 2014 that Indonesia was the second-largest producer of marine products. Indonesia's aquaculture sector yielded more than 4 million tonnes in that year, which constituted 5.7 per cent of global aquaculture production. It also contributed roughly 6.7 per cent to Indonesia's national GDP in 2016 and absorbed 4.1 per cent of the country's total workforce. In Indonesia, where two-thirds of coral reefs are considered

threatened by overfishing, the Coral Reef Rehabilitation and Management Project (COREMAP), has benefited 358 village communities by establishing marine protected areas and reducing illegal and destructive fishing. This work has increased communities' income in COREMAP areas by 21 per cent since 2008. In Peru, the government adopted new regulations to reduce overcapacity in the anchoveta fishing fleet. In December 2012, a total of 329 wood and steel vessels had been retired, representing around 30 per cent of the original fleet. The government compensated affected workers and facilitated their transition into other economic activities. Harvesting was kept within the catch limit, based on the science. As a result, independent fishers who remained in the sector landed with a better quality product and negotiated a 200 per cent increase in price for the sale of their catch. Five countries are responsible for more than 50 per cent of total plastic waste in the oceans (China, Indonesia, Vietnam, Philippines, and Thailand). Estimated 80 per cent of ocean plastic pollution has originated from inadequate land-based solid waste management. The Future to combat these issues and promote ocean sustainability, innovative solutions that prevent and mitigate detrimental impacts on marine environments is essential.

III. STATUS AND THREATS TO MARINE/COASTAL RESOURCES

Some of the common threats to coastal/marine resources are presented in the following Table 3.1

Table 3.1 Threats to Coastal/marine Ecosystems

ECOSYSTEMS		THREATS
ESTUARIES		Habitat destruction Pollution Unsustainable resource exploitation Harmful algal blooms / Alien species Global warming
MANGROVES		Land reclamations for construction activity, aquaculture, agriculture, tourism Industrial and domestic pollution Port development Dumping of all kinds of waste and debris Deforestation for fuel wood Over harvesting of marine resources
CORAL REEF		Destructive fishing practices/Overfishing Careless tourism Water pollution Sedimentation Coral mining Climate change
SANDY BEACHES		Erosion, SLR, construction activities for tourism, beach sand mining
SEAGRASS/ SEAWEED		Natural disasters – Cyclones and hurricanes Intensive grazing Infestation and diseases Deforestation of mangroves Construction activities Dredging Pollution

The Table 3.1 reveals that the cost of conservation of these marine resources would be the cost of avoiding/minimising the threats associated with each resource.

3.1 Coastal and Marine Pollution and Impact of Other Land Based Activities

In coastal Karnataka, apart from 6 existing hazardous industries monitored by the Karnataka State Pollution Control Board and many industries/facilities are established /proposed which could cause burden on the water quality and quantity. Some them are coal-fired thermal power plants (Udupi dist.), existing and expansion of petroleum refinery (MRPL) petroleum and petro chemical complex (MSEZ), chemical fertilizers (MCF), chemicals and pesticides (BASF), iron and steel (KIOCL), existing and proposed shipyards, river linking – Nethravathi diversion projects and others could divert fresh water into other upland regions leading to reduced environmental flow in the rivers.

There are ample evidences to show that the oil refineries and chemical industries along the coast have been violating water, air and environmental acts/guidelines. An expert Committee constituted by the District Administration, has confirmed coke & sulphur pollution and admitted that it is too close to densely populated areas and has recommended displacement of certain units (petcoke) etc. It's not just emissions from one company alone, but cumulative amount of air, water and other pollutions, safety concerns of a densely populated abutting city, sensitive areas like an international airport and port all need to be taken into account. According to the District Disaster Management Plan 2017-18, prepared by the D. K District Administration, hazardous industries are located with 14 MAH (Major Accident Hazard) units and 8 potentially Hazardous Industrial units along the urban wards of Mangalore city. Growth of large number of hazardous industries in the neighbourhood of the urban wards threatens the life & well being of citizens around (Ref. Disaster Management unit, D.K. district, in website dc.nic.in). Impact of expansion of the refinery capacity is already visible if one observes the actual ground level impacts at Jokatte, Kalavar and other areas, with constant unabated air, water and noise pollutions. Fish production is dependent on the river and coastal waters for their breeding and recruitment. The study on physical, chemical and biological aspects of seawater and sediments of the coastal belt from New Mangalore Port to Surathkal reveals high ammonia off Surathkal, high nitrite (NO2-

N) and nitrate (NO3-N) in the near-shore waters off Kulai and high nitrite (NO2-N) and ammonia (NH3-N) in the harbour area. Similarly high petroleum hydrocarbon (PHc) values were observed near the harbour, while phenols remained high in the near shore waters of Kulai and Surathkal. Significantly, high concentration of cadmium and mercury were observed off Kulai and harbour regions, respectively (Shirodkar et al. 2009). A recent study by National Institute of Oceanography (NIO 2007) for the Mangalore Special Economic Zone (MSEZ) found high concentrations of heavy metals in the coastal water of Thannirubhavi- Chitrapura area. The above study also points out those deteriorating levels of dissolved oxygen (DO_2). In these waters DO_2 ranged from 2.52ml/ltr to 3.7ml/l, whereas 4ml/ltr to 6ml/ltr are considered healthy. The impact of these factors on the overall fish production and quality is yet to be ascertained scientifically which calls for a detailed study.

Box. 1 Rice-shrimp Harvesting in coastal wetlands (Gazni lands)

Gaznis are flooded coastal wetlands along the natural estuarine borders and river banks of west coast districts of Uttara Kannada district, Karnataka. The Aghanashini estuary is surrounded about 22.136 sq km of Ghazni land or khar land. This is a more productive ecosystem used for rice cultivation, with verities unique to this region with salt resistant varies. Also this ecosystem is used for natural shrimp cultivation. This mode of shrimp farming involves natural seed collection during tidal influx and also rich ecosystem provides natural food for the shrimps till it attains the harvesting size. The rich mangrove vegetation of this estuary has significant role in food supply for the diverse faunal life dependent on this estuary. The mangrove swamp acts as food rich and protective nurseries even for many species of marine fishes and prawns, which lay eggs in the swamp.

Being highly fertile, traditional farmers of Uttara Kannada district grew a salt tolerant variety of rice called 'Kagga', a variety rich in protein known for its flavour. Paddy –Prawn rotation is a traditional system followed in the region. In this system paddy is grown in one season followed by prawn culture. The natural tides bring along with them the wild fingerlings and post-larvae, thus enabling farmers to produce prawns and fish in the paddy field, through a rotation system. Thus, the rotation system includes two enterprises viz., Paddy and Prawn and therefore had an advantage of the risks being distributed among enterprises. During late 90s by adopting modern shrimp farming technologies farmers started growing 4-5 tons/hectare and stopped rotation system of paddy-shrimp. In recent year farmers are adopting Bio-flack and Re-circulatory Aquaculture System (RAS) of shrimp farming as environmentally friendly, ecologically sustainable, economically profitable and socially acceptable.

Fig.1 Overview of the Gazni land in Kumta

In Bio-flock system a substrate is introduced to floc (attract) many primary producers like plankton, microbes, etc. and develop into a system which acts as a feed as well as control the water quality parameters like ammonia and oxygen, to be the optimum control by manipulating carbon-nitrogen ratio. The plankton groups that are attached develop into a peri-phyton lab-lab formation. It acts as a feed to the animals. Bio-floc and P. Lining of pond bottom is an integrated system of shrimp production in a recirculating system, in which bio-floc fertilize phytoplankton. This alternative technology results in a significantly higher shrimp yield, with significantly lower nitrate-N (NO3-N) and total dissolved solids (TDS) in the shrimp culture water over the course of the production. Total ammonia nitrogen (TAN), pH and dissolved oxygen (DO) levels were maintained at the optimum level. Economic analysis revealed that improved yield, lower cost and reduced cost of externality could potentially increase total shrimp farm revenue and also increased shrimp production. Stocking density could go up to 250 275 pieces meter^2 with partial harvesting and diffused aeration of pond bottom with the help of aero tubes. This will have the advantage of better mixing up of oxygen into the water. This system is less energy intensive compared to RCS which needs 120 hp pumps per hectare. Although 24 tons per hectare is harvested in RCS system the breakeven output could be very high due to high capital investment costs. In the case of bio-flock system the yield per acre is around 17 tons /acre /crop but energy efficient and very less water exchange (1-2%).

Table 3.2 Declining Bivalve Production: An Indicator of coastal Water Quality

Year	Karnataka				India (Qty in tons)
	Total Quantity (in tons)	Clams	Mussels	Oysters	
2002	12952	2284(18)	10471(81)	197(2)	55343

2003	8348	2438(29)	5722(69)	188(2)	58702
2004	6948	2669(38)	4077(59)	202(3)	48792
2005	23115	13488(58)	9627(42)	0	63283
2006	20928	11971(57)	8842(42)	115(1)	85582
2012	12462	NA	NA	NA	89897
2013	7361	5041(68)	2180(30)	140(2)	113858
2014	6681	1882(28)	3129(47)	1670(25)	134235
2015	3845	800(21)	861(22)	2184(57)	92513

Source: CMFRI annual reports. Note: Figures in the brackets are parentage;
NA: Not available; Data during 2007-2013 are not available

Dams affect the natural flow of rivers by reducing the quantum and speed of the flow of water. While dams serve the purpose of irrigation and electricity generation, they also greatly impede the flow of water, nutrients and sediment – particularly in the form of sand – from reaching the sea. The long-term effect of reduced fresh water flow into the sea also increases its salinity levels with a possible impact on climate patterns. Over time, the cumulative effect of numerous large dams can seriously hurt the productivity of the sea by starving it of vital nutrients, thus affecting marine life. But there are other equally untoward consequences. For instance, the quantity of the sediment flow into coastal waters is reduced and its quality also changes. This upsets the natural balance of littoral sand transportation along the shore and contributes significantly to coastal erosion, which has harmful effects on the occupations and homes of fishing communities. These twin adverse effects are now starkly felt in many of our western coastal states, where most of the rivers flow from the Western Ghats into the Arabian Sea and have been dammed for over three to four decades.

River sand mining is another activity with far reaching impacts on coastal zone shorelines adjacent to river deltas. The erosion of the coastline is caused because of complex interactions between river flow, waves and the tides. Excessive mining of river sand creates hungry water – without sediments and nutrients – further exacerbating the productivity loss of coastal waters.

Box No. 2. Sand mining in coastal areas

The river beds, banks, fish and all the other organisms living in and around the river are a major source of livelihood for the traditional communities who live there. The river beds have sand, which is extracted for both domestic and commercial use. However, the excessive removal of sand, boulders and stones from the rivers, creeks, estuaries and beaches can destroy the river beds, affect the fish catch and clam collection in that region. It may cause river bank erosion, changes in the flow pattern, intrusion of saltwater into adjacent water bodies. Moreover, in coastal areas, this can potentially lead to land erosion and intrusion of seawater during high tide. Sand mining, (the removal of sand, boulders and stones from riverbeds and beaches), is an activity which is regulated through various national and state laws. Legally, it can be carried out only after obtaining permissions and with mandatory safeguards.

The National Green Tribunal (NGT), has directed that the states should strictly follow Sustainable Sand Mining Management Guidelines of 2016 framed by the MoEF&CC where sand ghats were auctioned by following district survey report (DSR).These guidelines call for preparation of DSR and management plan and envisage mapping of the resources at district level, identification of appropriate sites for extraction, appraisal of the extraction process etc. Mining can be allowed manually and only up to the depth of 3 metres. The bench said the system shall enable the authorities to develop periodic report on different parameters like daily lifting report, vehicle log/history, lifting against allocation, and total lifting. This will enable the district collector to get all the relevant details and will enable the authority to block the scanning facility of any site found to be indulged in irregularity. If in the course of mining, damage is caused, the same must be recovered from such violators.

There are various steps that might be required to understand the legal status of sand mining before pursuing any remedy or seeking a regulatory response from concerned authorities. These are specified in three sections:

Section I: The collection of background information, including but not limited to identification of the location and the lease area and obtaining clearance letters issued for the mining operations.

Section II: The understanding of legal hooks which one can use to form the basis of a complaint.

Section III: The identification of the appropriate government authority, to which the complaint is to be filed. What is the information required?

Sl.No.	Documents	Issued under	Institutions
Prior Permission			
1	Environment Clearance (EC) for Category B1 projects	Environment Impact Assessment (EIA) Notification, 2006	State Environmental Impact Assessment Authority (SEIAA)
2	EC for Category B2 projects		District Level Environmental Impact Assessment Authority (DEIAA)
3	CRZ clearance (in case of estuarine beds and coastal area)	Coastal Regulation Zone Notification, 2011	State Coastal Zone Management Authority

			(SCZMA
4	Forest clearance(when forest land is involved)	Forest Conservation Act, 1980	Forest Department (Division Forest Officer)
5	Panchayat clearance for sand collection	Panchayat Raj Act, 1991	Village Panchayat

To establish if approval has been taken or not, the documents specified in this section will need to be collected and examined, along with exact location referring to a village map. The location, validity of the clearances, Global Positioning System (GPS) coordinates of the length and width of sand bar, the approved area (in hectares) will be available in the EC, and are useful information.

Source: Team CPR-Namati Environmental Justice Program India Water Portal 2017

Pollution from rivers and their banks is the most well-known and visible negative effect of terrestrial activities that despoil the coastal zone. From the landscape perspective, the coastal zone is at the tail-end of the ecosystem. As a result, all the run-off from fertilisers and pesticides used in agriculture, industrial effluents and urban sewage waste ultimately find their way to the coastal waters. Industries along the coast make substantial demands on fresh water too, and send chemical and thermal pollution directly to the coastal waters. The pollution load often affects the quality of coastal ground water. It also ruins the productivity of coastal vegetation such as mangroves. Runoffs of the chemical inputs into agriculture cause harmful algal blooms known as red tides in the coastal sea. Discarded plastics sink to the bottom of the sea and destroy coral-reefs, and are also ingested by fish. Waves and tides wash plastic garbage back onto beaches spoiling their aesthetic beauty and hurting economic activities such as tourism. Coastal ecosystems and the people living on the coast thus bear all these negative effects of land-based water pollution. The impact of mangrove loss on the pelagic fish population is not known but many species rely on mangroves as nursery areas. The loss of mangroves may be one of the causes of pelagic fishery catch decline.

Box 3. Story of CEPI at Mangalore

In 2009, the Ministry of Environment &Forests(MoEF), Govt. of India in association with Central Pollution Control Board (CPCB), New Delhi and Indian Institute of Technology (IIT), New Delhi have carried out an environmental assessment of industrial clusters across the country through Comprehensive Environmental Pollution Index (CEPI) to identify polluted industrial clusters & to prioritize planning needs for intervention to improve the quality of environment in these industrial clusters and the nation as a whole. It was concluded that the industrial clusters/areas having aggregated CEPI scores of 70 and above were considered as critically polluted clusters/areas and those with

scores above 60 were classified as Severely Polluted. Baikampady Industrial Cluster Mangalore with CEPI score 73.68 was declared as Critically Polluted Area by MOEF.

Industry specific action plans were prepared and implemented. Few action plans were Establishment of CAAQM Station at Baikampady Industrial Cluster on PPP model, Transportation of LPG through pipelines instead of tankers by oil companies. Cleaning of roads and maintenance of roads besides planting of trees to avoid dust problems. Providing UGD system to the entire Corporation area and establishment & operation of STP to treat the sewage to the required standard. Treated Effluent from MRPL 3rd phase ETP of the industry shall be discharged into sea through MSEZ pipeline to meet KSPCB standards, Installation of RO plant for Treated Sewage water from Mangalore, Explore the possibility of recycling/reutilization of treated effluents in order to reduce the quantity of discharge as well as water consumption etc

These action plans were implemented and monitored through Local Area Committee (LAC) through review meetings at a regular interval to review the status of implementation of CEPI action plans. As a result, the recent assessment of CEPI has indicated a score of 59.44 and KSPCB has already submitted the report to CPCB for reconsideration. This effort has clearly indicated the commitment by different stake holders in reducing the pollution and protection of different environmental attributes. This has also supported the cooperation & combined effort of everyone in the protection of environment.

Another view was that the CPCB revised its methodology which became much weaker by removing the critical factors used to construct Comprehensive Environmental Pollution Index

(Source: Personal communication from Dr. D R Ravi Officer Karnataka State Pollution Control Board, Bangalore

The Convention on Biological Diversity (CBD,1993) identifies mariculture as one of the fastest growing food industry. However, CBD cautions the disadvantages of using high nutrients, antibiotics, the disposal of mariculture wastes, accidental releae of alien species, trasmission of diseases to wild stock, and the displacement of local communities. The studies show that the shrimp farming which gained popularity during 1990s-2000 could not be regulated by using water Act 1974 and also Environmental (Protection) Act 1986 and did not address the problems of degradation of coastal ecosystems. The draft mariculture policy of the Government of India

3.2 Absence of Economic Valuation as a Basis for Sustainable Management

Assigning a monetary value to ecosystem services in coastal/marine areas will help to raise awareness of the importance of the services that upstream systems provide to downstream users. For example, when biodiversity conservation or carbon sequestration in mountain ecosystems is expressed in monetary terms, it will highlight the significance that these ecosystems have for local, national, regional, and global communities, and can help to overcome existing policy dilemmas concerning their conservation. Valuation of ecosystem services is essential for creating a market. Economic valuation of ecosystem services not only demonstrates the importance and value of coastal and marine ecosystems, but also provides insights about the gains and losses

faced by different stakeholders directly or indirectly due to ecosystem degradation and subsequent loss of these services. Economic valuation can contribute to conservation by rewarding communities for their conservation services of the ecosystem resources. Valuation also helps in deciding between different policy options, in identifying more efficient and cost effective alternatives, and in designing appropriate institutional and market (and non-market) instruments, including payment for ecosystem services (PES). Valuation will play an important role in decision making and prioritisation in resource allocation, distribution, and management. In many countries, investment decisions on public goods and utilities such as dams, roads, and others often ignore the possible impacts (and real financial implications) that these activities have for the environment and for livelihoods (Bateman et al. 2010). Pearce (2001) argues that measuring the economic value of ecosystem services is a fundamental step in conserving resources since "the pressures to reduce biodiversity-based goods and services are so large that the chances that we will introduce incentives [for the protection of biodiversity] without demonstrating the economic value are much less than if we do engage in valuation". The Convention on Biological Diversity's Conference of the Parties decision IV/10 acknowledges that "economic valuation of biodiversity and biological resources is an important tool for well-targeted and calibrated economic incentive measures" and encourages parties, governments, and relevant organisations to "take into account economic, social, cultural, and ethical valuation in the development of relevant incentive measures". The provision of services are thus interlinked World Bank (2013) has put together the value of ecosystem services from the major biomes in India. The total value has been estimated as Rs. 1.4 trillion in 2009 – which is about 3 percent of India's GDP in that year. It may be noted that although the atmosphere provides a 'provisioning' ecosystem service in the form of clean air and water, the ecosystem service valuation exercises (including World Bank, 2013) do not typically account for such services. This partly explains the divergence between the cost of environmental degradation and the value of ecosystem services estimated for India in 2009. Among the ecosystems and their services valued in World Bank (2013), wetlands including coastal wetlands, account for the highest percentage (48 percent), followed by coral reefs (22 percent). The total value of the provisioning services estimated amounts to Rs. 383 billion. The total value of the regulating services estimated is roughly 1.7 times that of the provisioning service value at Rs. 655 billion with a value range of Rs. 561 – 756

billion. The total coastal recreational value is estimated at Rs. 453 billion. The total value of coastal and marine ecosystem services in India is approximately Rs. 1.5 trillion, of which provisioning services account for 26 percent, regulating services account for 44 percent and coastal recreation accounts for 30 percent of the total value.

Box. 4. Economic Value of Bivalves

Mussels, clams, and gastropods are used as fish bait. A number of species of Molluscan soft bodies and their shells are used in the treatment of various diseases and preparation of medicines and medicinal oils. The pearl oysters and other molluscan shells fished for decorative and ornamental purposes are of considerable commercial importance in Madagascar, Western Australia, Philippines, Japan and Ceylon. In India, among bivalves the shell of the windowpane oyster, Placuna placenta, is used for glazing windows and verandah roofs. The calcium rich bivalve shells are mainly used for making lime, poultry feeds, prawn feed and fertilizers. The shells are directly used for the production of high grade cement. The lime is used for white-washing and for chewing with betel pan. Lime is used in neutralizing acidic agricultural soils. The commonly used bivalve species for lime manufacture in the Aghanashini estuarine region are the Paphia malabarica, Meretrix meretrix, M. casta, Katelysia opima and Vellorita cyprinoids.

The Catchment of Aghanashini river received higher rainfall from 2500 mm to 6500 mm. Due to this heavy rainfall spread across four months of a year from June to September, soils in catchment leech- out. Nutrients including calcium flow through the river and deposited in estuary. Additionally, Calcium rich lime stone formations like Yana rocks and surrounded region may add higher calcium to this flow. Bivalves form their shelves using such deposited calcium. Production of bivalves directly related to the nutrient flow in river valley

Aghanashini estuary with 4940.7 ha of water spread area, about 119.36 ha area is covered with mangrove and another 732.5 ha potential area for mangrove growth. There are about 45 mangrove associated species with over 12 species of mangroves within the estuary. (CES, 2012). For this ecosystem to remain productive, some form of protection is needed for the network of mangroves, tidal waters and coastal

land. Some parts of the estuary are protected through CRZ notification as CRZ I areas but this does not extend to the entire estuary. The estuary acts as a sink for calcium which is collected from the upper ghat region. Erosion of calcium from the upper ghat region makes the landscape more acidic in nature. Farmers in upper ghats region put powders of calcium rich shells, collected from shell mining from the estuary to maintain the PH level of their farm. Productivity of Aghanashini river especially estuary results in rich production of fishes. Boominathan *et al.* (2008) documented the diversity and distribution of edible bivalve species they found that the bivalve collectors collected eight different species of edible bivalves and the edible bivalves were popularly categorized into clams, mussels and oysters. The bivalve harvested in this estuary was estimated to be 22,006 ton per year, which generated a total primary annual net income of about ₹57.8 million. There are three major clam beds in Aghanashini Estuary. They are located near Tadri, Betkuli and mirjan – Hegde. All these clam beds together extend to an approximate area of about 300 ha in estuary. Department of Mines and Geology leased clam beds for extraction of shells. Data from 2011 to 2016 shows that 30107 tonnes of shells have been despatched out of the estuary providing a revenue of Rs. 24, 60, 947 to the Government. However, villagers and some experts feel that quantity of shell extracted from estuary is much higher than the quantity reported by the Department of Mines and Geology. Thus the decline in bivalve production from 12952 tons in 2002 to 3845 tons in 2015 could have been due a multiple factors such as declining nutrient flow, over extraction of shells, sand mining and impact of surface water temperature. The research and development institutes could introduce technology extension services and infrastructure for culturing of bivalves in the region to supplement income and employment to the local communities.

As per the information provided by the Karnataka Forest Department, about 1242.50 ha area is planted with mangroves (man-made mangrove plantations). Mangrove eco-systems support both commercial and recreational fisheries, boating, bird watching and photography. They also attract tourists, nature lovers and researchers. The people living in the coastal region are well aware of the beneficial role of mangrove forests in mitigating the harsh effects of cyclone. People are fully aware that mangrove forests have reduced wind velocity, sand drift, salt-spray and erosion of sea bank and stabilized sand dunes. One of the most disasters that occurred on 26th December 2004 was tsunami which affected the lives of millions in Asia But as per a few reports; wherever mangroves were intact they had actually reduced the harsh effects of tsunami.

3.3 Measures to Address the Ocean Acidification and Shoreline Changes

Recognizing the need to address these issues in a coordinated manner, Prime Minister's Council for Climate Change (PMCCC) has directed to launch a Coastal Mission jointly MoES and MoEFCC in a coordinated way for the entire coast of India. The Coastal mission should combine scientific studies, protection measures and climate projections generated by MoES along with integrated Coastal Zone management programs carried out 3 coastal states by

MoEFCC. Climate change driven sea level rise, variations in the local wave climate, storms /cyclone intensity etc have direct impact on coastal areas. The major issues being faced currently in coastal region are:

- accelerated changes in shoreline- loss of beaches and closures of inlets,
- degradation /changes of coastal habitats and land use- land cover
- changes in coastal and marine environment, ecosystem and productivity
- changes in biological marine system, coastal resources- fisheries
- increased levels of flooding due to extreme events, and
- Changes in islands, including coral islands.

In order to understand these issues, it is important to have adequate knowledge and information on coastal processes because of the dynamic nature of coastal zone both terms of space and time. There is a need to address these issues through development of systematic and scientific techniques, in a coordinated way considering all the concerned stakeholders. The objective is to establish an Integrated GIS based coastal management system for the entire coast of India for coastal developmental activities and protection of coastal areas. There is a need to build robust resilience GIS based coastal and island management system to deal with various vulnerabilities to various hazards (with coordinated and scientifically demonstrated approaches. In addition, the long-term variations in the coastal zones, potentially caused by climate change (sea level rise) could be dramatic which demand careful understanding and estimations of coastal processes, which require continuous scientific experiments.

Rising sea level and shoreline erosion will also imperil critical habitats for many commercially important fisheries that depend on near-shore waters for either permanent residence or nursery area. Coastal management agencies find it difficult to strike a balance between the pressures of coastal development and the conservation and protection of the coastal environment. Increased cyclone activity and rising sea levels already threaten shoreline habitats, as well as productive wetlands, particularly on the east coast of India.

A large number of data/products are generated to address the various issues. The major coastal issues including sea level rise having direct relevance to `*Coast* ‘are considered for National

Coastal Climate Mission (NCM). In order to understanding the coastal process/issues, a systematic observation system, research and development, numerical modelling to address the coastal issues and providing the services /information to public and coastal managers on various ICZM aspects are considered major component for NCM proposed by Ministry of Earth Sciences.

Since, the coastal issues are highly complex, multidisciplinary, and multi-sectoral involving a large number of stakeholders, it is important to address these issues in holistic, coordinated and integrated way by all the concerned ministry/departments viz., MoEFCC, MoES, Central Water Commission, and coastal states/island territories. The overall objective of the India Integrated Coastal Zone Management Programme is to support the Government of India and selected states in developing and implementing an improved strategic management approach for India's coastal zones to preserve the long-term productivity of this highly populated region for continued sustainable development and economic growth. The objective of the project will be achieved through a combination of targeted capacity building interventions and demonstrative investments that would enhance the implementation capacity of responsible agencies.

3.4 **Regulation of overfishing, illegal, unreported and unregulated fishing**

Illegal fishing refers to activities: conducted by national or foreign vessels in waters under the jurisdiction of a State, without the permission of that State, or in contravention of its laws and regulations; conducted by vessels flying the flag of States that are parties to a relevant regional fisheries management organization but operate in contravention of the conservation and management measures adopted by that organization and by which the States are bound, or relevant provisions of the applicable international law; in violation of national laws or international obligations, including those undertaken by cooperating States to a relevant regional fisheries management organization.

Unreported fishing refers to fishing activities: which have not been reported, or have been misreported, to the relevant national authority, in contravention of national laws and regulations; or undertaken in the area of competence of a relevant regional fisheries management

organization which have not been reported or have been misreported, in contravention of the reporting procedures of that organization.

Unregulated fishing refers to fishing activities: in the area of application of a relevant regional fisheries management organization that are conducted by vessels without nationality, or by those flying the flag of a State not party to that organization, or by a fishing entity, in a manner that is not consistent with or contravenes the conservation and management measures of that organization. It is estimated that IUU fishing accounts for 30% of total catches for some fisheries globally (WW F 2008). In addition, IUU fishing makes up 15-20% of global high seas fishing which in 2005 was worth $1bn (FAO 2009b)

Fisheries regulation up to 12 nautical miles from the shore is a responsibility given to individual states in the Indian constitutional framework. Governments in some states formally or informally reserve portions of their territorial waters for specific gear types; many, for example, prohibit mechanized fishing in near-shore waters where traditional, non-motorized and small outboard motor crafts fish. States may also license both coastal and offshore fishing and make various regulations, under their respective marine fisheries legislations, though the strength and regularity of enforcement varies. For example, in 2012, Karnataka's Fisheries Directorate attempted to institute a ban on engines above 250 horsepower, a regulation that was scrapped after quick and heavy lobbying from mechanized boat owners. Individual states also offer a number of schemes for the welfare of fisheries. For example, many fishing operations rely on subsidies for fuel and other supplies to stay afloat. The central government's Ministry of Agriculture and Farmers Welfare, governs fisheries beyond 12 nautical miles and up to the boundary of the Exclusive Economic Zone (EEZ), which is as far as 200 nautical miles from shore. Due to more onerous licensing requirements and lower capacity, few Indian fishers venture far into centrally governed waters. The central government, in 2006, set up the National Fisheries Development Board (NFDB) to provide financial and institutional support for development of marine and inland fisheries and aquaculture. Enhancement of production and productivity remains the core mission of the NFDB. The Marine Products Export Development Authority (MPEDA) is another key piece of central government bureaucratic infrastructure devoted to fisheries development. However, a management system based on rights among the resource users or community groups is needed.

During the past 10 years the Coast Guard, fishing federations and Indian Ocean Tuna Commission (IOTC) has received several complaints about foreign vessels illegally fishing in Indian waters. Many foreign fishing vessels have duel registration which is illegal under Section 435 of the Merchant Shipping Act 1958.

There is a strong economic incentive for both mechanized and non-mechanized fishers to fish during the monsoon period. Fishers are able to harvest highly valuable commercial fishes and shrimps with less fishing effort during the monsoon period. In Karnataka, the fishing ban remains imposed from June 15 to August 15 with exception to the traditional boats fitted with engines up to a capacity of 10 horsepower. However the debate — and discrepancies between the Supreme Court and state directives — has created uncertainty for traditional fishers for whom fishing is not merely an occupation but a way of life. This issue requires strategies to make a trade-off between conservation and livelihoods. The 1995 Food and Agriculture Organisation of the United Nations [FAO] Code of Conduct for Responsible Fisheries highlighted the importance of protecting the rights of subsistence, small-scale and artisanal fishers and fish-workers to a secure and just livelihood through preferential access to traditional fishing grounds and resources while deciding on the use, conservation and management of fisheries resources (Anonymous 2008). As mentioned in Gujarat Fisheries Act section 6 (4)b In the case of trawl net, permission for operating only square mesh of minimum 40 mm size at that cod end portion should be permitted.

To combat illegal fishing, a catch certificate must accompany fish imported or transhipped in the European Union, USA and other developed countries. Rules should be framed to obtain the catch certificate for catches destined for export to such countries. If a country fails to adhere to the guidelines to prevent and eliminate illegal, unreported and unregulated (IUU) fishing, it risks a temporary ban from the seafood market in the importing country.

In order to avoid the harvest of juvenile fishes, mesh size regulation should be imposed on the net manufacturing factories and patrolling by vigilance team (consisting of both officials of government and representatives of fishermen organizations) need to be initiated in all the fishing ports and landing centers. Surveillance system should be developed in all the fishing ports. The

government should take necessary steps to limit the adverse impact of climate change, Night fishing, light fishing, high speed engines, bull trawling, and other destructive fishing practices. Proper monitoring of sea water about level of pollution is required to be done with a representative from the fishermen associations and the reports must be available to all the stakeholders. In fishery related decision making bodies, the representation from fisherwomen association should also be given the chance. Government should introduce the social security measures like pension scheme, insurance to all the fish workers. Changes in the fisheries sector substantially affected the their livelihood in the form of non-availability of fish in adequate quantity, decline in coastal space for fish processing activities, competition from men traders and growing number of fish retailing shops. Therefore, there is a need to protect the livelihood of women fish retailers who sell fish in fixed market places and head-loaders.

Use of high HP boats for trawling resulting in unsustainable fishing practices was discussed during the 10th meeting of the Standing Committee of Southern Zonal Council held on 28.11.2017. Decision of Standing Committee of Southern Zonal Council was:- "The Standing Committee advised DAHD&F to constitute a Committee to look into the aspects of banning/ regulating high HP boats and send the report to DGFT for its consideration."

In this connection it is relevant to mention that 'Fishing within the 12 nautical miles of territorial waters comes under the jurisdiction of respective Coastal States/UTs. The Fisheries Department of the coastal States/UTs are registering their fishing boats under Merchant Shipping Act, 1958 following the uniform registration regime i.e., 'ReALCraft'. The method of fishing, gear-type, net/mesh-size and engine power etc. are regulated by the respective States/UTs in accordance with their 'Marine Fishing Regulation Act' (MFRAs). Moreover, the National Policy on Marine Fisheries, 2017 (NPMF) in its para-12 recommends for framing of a Capacity Appraisal Framework for fisheries management. Para-20 of the NPMF, 2017 also recommends for updating legislations(s) to meet the standards. It is also relevant to mention that the CIFT, Kochi has been engaged in studies regarding maximum HP of the boat engines and had made certain recommendations on the same including 250 HP engine for boats of length up to 20m. The Standing Committee of Southern Zonal Council, recommended following definitions for classification of deep-sea vessels.

Table 3.2 Classification of Fishing vessels

LOA of fishing vessel	Maximum allowable Horse Power
Up to 15.0 m	140 HP
15.0-17.5 m	200 HP
17.5-20.0 m	250 HP

Source: Government of Kerala Notification 2018

3.5 Need for Marine Protected Areas for Conservation

In situ conservation of biodiversity and protection of marine habitats constitute international obligations under article 8 of the CBD and article 194 (5) of the UN Convention of the Law of the Sea (UNCLOS). Among these commitments, CBD Aichi Biodiversity Target 11 states that: "By 2020, at least 17 per cent of terrestrial and inland water, and 10 per cent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes." "An MPA has been defined as "any area of intertidal or sub tidal terrain together with its overlying water and associated flora, fauna, historical cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment" [Resolution 17.38 of the IUCN General Assembly, 1988, reaffirmed in Resolution 19.46 (1994)]. They occupy 2.8% of global ocean, but provide a plethora of ecological and economical services. MPAs in India comprised of national park and sanctuaries, with national parks accorded higher level of protection than sanctuaries. These MPAs cover coastal wetlands, mangroves, coral reefs, lagoons, seagrasses beds and other biologically active resources. All the MPAs in the country are notified under the Wildlife (Protection) Act, 1972 and fall in category I and II of IUCN categories of Protected Areas (PAs).

Although, most Indian fisher organizations are against this concept, this would become essential in future years to conserve and protect spawning stocks of our commercial fish stocks. Already many Southeast Asian countries have set up fish refugias to protect their spawning stocks.

Currently, there are 31 MPAs (majority in A&N). The current area under MPAs is 6.16 per cent of the area in the coastal biogeographic, which is proposed to be expanded to 7.12 per cent. Protected Species under the Indian Wildlife Protection Act 1972 include all marine mammals, corals, gorgonids, sea cucumber, sponges & sea horses, 7 sharks, 2 rays, 1 skate, 1 giant grouper, 4 bivalves, 1 cephalopod 19 gastropods. The draft proposes to remove the ban on reclamation of land in coastal areas for commercial or tourism activities even in ecologically-sensitive areas. In doing so, it does not adequately acknowledge the coastal areas. Sand dunes, for example, are natural bulwarks against strong sea winds and high waters. Mangroves, the tiny forests along the coastlines, cushion the impact of tidal waves. Flattening them in order to construct tourism infrastructure compromises the coast's resilience to natural calamities.

Wetland (Conservation and Management) Rules 2010 observes that wetlands are like "biological supermarkets" and the area of marsh, fen, peat-land or water, natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salty, including areas of marine water, the depth of which at low tide does not exceed 6 m. The Ramsar Convention suggests "wise use" of wetlands and sustainable utilization for the benefit of mankind in a way compatible with the maintenance of the natural properties of the ecosystem (Ramsar Convention on Wetlands of International Importance 1971). India has 26 Wetlands of International Importance (Ramsar Sites) covering an area of 12,119.03 km2. But Karnataka does not have even a single Ramsar site.

The Sea Bird project claimed to be the largest in Asia, has already displaced 4779 families from 13 villages of Karwar. 8423 acres of prime coastal and agricultural land has been acquired for this project. We suggest that the entire area could be notified as marine protected area under the Wildlife Protection Act since fishing is strictly prohibited in this area due to security reasons.

3.6. Control and Reduction of Fishing Subsidies

The discourse linking fisheries subsidies to over fishing and environmental degradation has gained momentum globally and influences trade relations and environmental geopolitics. While these concerns are in reference to the mechanised fishing fleets of both developing and

developed countries, subsidies targeting small scale fisheries have also come under the scanners. Subsidies and state intervention are essential for the sustenance of small scale fishery across the world and is also necessary to promote sustainable practices. Results show that the reasons for the poor responses to subsidies are: inadequate communication and promotional measures by government agencies, persecution associated with the procurement of the subsidy. The study identified areas for reform in the information dissemination processes. It also pointed to technical, political and social factors that could prevent small scale fishers from relying on state welfare measures as a security against vulnerabilities.

Provision for capital and operational subsidy for primary sector such as agriculture, horticulture, animal husbandry and fisheries are common in order to minimize the vulnerability of the families to natural risks of uncertain catch and risks of adopting capital intensive technologies for augmenting production. The gross income from fishing has been stagnating in spite of increased exports and increase in price index. The results indicate that nearly 60% of the fishing income is now realized from exporting 40 % of the total production in Karnataka. The catch per unit of fishing effort (CPUE) has been declining for the small scale fishers due to indiscriminate fishing by the mechanized and deep sea fishing. The average catch per unit of fishing effort of small scale fishers with less than 70HP was only 615 kg compared to 2055 kg for mechanized trawlers with greater than 130 HP. Even the average gross return per effort was only Rs. 5652 for small scale fishers compared to Rs. 37222. The fishing vessels with greater than 130 HP harvest quantity is four times greater than fishing boats with less than 70 HP.

Table 3.3 Income and catch per unit of fishing effort in Karnataka

Particulars	**Horsepower classification**			
	> 130 hp (*n*=135)	**91-130 hp** (*n*=86)	**71-90 hp** (*n*=18)	**< 70 hp** (*n*=31)
Average expenditure in a season for the purchase of diesel in Rupees (mean)	3350902	2125362	1419400	910493
Average catch per effort in Kg (mean)	2055	4066	1338	615
Average gross return per effort in Rupees (mean)	37222	38900	6189	5652
Total fish harvest in Kg (mean value)	46310	28059	10000	9836

Source: Primary data 2015-16

Hence, removal of diesel subsidy could affect the income and employment in fishing and fishery related sectors. The diesel subsidy should not lead to over-exploitation of the resources and indiscriminate use of un-sustainable fishing practices. Hence, we recommend that the fuel subsidy may be linked to the adaptation of the existing management regulations as per the Karnataka Marine Fisheries Regulation Act. Thus those fishing boats which adopt the management regulations such as mesh size, zoning of fishing areas, closed seasons (monsoon ban) strict adherence to limits to fishing capacity (HP and size) may be given incentives and subsidies rather than giving subsidy to each and every licensed boats. At present as per the fuel subsidy policy discrimination is not made between approved method of fishing and prohibited method of fishing. Highly destructive fishing practices such as bull-trawling, night fishing and other un-sustainable practices should be discouraged by completely withdrawing the subsidy to these fishing units.

As the fishing intensity increases (horse power of the engine and size of the boat) the demand for subsidy also increases since the operation becomes more energy oriented. On an average a deep sea vessel with greater than 130 HP receives Rs. 7.50 lakh rupees as fuel subsidy @ Rs. 10.00 per litre. On the other hand a small scale fishing unit with less fuel demand is eligible for smaller subsidy and receives Rs. 80, 000-100,000 as fuel subsidy. We recommend that the government may follow the principles of progressive subsidy in which the rate of subsidy decreases with increase in fishing intensity. Thus the fuel subsidy for a fishing boat with greater than 130 HP engine capacities would be limited to Rs. 4.50 lakh @ Rs 5.00 litre and a small fishing boat would continue to get the diesel subsidy @Rs. 8.00 per litre.

The use of kerosene by small engine boats is mainly limited to reach the fishing ground and their capacity to pull the fishing nets is not enough. Thus the kerosene is a viable fuel only for smaller outboard engine boats within 10-15 hp engines. The present availability of kerosene is only around 220-250 litres per boat per month which is hardly enough to meet the requirements. Hence the restrictions on the supply of kerosene could be relaxed and released through open market operations. The government must invest in substituting non-renewable fuel with solar and other renewable sources by increasing the installed capacity.

Table 3.4 Level of poverty among Fishing Communities in Karnataka

	Year	Total No. households	No. of BPL families	Percentage of BPL families
D.K	2010	4570	1485	32.49
	2016	3610	1304	36.12
UDUPI	2010	9907	7650	77.22
	2016	11976	10150	84.75
U.K	2010	16236	14489	89.24
	2016	16893	15858	93.87
TOTAL	2010	30713	23624	66.32
	2016	32479	27312	71.58

Source: Estimation based on Marine Fisheries Census 2010 and 2016, CMFRI, Kochi.

3.7 Scientific knowledge, develop research capacity and transfer marine technology

The Ministry of Agriculture and Farmers Welfare collects, collates and compiles data on marine fish landings and fishing fleets through the state governments, fisheries departments and central institutions like the CMFRI and the Fishery Survey of India (FSI). Under the Ministry of Agriculture and Farmers Welfare, it is the responsibility of the Department of Animal Husbandry, Dairying and Fisheries (DAHDF) to report national fisheries statistics to international agencies, such as the FAO. Regarding the coastal fishery around mainland India, the CMFRI collects data on fish landings through a stratified multi-stage random sampling procedure. The Government of India introduced a centrally sponsored scheme called Strengthening of Fisheries Database during 12th Five year Plan and identified Central Marine Fisheries Research Institute as the nodal agency for collecting and dissemination of marine fisheries production data and Central Inland Fisheries Research Institute-CIFRI as the nodal agency for inland fish production. India has a huge network of institutes under different organizations to carry out R&D in fisheries sector. These include: (i) Indian Council of

Agricultural Research (ICAR); (ii) Ministry of Agriculture and Farmers Welfare (iii) Ministry of Commerce and Industry; (iv) Ministry of Food Processing Industries; (v) Council of Scientific and Industrial Research (CSIR); and (vi) State Agricultural Universities. Many other organizations/agencies also support/conduct R&D in fisheries; these include the Ministry of Earth Sciences, Department of Science and Technology (DST); Department of Biotechnology (DBT); University Grants Commission (UGC); Indian Institutes of Technology (IITs); Indian Institutes of Management (IIMs) voluntary agencies/ private industries. The need for credit support for facing the emerging market forces and harnessing the benefits of technological developments has been realized and some measures have been evolved to enhance the flow of credit to the fisheries sector. The National Bank for Agriculture and Rural Development (NABARD), as a refinance agency for commercial banks, co-operative banks and regional rural banks has been the major facilitator of credit to the fisheries sector. Many financial institutions like Industrial Finance Corporation of India (IFCI), Industrial Development Bank of India (IDBI), Shipping Credit and Investment Company of India (SCICI), State Finance Corporations (SFCs) and National Co-operative Development Corporation (NCDC) have also entered this sector to lend credit for deep sea fishing. Credit support from financial institutes is available for almost all the activities of fisheries and for creation of infrastructure. However, there are some weaknesses and threats to the fisheries sector, which need to be addressed if the sector has to achieve the production projections.

Previously, registration of fishing vessels was done by the Coastal States/UTs under their respective Marine Fisheries Regulation Act (MFRA). However, some States like Karnataka and Gujarat were doing registration under the Merchant Shipping (MS) Act. After the Mumbai terrorist attacks on 26th November, 2008, it was decided to have a uniform registration system for registration of all types of fishing vessels irrespective of their size and tonnage. This registration is now done under the Merchant Shipping Act, 1958 (MS Act) and the Coastal State Fisheries Departments have been presently empowered to do the registration of fishing vessels. The Ministry of Shipping (MoS) had on 24th June, 2009 notified a format for uniform registration of fishing vessels and also the State-wise registrars as identified by the States/UTs. The Department of Animal husbandry, Dairying and Fisheries (DADF) through the National Informatics Centre (NIC) has developed a uniform web based registration regime (***ReALCraft***)

for online registration of fishing vessels. *ReALCraft* is a work-flow based online application system for registration of all category of fishing vessels under the MS Act and issuance of fishing license under the Marine Fisheries Regulation Act (MFRAs) to the fishing vessels operating in the Indian waters. Registration under the ReALCraft done is being done by the notified registrars of the Department of Fisheries of all Coastal States and Union Territories (Registrars are notified by the Ministry of Shipping). As on 20th June, 2018, a total of 2,56,246 fishing vessels have been registered under ReAL Craft system.

Box 5. Deep-sea Ecology and Mining As terrestrial and coastal resources dwindle, nations are increasingly looking to the deep sea to meet demands for food in the form of fish and shellfish, energy in the form of oil, gas, wind and wave, and raw materials such as gold, copper, zinc, manganese and phosphate. Fishing now extends to depths of up to 2km below the sea surface, while oil and gas extraction occurs down to 2.5km. Recently a new industry (deep seabed mining) has also begun to develop. India is contemplating development of deep-sea phosphate mining industries within their exclusive economic zones (EEZs), and India (among others) have licences to mine polymetallic nodules in areas beyond national jurisdiction (ABNJ) in the Indian Oceans. Deep-sea mining is set to be a major player in the world economy over the next three decades. The sector may supply 10% of the world's mineral resources, with an annual turnover of €10 billion, by 2030 (EU, 2012).The deep sea is the most poorly understood ecosystem on our planet and this is particularly the case for the Indian Oceans. A lack of basic data such as the identity and diversity of species present, the distribution of animals, how they respond to disturbances, and the ecological resilience of the system are of concern with respect to the development of environmentally responsible mining industry practice, and sustainable deep-water fisheries in line with SDG 14. The marine spatial planning (MSP), marine protected area (MPA) establishment, and offshore environmental impact assessment (EIA) and management within their EEZs are constrained by the poor state of knowledge for deeper (>200m), less accessible ecosystem types. The aim will be to address questions relating to the fundamental ecology of the deep-sea ecosystem to inform sustainable management and spatial planning. The marine spatial planning (MSP), marine protected area (MPA) establishment, and offshore environmental impact assessment (EIA) and management within their EEZs are constrained by the poor state of knowledge for deeper (>200m), less accessible ecosystem types. The aim will be to address questions relating to the fundamental ecology of the deep-sea ecosystem to inform sustainable management and spatial planning

The marine resources provide lot of utilities such as medicinal, nutritional, cosmetics and industrial products. Many diseases such as tumors, cancer (ovarian, colon etc) are treated by using sea squirts, sea sponges, jellyfish, chitosan and ocean floor fungil. The extracts from marine resources such as micro algae, cyaobacteria, krill etc provide nutritional products such as vitamins and anti-oxidants, vital amino acids, proteins, gelatin and food colours. The seaweeds and micro algae are being used for manufacturing cosmetics such as toothpaste, gels lipsticks and lotions. Some of the industrial products such as paper and pulp enzymes, befouling agents and adhesives are manufactured from the extracts of marine resources such as sponges, chitosan from crustaceans and molluscans.

Table 3.5 Marine biotechnology linked corporate sector

Biodiversity linked resources	Utility of the of the final products	Major industries involved
Sea squirts	Tumors, viruses, suppression of immune responses	Pharmaceutical industries
Encrusting invertebrates	Ovarian cancer	Pharmaceutical industries
Sea sponges	Herpes, simple, cancer, pain, inflammation	Pharmaceutical industries
Jelly fish	Neurological disorders, cancer, inflammation, anesthesia	Pharmaceutical industries
Chitosan	Burns	Pharmaceutical industries
Ocean floor fungi	Human colon cancer	Pharmaceutical industries
Micro algae and fungi	Vitamins and anti-oxidants and vital amino acids, gelatin and food colours	Nutrition related companies
cyanobacteria	Fluorescent tags and tracers	Nutrition related companies
Krill apart from fish, algae, plants	Proteins	Nutrition related industries
Seaweed (carrangenan)	Toothpaste and gels	Cosmetics
Pigments and cynobacteria	Lipsticks	Cosmetics
Sponges	Paper and pulp products	Industrial products
Chitosan and crustaceans, fungi	Bio-fouling	Industrial products
Molluscans	Adhesives	Industrial products

The marine organisms produce unique bioactive compounds for their reproduction, communication and against predation, infection and competition. This genetic material and chemicals in marine plants, animals and microorganisms constitute an extraordinary resource for pharmaceuticals, industrial enzymes, agricultural products and bioremediation and so on. However, there is a need to evolve laws and statutes for the exploration, protection and sustainable development of marine resources. For example dredging of sea for various industrial purposes such as construction of ports, thermal power plants and other explorations severely damage coral reef and marine resources. The restrictions on tapping the wild marine resources are also required to prevent over harvesting of these resources.

3.8 Access to marine resources and markets for small-scale fishers

India's domestic fishing fleets and the marine catch they generated have been increasing since the mid-1970s. The industrial sector contributed 35% of the total reconstructed catch, and is

dominated by catches of shrimp, small pelagics and large (offshore) pelagic species such as tuna, billfishes and sharks. The subsistence sector, which is not included in any official catch statistics, was estimated to be the second largest sector, with over 50 million tonnes and represented 33% of the total catch. The artisanal (small-scale commercial) sector contributed slightly less than the subsistence sector, i.e., 32% of the total catch. Seven paragraphs in UNCED document Agenda 21 (1992) on small-scale fishers, fish-workers, women and indigenous people 1995 UN Fish Stocks Agreement:…avoid adverse impacts on, and ensure access to fisheries by subsistence, small-scale and artisanal fishers and women fish-workers, as well as indigenous people in developing countries…" . The doctrine of public trust primarily rests on the principle that certain resources such as sea, water and forests are important for common good and it is completely unjustified to allocate it for the private ownership. These resources should be freely available to general public rather than to permit their use for private ownership or commercial purposes" (Supreme Court of India, 1996. M.C. Mehta vs. Kamal Nath and others, 13 December, Delhi). There are many cases of successful community management of coastal common areas and hence a list of priority firms/organizations should be prepared to develop mariculture as a social enterprise and not as a privately owned/leased enterprise in which accumulation happens through dispossession.

Karnataka Marine Fisheries Regulation Act in 1986 came into force in 1989 which imposed its hallmark rule — a monsoon ban on mechanized fishing for 90 days from June 1 to August 31. Traditional boats fitted with outboard engines remained exempt (GOK 1989). Facing mechanized boat owner outcry, GOK later reduced the ban (which functioned effectively as a fishing season reserved for traditional fishers) from 90 days to 65 days (GOK 2000). Vivekanandan et al. (2010) and Mohamed et al. (2013), argue for other policies (e.g. poverty benefits or alternative job creation) to address these problems without attacking a generally accepted piece of fishery governance. That is not to say that this or other regulations need no modifications. Given the above analysis, we would actually support lengthening the ban coupled with compensation for those truly suffer. But in reality the fishing ban during monsoon period has failed to achieve its prime objective as there is absence of community involvement in its implementation.

Box. 6. **Access to Coastal Space for Livelihoods**

Malpe fisherwomen society is a unique society started in the year 1977 with 297 members and initial working capital of Rs.35000 at a share price per unit is Rs 100. Subsequently Government of Karnataka contributed Rs. 100000. Out of it Rs. 40000 for share capital, remaining Rs. 40000 and Rs. 20,000 for working capital and administrative expenses respectively. In the year 2007 society refunded the entire contribution of Government. In the year 2008-2009 society had 1073 members with share capital of Rs. 148210. The uniqueness of society lies in two aspects. First one is the involvement of the society in promotion of collective enterprise of fisherwomen i.e by supplying salt to the women involved in fish drying activity. Secondly, management of leasing and maintenance of the port-land given to fisherwomen for fish drying since 1992. Nearly 200 fisherwomen involved in fish drying activity in four hectares of leased in land from port authorities. These fisher women are in the group of 4-6 members. The leased area is again sub-leased out to the co-operative members at Rs.1.50 per sq m for drying fish. Later port authority increased the lease rate to Rs. 4.50 per 10 sq.metre. But in the year 2006 port authority once againt incrased the rate to Rs. 15 per 10 sq.m (Karnataka Ports (Landing and Shipping Fees (Amendment) Rules, 2006). But this proposal was not accepted by the society and society continued to collect the lease @ Rs. 4.50 per 10 sq. m. Now the society has received number of letters from the port authorieties, directing the society to pay the lease at revised rate and warned them to pay the dues cumulatively from the year 2006 which is Rs. 470,000. In addition, port authorities also levid service tax of Rs. 32000. The hard reality is most of the BPL fisherwomen familes and fish drying is theire livelihood activity and not commercial activity. Further port has informed in wirting that for the delayed lease rent, the society has to pay a penalty which is double the amount of delayed tax and steps will be taken to vacate the fisherwomen. The collective representation and resisting the directions of the port by the society was effective in preventing the port authorities in taking actions to dispossess the drying yard which is an essential infrastructure. The society also punctually pays the annual lease rent for all the drying groups and collects the same as and when the fisherwomen groups are able to pay to the society. The present leased in land was given by the port authorities when they were displaced by the port to allot the original drying yard to the TEBMA Ship building company. At the time of displacement they were asured of better and more port-land for their activities which is under threat at present.

FAO in the year 2013 issued the Voluntary Guidelines for Securing Sustainable Small-Scale Fisheries. On the issue of customary tenure rights in most coastal areas, beach space available for fishing activities had declined drastically due to erosion, tourism, setting up industries, climate change, disasters (natural and human made), and other allied reasons. It threatened the livelihood of traditional fishermen as they do not get space for operating shore-seines and also for landing their vessels. In the past, government reserved (notified) some of the coastal land for fish curing purposes, but today such land are diverted for non-fishing activities. Whenever the fish curing-land would be leased out, the fisherwomen should be given the preference as they depend on such land for fish drying activities. Most of the coastal lands are controlled by the port department; as a result there is a scarcity of land for constructing basic infrastructural facilities at the fishing harbour. The discharge of industrial effluents, Single Point Moring of MRPL, naval

base-Seabird projects has led to a decline in the fishing space as areas where fishing is prohibited has increased, thus reducing the fertile area for fish production.

Table 3.6 Fishing conflicts and socio-ecological equity

	HP Range		
Variables	**<140**	**141-300**	**>300**
Average Commercial Catch (Kg)/Trip	698.5	4150.5	5221
Average Trash (Kg)/Trip	81	973.5	2280
Total (Kg)/Trip	779.5	5124	7501
Per cent loss of biodiversity (Trash fish)	10.39	19.00	30.40
No. of Commercial Species	40	93	90
No. of Trash species	4	18	30
Per cent loss of biodiversity (Trash fish)	3.15	16.22	25.00
Diversity Index			
Total No. of Species	44	111	120
No. of Family	31	53	60
Richness (d)	8.75	17.82	18.52
Shannon Index [H'(log10)]	1.5171	1.8521	1.8866
Simpson Index [1-Lambda']	0.9651	0.9805	0.9818

Source: Primary data collected from Mangalore fisheries harbour during 2014-15

The results presented in the Table 3. 6 show the emergence of conflicts in the distribution and share of marine fishery resources between small-scale and industrial fishing vessels. While the small scale fishers harvest only 40 species their counterparts harvest 90-93 species with higher fishing capacity. The average catch of trash fish of deep sea fishing vessels is 30 times greater

than small scale fishing units. The loss of biodiversity indicated by percentage of trash fish to total catch reveal enormous impact of deep sea fishing vessels to the extent of 25 percent.

The customary management systems related to scheduling of fishing activities, sequencing of gear use, sale of fish catch, owner-crew relations, controlling destructive fishing in their area were used to take decisions relating to fisheries, including fishing, covering the activities of women, but these systems are no longer functioning effectively. About the government-implemented management measures, that the sixty-one days fish ban has been in practice and implemented effectively. Though there are rules about monitoring, control and surveillance (MCS) systems, fishing zones, mesh size regulations and destructive fishing, such rules are not implemented up to required level.

The share of fisheries in the total value of agricultural and allied sectors has increased from 4.08% in 1995-96 to 4.65% in 2015. The share of fish in total consumption expenditure (rupees per person per month) increased from 0.18 % in 1994 to 0.27% in 2012 for rural and from 0.20 to o.25% for urban households respectively. The projected demand for fish by 2030 is 11 million tonnes which corresponds to current level of production and thus calls for increased productivity and enhancement of production increasing export share.

The infrastructure development supplemented by changing preferences led to a change in the utilisation pattern of fish. The proportion of the total production disposed in the fresh form has increased from 45 per cent to 78 per cent during 1970-2015. At the same time there has been a corresponding decrease in the percentage of cured fish from 32 per cent to 11 per cent, indicating that fish which used to be traditionally cured and dried, might have been utilised in fresh form. The shared allocation towards reduction and miscellaneous purposes has also reduced. The growing urban demand for products such as fish and prawn pickles, sausages, and chatni-powder has encouraged many women workers to undertake production of value added products. Among the important species utilised for such products are: sardines, jewfish, silver bellies, prawns and shellfish. The value added products are prepared in Malpe and Mangalore and sold in retail markets. The pink perch, which was not preferred by consumers, is now used for fresh fish consumption and by surimi plants. It is sold at the rate of Rs. 15-20/ kg to surimi plants. A few community based enterprises were established in recent years for the production and marketing

of improved dry fish which is being sold through organized marketing system. Couples of such enterprises were successful in introducing such products into super markets.

The capacity development training programmes were organized for a limited number of people to produce good quality fish and fishery products for both domestic and export markets. But there is no support after training and no follow-up from the government. In most of the landing centres, processing and storage areas and fish markets there is no adequate and suitable basic infrastructure, amenities and services to meet their business and personal needs. To reduce the loss of quality of fish, fisherwomen must be given big-size icebox and there must be a cold-storage facility at landing centres. There is no woman group engaged in supplying fish and fishery products to international markets and are willing to take up such activities, provided there is a support and assistance from the government. The export of fish to international markets resulted in fisherwomen could not get sufficient fish to trade in the local market which in turn affected their food security. The timely and adequate market information is not available to women to earn better returns.

Box 6 The New Business Model for fish retailing

The sharing of the value added generated through the ultimate sale to the final consumer should be the same compensation as a producer/processor. Change in the business model that is based on the market economy but that recognizes the unique role of the fish farmers/fishermen involved in harvesting of fish and the need to preserve the resources. Instead of subjecting the fishers to an ever lower market price which is decided by the auctioneers/buyers and the processors, the fishers should be compensated based on the consumer price. Payment of consumer price to farmer after deducting a 10 % commission on the sales price of the consumer would increase revenues of the farmers by 10-15 percent. Most farmers immediately reduce the quantity harvested and so relieve pressure on the resources. The first rule of trade that must change is the price setting for fish or other natural resource based products is sharing of value added generated through the ultimate sale to the final consumer should be the same compensation model: 10% of the sales price. This allows the farmer to imagine the size of the supply, the seasonality in the production. If the farmer on delivery of the product will be paid 90% of the average market price and the rest will be credited to his account once the product is sold. Everyone will be looking for the best quality and value instead of pushing for more volume at ever lower costs. The second shift in the terms of trade is transformation process of fish processing.

The changes in the fisheries sector substantially affected the women livelihood in the form of non-availability of fish in adequate quantity, decline in coastal space for fish processing activities, competition from men traders and growing number of fish retailing shops. The women head loaders found it difficult to sell the fish due to two-wheeler and four-wheeler men retailers. Even in the marketplaces, women lose customers due to an increase in the number of men

retailers who cover every nook and corner of the villages and cities. Schemes like Matsya Mahila Swavalabana Yojane, Savings Cum-Relief Scheme are not big enough to meet or compensate the needs of the fisherwomen. There must not be any age restriction while sanctioning benefits (compensation/insurance) to the injured or deceased fish worker under any social security measures. There is a need to formulate a policy to provide rights over coastal land, social security measures (specific to fishermen and fisherwomen engaged in fishing and related activities) and also to extend a credit facility like in the agriculture sector. Though there are organizations at different levels to provide support in their activities, these are not functioning effectively. The negative impacts of irresponsible industrial fisheries on small-scale fisheries are profound. The good news is that these dramatic scenarios can be reverse with an incredible effort from all stakeholders. The LOP (Letter of Permits) vessels were in operation during 2002-2015, were issued to Indian-owned deep sea fishing vessels. As per recommendations of the 'National Policy on Marine Fisheries 'the Guidelines for issuing LOPs were rescinded on 30th January, 2017 and all the LOPs issued earlier previously have also been cancelled in March 2017.

Box 7. Water management in fishing harbour

Acute scarcity of water for drinking for on-board vessels and establishments and maintenance of hygiene and sanitation are the major problems in Karnataka ports especially during summer months. Most of the deep sea vessels and other fishing vessels are dependent upon the water tankers supplied by private traders. Each deep-sea fishing vessel require around 6000-7000 litres of water per fishing trip with 8-10 crewmen on board. These tankers source the water from the bore-wells owned by private individuals and sell at a price of Rs. 1000-1200 per tanker. In fact each fishing boat enters into a contractual agreement with the owners of the tankers. However, during the summer months the water rate goes up to Rs.2000 /tanker and 8-10 hours of waiting time after placing orders. The vessels need fresh water for drinking, cooking, bathing and as coolant for boat engine. It is estimated that with 1250 trawlers Mangalore fisheries harbour would need at least one million litres of fresh water for each fishing trip staggered for 15-20 days. Malpe fisheries harbour requires around 1.5 million litres to meet the demands of around 2000 trawlers. In addition to the demand from bigger vessels, small-scale fishers with outboard engines also need water.

The fresh and drinking water requirements of shops, input dealers, restaurants, coffee shops, ice factories adds to the problems and maintenance of hygiene and sanitation, drainage system, solid waste management are some of the related issues. Each harbour should have a harbour management cooperative/company consisting of share holders from each category of workers, fishers, traders' commission agents and other service providers. The cooperative could charge a access fee to utilize the harbour services including the retailers who visit harbour for the procurement of fish from the landing centres.

Now, water scarcity haunts fishing boats

Tankers, which usually supply water, have hiked prices in summer

AROCKIARAJ JOHNBOSCO
@Mangaluru

"I USED to get a tanker full of water in less than 15 minutes. Now, the same task takes two-hours because there is no water in the well," says Mansoor B K of BK Water Supply at Mangaluru fishing harbour. There are 15-odd tanker truck operators at the fishing harbour, who supply drinking water to the boats going on fishing expeditions. Of late, getting water has become a laborious task for them.

Every deep sea-faring boat requires 6,000 litres of water per trip for 8 to 12 fishermen. The tanker trucks operating round the year supply water to these boats from the open wells at Kadri, at a fee of ₹800-₹1000 per tanker. "We supply water to the boats on a contract basis starting from August to May every year and take a break for two months during the fishing ban period in the month of June and July," says Ilyas, another tanker truck operator at the harbour.

While their counterparts are minting money, utilising the present water shortage to their fullest, charging anywhere between ₹1,200 to ₹2000 per tanker, these tanker truck firms stay attached to fishing industry. "Unlike them, our business is permanent and fishing boats give us business round the year. It is true that we can make quick money in these summer months, but we will have to idle away the rest of the year if we charge such prices," said Mansoor.

Arun, a boat owner, says the price of water has been marginally hiked. "They won't increase the prices all of a sudden. They will increase the prices slightly and we know they are struggling to get water in the present situation," he said. For a deep sea fishing vessel, 6,000 litres of water is very precious. Each fishing boat has a tank fitted inside. Most fishermen utilise this water for drinking, cooking and bathing, while some generous boat owners provide cans of RO purified water for drinking.

"In deep sea, 6,000 litres of water is a life-saving resource. We use it judiciously so that it lasts till we come back and we also keep a reserve in case of emergencies like rough weather at sea," says Michael, a fisherman at the harbour. A small portion is used as a coolant for the boat engine. "The health of the engine depends on our survival so we keep an eye on the coolant in the boat engine. Any time, it may require 20 litres of water as coolant," explained Ravi, another fisherman.

Fishermen leaders at Mangaluru and Malpe said the water crisis has not hampered fishing operations as of now. "Since they operate on a yearly contract, the water suppliers won't refuse water and take the pain of going far to supply water in time. However, our concern is that authorities should find lasting solutions for the water crisis because it worsens every year," said fishermen's leader Dayanand Suvarna.

Water being supplied to a fishing boat at Mangaluru Fishing Harbour | EXPRESS

Water-The lifeline of deep sea-faring fishing vessels

* There are 1,250 mechanised trawlers mostly operating from Mangaluru and there are 2,000 trawlers at Malpe taking up deep sea fishing
* Each vessel needs 6,000 litres of water for a 10-day trip for a crew of 8 to 12 fishermen
* The water is used for drinking, cooking and bathing during the fishing expedition
* A small portion of water is used as coolant for the boat engine
* There are around 15 tanker truck operators catering to fishing vessels at Mangaluru, each attending 5 to 7 fishing boats per day
* A tank load of water is priced ₹800 - ₹1000 which remains constant round the year
* At Malpe, fishermen's associations offer water to boats along with fuel at nominal prices while there is also a small number of tanker truck operators catering to boats

Unlike them, our business is permanent and fishing boats give us business round the year. It is true that we can make quick money in these summer months, but we will have to idle away the rest of the year if we charge such prices

— Mansoor B K, owner of BK Water Supply

3.9. Role of National and International law

Various laws and regulations in India are dealing with aspects of marine biodiversity under the broad goal of environment protection. These are the Environment (Protection) Act, 1986, the Water (Prevention and Control Pollution) Act, 1974 as well as the Fisheries Act, 1897, the Wild Life Protection Act, 1972 and the Forest Conservation Act, 1980. For instance, it appears that under the Environment (Protection) Act, 1986, effluents discharged by commercial shrimp farms could be covered by the definition of environmental pollutant, environment pollution and hazardous substance. The Water (Prevention and Control Pollution) Act 1974 has been enacted to provide the prevention and control of water pollution and maintaining or restoring of wholesomeness of water. The term trade effluent under this Act includes "any liquid, gaseous or solid substance which is discharged from any premises used for carrying on any (industry

operation, or treatment and disposal system), other than domestic sewage". Shrimp farmers should obtain from the Pollution Control Boards an authorization to set up any treatment and disposal system, which is likely to discharge sewage or trade effluent into a stream or well or on land.

In December 2018 the Government of India enacted the third Coastal Zone Regulation Notification. It applies to "coastal stretches of seas, bays, estuaries, creeks, rivers and backwaters which are influenced by tidal action." It is further limited by boundaries, which reduce the regulated core area to the inter-tidal zone and an adjacent 500-meter wide strip of land from the high tide line. The seaward side extended up to 12 nautical miles. It regulates a whole series of activities and uses. India's Coastal Regulation Zone is a good example of a coastal management law, which is built around a set of exiting development realities. The core of the regulation is a moratorium on new construction, such as in ecologically sensitive area, and a prohibition of most development activities between the Low Tide Level (LTL) and the high tide level (HTL). The formulation of the rules is complex and sometimes unclear as if the Government did not want to compromise all economic development activities. The annex to the Notification classifies the inter tidal zone and the landward area from the High Tide Line into four zoning categories, with fixed upland and offshore dimensions, and with different corresponding restrictions on construction and land use. Shrimp culture activities in these categories could either be excluded or authorized under special terms and conditions.

In 2014 Government of India notified access and benefit sharing (ABS) rules which has relevance to marine bio-resources. Any person who intends to access any biological resource including marine bio resources and /or traditional knowledge should seek permission from the biodiversity board. If the buyer is a trader / manufacturer the benefit sharing obligation will be on buyer and in the range of 1-3% of the purchase price of the bio-resource. Collection of fees, if levied by Biodiversity Management Committee (BMC) for accessing or collecting any biological resource for commercial purposes from areas falling within its territorial jurisdiction under sub-section (3) of section 41 of the Act, shall be in addition to the benefit sharing payable to the NBA/SBB under these regulations. ABS is like CSR (corporate social responsibility) where benefits are not direct and CSR is just 2% of profit while ABS is 2% of purchase value, so 7-10

times higher. International trade in many marine species is prohibited under various Acts and notifications. The exports of some of the species such as marine turtles, shells, gastropods (except the giant clams) are banned under the Wildlife Protection Act 1972 (WPA) and the Convention on International Trade in Endangered Species (CITES). The sea cucumber (*Beche-de-mer*) is another commercially important marine species that has very high export value. In 1982 Government of India put a ban on the export of *Beche-de-mer* below the size of 7.5 cm. In Andaman and Nichobar Islands fishing for sea cucumber is totally banned. Corals and associated species like sea-fans and sea-sponges are heavily exploited for their known sources of bio-active substances with wide application in the pharmaceutical industry. Especially sea-fans (*Gorgonids*), which constitute only source of prostoglandins and terpenoids (Hanfee, 2001). Black corals were listed in CITES Appendix II in 1981 to protect the highly exploited stony corals. However, control of coral trade is difficult since they are often collected in offshore areas not directly controlled by the coastal nations. Further, it is difficult to identify the species origin of final coral products. The urgency for protecting marine biodiversity seems to have been realized at the international and national levels. However, the anthropogenic activities that lead to biodiversity losses at the local levels are often influenced by state and local decisions. Tougher standards at the local levels are lacking. Even at the national level, only high-profile species get more protection. The part of the reason for this lop-sided or inadequate legal protection is the excessive emphasis on the market or export values of marine resources. In reality, market prices, and in turn, harvesting decisions may not take into account the societal value of the impairment inflicted on the biodiversity's ecological functions while harvesting marine biota. The following is an attempt toward developing a more comprehensive valuation framework that captures both market and non-market values of marine biodiversity.

The fishery management regulations are aimed at direct and indirect control of fishing efforts or some of its components. For example a minimum mesh size may be instituted and enforced for the purpose of regulating the size of the fish at capture. The fishery resources are renewable but exhaustible assets of mankind. The state policy should promote sustainable use of these resources for the current and future generations. It implies that the current generation has an obligation to pass on the marine resources to the future generations following inter-generational

equity principle. Therefore overharvesting of resources leading to exhaustible nature of the resources through destructive fishing practices does not ensure sustainability. If we start mining of fishing resources, the loss is not only to the current generation but also to future generations. Note that the public trust doctrine flow from Article 21 and 295/297 ensures inter-generational equity principle and Article 14 Right to Equality. From an economic theory perspective all are related with property rights. Any loss of species and biodiversity due to overharvesting and pollution are permanent.

Box 7. Marine bio resources and fishmeal industry

We observe that in Karnataka around 30-40 of rich marine biodiversity is lost annually due to fishing speed boats compared to less than 5 % by the traditional sector. Most of these resources are sold to fish-meal companies for feed manufacturing to aquaculture, Mariculture and poultry industries. The loss of marine bio resources through such conversion into feed for culture of aquatic animals is 2-3 times greater than the value of aquaculture production, in addition of subsidized fuel spent on deep sea vessels. Data indicate similar trend across the country. The loss of marine resources affects everyone while benefiting a few fish meal and oil companies rich in the short run. In the long run even the marine-based value-addition industries also might get affected. Windfall-gain by the deep sea fishing companies and fish meal companies is treated as private profits and not the sale of common inherited assets and were spent on consumption. However fishing policy should treat this revenue from deep sea fishing and fish meal companies as inherited assets. The immediate impact of such change would be that the government will not have any money from the fishing industry to provide subsidized fuel and other capital input which further encourages over-harvesting of resources. The introduction of multi-day trawling resulted in harvesting of a large quantity of biodiversity-rich by-catch in addition to commercially important fishes. India produces around 65000 tons of fishmeal and 34000 tons of fish oil with 35 fishmeal plants approximately. The raw material of one ton procured at the cost of Rs.7500 is processed and value is added to the extent of Rs. 76710 by producing four joint products. The net value added (profit) per ton of raw fish was Rs. 69210. Thus the value of the final products is almost 10 times the value of raw material which is exclusively enjoyed by the fish oil/meal companies. All the super normal profits earned from imposing a royalty on fisher meal /deep sea vessels. It should be deposited in a biological permanent fund. This fund could be distributed among traditional fisheries following sustainable fishing practices. This will reduce poverty among the fishers and promote equality among fishing community. The biodiversity is also protected with lower incentives to extract the resources, higher price to fish and it could reduce fishing conflicts also. Based on a study of primary data collected for two years (2013-14 and 2014-15) Jyothis (2017) reveal that 14.5 percent of the total biomass is harvested in the form of by catch which is nearly 35 percent of the land value of Rs. 20.42 billion and 318,827 tons. One of the major attraction for harvesting by catch and juveniles is the increasing demand from the poultry, and aqua feed industry to manufacture feed for mariculture and shrimp farming sectors.

3.9 Economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism

India is neither classified as a Small Island developing state nor as a least developed state by the classification made by the United Nations Conference on Trade and Development (UNCTAD). Afghanistan, Bangladesh, Bhutan, Myanmar and Nepal are the least developed countries in South Asia. The Union Territory of Lakshadweep, a group of 11 inhabited and 25 uninhabited tiny islands, is geographically isolated and segregated at 200–400 km from Mangalore Coast. The archipelago consists of 12 islands with a range of area up to 440 ha. Mangroves are limited to Minicoy Island on its south-eastern and south-western sides, of which one site is landlocked and the other opens to seawater. The Arabian Sea around the islands of Lakshadweep over an area of 1 lakh sq. km is Lakshadweep water. The marine fishery resources of Lakshadweep are contributed by a variety of fishery resources and the estimation of sustainable resources on a scientific basis has not been done.

There has been a steady growth of fish production, which once stood at 500 tonnes during 1950 has crossed 10000 tonnes in recent years. It has been roughly estimated that Lakshadweep water support a fishable stock of 60,000 tones of tuna and 1, 00,000 tones of other fishes mainly sharks. Out of these the present exploitation is only about 12,200 tones per annum. The fish caught from open sea consists mainly Tunas, Sharks, Seer fish, Sail fish, Rays, Snappers, Gar fish etc. Tuna contributes 80% of the total landing. Tuna fishing season starts from September and extends up to May. Skipjack is the major species, which is the main source of raw material for production of masmin. Other tunas like Little-tunny and Yellow fin Tuna are also landed in limited quantities. Of the 36 Islands and a number of sunken banks and open reefs, only ten islands are inhabited. The Islands do not have any rivers or creeks. These coral atolls with a total area of 32 sq. km have a lagoon area of 4200 sq. km and territorial waters of about 20,000 sq. km. The EEZ around of Lakshadweep is about 4 lakhs sq. km. Of a total population of about 60,000, five thousand are directly involved in fishing while another 3000 are indirectly engaged in fisheries related activities for their livelihood. According to the marine fisheries policy document of the Government of India (2004) intensifying the traditional processing techniques of smoked/ drying (masmin production) in Lakshdweep would be supplemented by providing facilities of storage of the products and transportation to the mainland.

Mangalore is an important terminal market for dry fish trade from Lakshadweep, Gujarat, Maharastra and other states. Historically, Lakshdweep was part of the Mangalore administration until 1928 under the British administration. Thus over the years, because of the port facilities and the proximity of the islands, availability of food supplies and institutional infrastructure, Mangalore has become the main trading centre for Lakshadweep. Mangalore has a very large number of dry merchants specialized in trading with the islands and also other states. They get the Masmin not only from the islands but also from other states. Sri Lanka was the principal buyer of Indian dried fish and fishery products accounting for about 95 % of the total export of this item. On the basis of a trade agreement between India and Sri Lanka, Indian shippers had been exporting this product from the Tuticorin port only. The import of dried fish by individual importers was banned subsequent to the formation of the Co-operative Wholesale Establishment (CWE) in Sri Lanka in 1961. The CWE dictated its terms and conditions which included *inter alia* a fixed price also for the Indian exporters. A common price list for all major dried fish suppliers to Sri Lanka like India, Pakistan, Aden, etc was also promulgated by the CWE. The supply was regulated on cost, insurance and freight (C.I.F) basis and the payment was on landed weight and quality of the products. The competition from Maldives and lack of improvement of quality is making the Lakshadweep product less acceptable among the high-end consumers in Srilanka. The Packaging, appearance and hygiene in handling of masmin has resulted in lower price for our product compared to masmin of Maldives.

IV. MEASUREMENT OF INDICATORS OF SUSTAINABLE DEVELOPMENT

It is proposed to assess the effective implementation of SDGs through budgetary provisions and institutional arrangements. The SDG implementation mechanisms could be synergic with the ongoing schemes or in conflict with them in certain cases. In this analysis we present the expenditure incurred on various schemes by the respective departments and the future allocations on ongoing /new/modified schemes focusing more on SDG indicators. The criteria for assessment of implementing SDGs include examining how the ongoing schemes contribute t the conservation, restoration and maintenance of marine resources with the protection of livelihoods of small scale and artisanal fishers.

Table 4.1 Targets and Indicators

Sl. No	Indicators	Quantification of Results/Comments
14.1	By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	
	Health index of area of coastal water (percentage)	Declining bivalve production as an indicator of declining water quality. The total bivalve production declined by 71% during the last 15 years
	Number of Sewage treatment plants installed along the coast and construction of toilets under Swachh Bharat Mission	Out of 27 ULBs in 3 costal district of Karnataka (Utthara Kannada, Udupi & Dakshina Kannada) 23 ULBs have certified ODF, other 4 ULBs have self certified as ODF, 3rd party inspection is under progress. KUIDFC sewerage treat plant (STP) had been constructed and commissioned in Mangaluru, Udupi, Bhatkal and Karwar under Karnataka Urban Development And Coastal Environment Management Project (KUDCEMP) during 2000 to 2012.
	Discharge of industrial pollutants in the ocean	No specific data is available
	By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	
14.2	Percentage change in area under mangroves	The coastal Karnataka has a total of 71 sq. km of mangrove area during 2018. There are no baseline data on area to estimate the percentage. Coastal land use policy as per CRZ 2018 should be revisited to

		stop conversion of mangroves in privately owned land including less than one hectare.
	Proportion of national exclusive economic zones managed using ecosystem-based approaches	CRZ Notification 1991, 2011 and newly notified 2018 is being implemented along with approved CZMP map of 2018. However, 2018 notification is more concerned with development objectives rather than conservation and restoration.
	Percentage of Change in Marine Protected Areas (MPA)	State coastal/marine area does not have even a single notified marine protected area and hence there is a need to identify and notify such areas which are ecologically important and have threatened.
		It is suggested that No-Go zones to trawlers and other intensive gears in the fishing grounds which have threatened species.
14.3	Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels	
	Coral health index of Exclusive economic Zone	Not available
	Coral health area of Marine Protected Areas (this should include 12 sensitive areas in the CRZ	Not available
14.4	By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics	
	Maximum Sustainable Yield (MSY) in fishing	The present catch (2017-18) of 4.14 lakh tons is very close to estimated marine fisheries potential of 4.25 lakh tons and there is no scope for further increase in exploitation rate.
	Annual marine fish catch	
	No of non-fishing days	In addition to mandatory non-fishing days of 61 days during monsoon, fishers are forced to observe increasing number of fishing holidays due to climate factors such as cyclones and other forms of extreme weather conditions.
	In addition to mandatory non-fishing days of 61 days during monsoon, fishers are forced to observe increasing number of fishing holidays due to climate factors such as cyclones and other forms of extreme weather conditions.	Compensation/insurance mechanism should be developed to provide relief for fishers for the loss of income and employment due to frequent climate related factors.
	Fish stock restoration	Measures such as banning of destructive fishing practices (light fishing, bull trawling, deep-sea speed engines beyond 350 hp capacity are prohibited by

		the Government under KMFRAct
14.5	By 2020, conserve at least 10% of coastal and marine areas, consistent with national and international law and based on the best available scientific information	
	Percentage change in area under 12 Ecologically Sensitive Areas	NA
	Coverage of protected areas in relation to marine areas	NA
14.6	By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation	
	Progress by states in the degree of implementation of international instruments through national/state level legislations to combat illegal, unreported and unregulated fishing	NA
	Reduced percentage of overall budget extended as subsidy towards fishing	In 2018-19, 55% of the total fisheries budget was incurred on fuel subsidy Rs 135.00 crore has been allotted for the scheme “Reimbursement of sales tax on diesel used by fishing boat" out of the total budget of Rs 248.00 crores. Action will be taken to reduce subsidy to the boats which are involved in illegal fishing, those boats which do not comply with the Karnataka Marine Fisheries regulation Act
	Measures such as banning of destructive fishing practices (light fishing, bull trawling, deep-sea speed engines beyond 350 hp capacity are prohibited by the Government under KMFRAct	Satellite mapping and tracking of fish schools to identify the potential fishing zones with appropriate regulations
14.7	By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism	
	Small scale fisheries as a percentage of GDP	Around 15 percent of the fisheries GDP is contributed by small scale fisheries and 45 percent of employment
14a	Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island	

	developing States and least developed countries	
	Proportion of total research budget allocated to research in the field of marine technology	NA
14.b	Provide access for small-scale artisanal fishers to marine resources and markets	
	Progress by states in the degree of application of a legal/ regulatory/policy/institutional framework which recognizes and protects access rights for small-scale fisheries	The zoning of area up to 6 km from the coast from small scale fishers and exemption of small scale fisheries from mandatory fishing ban are some of the relaxations under the regulations. Further various forms of subsidies are directed towards promoting small scale fishing. The Department of Animal Husbandry, Dairying and Fisheries (DADF), Ministry of Agriculture and Farmers Welfare is implementing the Central Plan Scheme on Integrated Development and Management of Fisheries' with 'National Scheme of Welfare of Fishermen' as one of the components. The National Scheme of Welfare of Fishermen provides financial assistance to fishers during the lean fishing season/fishing ban period especially for fishermen who do not have their own fishing boats. In addition, financial assistance is also provided for construction of houses for fishers and creation of other basic amenities such as drinking water facility & community halls. Besides, insurance coverage for fishers is also provided under the scheme. (b)The scheme also aims for an integrated development and management of the fisheries sector covering inland fisheries, aquaculture, marine fisheries, mariculture, cage/pen culture and creation of fisheries infrastructure through central financial assistance towards sustainable livelihood to fishermen. The scheme has various broad components namely, (i) Development of Inland Fisheries and Aquaculture, (ii) Development of Marine Fisheries, Infrastructure and Post Harvest Operations, (iii) National Fisheries Development Board (NFDB) and its activities (iv) National Scheme of Welfare of Fishermen, , (v) Strengthening of Database and Geographical Information System of the Fisheries Sector and (vi) Monitoring, Control and Surveillance (MCS) and other need based

		interventions. (c)The central financial assistance is provided to the State Governments/UTs for onward transfer to the eligible fishermen as per the provisions of the scheme. State-wise details of financial assistance provided by the DADF under the three components of the scheme namely National Scheme of Welfare of Fishermen, Development of Marine Fisheries, Infrastructure and Post Harvest Operations and National Fisheries Development Board which have direct bearing on livelihood activities of fishermen during the last three years and the current year are furnished at Annexure.
	Assistance to the traditional/ artisanal fisheries for procurement of FRP boats and other associated fishing implements	1. 10% subsidy on introduction of intermediate craft has been discontinued by GOI. 2. No subsidy on new boats 3. No increase in quantity of subsidized diesel used by mechanized boats. Rs.138.48 lakh has been earmarked as subsidy amount for fishing activities in inland and marine areas.
	No of traditional boats	The total number of traditional boats 8512 constituting 50% of the boats contributes only 15 percent of the catch indicating inequity in sharing the common resources
	No. of motorized boats	9000 Boats with varying fishing capacity ranging from 105 Hp to 350 and above HP
	No. of public fish markets established	65 modern markets were constructed specially for women retailers.
	Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want	
14.c	Progress in ratifying, accepting and implementing through legal, policy and institutional frameworks as reflected in the United Nation Convention on the Law of the Sea, for the conservation and sustainable use of the oceans	Responses of state legislations in the use of marine legislation and regulations to provide access for small access fishers. The recent increase in the number of deep sea It is a Key Control Indicator as legislative and regulatory tools can improve the effectiveness of the management system.

V ACTION POINTS TO ACHIEVE THE TARGETS

The current conditions of coastal Karnataka and expected climate changes would expose the narrow coastal strip and its inhabitants to vulnerabilities. A large number of these households are small scale fishers who depend upon day-to-day fishing within the territorial waters. Projected sea level rise and erosion on the one hand and stagnating catches due to overharvesting by the deep-sea fishing vessels, industrial and urban pollution, habitat destruction, are some of the serious threats. Moreover these marginalized communities have limited access to healthcare and public services. Therefore planning of all the ongoing and new schemes and strategies should pass through the lens of SDG indicators. Following are the proposed activities that can be considered by the Government of Karnataka:

1. The customary management systems related to scheduling of fishing activities, sequencing of gear use, sale of fish catch, owner-crew relations, controlling destructive fishing in their area were decided by the community based associations. But today these systems have not been functioning effectively due to increased diversity of the fishing communities and also increased capital intensity in the fishing industry. About the government-implemented management measures, the 61 days fish ban has been in practice and implemented effectively. But about fishing zones, mesh size regulations, destructive fishing, though we have rules, such rules are not implemented and practiced. The creation of more awareness about all such rules and with the co-operation of fishers these could be implemented. The subsidies and other state sponsored welfare schemes could be linked to practice of such regulations. There a need for strengthening all organizations and co-operatives of fishers and all the associations should come together in one platform with proper co-ordination and discuss their problems to compel the government to meet their demands.
2. Develop the concept of no-Go zone to rejuvenate fish catch areas. Those fishing grounds with ecologically sensitive areas and threatened species should be protected from trawling and other forms of fishing methods. All trawlers and other gears should be fitted with GPS which can be tracked by satellite and registered
3. The Sea Bird project claimed to be the largest in Asia, has already displaced 4779 families from 13 villages of Karwar and 8423 acres of prime coastal/marine areas has been acquired

for the project. We suggest that the entire area could be notified as marine protected area (marine sanctuary/marine national park) under the Wildlife Protection Act since fishing is already strictly prohibited in this area due to security reasons. Thus there will be no further loss of livelihoods and conflicts with fishing communities.

4. In India there are only regulatory controls to protect wetlands and there is no scope for market based approach within the existing legal framework. It is important that the existing regulatory system should incorporate rules to introduce market based approaches. In this regard regulating the access to biological resources by imposing a cess based on the net value realized by the users is a significant step. The products can be listed by their manufacturing industries and fees could be levied under the Access and Benefit Sharing Regulations 2014 issued under the provisions of Biodiversity Act 2002. The Biodiversity Board could also start marking system like Green line/ triangle for bio-products & fees paid, red/ orange if unpaid. A bio-declaration form may be introduced for export at airports/ shipping ports at airports/ flight, to declare bio-goods & if ABS fee is paid. The Export Inspection Authority under the Ministry of Commerce and relevant export promotion boards could join NBA/state biodiversity boards and begin to screen all bio-resource products exported/processed for its contents to check if any bio-resource has been used. If any bio-resource elements were found the royalty payable could be some percentage of the market value of the product. The Board could insist on all processors/exporters to execute an agreement/declaration that the product does/doesn't consist of any bio-resource before it was shipped out of the country. The Board could also finance laboratories to detect the contents of the bio products at a few selected ports and also enter into an agreement with Export Inspection Authority.

5. Shrinking coastal space for fishing related activities was one of the main concerns of the fisher groups. New claimers such as tourism, housing, infrastructure, industries etc have - alienated the land and resources transfer hitherto available for fishing related activities. By using the existing legislations such as CRZ 2018 and areas currently need and required for future expansion by fisher groups should be protected. The beach space along harbors, jetties and beaches are mostly under ports departments. The port areas are being permitted to be used for bus shelters, roads, ship building/ breaking companies, pipelines for petroleum etc.

on the ground that they are all shore based activities. The space required for fish drying, net mending, marketing and storage activities are not allowed by the port departments. Hence, those land areas customarily used by the women for their livelihood activities should be permanently leased for specified purposes.

6. Improvement of basic infrastructure in fisheries harbours, landing centres and jetties such as Supply of potable water for drinking, fresh water for hand washing and cleaning of auction halls, ETP and Drainages inside the harbour – With proper size, slope and covering, Proper construction of wharf, auction hall, packing and parking area, sufficient number of working toilets/wash rooms –based on working strength. Sufficient lighting facility inside the harbour compound wall for entire harbour premise, infrastructure facility based on number of fishing vessels, proper landing and berthing facility for OBMs/ traditional crafts, berthing facility for mechanized fishing vessels, facility for lab and record maintenance, facility for preventing entry of land-animals, rodents, bird and pest control, facility for washing crates/insulated containers, waste disposal management systems, appointment of hygiene inspectors for fishing harbours, facility for regular health check-ups/ medical aid for fish workers, insurance for fish workers, training facility for fish workers, harbour management societies for each harbours consisting of officials and stake holders.

7. Rainwater capture, storage and ground water recharge to address the scarcity of fresh water for drinking and sanitation, should be prioritised and supported. There are technologies and organizations which have skill and expertise to undertake micro treatment plants and provide intermediate low cost technology

8. The discharge of industrial effluents (UPCL, BASF, MRPL, NMPT, MCF, and other 35 hazardous and red category industries) and urban sewage has led to increased pollution level and also due to the SPM (Single Point Moring of MRPL) and SEABIRD projects the fishing space in the coastal waters has declined, fishing-prohibited area has increased and reduced fertile area for fish breeding and production. The coastal industrial infrastructure

development cannot be at the cost of fisheries. Hence as directed by the Karnataka High Court Legal Services Committee at the Lok Adalat on December 15, 2012 a comprehensive study of the impact of coastal pollution on marine/coastal fisheries should be done by a national level environmental/fisheries institute before permitting any new industry to be established in coastal areas. Proper monitoring of sea-water quality and level of pollution is required to be done with a representative from civil society group and /or fishermen associations and the reports must be available to all the stakeholders.

9. The coordination of different related state departments such as disaster management, port, fisheries, ecology and environment minor irrigation, transports etc. is required for better planning and exchange services with minimum disturbance /in convenience to the communities. There are several legislations such as Marine Fisheries Regulation Act, biodiversity Act, Water Act, Wild Life Protection Act, Environment (Protection) Act and CRZ notification which aims to implement sustainable fishing practices but lack of cooperation among different implementing agencies departments frame led to poor implementation and causing distress to fisheries. It is suggested that all relevant departments, organizations, trade associations and civil society groups should join together in framing state fisheries policy and the modal to implement the policy. Social impact analysis of each industry with a focus on its impact on fishers' livelihoods should be carried out before planning/approving any industry in the coast as per the provisions of the Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, 2013.

10. The mangrove forests along the coastline and estuaries should be promoted with community participation as a coastal protection, ground water recharge, flood control benefits and also carbon sequestration and livelihood benefits. The formation of mangrove conservation and management committees under the ICZM project under the Department of Environment and Ecology is a good initiative. The decline in oyster and other freshwater bivalve catch could be addressed through farmed bivalves by borrowing technology from other parts of the

country/world. Farmed bivalves could be explored and encouraged in Karnataka under the ICZM project.

11. With an increase in the number of extreme weather event forecast under the IPCC models mangroves as coastal defences are often cost effective solutions with biological benefits. They would also help with freshwater eutrophication being passed to the marine environment and capture carbon. The mangroves are unpopular with shrimp farmers as they encourage wading birds that may transmit disease, may reduce Ph required for growth of shrimp and may increase crab population which will borough the bunds of shrimp ponds. These issues could be addressed through management measures and education/information in fishing villages.
12. In order to avoid the harvest of juvenile fishes, mesh size regulation should be imposed on the net manufacturing factories and patrolling by vigilance team (consisting of both officials of government and representatives of fishermen organizations) need to be initiated in all the fishing ports and landing centers. Surveillance system should be developed in all the fishing ports. The government should take necessary steps to limit the adverse impact of climate change, night and light fishing, high speed engines, bull trawling, and sea erosion. The fishers associations could be convinced for the extension of the fishing ban period from June 15 to August 31, for restricting the harvesting of juvenile fishes in the month of August, as we get juvenile fishes in the month of August too. There should be a uniform rules for fishing ban.
13. Legalize leasing of certain parts of the sea not exceeding 25% to promote aquatic productivity (through stocking of threatened species and conservation biology, in addition to production of commercial species, maintenance of equity and poverty reduction). This could help in much needed productivity improvement in coastal areas.
14. All mariculture enterprises should be licensed annually, renewed with a maximum lease period of five years beyond which extension has to be based on a fresh assessment of environmental and social impacts.

15. A list of priority stakeholders to bid for lease should be prepared such as social enterprises of the artisanal fishers, local coastal community members, etc. Wherever such groups are not available, at least 50% of the ownership should be shared with such local groups.
16. All leases would be executed on advisories of research and development institutes with respect to the area limits based on suitability of the water bodies for the farmed species. There would be close liaison between the LSGs and State Fisheries Departments/UTs in this regard.

17. All the west coast states should have the uniform fishery management rules and regulations such as control on fishing intensity, eligibility for fuel subsidy; sustainable fishing practices, zoning regulations, closed seasons and areas etc. The fuel subsidy may be linked to the adaptation of the existing management regulations as per the Karnataka Marine Fisheries Regulation Act. Thus those fishing boats which adopt the management regulations such as mesh size, zoning of fishing areas, closed seasons (monsoon ban) strict adherence to limits to fishing capacity (HP and size) may be given incentives and subsidies rather than giving subsidy to each and every licensed boats.

18. The current disaster preparedness, mitigation processes are inadequate to help the fishers to address the threats posed by natural and manmade disasters. There is lack of sufficient information in advance about the disasters. The officials of office of the disaster management need to develop a mechanism to reach the information about likelihood of happening disasters well in advance to all fishermen with special emphasis on fishermen who are in the sea.

19. The gender equity and inclusion of women issues should be considered in all government policies and programs. Government should introduce the social security measures like pension scheme, insurance to all the fish workers.

20. There must not be any age restriction while sanctioning benefits (Compensation/insurance) to the injured or deceased fish worker, under any social security measures and there is a urgent need to formulate the policy to provide rights over coastal land, social security measures (Specific to fishermen and fisherwomen engaged in fishing and related activities) and also to extend a credit facility as like agriculture sector. All the facilities extended to the farmers must also be given to the fishermen. Accidental deaths during fishing should be considered on par with the farmers for deciding compensation. In the fishermen identity card, there is a need to mention that they belong to the fishermen community.

21. The existence of a large number of fishmeal companies shows the destructive fishing practices followed by the deep sea fishing vessels by harvesting non-target species and by-catch. Therefore, the government should impose restrictions on the expansion and starting of fishmeal companies through a system of progressive taxation of turnover of such companies under Biodiversity Act 2004.

22. Mechanism should be developed to provide timely and adequate market information to the fisherwomen to earn better returns. At the landing centers fishermen should give preference to the fisherwomen while auctioning/selling fish.

23. The government in consultations with fisher organizations and experts should identify the sustainable fishing practices and those who adopt such practices may enjoy the progressively higher subsidy. It is suggested that the diesel subsidy may be continued in a modified manner to promote sustainable fishing practices. The government does not discriminate between approved method of fishing and prohibited method of fishing. Highly destructive fishing practices such as bull-trawling, night fishing and other un-sustainable practices should be discouraged by completely withdrawing the subsidy to these fishing units.

24. The Roadmap for the process of Marine Spatial Planning (MSP) may be designed and created involving all the relevant stakeholders, focusing on generation of data and sharing of

data information; Implementation and enforcing the plans; monitoring and evaluating performance and; adapting the spatial planning process.

25. Plastic wastes pose disturbance to boat propelling, difficulty in fish sorting on board as well. It affects breeding and growth of fishes and other marine organisms which in turn reduces marine production too. Fishermen could be asked to collect plastic and to keep the same in the bags supplied after proper cleaning and this has to be supplied to the shredding unit going to be operated. Each boat will be getting price for the plastic wastes they bring to the shredding unit and it will encourage fishermen to continue this activity.

26. With growing affluence particularly in urban areas, people tend to buy clean, ready-to-eat and ready-to-serve fish products from supermarkets than buying raw fish. By designing a suitable business model for women involving mobile kiosks for value added fish products; Capacity building of fisherwomen on the preparation of fish value added products; establishing mobile market units for promotion of the enterprise; exposing SHGs to various market and credit opportunities; and providing basic entrepreneurial knowledge and skills to the fisherwomen would lead to women empowerment. This project could be a partnership venture of NETFISH, NGO and Central Institute of Fisheries Technology (CIFT) for piloting the value added fish product promotion through Designer Mobile Fish Kiosks as one of the income generation activity for fisher women.

27. The guiding principles in developing mariculture activities in open access water bodies would be public trust responsibility where, care would be taken to prevent conflicts among other users such as fishers and navigational users; ensure limits to biological production based on carrying capacity; integrate principles of sustainability to mariculture by limiting impacts on the environment and society; promote conservation of marine habitats and protection of rights of those carrying out mariculture. All mariculture farms in the sea would operate only in an area leased out for the purpose by the respective maritime States. Besides, the State would register and license all farms for a specific period. The doctrine of public

trust primarily rests on the principle that certain resources such as sea, water and forests are important for common good and it is completely unjustified to allocate it for the private ownership. These resources should be freely available to general public rather than to permit their use for private ownership or commercial purposes.

28. Data Transparency may be ensured in order to evolve a fresh perspective required for national fisheries policy as well as to resolve the challenges lack of consolidated marine information; Difficulty envisioning spatial scenarios; Lack of transparency regarding spatially explicit data; and Interfacing with the public.

29. The state policy briefs on Marine Spatial Planning (MSP) focusing on sustainable use of the coast may be initiated and the attempts may be made to translate the knowledge generated by the national and international level into commercial use of mineral/fisheries resources available in the territorial waters.

30. The adoption of the Sustainability Principles in order to avoid damage to marine ecosystems for benefitting future generation and protect the coastal areas and islands from climate change, sea level rise, coastal erosion, etc.

31. Enacting suitable regulations related with legal issues such as Coastal Regulation Zones; the United Nations Law of the Sea (UNCLOS); coastal processes and change; environmental ecosystems; and coastal services and products, along with policy guidelines for marine pollution and litter, mandated to avoid development falling into environmental pitfalls.

32. Capacity building, institutional mechanisms and cooperation with other west-coast states are vital for the successful implementation of the Marine Spatial Planning (MSP).

33. Development of "Accelerated Technology including Artificial Intelligence, Automation, Robotics and Digitalization" for exploiting in a sustainable way State's EEZ, which may contribute to economic development of the country and enhance societal benefits.

34. We need insurance mechanisms that pay out quickly to the victim-fishing and other coastal communities who incur financial and physical losses due to erosion, cyclones and other climate related disasters. Such insurance mechanisms should be funded by imposing taxes and penalties who contribute to climate change as measured by the stock of green house gases they have produced. The Karnataka Catastrophic Risk Insurance Facility could be established to pay and undertake the immediate relief efforts.

VI. GOVERNANCE AND INSTITUTIONAL ARRANGEMENTS

6.1 Introduction

In 2019, the Government of India will be reporting on progress on SDGs, including the commitment made by all the Karnataka State to ensure equal access to resources and sustainable development by 2030. We need to highlight the highlight the existing gaps and financing of the sustainable development indicators. During the next 10 years we need to mobilise our efforts to take local action to change the way state social planners deliver to meet the SDG goals at the United Nations. The execution of sustainable development goal program could be achieved by establishing a network of state and other stakeholder groups within the framework of a single integrated regulatory authority which includes developing a new budget, National Action Plan, or writing an SDG progress report, called a Voluntary National Review. The steps in the process of designing and implementing such an authority would be as follows:

1. Defining context and Authority;
2. Obtaining fiscal support;
3. Organising stakeholder participation;
4. Organize the process through pre-planning; (v) Analyzing current conditions;
5. Analyzing future conditions;
6. Developing Spatial Plan;
7. Implementation and Enforcing the Plans;
8. Monitoring and Evaluating Performance and;
9. Adapting the Spatial Planning Process.

The governance and regulation of marine environment is mainly governed by Environment (Protection) Act 1986, Coast Guard Act 1978, Territorial Waters Continental Shelf – Exclusive Economic Zone and Other Maritime Zones Act, 1976, Biodiversity Act, Karnataka Marine Fisheries (Regulation) Act 1986, Coastal regulation Zone Notification 2011 and many other executive orders, notifications and policy documents. The offshore development is further regulated by various national and international laws and organizations. There are a large number of institutions, NGOs, industrial trade associations, which keep a watch on over the fisheries and energy development and pollution. However, there is no single specific organizational framework for implementation of complete/comprehensive regulations relating to granting

permission, leasing, evaluation and monitoring of these inshore/offshore structures such as deep sea fisheries, exploration, transport, storage, etc. for the compliance of environmental safeguards. There is a need to suggest appropriate governance structure for the environmental management of all ocean resources minerals, deep sea fishery resources, offshore energy development in India through a detailed study of the existing Indian system and international experiences with different regulatory and governance systems. It is important to develop a sound environmental governance system and process which creates proper leasing system of marine space for mariculture activities, size and location for leasing activities, an opportunity for the public review of the operational aspects needs to be developed. It is also important to involve the regional/state authorities in the consultation process of approval, development and production plans. The public consultation process at present in this area is very week and needs to be strengthened. Interagency consultations have never been fully integrated and a true system of integrated coastal zone management is yet to be developed. Collaborative partnership is required between the centre and states for the smooth mechanism in development of ocean energy. Compliance and implementation is another facet that remains as a challenge, especially when some principal stakeholders remain primarily interested in profit, and reducing the profit for the benefit of the environment might seem to be a major challenge to put forth. Regulations itself and their lack of implementation seems to be a major bottleneck. It can be stated that the effort should be to bring together the stakeholders along with fishermen in the protection of the environment as well as sustainable development. The Shipping Ministry's detailed plan for Sagarmala and the National Perspective Plan have been released in 2016. It is in the process of finalizing and specifying agencies to implement the plan. The Ministry will have to make sure that the coastal communities are participants in the whole process.

Box 8. **Public-private-partnership** projects generally operate based on the concession agreements or a contract between a government entity and private sector for the delivery of infrastructure services for processing, marketing and export services. The Marine Products Export Development Authority has suggested improving the live fish exports from Karnataka and also production of value added products such as ready to eat/cook, fish protein, sausages, fish oil, etc driven by the modern technology which results in the utilization of the entire body with zero waste and fulfils market expectations. In each of the three districts a cluster of fishing vessels could be formed and enrolled to a producer company which will be able to utilize ongoing subsidy schemes of the state/Centre. The producer company could also form clusters of shrimp (farms also) and operate with a production capacity of 10,000 tons/year. A Mangrove cell in partnership with the Forest Department for streamlining of biodiversity for economic

empowerment of villagers could be part of such an initiative. The mangrove cell has identified 28 villages covering about 15 ha for culture of mangrove crab in pens. The fixed cost for a unit of 5 pens of 0.5 acre each is estimated at Rs. 4.5 lakh and the Operational cost Rs. 3.5 lakh. The seed requirement is 2000 crablets per unit and estimated production is 1060 Kg. The harvested crab can be marketed live domestically or exported to international markets. The estimated income @ Rs. 550 per kg is about Rs.5.8 lakh.

In addition to the above laws and regulations which are directly connected with the marine resources following laws are also important to protect the livelihoods of the coastal communities: The Right to Fair Compensation and Transparency in Land Acquisition, Rehabilitation and Resettlement Act, No. 30 of 2013, Scheduled Tribes and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, No. 2 of 2007, Forest (Conservation) Act, No. 6 of 1980, Wildlife Protection Act, No. 53 of 1972 (as amended), Mines and Minerals Act, No. 67 of 1957 and Oilfields (Regulation and Development) Act, No. 53 of 1948 (as amended) Regulations.

6.2 Addressing the Coastal Vulnerability and climate change Issues

The coastal panchyats should be involved in the development of a vulnerability preparedness plan. Coastal model villages/panchyats have to be selected for development of such plans. Develop vulnerability index based on a comprehensive indicators such as coastal erosion, hazard line, socio-demographic structure, etc. Integrating community perception in the index is most important. We need to develop climate resilient national plan to make the coastal states which integrates the perception of the coastal communities. Increased occurrence of tropical cyclones reduces the number of fishing days for which there is no risk coverage and compensation system.

According to MOEF&CC the minimum temperatures may rise by 2.0o C to 4.5o C and the maximum temperature is likely to rise by 1o C–3o C. Rainfall variation from 935±185.33mm to 1794± 247mm, which is an increase 6%–8% with respect to the1970s. The number of rainy days are likely decrease along the entire Western coast, including in the Western Ghats. The projected number of cyclonic disturbances along the coasts in the 2030s is likely to decrease with respect to the 1970s. However, cyclonic systems might be more intense in the future. The sea level along the Indian coast has been rising at the rate of about 1.3mm/year on an average. The increase in sea level rise could increase the risks of erosion, flooding and other disasters. The estimates of economic losses include direct physical damage to infrastructure and indirect damage such as

loss of revenue and unemployment to business enterprises due to disturbances. Global Climate Change and Vulnerability Index 2011 ranked India as the second extreme risk country after Bangladesh. The Govt of India (2010) reported that 76 percent of Indian coast line of 7500 km is susceptible to cyclone hazards. However, in terms of economic growth, the net impact of disaster could be negative and/or positive. The negative impact is the loss of productive assets due to disaster and positive impact is that the replacement of damaged assets will increase the GDP. Land use/land cover changes modified by humans in response to specific development needs are the common reasons affecting the availability of coastal space for fishers' activities. Such changes also affect the coastal fish production, biodiversity, water availability and other ecosystem services. Meyer and Turner (1992) shows that the human impact on environment is a product of not only the number of people but also the level at which they consume and the character of material and energy flows in production and consumption.

The coastal erosion due to climate change could bring new risks to the infrastructure, settlements and industries. The adaptation needs depends on the specific risks faced by the landscape of a region which is prone to such risks. The insurance industry has an important role to play in the assessment and pricing of such risks. Integrated risk assessment could be developed for specific climate related hazards that needs to be identified, quantified and prioritised at the local and regional level. The study by Byravan et al (2010) estimated the total replacement value of infrastructure for Tamil Nadu coast (ports, harbour, power plants, roads etc.) impacted by sea level rise to be between Rs. 47418 crores and 53554 crores (at 2010 prices). The study also estimated the present value of wetlands in terms of foregone ecosystem services (through 2015) to be between 3583 and 14608 cores. The largest impact will be on land whose market value was estimated to be between Rs. 317661 and 6115471 crores. The GDP of the Tamil Nadu was estimated at Rs.250,000 crore which indicates that a significant part of the GDP of a state will be at risk due to sea level rise.

Coastal ecosystems are always areas of conflicts between multiple uses and user groups due to diverse and rich resources. Since most of the ecosystem services provided by these resources are of public goods nature there is a tendency for it's over exploitation. Lack of full economic valuation of natural capital: Quite often a number of development projects are undertaken which

have trade-offs between the environmental services provided by the coastal ecosystems and infrastructure services provided by development projects. The coastal ecosystems provide coastal protection services are of public goods characteristics and hence attracting private investment to protect/conserve such capital resources is difficult. The lack of understanding of the full value (temporal and spatial) of the ecosystem services by the private investors also leads to biased benefit-cost analysis. In the coastal development projects the environmental costs are not often considered while assessing the social benefit cost ratios. The short term interests of the current period favour conversion of natural capital into manufactured capital rather than conservation from the view point of long term needs of the society. The wetlands, estuaries, mangroves and beaches are valued only for their direct cash benefits such as fish production, water etc. The regulatory and supporting services are ignored and /or under-valued while converting such natural capital. Although the estimation of non-market value of coastal ecosystem goods and services have become an issue of policy interest, some of the assumptions involved in the estimation (through the willingness to pay / accept) have led to differences in the estimated values between different studies and lack of accuracy.

6.3 Coastal/Marine Tourism

Coastal tourism is being promoted by all coastal states including Karnataka as a means to promote sustainable development and to utilize the coastal ecosystem services for recreational purposes. Karnataka beaches have many religious shrines which could be converted into a major source of revenue. Large investments are needed for underwater explorations and cruise tourism in places such as Karwar where there is a need to create enough capacity to encourage cruise tourists as well as regular tourists. Simplification of processes is another vital aspect for the promotion of coastal tourism. There is need to connect the domestic ports for cruise tourism. The travel will have to be cost effective to attract the large middle class. The beach and sea have become sources of tourism and recreation is a recent phenomenon in our country. It began with the Hippies during 60s with handpicked centres like Goa, Gokarna (Karnataka) and Kovalam in Kerala (Routledge, 2000: 26480). In Karnataka, the Government has identified Mangalore, Someshwar, Ullal, Panambur, Suratkal, Malpe, Bhatkal, Karwar, Murdeshwara, Kundapur, Honnavar, Gokarna, Kumta and Mulki as coastal tourism centres. The adverse effects of mass

tourism on coastal ecology have many facets: construction of resorts, highways, destruction of coastal habitats like sand dunes, coastal vegetation, mangroves for landscaping and recreation, contamination of water bodies from fertilizers and pesticides, disturbing coastal and marine life by mass human pressure could affect the livelihood of traditional communities. The Government of Karnataka has sanctioned Rs. 9567.38 lakhs for coastal tourism called 'coastal circuit' for the period 2016-18 under Swedesh Darshan scheme. Some of the project activities included in this project are Malpe beach: CCTVs, construction of seawalk, watch towers along the beach Karwar: Handwinch gliding as a sport, CCTVs, beach cleaning machines, Plan to develop select beaches- Om, Karwar, Gokarna, Kudle, Murudeshwar, St. Mary's island- Floating jetty Heli tourism in Udupi.

The integrated rail, road, ship transport system with a travel hub in Mangalore is also proposed for building all modes of transport system (metros and inter-state trains, transport buses and trucks, taxis and cars) could be available to the commuters within easy access and safety to move to other towns along the coast.

6.4 Insurance for Risks

The insurance companies rely heavily on detailed estimates of costs of climate events in order to price the risks and establish sound insurance system. It is important that research support system needs to be established for climate and erosion related cost assessments. This will facilitate developing strategies to execute proper insurance packages to coastal structures and also settlements. Whenever possible, the investment in insurance that could protect human activity against coastal erosion and other hazards should be encouraged through incentives. Such insurance could provide compensation package for meeting the basic needs such as food, shelter and sanitation during the hazards and also long term investment needs for building coastal protection infrastructure. The investment in insurance requires assessment of the variability and stability of the ecosystem services. The reduction in the variability of ecosystem services would be the management strategy. In the context of coastal ecosystem services for example conservation of mangroves for prevention of coastal erosion and also corals could be considered for their insurance value. For some of the ecosystem services substitutes are available through technological interventions. The cost of such technological interventions could be very high

considering the income, access and equity factors. Another important point is that such substitutes may not provide long term needs of the growing population.

6.5 Maritime Issues

In the absence of formal security architecture, the region has tended to rely on a dialogue-centric approach with SAARC, ASEAN and the IORA. The attempt has been to aim for a convergence of views and perspectives through regular and frequent interactions rather than legally binding commitments. Common maritime cooperation has two essential and intertwined aspects – economic integration/cooperation/trade and maritime security. At the state level coastal police system exists but is not properly coordinated with Coast Guard.

6.6 Budgetary Support for achieving the target indicators

The progress in the allocation of budgetary provision during 2020-2030 is indicated in the Table. In order to achieve the targets of SDG 14 a detailed budgetary plan under all relevant scheme could be developed in consultation with the Department of Fisheries within the indicated share for each target.

Table 6.1 Indicated Budgetary Allocation for achieving SDG 14

Sl. No	Share of total Budget (%)	Relevant schemes proposed
By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution		
1	12	Monitoring coastal pollution and relationship between the changes in the harvest/stock levels aquatic animals sensitive to the current level pollution
2		Enforcement and control of release of untreated Industrial and Sewage treatment regulations
3		Public/ Private Investment in sewage treatment plants and common effluent treatment plants
4		Incentive and technology support system for fishermen to collect plastic debri from marine areas

2. By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans			
2	15	Stock Restoration and conservation projects through modern mariculture technologies and enforcement of restricted areas by destructive fishing	
		Subsidies to Phase out of diamond shaped trawl nets and introduction of square mesh size nets	
		Subsidies for Introduction of tuna long liners and hook and line/gill net fishing	
		Demarcation and enforcement of Exclusive fishing areas for small scale fishers	
3	Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels		
	10	Scientific investigations and research and extension services for conservation and sustainable development	
		Demonstration of benefits from reduced pollution, excess fishing efforts and quality enhancement	
		Certification of small scale fisheries	
4	By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics		
	5	Enforcement of UNCLOS/Marine Fisheries Regulation Act and Biodiversity Act	
		Strengthening of Coastal Protection Force and Coast Guard	
		Remote sensing and GIS for collection of data, surveillance and monitoring of implementation of the research schemes.	
		By 2020, conserve at least 10% of coastal and marine areas, consistent with national and international law and based on the best available scientific	

		information
	8	Declaration, demarcation and notification of five marine protected areas (sanctuaries)
	Provide access for small-scale artisanal fishers to marine resources and markets	
	10	Construction of separate berthing facilities and markets for small scale fishers and women and other social welfare measures.
	5	Progress in ratifying, accepting and implementing through legal, policy and institutional frameworks as reflected in the United Nation Convention on the Law of the Sea, for the conservation and sustainable use of the oceans
	5	Creation of a separate Legal and Environmental Cell within the Department of Fisheries for revision, amendments and enforcement of relevant provisions of the national and international regulations
	30	Administration, SDG Cell, subsidies towards capital and operational costs of fishing

REFERENCES

1. Amaratya Sen 1999. Development as Freedom Oxford University Press, London.
2. Bateman I J, M. Georgina, M. C. Fezzi, G. Atkinson and K. Turner 2010. Economic Analysis for Ecosystem Service Assessments *Environ Resource Econ* DOI 10.1007/s10640-010-9418-x.

3. Bhatta, R. and Mahadev Bhat. 1998. Impacts of Aquaculture on the Management of Estuaries in India. *Environmental Conservation* 25(2): 109-121.

4. Bhatta R, K Aruna Rao and Suguna M. Nayak, 2003. Marine Fish Production in Karnataka: Trends and Composition. *Economic and Political Weekly*, vol. XXXVIII No.44 November 1-7. p. 44685-4693.

5. Byravan S, R Rangarajan and S C Rajan 2010. "Sea Level Rise: Impact on major infrastructure, ecosystems and land along Tamil Nadu Coast", Institute for Financial Management and Research, Chennai p36.

6. Boominathan, M. M, Chandran, D. S. and Ramachandra, T. V., 2008, Economic valuation of bivalves in the Aghanashini Estuary, West Coast, Karnataka. Centre for Ecological Sciences. Indian Institute of Science, Bangalore, India.

7. Boominathan, M., Ravikumar, G., Chandran, M. D. and Ramachandra, T. V., 2012, The impact of dams on the edible bivalves-A comparative study of kali and Aghanashini estuaries of Uttara Kannada district, Karnataka, India. National conference on *mangrove wetland and near shore marine ecosystems from sustainability issues to management and restoration*, March, School of environmental sciences, Jawaharlal Nehru university, New Delhi, India,45-6.

8. Central Marine Fisheries Research Institute 2005. Marine Fisheries Census Part I Indian Council of Agricultural Research, Kochi.

9. Central Marine Fisheries Research Institute 2010. Marine Fisheries Census Part I Indian Council of Agricultural Research, Kochi.

10. Central Marine Fisheries Research Institute 2016. Marine Fisheries Census Part I (Draft) Indian Council of Agricultural Research, Kochi

11. Coleman, J. S. 2000. Social Capital in the Creation of Human Capital. In P. Dasgupta & I. Serageldin (Eds.), *Social capital: A multifaceted perspective* (pp.13-39) Washington D. C.: The World Bank.

12. Daniel Pauly and J. Alder 2005. Marine Fisheries Systems *Millennium Ecosystem Assessment* United Nations Environment Programme (UNEP) Nairobi, Kenya.

13. Directorate of Economics and Statistics Karnataka 2018. Economic Survey of Karnataka 2017-18 Department of Planning, Programme Monitoring & Statistics, Government of Karnataka, 40th Edition, Bangalore

14. District Disaster Management Plan for Dakshina Kannada District 2016-2017. https://dk.nic.in/en. District Disaster Management Authority Dakshina Kannada, Mangaluru.

15. Food and Agriculture Organization 2001. International Plan of Action to prevent, deter and eliminate illegal, unreported and unregulated fishing. Rome, FAO. 2001. 24p.

16. Food and Agriculture Organization 2018. The state of world fisheries and aquaculture 2018 Rome: Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations

17. Food and Agriculture Organization 2015. Report of the Expert Workshop to Estimate the Magnitude of Illegal, Unreported And Unregulated Fishing Globally Fisheries and Aquaculture Report No. 1106, Rome: Fisheries and Aquaculture Department, Food and Agriculture Organization of the United Nations

18. Fukuyama F. 1995. Trust: The Social Virtues and the Creation of Prosperity chapter 9, Free Press, New York.

19. Ghosh N. 2019. The "Sustainable Business Index" Mail Today e-paper April 29, 2019

20. Government of Karnataka (GOK 2009). Statistical Bulletin of Fisheries, Directorate of Fisheries, Bangalore.

21. GOK (2010). Karnataka at a Glance. Bangalore: Directorate of Economic and Statistics.

22. Government of Kerala 2018. Notification No. G.O(P) No. 18/2018/F&PD Sept 1, Department of Fisheries, Thiruvanthapuram.

23. GOI (2011). Census of India 2011, Provisional population totals. Bangalore: Directorate of Census Operations.

24. Government of India 2015. Fisheries Profile of India, Department of Animal Husbandry, Dairying and Fisheries, Ministry of Agriculture and Farmers Welfare, Delhi.

25. Government of Karnataka 2018. Karnataka State Disaster Plan Karnataka State Disater Management Authority 2016-17, Revenue Department, Bangalore.

26. Government of Karnataka, 2018. Economic Survey Of Karnataka 2017-18 Department of Planning, Programme Monitoring and Statistics.

27. Grafton R Q, J. Pittock, R. Davis, J. Williams, G. Fu, M. Warburton, B. Udall, R. McKenzie, Xiubo Yu, Nhu Che, D. Connell, Q. Jiang, T. Kompas, A. L. Ri 2012. Global Insights into Water Resources Climate Change and Governance *Nature Climate Change* Vol. 3 April 2013 www.nature.com/natureclimatechange.

28. Grootaert. C, 1998. Social Capital: The Missing Link? Social Capital Initiative Working Paper No. 3 www.worldbank.org/socialdevelopment.

29. Meyer W. B and B. L. Turner II 1992. Human Population Growth and Global Land-Use/Cover Change *Annual Review of Ecology and Systematics*, Vol. 23 (1992), pp. 39-61y: Annual Reviews Stable URL: http://www.jstor.org/stable/2097281.

30. Millennium Ecosystem Assessment (MA, 2005) Ecosystems and human well-being: a framework for assessment. Island Press, Washington DC.

31. Mohammed S. 2015. Future of India's Marine Fisheries Central Marine Fisheries Research Institute Kochi.

32. Myers R A and B. Worm, 2003. Rapid worldwide depletion of predatory fish communities *Nature* Vol. 423. www.nature.com/nature.

33. Nayar S, B.P.L. Gohb, L.M. Cho, 2004. The impact of petroleum hydrocarbons (diesel) on periphyton in an impacted tropical estuary based on in situ microcosms Journal of Experimental Marine Biology and Ecology 302, 213 – 232.

34. Nayar B.P. L.Goh and L.M. Chou 2005. Environmental Impacts of Diesel Fuel on Bacteria and Phytoplankton in a Tropical Estuary Assessed Using In Situ Mesocosms. Ecotoxicology, 14, 397–412.

35. Pauly D. 2006. Major Trends in Small-Scale Marine Fisheries, with Emphasis on Developing Countries, and Some Implications for the Social Sciences. MAST 2006, 4(2):7-22.

36. Pearce DW (2004. Does European Union Environmental policy pass a cost-benefit test? World Econ 5:115–138.

37. Putnam, R. D. (1995). Bowling alone: America's declining social capital. *Journal of Democracy, 6*(1), 65-78.

38. Ramachandra. T.V, Subash Chandran M.D, Joshi N.V. and Boominathan M., 2012. Edible Bivalves of Central West Coast, Uttara Kannada District, Karnataka, India., Sahyadri Conservation Series 17, ENVIS Technical Report : 48, Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012.

39. Shirodkar P.V, A. Mesquita, U.K. Pradhan, X.N. Verlekar, M.T. Babu, P. Vethamony, 2009. Factors controlling physico-chemical characteristics in the coastal waters off Mangalore—A multivariate approach *Environmental Research* 109 (2009) 245–257.

40. Subash Chandran M.D, Prakash Mesta, Boominathan M, Rao G.R, Vishnu D.M and Ramachandra. T.V, 2012. Aghanashini Estuary in Kumta Taluk, Uttara Kannada - Biological Heritage Site., ENVIS Technical Report : 35, Energy & Wetlands Research Group, Centre for Ecological Sciences, Indian Institute of Science, Bangalore 560 012.

41. United Nations Conference on Environment & Development 1992. United Nations Sustainable Development: http://www.un.org/esa/sustdev/agenda21.htm.

42. WWF International 2008. Illegal Fishing in Arctic Waters Vassily Spiridonov.

43. World Bank; United Nations Department of Economic and Social Affairs. 2017. The Potential of the Blue Economy: Increasing Long-term Benefits of the Sustainable Use of Marine Resources for Small Island Developing States and Coastal Least Developed Countries. World Bank, Washington, DC. © World Bank.

44. Xivanand N. Verlecar, Somshekhar R. Desai, Anupam Sarkar, S.G. Dalal 2006. Biological indicators in relation to coastal pollution along Karnataka coast, India *Water Research* 40 (2006) 3304– 3312.

Annexure 1

State initiative in preparing the SDG 14 Action plan

Sl.No	Meetings held on	Summary of the meetings or decisions taken
1	19-04-2018	Being the first meeting The members were introduced to the concept, definition, broader objectives, targets, indicators of the Goal 14. The group discussed the issues with the data collection and the responsibility of the line departments in furnishing the required data. The follow up work from the SDG Cell to invite additional experts was discussed.
1	25-09-18	The objectives, targets and indicators of Goal 14 were presented by the SDG Cell and detailed discussion on the data/information required was discussed. It was identified that majority of the data needs to be collected from the line departments such as Fisheries and Ecology and Environment, Pollution Control Board and national R & D organizations The members suggested that small case studies could be undertaken as part of the work-plan
2	20-11-18	The progress of the data collection and difficulties in accessing the data was discussed. It was decided to write to all relevant organizations to provide data.
2	11-04-19	Reviewed the draft final report of the SDG 14 with inputs from Principal Secretary Ecology and Environment and Director of Fisheries. The Committee reviewed each and every item mentioned in the action points and the chairperson requested all the members and officers to offer their suggested revisions within two weeks.

CONSULTATION MEETINGS		
1	04-01-2019	Indicator wise base line data on the current status and budget support and expected status and budget support needs to be developed was discussed with the Fisheries Department
2	05-01-2019	Discussion with KSPCB on coastal water quality index, industry wise indicator of water quality and summarize the data. Meeting with Committee of Goal 15 to seek data and documents related with mangroves, coastal resources and CRZ.
3	09-01-2019	Consultation meeting with Regional Director Ecology and Environment, Mangalore for the data on ecologically sensitive areas of the coastal areas within the jurisdiction of CRZ and implications of CRZ 2018 notification in conserving the resources.

Meetings with concern departments, especially Fisheries department, Forest Ecology and Environment Department and Pollution Control Board

Members of SDG 14 committee

1. Sri. Rudhra Gangadharan, IAS (R) - Chairperson
2. Prof. D. Sengupta, CAOS, Indian Institute of Science, Bengaluru - Academician/Expert
3. Prof. Srinikethan, Department of Chemical Engineering, Mangalore NITK, Surathkal - Academician/Expert
4. Sri. Kshitij Urs, Campaign Against Water Privatisation, Bengaluru - NGO/ Civil Society representative)
5. Dr. Ramachandra Bhatta, Former ICAR-Emeritus Scientist and Former Division Chair Social Sciences and Economics, National Centre for Sustainable Coastal Resources Management, MOEF &CC, GOI) Chennai (Professional Writer)
6. Sri. Chikkasubbaiah, Joint Director, SDP, Planning Department - Member Secretary

Annexure 2

State Matrix – Targets National indicators, State indicators, Base line year, Base line value, 2022 & 2030 Targets

Sustainable Development Goals to transform our World - State Matrix Goal 14									
Goal 14: Conserve and sustainably use the oceans, seas and marine resources for sustainable development									
Targets	**State Nodal Department**	**Draft National Indicator**	**Indicator No**	**State Indicators**	**Tentative Data Sources**	**Base Line Year**	**State Baseline Value**	**Target**	
								2022	**2030**
1	**2**	**3**	4	**5**	6	**7**	**8**	**9**	10
14.1 - By 2025, prevent and significantly reduce marine pollution of all kinds, in particular from land-based activities, including marine debris and nutrient pollution	**POLUTION CONTROL BOARD**	14.1.1: Health index of area of coastal water%	**14.1.1**	Health index of area of coastal water %	CMFRI				
	UDD	14.1.2: Number of Sewage treatment plants installed along the coast and construction of toilets under Swachh Bharat Mission	**14.1.2**	Number of Sewage treatment plants installed along the coast and construction of toilets under Swachh Bharat Mission	UDD **(DMA)**	2017-18	12798 No.s	15175 (In all House holds)	15175 (In all House holds)

	AGRICULTURE, CO-OPERATION,	14.1.3: Decrease in use of nitrogen fertilizers in the coastal States	**14.1.3**	Decrease in use of nitrogen fertilizers in the coastal States					
	POLUTION CONTROL BOARD		**14.1.4**	Discharge of industrial pollutants in the ocean	PCB	2017-18	There are 4 Industries located near Mangalore region namely, BASF, MRPL, UPCL and MCF which are discharging industrial pollutants in the ocean.		
	UDD (DMA)		**14.1.5**	Quantity of sewage discharged in the ocean	PCB	2017-18	Quantity of sewage discharged into the ocean is given in Annexure II		
14.2 - By 2020, sustainably manage and protect marine and coastal ecosystems to avoid significant adverse impacts, including by strengthening their resilience, and take action for their restoration in order to achieve healthy and productive oceans	**FOREST, ECOLOGY & ENVIRONMENT**	**14.2.1: Percentage change in area under mangroves**	**14.2.1**	Percentage change in area under mangroves	Forest Survey of India	2017	D.K - 5.62Sq. Km Udupi - 17.50 Sq. Km Karwar - 47.88 Sq. Km Toal - 71.00 km	10% increase from baseline	20% increase from baseline

	FOREST, ECOLOGY & ENVIRON MENT	14.2.2: Implementat ion of Coastal Zone Regulation Notification of 2011	**14.2.2**	Implementati on of Coastal Zone Regulation Notification of 2011 (12 types of sensitive areas to be incorporated)	Ecology and Environment dept.	2018	CRZ Notification 1991/2011/2018 is being implemented along with approved CZMP map of 2018	Minimize violations OF CZMP and increase area under CRZ 1	Execute revised CRZ guidelines to Maximise and achieve 10% Targeted Marine protected area
	FOREST, ECOLOGY & ENVIRON MENT	14.2.3: Percentage of Change in Marine Protected Areas (MPA)	**14.2.3**	Percentage of Change in Marine Protected Areas (MPA)	State Does not have Marine Protected Area				
	FOREST, ECOLOGY & ENVIRON MENT		**14.2.4**	Identify the fish breeding grounds	The fish breeding area as identified in CZMP 2018 furnished				
14.3 - Minimize and address the impacts of ocean acidification, including through enhanced scientific cooperation at all levels	**FOREST, ECOLOGY & ENVIRON MENT (Economic Zone)**	14.3.1: Coral health index of Exclusive economic Zone	**14.3.1**	Coral health index of Exclusive economic Zone	Coral production pattern: as there is no particular data for index.				

	FOREST, ECOLOGY & ENVIRONMENT		**14.3.2**	Coral health area of Marine Protected Areas (this should include 12 sensitive areas in the CRZ)	Forest dept.	As on 2018	1. Coral - 0.87 Sq. Km 2. Mangrove - 24.67 Sq. Km 3. Mangrove Buffer - 46.33 Sq. Km 4. Sand dunes - 1.09.Sq. Km 5. Salt Marsh - 3.18 Sq. Km 6. Nesting ground of Birds - 0.04 Sq. Km 7. CVCA 8. Coral and coral associated Biodiversity has been observed at 4 place off coast of KArnataka as below : - 1. St. Mary;s island 2. Netrani island 3. Mugali to Apsarakoonda rocky shore. 4. Devgad island Apart from the above details, information received from Geological Survey of India (GSI with regard to Corals details of Karnataka coast also Showed several others locations. Details of Location Annexed herewith at Page 1-6.	Not applicable	
14.4 - By 2020, effectively regulate harvesting and end overfishing, illegal, unreported and unregulated fishing and destructive fishing practices and	**FISHERIES**	14.4.1: Maximum Sustainable Yield	**14.4.1**	Maximum Sustainable Yield (MSY) in fishing			604603 lakh tons in the depth of 0-200 meter depth zone		

implement science-based management plans, in order to restore fish stocks in the shortest time feasible, at least to levels that can produce maximum sustainable yield as determined by their biological characteristics		(MSY) in fishing							
	FISHERIES		**14.4.2**	Annual marine fish catch	CMFRI	2017-18	4.14 lakh metric tonne	4.25 lakh MT	4.25 lakh MT
	FISHERIES		**14.4.3**	No of non-fishing days	Fisheries	2017-18	61 days statuary fishing ban in addition to voluntary non-fishing days due to natural disasters.	61	61
	FISHERIES		**14.4.4**	No of mechanised fishing boats	Fisheries	2017-18	72559 vessels with HP ranging from 100-350	70000	70000
	FISHERIES		**14.4.5**	Fish stock restoration	Fisheries	2017-18	Identification and promotion of sustainable fishing practices	Identification and notification of fish breeding grounds and Implementation of minimum legal size	
14.5 - By 2020, conserve at least 10 per cent of coastal and marine areas, consistent with national and international law and based on the best available scientific information	**FOREST, ECOLOGY & ENVIRONMENT**	14.5.1: Coverage of protected areas in relation to marine areas	**14.5.1**	Coverage of protected areas in relation to marine areas	State Does not have Marine Protected Area				
	FOREST AND ENVIRONMENT	14.5.2: Percentage change in area under mangroves	**14.5.2**	Percentage change in area under mangroves	FSI	2017	10 Km2	10% increase from baseline	20% increase from baseline

	FOREST, ECOLOGY & ENVIRONMENT		**14.5.3**	Percentage change in area under 12 Ecologically Sensitive Areas	Given in the report				
4.6 - By 2020, prohibit certain forms of fisheries subsidies which contribute to overcapacity and overfishing, eliminate subsidies that contribute to illegal, unreported and unregulated fishing and refrain from introducing new such subsidies, recognizing that appropriate and effective special and differential treatment for developing and least developed countries should be an integral part of the World Trade Organization fisheries subsidies negotiation	**National Indicator Not yet evolved**								
	FISHERIES		**14.6.1**	Reduced percentage of overall budget extended as subsidy towards fishing	Fisheries	2017-18	54.43%	25%	0%
14.7 - By 2030, increase the economic benefits to Small Island developing States and least developed countries from the sustainable use of marine resources, including through sustainable management of fisheries, aquaculture and tourism	**National Indicator Not yet evolved**								

14.A - Increase scientific knowledge, develop research capacity and transfer marine technology, taking into account the Intergovernmental Oceanographic Commission Criteria and Guidelines on the Transfer of Marine Technology, in order to improve ocean health and to enhance the contribution of marine biodiversity to the development of developing countries, in particular small island developing States and least developed countries	**FISHERIES**	14.A.1: Allocation of budget resources for research as per the EEZ or coastal line	**14.A.1**	Allocation of budget resources for research as per the EEZ or coastal line					
14.B - Provide access for small-scale artisanal fishers to marine resources and markets	**FISHERIES**	14.B.1: Assistance to the traditional/ artisanal fisheries for procurement of FRP boats and other associated fishing implements	**14.B.1**	Assistance to the traditional/ artisanal fisheries for procurement of FRP boats and other associated fishing implements	Fisheries	2017-18	Under Blue Revolution scheme it is proposed to assist 30 fishermen to replace their traditional wooden boats to FRP boats. The assistance earmarked is Rs.53.55 lakhs Under Blue Revolution scheme it is proposed to assist 300 fishermen to re-install Out board engine. The assistance earmarked is Rs 151.2 lakhs	Target can not be fixed	Target can not be fixed
	FISHERIES		**14.B.2**	No of traditional boats	Fisheries	2017-18	8512	5000	3000
	FISHERIES		**14.B.3**	No. of motorised boats	Fisheries	2017-18	8999	9062	9762

			14.B.4	No. of public fish markets established	Fisheries	2017-18	65	95	150
14.C - Enhance the conservation and sustainable use of oceans and their resources by implementing international law as reflected in UNCLOS, which provides the legal framework for the conservation and sustainable use of oceans and their resources, as recalled in paragraph 158 of The Future We Want	**FISHERIES**	14.C.1:Percentage compliance of international laws	**14.C.1**	Percentage compliance of international laws	Fisheries	2017-18	KMFR Act is being enforced	NA	

Now, water scarcity haunts fishing boats

Tankers, which usually supply water, have hiked prices in summer

AROCKIARAJ JOHNBOSCO
@Mangaluru

"I USED to get a tanker full of water in less than 15 minutes. Now, the same task takes two-hours because there is no water in the well," says Mansoor B K of BK Water Supply at Mangaluru fishing harbour. There are 15-odd tanker truck operators at the fishing harbour, who supply drinking water to the boats going on fishing expeditions. Of late, getting water has become a laborious task for them.

Every deep sea-faring boat requires 6,000 litres of water per trip for 8 to 12 fishermen. The tanker trucks operating round the year supply water to these boats from the open wells at Kadri, at a fee of ₹800-₹1000 per tanker. "We supply water to the boats on a contract basis starting from August to May every year and take a break for two months during the fishing ban period in the month of June and July," says Ilyas, another tanker truck operator at the harbour.

While their counterparts are minting money, utilising the present water shortage to their fullest, charging anywhere between ₹1,200 to ₹2000 per tanker, these tanker truck firms stay attached to fishing industry. "Unlike them, our business is permanent and fishing boats give us business round the year. It is true that we can make quick money in these summer months, but we will have to idle away the rest of the year if we charge such prices," said Mansoor.

Arun, a boat owner, says the price of water has been marginally hiked. "They won't increase the prices all of a sudden. They will increase the prices slightly and we know they are struggling to get water in the present situation," he said. For a deep sea fishing vessel, 6,000 litres of water is very precious. Each fishing boat has a tank fitted inside. Most fishermen utilise this water for drinking, cooking and bathing, while some generous boat owners provide cans of RO purified water for drinking.

"In deep sea, 6,000 litres of water is a life-saving resource. We use it judiciously so that it lasts till we come back and we also keep a reserve in case of emergencies like rough weather at sea," says Michael, a fisherman at the harbour. A small portion is used as a coolant for the boat engine. "The health of the engine depends on our survival so we keep an eye on the coolant in the boat engine. Any time, it may require 20 litres of water as coolant," explained Ravi, another fisherman.

Fishermen leaders at Mangaluru and Malpe said the water crisis has not hampered fishing operations as of now. "Since they operate on a yearly contract, the water suppliers won't refuse water and take the pain of going far to supply water in time. However, our concern is that authorities should find lasting solutions for the water crisis because it worsens every year," said fishermen's leader Dayanand Suvarna.

Water being supplied to a fishing boat at Mangaluru Fishing Harbour | EXPRESS

Water-The lifeline of deep sea-faring fishing vessels

* There are 1,250 mechanised trawlers mostly operating from Mangaluru and there are 2,000 trawlers at Malpe taking up deep sea fishing
* Each vessel needs 6,000 litres of water for a 10-day trip for a crew of 8 to 12 fishermen
* The water is used for drinking, cooking and bathing during the fishing expedition
* A small portion of water is used as coolant for the boat engine
* There are around 15 tanker truck operators catering to fishing vessels at Mangaluru, each attending 5 to 7 fishing boats per day
* A tank load of water is priced ₹800 - ₹1000 which remains constant round the year
* At Malpe, fishermen's associations offer water to boats along with fuel at nominal prices while there is also a small number of tanker truck operators catering to boats

Unlike them, our business is permanent and fishing boats give us business round the year. It is true that we can make quick money in these summer months, but we will have to idle away the rest of the year if we charge such prices

— Mansoor B K, owner of BK Water Supply