Report on the Conceptualisation and Supervision of a Harmonised Approach to the Implementation of Baseline Studies at Selected Project Pilot Sites (Contract N°: 81167108)

by

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Bremen, August 2016

Indo-German Biodiversity Programme
Conservation and Sustainable Management of
Coastal and Marine Protected Areas
(CMPA)
PN: 11.9299.6-001.00

Disclaimer

This study has been financed through a contract with the Project on "Conservation and Sustainable Management of Existing and Potential Coastal and Marine Protected Areas" (CMPA), of the Indo-German Biodiversity Programme. The Project is jointly implemented by the Ministry of Environment, Forests and Climate Change (MoEF&CC), Government of India, and Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH on behalf of the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB).

Contents

1 Introduction

The Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India, has entered into a Technical Cooperation Project on "Conservation and Sustainable Management of Coastal and Marine Protected Areas" (CMPA). The CMPA Project is supported by the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMUB), Government of Germany, and implemented by the Gesellschaft für Internationale Zusammenarbeit (GIZ) in collaboration with MoEFCC and various State Governments.

The overarching goal of the CMPA Project is to improve conservation and management of biodiversity in a number of existing – or eventually to be created –Marine Protected Areas (MPA) with the aim to support improvements both in biodiversity and the local livelihoods of those depending on the sustainable use of this biodiversity. It approaches this goal through the strengthening of participatory management, capacity development, and through information, communication and training.

The basic assumption of the project is that despite a growing awareness on the importance of biodiversity, there is still a need to conduct solution-oriented demand-based research (e.g. socio-cultural aspects, participation), and integrating the research findings into relevant decision-making, management system and policies for coastal and marine biodiversity conservation. This demands that the conservation and management systems must enable the participation of local communities and other actors to ensure that both conservation goals and sustainable livelihood needs of local communities are met.

2 Rationale

In order to measure its impact, the Project has to establish baselines against which future changes are to be measured. Given the diversity of the pilot sites and the wide range of topics to be covered, the Project needs to ensure that approaches applied to all sites and the ensuing evaluation of the collected data are standardised in order for the results to remain comparable between sites.

The Leibniz Center for Tropical Marine Ecology (ZMT) in Bremen, Germany was contracted to:

1) ensure a standardisation and harmonisation of baseline studies carried out at the selected pilot sites by Indian partner institutions, in order to allow the Project to measure and demonstrate the impact of its intervention at comparable levels across all pilot sites.
2) support a scientific cooperation between ZMT and Indian research institutions involved in the implementation of the baseline studies.

3 Scope of work

For the objectives to be met, agreed-upon activities included the following:

1. Develop a conceptual framework for implementing baseline studies at the selected Project pilot sites in four states;
2. Organise a workshop in India with national partners to finalise the conceptual framework of the baseline studies;
3. Develop standardised questionnaires / data sheets;
4. Provide backstopping during the period of data collection by national partners;
5. Suggest suitable formats data compilation and comprehensive analysis;

For a more detailed description of the TORs, see Annex 1.

4 Implementation

The work was implemented in various phases, between November 2013 and November 2015 by a natural science and a social science team, formed by the ZMT.

4.1 Social Sciences

Two questionnaires were developed in Germany by the ZMT social science team (Marion Glaser, Achim Schlüter, Alexandra Gosh), one for application with local key informants and one for application with a representative sample at the household level of the respective areas where future MPAs were envisaged.

A 2-days workshop was conducted in Chennai, Tamil Nadu, in December 2013. It was attended by 28 national partners and was meant to finalise the conceptual framework of the approach to data collection to establish the socio-economic baseline. Parameters to be included were discussed by the social science team and, and the questionnaires were adjusted according to the consensus reached with Indian partners.

Pretesting of the questionnaires was then conducted in a coastal region of Tamil Nadu. This exercise was also used to convey the principles of survey field work to a team of 6 partner staff from various partner institutions so that at least one fully trained person was then available for each of the 6 states participating in CMPA.

After the pilot/pretesting phase in the field with Indian partners, the design of the questionnaire was then finalized (see Annex 2 and 3) and a plan for implementation and backstopping from the ZMT team agreed.

The schedule, however, could not be implemented as planned, as there were substantial delays in starting project implementation at various pilot sites, which, according to the CMPA Project, were due to administrative difficulties State governments had to formalise the collaboration with the CMPA project. This finally lead to some of the sites being removed from the list of pilot areas, and others being replaced by very remote areas, where it was difficult to perceive the utility of carrying out a socio-economic base-line survey. This had, of

course, a negative impact on the total set of activities foreseen under the current contract, which no longer could be carried out as planned and thus had to be curtailed.

The only full-fledged socio-economic survey that was finally carried out by the CMPA Project concerned the areas in Gujarat designed for being declared as Ramsar Wetlands. The ZMT team, represented by Alexandra Gosh collaborated in November 2014 and then again during field visits in January 2015 with the researchers from Wetland International, New Delhi, to design the survey. To the extent possible, the approaches agreed upon during the workshop in Chennai were taken into consideration. However, the Ramsar Convention has specific formats when it comes to the implementation of baseline surveys, which had to be adhered to. The socio-economic survey was then successfully carried out by a Gujarat-based research group.

4.2 Natural Sciences

The consultant was tasked to develop an evaluation concept for assessing the success of management measures geared towards the conservation of biodiversity in coastal areas. Under the coordination of Tim Jennerjahn (expertise: biogeochemistry, ecosystem health) a team of ZMT scientists (Inga Nordhaus: mangrove and benthos ecology; Lucia Herbeck: seagrass ecology, biogeochemistry; Andreas Kunzmann: coral reef ecology, physiology; Marc Taylor: fisheries biology, trophic modelling; Matthias Wolff: resource stock assessment, trophic modelling) developed such a concept.

The concept mainly builds on the guidebook "How is your MPA doing?" published by IUCN – The World Conservation Union (Pomeroy et al., 2004). Goals and indicators from the guidebook were blended with ZMT expertise and experience and were tailored to the characteristics and needs of the chosen systems along the Indian coasts. Moreover, they were streamlined for the purpose of a rapid assessment. It consists of a suite of biophysical indicators and a baseline study concept designed to evaluate the ecosystem status before and after implementation of CMPA measures. During the workshop held in Chennai in December 2013 this concept was introduced to representatives of Indian institutions invited by GIZ who were supposed to be candidates for the application of the concept in potential CMPA sites.

In a next step ZMT scientists refined the concept, detailed methods and developed sheets for data collection and evaluation. During a "CMPA Environmental Indicator Workshop" held in Mumbai in July 2014 and attended by 15 representatives of Indian institutions, Tim Jennerjahn and Inga Nordhaus presented the final version of the conceptual framework on methods and strategies for data and sample collection in sites to be chosen. The document is attached as Annex 4. During the ensuing discussions the participants who were chosen by GIZ to conduct the surveys in selected sites in the states of Maharashtra and Goa reported the site-specific characteristics of the environmental setting and the major issues and targets with respect to a potential CMPA status. As a result of discussions concrete sets of indicators were chosen tailored to the site-specific setting. A detailed report of the workshop is provided in Annex 5. As an outcome of the workshop, it was agreed that ZMT scientists (i) on request provide site-specific advice regarding the collection and evaluation of data and

samples to Indian institutions contracted by GIZ to conduct the surveys, (ii) receive and assess data and reports provided by the respective Indian institutions after surveys had been conducted and (iii) provide a final assessment of the environmental status of the chosen sites to GIZ.

In the following ZMT scientists provided data sheets and concrete advice regarding methods to some of these institutions. One report on the status of the Ansure Creek site in Maharashtra was submitted by a team of the Bombay Natural History Museum, Mumbai, under the lead of Dr. Deepak Apte. Another ecological survey of Chorao Island in Goa was conceptualised in line with the recommendations from the ZMT team. Its outcome was assessed by Dr. Aaron Lobo of the CMPA team, who also had attended the workshop in Mumbai.

A participation of the natural science team in the ecological survey of the future Ramsar sites in Gujarat was not envisaged, as the approach required by the Ramsar Convention is very specific and not necessarily compatible with the approach suggested by the ZMT team.

5 Conclusions

The collaboration between the different teams of ZMT and researchers from Indian universities has proven very fruitful with respect to developing common concepts for making baseline assessments in areas destined to become protected areas. Still, the consultancy could not attain all its goals. This was primarily due to delays the CMPA project experienced in setting up its pilot areas and obtaining formal permission from its partners to carry out biological and socio-economic research. This prevented many activities that were fundamental for the current consultancy to happen. India is culturally a very diverse country, with language being a major barrier to harmonising research tools. It also features a large number of research units working on socio-economic and ecological baseline assessment, each with their own set of experience and expertise. Lessons learnt from the current consultancy seem to indicate that much more time and resources should be allocated to identify and train whole teams of researchers in the design and implementation of baseline studies of the nature required by projects such as the CMPA project.

Annex 1

Terms of Reference

Terms of Reference
for a Consultancy on the
Conceptualisation and Supervision of a Harmonised Approach to the Implementation of Baseline Studies at Selected Project Pilot Sites

GENERAL INFORMATION

Project :	Conservation and Sustainable Management of Coastal and Marine Protected Areas, India (CSM-CMPA)
Project Nr.	2011.9299.6
Duration of the consultancy	01.11.2013 to 30.04.2014
Contact person	Dr J. M. Vakily (GIZ)

Background

Marine ecosystems are one among the most productive ecosystems in the world and are also unique in their biodiversity. In India, they provide livelihood for around 20 million people along a coastline of 7,500 km. Increased industrialisation and a rapidly growing population in coastal areas exert an immense pressure on these ecosystems, to the extent that their conditions have become critical in many parts of India, and their continued conservation a very challenging task for all institutions concerned. The negative impact of global climate change will exercise additional pressure on coastal and marine ecosystems. Strengthening a more participative approach in the establishment and management of protected areas is considered one of the most promising strategies to counter widespread losses in biodiversity due to unsustainable practices of those engaged – often illegally – in the exploitation of the areas under protection.

In 2012, the Ministry of Environment and Forests (MoEF), Government of India, and the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) have joined efforts in setting up the project "Conservation and Sustainable Management of Coastal and Marine Protected Areas, India (CSM-CMPA)". The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), GmbH, has been entrusted by the BMU with the implementation of the project, which – in its first phase – will cover a period up to September 2017.

The overarching goal of the CSM-CMPA Project is to improve conservation and management of biodiversity in a number of existing – or eventually to be created –Marine Protected Areas (MPA) with the aim to support improvements both in biodiversity and the local livelihoods of those depending on the sustainable use of this biodiversity.

The project has three main expected outputs to be achieved by the end of the project, which are:

Output I: *Participatory management of CMPA:* Participatory management approaches for conservation of selected existing and potential CMPA are designed and introduced.

Output II: *Capacity development:* Capacity strengthening system for supporting participatory management of CMPA is developed for selected states and at national level.

Output III: *Information, education and communication:* Information, education and communication contents are developed and applied for awareness raising, public relations and policy dialogues.

The project designs and implements, among others, participatory approaches for conservation and management of biodiversity at selected existing or potential coastal and marine protected areas in India. The basic assumption of the project is that despite a growing awareness on the importance of biodiversity, there is still a felt need for site-specific action and need to develop successful models for conservation of biodiversity with participation of stakeholders. There is a need to conduct solution-oriented demand-based research (e.g. socio-cultural aspects, participation), and integrating the research findings into relevant decision-making, management system and policies for coastal and marine biodiversity conservation. This demands that the conservation and management systems must enable the participation of local communities and other actors to ensure that both conservation goals and sustainable livelihood needs of local communities are met.

The sites selected for Project implementation are:

- Gujarat: (a) Jamnagar Marine National Park & Sanctuary;
- (b) Kerly Lagoon (Gosa Bara), Porbandar District;
- Maharashtra: (a) Ansure; (b) Velas - Dabhol stretch; (c) Thane Creek;
- Karnataka: (a) Aganashini Complex; (b) Gangavali;
- Tamil Nadu: Palk Bay

Rationale for the consultancy

The Project will implement a number of measures towards the betterment of biodiversity and the improvement of livelihoods in selected areas. In order to measure its impact, the Project has to establish baselines against which future changes are to be measured. Given the diversity of the pilot sites and the wide range of topics to be covered, the Project needs to ensure that approaches applied to all sites and the ensuing evaluation of the collected data are standardised in order for the results to remain comparable between sites.

Objective of the consultancy

The consultancy is to

1. ensure a standardisation and harmonisation of baseline studies carried out at the selected pilot sites by Indian partner institutions, in order to allow the Project to measure and demonstrate the impact of its intervention at comparable levels across all pilot sites.
2. support a scientific cooperation between ZMT and Indian research institutions involved in the implementation of the baseline studies.

Scope of work

For the objectives to be met, the activity plan shall comprise – but not be limited to – the following tasks:

1. Develop a proposal for a conceptual framework for implementing baseline studies at the selected Project pilot sites in four states and submit it for discussion with Project staff;
2. Organise the content of a workshop in India with national partners to finalise the conceptual framework of the baseline studies (parameters to be included, level of detail, method of analysis, output format etc.);
3. Develop standardised questionnaires / data sheets for use in the field;
4. Organise a series of test-runs with the questionnaires / data sheets and – where necessary – improve the design;
5. Finalise the design of the questionnaires / data sheets (hard copy or electronic version);
6. Provide – if necessary – backstopping during the period of data collection by national partners;
7. Ensure a suitable compilation of the data in a format that enables the intended analysis;
8. Organise a workshop in India for the comprehensive analysis of the data according to the methods previously agreed upon;
9. Summarize – for each site concerned – the results of the analysis in a report to be submitted to the Project;

The baseline studies are meant to help the Project assess its impact achieved at the end of its implementation phase. This impact will show at different levels such as ecosystems, region/ community, household, individual. For this reason, the following topics might need to be considered dependant on the selected sites:

A. Ecosystem level
   a. Ecosystem services provided (protection, food supply, maintenance of ecological equilibrium, economic value of services, etc.)
   b. Identification of – and appropriate monitoring systems for – status variables of environmental setting (water, sediment/soil, flora, fauna) and key biodiversity characteristics at the selected sites

B. Region/community level
   a. General characterization of the region/community affected by the Project (geographical parameters, demographic structure, governance, level of urbanization, economic structure, etc.);
   b. Major economic activities affecting directly and to some extent indirectly the area under consideration (aquatic resources involved and form of their exploitation, ancillary activities and their economic value, employment);
   c. Potential for equitable sharing at community level of benefits derived from a better conservation of biodiversity.

C. Household level
   a. Household characteristics (number of dependents, age, gender, property rights, cultural affiliations, etc.);
   b. Education (literacy, vocational training etc.);
   c. Sources of livelihood (wages, self-employment);
   d. Income and expenditures assessment.
   e. The role of gender in the conservation of biodiversity;

D. Individual level
   a. Access to information on the conservation of biodiversity;
   b. Awareness on issues related to the conservation of coastal and marine biodiversity (understanding of biodiversity issues, valuation and prioritisation, knowledge on drivers of biodiversity loss, etc.);
   c. Attitude towards formalised protection of coastal and marine biodiversity (perception of MPAs, role of Government vs. role of individual, perceived benefits or disadvantages, etc.);
   d. Experience with – and valuation of – participatory approaches in the management of natural resources (consultation process, recognition of traditional knowledge, transparency in addressing concerns, level and quality of stakeholder participation, conflict solution, support and capacity building, sustainability);

Required Expertise

The consultant/ organization should have:

- Strong research base on issues related to marine and coastal biodiversity;
- Proven experience in carrying out baseline surveys covering as diverse topics as biology, biogeochemistry, socio-economics, governance;
- Proven experience in the coordination of international research programs (preferably with Asia/India)

Work Plan and Expected Results

The expected result of this consultancy is a report detailing:

- The conceptual framework and methodology applied to carry out the baseline surveys;
- The results of the baseline survey carried out at each pilot site of the Project, comprising a standardised analysis of the data and the compilation of the original data.

Time table

N°	Task	Month
1	Preparation of a socio-economic survey and a set of natural science indicators	12/2013
2	Finalizing the survey and indicators during a workshop with Indian counterparts	12/2013
3	Training of the lead enumerators	12/2013
4	Training of the enumerators	01/2014
5	Backstopping of empirical work in India and close collaboration with Indian counterparts	01-02/2014
6	Reception of data collected by Indian counterparts	02/2014
7	First draft of the report summarising survey results from a socio-economic and natural science perspective for selected sites	03/2014
8	Workshop with counterparts for discussing report results	04/2014
9	Finalisation and delivery of the report	04/2014

Deliverables

- List of indicators to be used for the baseline surveys (by December 2013)
- Compilation of raw data from the field surveys (excel sheet, by the End of February 2014)
- Preliminary report on the analysis of the baseline surveys (by March 2014)
- Final Report in 3 hard copies and electronic version, format MS Word (by April 30, 2014)

Clause on intellectual property rights

The data collected in the context of this contract are the property of the CSM-CMPA Project. ZMT is free to use the results of the baseline surveys for academic publications, if scientific ethics about anonymity are guaranteed. Any publication shall be shared with GIZ prior to publication. ZMT shall ensure that any use of the data, be it for publications or for other purposes, properly acknowledges the role of the CSM-CMPA Project and that of the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU) as the commissioning agency.

Annex 2

Environmental and Economic Attitudes Survey: Baseline Assessment of Village Heads

Environmental and Economic Attitudes Survey: Baseline Assessment for Sustainable Management of Coastal & Marine Biodiversity in India

Feb-Mar 2014

RESPONDENT IDENTIFIER			
SITE	VIL	HH	RESP
		0 1	0 1

	NAME	CODE
COUNTRY		
STATE		
DISTRICT		
SUBDISTRICT		
VILLAGE		
DATE	URBAN / RURAL / METROPOLITAN	

ALTITUDE (METERS)	LONGITUDE (DECIMAL DEGREES)	LATITUDE (DECIMAL DEGREES)
	.	.

	NAME	CODE	DATE
INTERVIEWER 1 (HEAD ENUMERATOR)			
DATA ENTRY OPERATOR			

ITACT INFORMATION OF VILLAGE HEAD	Name	Tel.No

LANGUAGE IN WHICH SURVEY CONDUCTED	

Hello. My name is _____, I am an interviewer of the Indian-German research on coastal management.
We are running a survey of people in X, India The purpose of our survey is to understand how marine and coastal areas impact the lives of ordinary people.
We are particularly interested how people from this region use and value AREA X.

We selected this village at random. We would like to talk to you or another village official, if available. All of the information obtained during the interview will be used only in the aggregated form. Nobody except me and the supervisors of this project will know about our talk. Your participation, and all household participation in the survey is fully voluntary. You may refuse to answer any of my questions. Do you have any questions? Can we start?

VILLAGE HEAD QUESTIONNAIRE

RESPONDENT: VILLAGE HEAD, KNOWLEDGEABLE MEMBER OR RESPONDENT. REPORT ID CODE IN BOX

RESPONDENT'S ID CODE: ____

(1.01) What is the total population of this village? ____

(1.02) What is the main economic activity of the inhabitants in this village? ____

(1.03) What is the main activity of this community with respect to AREA X? ____

(1.04) What is the importance of AREA X for this village. Please rank the level of importance on a scale of 1 to 4, where 1 means "not important at all" and 4 means ____

1	2	3	4
not important	a little important	important	very important

(1.05) Are there any groups in this village (i.e., based on caste, religion, etc.) that value the area more highly? ____

YES 1
NO 0 ► (1.08)

(1.06) Who, in particular, values the area more highly? ____

(1.07) What characteristic denotes this group from the others? (caste, religion, etc.) ____

(1.08) What proportion of the population is engaged in fishing or aquaculture? ____ %

(1.09) What proportion of the population is engaged in farming? ____ %

(1.10) What is the target species in AREA X? ____

(1.11) In this village, is there a....

YES 1
NO 0

a	Primary school?	
b	High school?	
c	Hospital or community health center?	
d	Private doctor?	
e	Traditional birth attendant?	
f	Temple, mosque or church?	

(1.12) In this village, are there any of these cooperative societies?

		YES 1 / NO 0
a	Credit or microfinance	
b	Agricultural	
c	Fisheries	
d	Women's cooperative	
e	Dairy	
f	Textile	
g	Sugar	
h	Other (specify:	

(1.13) Does this community work with an NGO or similar organization to manage AREA X? YES 1 / NO 0 [ ]

(1.14) In your opinion, how successful is this NGO in bringing positive change to the coastal area? 1 means believe it is "very unsuccessful", and 10 means "very successful."

1	2	3	4	5	6	7	8	9	10

[ ]

(1.15) Do you (the village head) organize community meetings? YES 1 / NO 0 [ ]

(1.16) If not the village head, who organizes the meetings? [ ]

(1.17) How often are community meetings held?

1	2	3	4
rarely (1/year)	sometimes (2-3/year)	often (6/year)	very often (1/month)

[ ]

(1.18) What percentage of the village attends these meetings? [ ] %

(1.19) What percentage of attendees are women? [ ] %

(1.20) During these meetings, do you make decisions surrounding the use of AREA X? YES 1 / NO 0 [ ]

(1.21) How do you relay the information/decisions from these meetings to the rest of the village? (Newsletter, word of mouth, formal announcenement?) [ ]

VILLAGE HEAD QUESTIONNAIRE

RESPONDENT: VILLAGE HEAD, KNOWLEDGEABLE MEMBER OR RESPONDENT. REPORT ID CODE IN BOX

RESPONDENT'S ID CODE: ____

(1.22) I would now like to ask you if you know about the formal and informal rules surrounding the use of AREA X. Which of these rules apply to AREA X, and what is the level of respect for each rule? In your opinion, how fair is each rule? What types of monitoring systems exist for each rule, and what are the respective penalties? Who initiated these rules and how long ago?

	RULE TYPE	LEVEL OF RESPECT	FAIRNESS	MONITORING SYSTEM	SANCTIONS	RULE ORIGINS	WHEN
	No rules 1						
	Fishing/hunting/collecting forbidden 2						
	Certain fishing techniques/gear forbidden 3			No monitoring 1	Monetary 1	Government 1	
	Certain species forbidden 4	Very well respected 1	Very fair 1	Community self-monitoring 2	? 2	Panchayat 2	WHAT YEAR OR WHEN WERE THE RULES MADE?
	Closed periods 5	Well respected 2	Fair 2	Forestry officials 3	? 3	Locally decided 3	
	Certain people/outsiders exluded 6	Poorly respected 3	Unfair 3	External auditor 4	? 4	NGO 4	
	Other (specify) 7	Little to no respect 4	Very unfair 4	Other 5	? 5	Other 5	
1							
2							
3							
4							
5							

(1.23) Do you know of any conflicts or issues surrounding the use of AREA X over the last 4 years?

YES 1	
NO 0 ▶ (1.25)	

(1.24) Please describe these conflicts in detail.

	PARTY 1	PARTY 2	FREQUENCY	REASON	INTENSITY	RESOLUTION	VILLAGE
	RECORD TWO MAIN PARTIES INVOLVED.		ASK HOW OFTEN THIS TYPE OF CONFLICT OCCURS	WHAT WAS THE REASON FOR THIS CONFLICT?	IN GENERAL, HOW INTENSE IS EACH CONFLICT?	ASK RESPONDENT IF RESOLUTION WAS ACHIEVED THROUGH THE HELP OF THE FOLLOWING PEOPLE OR INSTITUTIONS	ASK IF CONFLICT INVOLVED PEOPLE FROM THIS VILLAGE OR OUTSIDERS. IF NO PARTIES INVOLVED ARE FROM THIS VILLAGE, ENTER "2"
	Fishers 1						
	Forestry officials 2						
	Government 3						
	Police 4						
	Government 5					No resolution 1	
	NGO 6					Village head 2	
	Traders 7					Panchayat 3	
	Navy/Coast guards 8		RARELY 1		No force/ 1	Police 4	
	Tourism operator 9		once/few years	Ownership 1	Passive	Government 5	
	Farmers 10		OCCASIONALLY 2	Access 2	Mild/ 2	NGO 6	This 1
	Aquaculturists 11		once/year	Gear use 3	Verbal	Forestry officials 7	Village
	Tourists 12		CHRONIC 3	Area use 4	Violent/ 3	Village action 8	Outside 2
	Other (specify) 13		(more than once/year)	Other (specify) 5	Destructive	Religious leader 9	Village
1							
2							
3							
4							

VILLAGE HEAD QUESTIONNAIRE

RESPONDENT: VILLAGE HEAD, KNOWLEDGEABLE MEMBER OR RESPONDENT. REPORT ID CODE IN BOX

RESPONDENT'S ID CODE: ____

(1.25) Personally, do you think you are well informed about…?

READ EACH LINE ALOUD

			Not at all informed	Not very well informed	Fairly well informed	Very well informed	Don't Know
a	The causes of coastal and marine degradation?		1	2	3	4	5
b	The consequences of coastal and marine degradation?		1	2	3	4	5
c	Ways in which we can slow down coastal and marine degradation?		1	2	3	4	5
d	Ways in which we can adapt to coastal and marine degradation?		1	2	3	4	5

(1.26) Do you know what a Marine Protected Area or MPA is?

INSERT GIZ DEFINITION OF MPA: READ SCRIPT EVEN IF RESPONDENT IS AWARE

YES	1
NO	0

(1.27) If an MPA were implemented here, would you agree or disagree that…

READ EACH LINE ALOUD

			Strongly disagree	Disagree	Neither	Agree	Strongly Agree
a	An MPA would improve the health of the coastal area.		1	2	3	4	5
b	An MPA would create a loss of income.		1	2	3	4	5
c	An MPA would increase the number of conflicts.		1	2	3	4	5
d	An MPA would benefit my household.		1	2	3	4	5
e	An MPA would benefit this community.		1	2	3	4	5

(1.28) If an MPA were implemented here, who, in your opinon, should be responsible for managing it?

CROSS ALL THAT APPLIES ▼

a	The government		
b	Local government or panchayat		
c	NGOs		
d	Local people		
e	Religious leaders		
f	Other (specify:)		

MARK WITH A CROSS THE MOST IMPORTANT ▲

(1.29) All things considered, how satisfied would you be if an MPA were implemented here? 1 means you are "completely dissatisfied", and 10 means you are "completely satisfied."

1	2	3	4	5	6	7	8	9	10	

(1.30) In your opinion, what do you think are the potential benefits of an MPA?
DO NOT PROMPT

CROSS ALL THAT APPLIES ▼

a	Improved fish catch		
b	Improved coral/fish conditions		
c	Increased tourism		
d	Pride/prestige for this village		
e	Protects future generations		
f	Excludes people from other villages		
g	Stops bad gear		
h	More money and benefits from NGO or government in the futı		
i	Reduced conflict		

MARK WITH A CROSS THE **THREE** MOST IMPORTANT ▲

(1.31) In your opinion, what do you think are the potential disadvantages of an MPA?
DO NOT PROMPT

CROSS ALL THAT APPLIES ▼

a	Unclear rules		
b	Outsiders breaking the rules		
c	Unfair		
d	Increased conflict within village		
e	Increased conflict with outsiders		
f	Difficulties to enforce rules		
g	Bad for fishing		
h	Less money for my family		
i	No money or support to run the MP/		

MARK WITH A CROSS THE **THREE** MOST IMPORTANT ▲

Annex 3

Environmental and Economic Attitudes Survey: Baseline Assessment of Households

Environmental and Economic Behaviour Survey: Baseline Assessment for Sustainable Management of Coastal & Marine Biodiversity in India

Feb-Mar 2014

RESPONDENT IDENTIFIER			
SITE	VIL	HH	RESP

	NAME	CODE
COUNTRY		
STATE		
DISTRICT		
SUBDISTRICT		
VILLAGE		
DATE	URBAN / RURAL / METROPOLITAN	

	NAME	CODE	DATE
INTERVIEWER 1 (INITIAL VISIT)			
INTERVIEWER 2 (SEC.3,4,5)			
DATA ENTRY OPERATOR			

CONTACT INFORMATION	TELEPHONE NUMBER OF HOUSEHOLD MEMBERS (PROVIDE AT LEAST 1 CONTACT INFO)		
HOUSEHOLD HEAD	RESPONDENT	OTHER ADULT (1)	OTHER ADULT (2)

LANGUAGE IN WHICH SURVEY CONDUCTED	

Hello. My name is _____, I am an interviewer of the Indian-German research on coastal management.
We are running a survey of people in X, India The purpose of our survey is to understand how marine and coastal areas impact the lives of ordinary people.
We are particularly interested how people from this region use and value AREA X.

We selected your family at random. We would like to talk to you and possibly to another person in your household also picked at random. All the information obtained during the interview will be used only in the aggregated form. Nobody except me and the supervisors of this project will know about our talk. Your participation in the survey is fully voluntary and you always can refuse to answer my questions. Do you have any questions? Can we start?

INTERVIEWER: THE TABLE BELOW IS FOR YOUR INFORMATION ONLY. YOU MAY REFER TO THIS IF THE RESPONDENT WANTS TO KNOW MORE ABOUT THE TOPICS OF THE INTERVIEW

TABLE OF CONTENTS

SECTION 1 HOUSEHOLD MEMBERS

RRESPONDENT: HOUSEHOLD HEAD, KNOWLEDGEABLE MEMBER OR RESPONDENT. REPORT ID CODE IN BOX

ID CODE	(1.01) INTERVIEWER LIST THE NAMES AND SURNAMES OF ALL PERSONS BELONGING TO THIS HOUSEHOLD. START THE LIST WITH THE HEAD OF THIS HOUSEHOLD. THEN LIST THE OTHER MEMBERS, FROM THE OLDEST TO THE YOUNGEST.	(1.02) What is [NAME]'s sex?	(1.03) What is [NAME]'s relationship to the household head?	(1.04) How old was [NAME] at his/her last birthday?
			HEAD 1 WIFE / HUSBAND 2 PARTNER (NOT MARRIED) 3 CHILD / ADOPTED CHILD 4 GRANDCHILD 5 NIECE / NEPHEW 6 FATHER / MOTHER 7 BROTHER / SISTER 8 SON / DAUGHTER IN LAW 9 BROTHER / SISTER IN LAW 10 GRANDFATHER / MOTHER 11 FATHER / MOTHER IN LAW 12 OTHER RELATIVE 13 SERVANT / SERVANT'S RELATIVE 14 TENANT / TENANT'S RELATIVE 15 OTHER, SPECIFY 16	IF 5 YEARS OR YOUNGER ▶ NEXT PERSON YEARS
01	HEAD OF THE HOUSEHOLD:		1	
02				
03				
04				
05				
06				
07				
08				
09				
10				
11				
12				

(1.05)	SELECTED RESPONDENT	

THIS WILL BE THE RESPONDENT FOR SECTIONS 3-5
NO SUBSTITUTIONS ARE POSSIBLE

SECTION 2 EXPENSES & ACTIVITIES

RESPONDENT: HOUSEHOLD HEAD, KNOWLEDGEABLE MEMBER OR RESPONDENT. REPORT ID CODE IN BOX

RESPONDENT'S ID CODE: ____

Firstly, I'd like to ask you some questions about the property you are currently living in.

(2.01) TYPE OF DWELLING ____

DETACHED HOUSE	1
SEMI-DETACHED HOUSE	2
APARTMENT/FLAT	3
MOBILE HOME (CARAVAN/TENT)	4
IMPROVISED HOUSING UNIT/SHACK	5
MUD/ADOBE	6
OTHER (SPECIFY	7

(2.02) Do you own the house you live in? ____

YES 1 ▶	(2.04)
NO 0	

(2.03) Who, in the household, holds the title for the house? ____

*LOOK AT ROSTER AND REPORT NUMBER. IF JOINT, REPORT 22. IF NO FORMAL TITLE, REPORT 0.

(2.04) Approximately how much does your household spend on each of these items per month?

		RUPEES (INR)
a	Food, beverages and tobacco	
b	Clothing and footwear	
c	Transport and communications	
d	Recreation, entertainment, meals outside the home, etc	

(2.05) And approximately how much does your household spend on each of these items per year?

		RUPEES (INR)
a	Education (including tuition, books, kindergarten expenses)	
b	Health (including medicines and health insurance)	
c	Furnishings (sheets, towels, blankets, linen)	
d	Household durable goods (e.g. furniture, household appliances. TV, car, etc)	
e	Other expenses without rent (DO NOT PROMPT - RECORD HERE ONLY ANY ADDITIONAL EXPENSES THAT THE RESPONDENT WOULD LIKE TO REPORT)	

(2.06) Does anyone in your household have…?

READ OUT - ONE ANSWER PER LINE

		YES 1 / NO 0
a	A car	
b	A bank account	
c	A debit or credit card	
d	A mobile phone	
e	A computer	
f	Access to internet at home	

(2.07) At the end of a typical month, does your household have anything left over to put into savings? Approximately how much does your household save in a typical month?

RUPEES /MONTH ____

IF NOTHING, WRITE ZERO

(2.08) Which of these sources of livelihood apply to your household?

READ OUT — CROSS ALL THAT APPLIES ▼

a	Wages		
b	Sales or bartering of marine products		
c	Other self-employment/business (farm products, textiles, etc.)		
d	Help from relatives or friends in this country		
e	Help from relatives or friends living abroad		
f	Pensions		
g	Other: _____ (do not prompt, record information volunteered by respondent)		

MARK WITH A CROSS THE MOST IMPORTANT ▲

(2.09) What are the top 5 activities this household does to bring in food or money? Who in the household is participating in these activities? Does this household do any of these activities in AREA X, and if so, how often? Finally, how important is AREA X for each activity?

	ACTIVITY	HH MEMBERS	AREA X?	FREQUENCY	IMPORTANCE
	Fishing 1	Who in the household participates in each activity?	Do you do this activity in AREA X?	How frequently do you visit AREA X for each activity?	How important is AREA X for doing this activity?
	Gleaning 2				
	Seaweed Cultivation 3				
	Fish fry 4				
	Hunting 5				
	Mangrove Logging 6	LOOK AT SEC.1 AND REPORT HH MEMBER CODE. RECORD ONLY ONE MEMBER PER ACTIVITY. PROBE FOR THE MAIN PERSON DOING THIS ACTIVITY.			
	Mussel gathering 7				
	Plant gathering 8				
	Gathering crustaceans (e.g., crabs) 9				
	Marine tourism 10				VERY IMPORTANT 1
	Collecting natural products for food 11			VERY OFTEN 1	IMPORTANT 2
	Collecting natural products for medicine 12			OFTEN 2	NEITHER 3
	Other jobs (INDUSTRY CODE) 13		YES 1	SOMETIMES 3	SOMEWHAT 4
	Other (specify) 14		NO 0	RARELY 4	TRIVIAL 5
1					
2					
3					
4					
5					

IF HOUSEHOLD LOGS MANGROVES… **If not, SKIP to (2.11)**

(2.10) Which species of mangrove does this household prefer? Why do you prefer these species, for which purpose do you use it? And finally, what is the condition of each species?

	TYPE OF MANGROVE	REASON FOR PREFERENCE	CONDITION OF MANGROVE
			VERY BAD 1
			BAD 2
			NEITHER 3
			GOOD 4
			VERY GOOD 5
a			
b			
c			

IF HOUSEHOLD ENGAGES IN FISHING… **If not, SKIP to (2.17)**

(2.11) Does the household go fishing/crustacean collecting for the purpose of selling the fish, or for subsistence, or for both?

SALE	1
SUBSISTENCE	2
BOTH	3

(2.12) What is your target species?

(2.13) What kind of gear do you use to acquire your target species?

(2.14) Does this gear destroy any of the bottom of the sea?

YES 1
NO 0

(2.15) Does it destroy anything else in the sea?

YES 1
NO 0

(2.16) Out of 10 fish/crustaceans that you catch, how many do you sell?

(2.17) Do you collect crabs or mollusks in the mangrove forests?

YES 1
NO 0 ▶ (2.19)

(2.18) If yes, which species?

(2.19) Do you own a boat, and if so, how many?

IF NO BOATS, WRITE ZERO

(2.20) Do you or anyone in your household do any farming or agricultural work?

YES 1
NO 0 ▶ (2.23)

(2.21) What is the main crop you produce?

CROP CODE

(2.22) Do you hold a formal title for the land you farm?

YES 1
NO 0

(2.23) Do you or anyone in your household herd animals?

YES 1
NO 0 ▶ (2.24)

(2.23a) What kind of animals? ANIMAL CODE	**(2.23.b)** How many do you have? RECORD NUMBER FOR EACH

(2.24) For each of the following statements, please indicate whether this situation applies to this household often, sometimes, seldom, or never?

In the last 12 months…			Often	Sometimes	Seldom	Never
a	We were worried whether our food would run out before we got money to buy more.		1	2	3	4
b	We couldn't afford to eat balanced meals.		1	2	3	4
c	We had to cut down or skip meals because we could not afford to buy enough food.		1	2	3	4
d	Some or all of our household did not eat for an entire day because we could not afford enough food.		1	2	3	4

(2.25) Please imagine a ten-step ladder where on the bottom, the first step, stand the poorest 10% people in our state and on the highest step, the tenth, stand the richest 10% of people in our state. On which step of the ten is your household today?

1	2	3	4	5	6	7	8	9	10

(2.26) Now, imagine the same ten-step ladder 4 years ago. On which step was your household at that time?

1	2	3	4	5	6	7	8	9	10

(2.27) And where on the ladder do you believe your household will be 4 years from now?

1	2	3	4	5	6	7	8	9	10

SECTION 3 ATTITUDES & VALUES

RESPONDENT: THE PERSON SELECTED AT THE BOTTOM OF SECTION 1. NO SUBSTITUTIONS ARE POSSIBLE.

RESPONDENT'S ID CODE: ____

(3.01) To what extent do you agree with the following statements?

			Strongly disagree	Disagree	Neither	Agree	Strongly agree
a	We do not have to worry about the air and the sea, God will take care of it for us.		1	2	3	4	5
b	If our community works together, we will be able to protect our resources.		1	2	3	4	5
c	Protecting the environment and fighting pollution is less urgent than often suggested.		1	2	3	4	5
d	The government should reduce environmental pollution, but it should not cost me any money.		1	2	3	4	5
e	Human activities do not influence the number of fish in the ocean.		1	2	3	4	5
f	Unless mangroves are protected, we will not have any small fish to catch.		1	2	3	4	5
g	We have to take care of the land and the sea or it will not provide for us in the future.		1	2	3	4	5
h	If we throw our garbage on the beach, the ocean takes it away and it causes no harm.		1	2	3	4	5
i	Fishing would be better if we cleared the coral where the fish hide from us.		1	2	3	4	5
j	There are so many fish in the ocean that no matter how many we catch, there will always be enough for our needs.		1	2	3	4	5
k	I would be willing to contribute some of my own money to help reduce pollution in my village.		1	2	3	4	5

(3.02) How concerned are you about environmental pollution/degradation? Please answer on a scale of 1 to 5, where 1 means that you are not at all concerned and 5 means you are extremely concerned. SINGLE CODE

1	2	3	4	5

____

(3.03) And how concerned are you about coastal and marine degradation?

1	2	3	4	5

____

(3.04) Now I'd like you to tell me your views on various issues. How would you place your views on this scale? 1 means you agree completely with the statement on the left; 10 means you agree completely with the statement on the right; and if your views fall somewhere in between, you can choose any number in between.

Community ownership of marine resources should be increased	1	2	3	4	5	6	7	8	9	10	Government ownership of marine resources should be increased	____
In some cases, women are preferable to men in leadership positions	1	2	3	4	5	6	7	8	9	10	On the whole, men make better leaders than women do	____
People should take more responsibility to protect the coastal areas for themselves	1	2	3	4	5	6	7	8	9	10	The government should take more responsibility to ensure that the coastal areas are protected	____
Women can be good politicians and should be encouraged to stand in elections	1	2	3	4	5	6	7	8	9	10	Women should stay at home to take care of their household	____

(3.05) Generally speaking, would you say that most people can be trusted, or that you can't be too careful in dealing with people? Please answer on a scale of 1 to 5, where 1 means that you have complete distrust and 5 means that you have complete trust.

1	2	3	4	5
Complete distrust	Some distrust	Neither trust nor distrust	Some trust	Complete trust

____

(3.06) Using the same scale from the previous question, I'd like to ask you how much you trust the following institutions. Could you tell me for each, whether you trust these institutions completely, somewhat, not very much, or not at all?

			Complete distrust	Some distrust	Neither trust nor distrust	Some trust	Complete trust
a	The government / cabinet of ministers		1	2	3	4	5
b	The parliament		1	2	3	4	5
c	Courts		1	2	3	4	5
d	Armed forces		1	2	3	4	5
e	The police		1	2	3	4	5
f	Banks and the financial system		1	2	3	4	5
g	Political parties		1	2	3	4	5
g	NGOs		1	2	3	4	5
h	Religious institutions		1	2	3	4	5

(3.07) Using the same scale from the previous question, I 'd like to ask you how much you trust people from various groups.

a	Your family		1	2	3	4	5
b	Your community		1	2	3	4	5
c	People you know personally		1	2	3	4	5
d	People you meet for the first time		1	2	3	4	5
e	People of another religion		1	2	3	4	5
f	People of another nationality		1	2	3	4	5

(3.08) All things considered, how satisfied are you with your life as a whole these days? Using this card on which 1 means you are "completely dissatisfied" and 10 means you are "completely satisfied" where would you put your satisfaction with your life as a whole?

1	2	3	4	5	6	7	8	9	10	

SECTION 4 INDIVIDUAL DEMOGRAPHICS

RESPONDENT: THE PERSON SELECTED AT THE BOTTOM OF SECTION 1. NO SUBSTITUTIONS ARE POSSIBLE.

RESPONDENT'S ID CODE: ____

(4.01) What is…

Your mother tongue?	
Your mother's mother tongue?	
Your father's mother tongue?	

(4.02) What is your ethnic identity? ____

(4.03) How long have you lived in this village? YEARS ____

IF THE WHOLE LIFE, WRITE 99 ►

(4.04) Where were you born?

Country	
State	
City	

URBAN 1 RURAL 2 ____

(4.05) What is your religion? ____

HINDU	1
SUNNI MUSLIM	2
SHIA MUSLIM	3
CATHOLIC	4
PROTESTANT / OTHER CHRISTIAN	5
SIKH	6
BUDDHIST	7
JAIN	8
ATHEIST/AGNOSTIC/NONE	9
OTHER	10

(4.06) Did you go to temple, church, or mosque last week? ____

YES 1
NO 0

(4.07) How many years of education have you received? ____

(4.08) Can you read? ____

YES 1
NO 0

(4.09) Can you write? ____

YES 1
NO 0

(4.10) Here is a list of voluntary organizations. For each one, please indicate whether you are a member or not a member of that type of organization.

a	Religious Organization (e.g., church)	
b	Non Governmental Organization	
c	Neighborhood group	
d	Labor Union	
e	Environmental Organization	
f	Art, music, or educational organization	
g	Sport and recreational organization	
h	Professional Association	
i	Humanitarian or charitable organization	
j	Youth Association	
k	Other (specify:)	

MEMBER	1
NOT MEMBER	0

(4.11) Have you ever attended any village meetings?

YES	1	
NO	0 ▶ (4.13)	

(4.12) How often do you attend village meetings?

VERY OFTEN	1	
OFTEN	2	
SOMETIMES	3	
RARELY	4	

(4.13) How likely are you to…

HAVE DONE	1
MIGHT DO	2
WOULD NEVER DO	3

…attend a lawful demonstration	
…participate in a strike	
…join a political party	
…sign petitions	
…lobby a politician or offical	

(4.14) What is your caste?

BRHAMIN	1	
KSHATRIYA	2	
VAISHYA	3	
SHUDRA	4	
SCHEDULED CASTE/TRIBE	5	

(4.15) Do you belong to any of the following cooperatives?

		YES 1 / NO 0
a	Credit or microfinance	
b	Agricultural	
c	Fisheries	
d	Women's cooperative	
e	Dairy	
d	Textile	
d	Sugar	
d	Other (specify:	

SECTION 5 COASTAL CONDITIONS, MANGEMENT & PRESSURES

RESPONDENT: THE PERSON SELECTED AT THE BOTTOM OF SECTION 1. NO SUBSTITUTIONS ARE POSSIBLE.

RESPONDENT'S ID CODE: ____

(5.01) In this village, are there less marine resources now compared to 4 years ago?

YES 1
NO 0 ____

(5.02) We would like to ask you some questions about the condition of AREA X. Please rank the condition on a scale of 1 to 5, where 1 means "very bad" and 5 means "very good".

READ EACH QUESTION ALOUD, AND EACH RESPONSE OPTION.

			Very bad	Bad	Neither	Good	Very good
a	What is the condition of coral in AREA X?		1	2	3	4	5
b	What is the condition of the fish in AREA X?		1	2	3	4	5
c	What is the condition of sea grass in AREA X?		1	2	3	4	5
d	What is the condition of mangroves in AREA X?		1	2	3	4	5

(5.03) We would now like to ask you about the abundance of resources in AREA X. Can you please answer on a scale of 1-3, where 1 means that the resource is decreasing, 2 means it has remained the same, and 3 means the resource is increasing.

READ EACH QUESTION ALOUD, AND EACH RESPONSE OPTION.

			Decreasing	Same	Increasing
a	What is the abundance of coral compared to 4 years ago?		1	2	3
b	What is the abundance of fish compared to 4 years ago?		1	2	3
c	What is the abundance of sea grass compared to 4 years ago?		1	2	3
d	What is the abundance of mangroves compared to 4 years ago?		1	2	3

(5.04) Using the same scale as the previous question, is the number of fishers in AREA X increasing, decreasing, or has it remained the same compared to 4 years ago? ____ 1 2 3

(5.05) Have you noticed any discoloration or bleaching of corals in AREA X?

YES 1
NO 0 ____

(5.06) Over the last 4 years, have you had periods of algal blooms (a lot of green floating material on the surface of the sea) in AREA X?

YES 1
NO 0 ▶ (5.08) ____

(5.07) On average, how often per year do you observe this? ____

(5.08) Have you ever observed the estuarine/marine areas of AREA X stinking of sulphide (like fouling eggs?)

YES 1
NO 0 ▶ (5.10) ____

(5.09) In the mangrove area, estuary area, or marine areas?

CROSS ALL THAT APPLIES ▼

a	MANGROVE	
b	ESTUARY	
c	MARINE	

(5.10) I would now like to ask you if you know about the formal and informal rules surrounding the use of AREA X. Which of these rules apply to AREA X, and what is the level of respect for each rule? In your opinion, how fair is each rule? And finally, what types of monitoring systems exist for each rule?

	RULE TYPE?	LEVEL OF RESPECT?	FAIRNESS?	MONITORING SYSTEM?
	No rules 1			
	Fishing/hunting/collecting forbidden 2			
	Certain fishing techniques/gear forbidde 3			No monitoring 1
	Certain species forbidden 4	Very well respected 1	Very fair 1	Community self-monitoring 2
	Closed periods 5	Well respected 2	Fair 2	Forestry officials 3
	Certain people/outsiders exluded 6	Poorly respected 3	Unfair 3	External auditor 4
	Other (specify) 7	Little to no respect 4	Very unfair 4	Other 5
1				
2				
3				
4				
5				

(5.11) How are the rules relating to the use of AREA X made? Who initiated these

a	Government	
b	Local government (panchayat)	
c	Local people	
d	Others (NGOs)	

(5.12) Do you know of any conflicts or issues surrounding the use of AREA X over the last 4 years?

YES 1	
NO 0 ▶ (5.15)	

(5.13) Please describe these conflicts in detail.

	PARTY 1	PARTY 2	FREQUENCY	REASON	INTENSITY	RESOLUTION	VILLAGE
	RECORD TWO MAIN PARTIES INVOLVED.		ASK HOW OFTEN THIS TYPE OF CONFLICT OCCURS	WHAT WAS THE	IN GENERAL, HOW INTENSE IS EACH CONFLICT?	ASK RESPONDENT IF RESOLUTION WAS ACHIEVED THROUGH THE HELP OF THE FOLLOWING PEOPLE OR	ASK IF CONFLICT INVOLVED PEOPLE FROM THIS VILLAGE OR OUTSIDERS. IF NO PARTIES INVOLVED ARE
	Fishers 1					No resolution 1	
	Forestry officials 2					Village head 2	
	Government 3					Panchayat 3	
	Police 4					Police 4	
	Panchayat 5		RARELY 1		No force/ 1	Government 5	
	NGO 6		once/few years	Ownership 1	Passive		
	Traders 7		OCCASIONALLY 2	Access 2	Mild/ 2	NGO 6	This 1
	Navy/Coast guards 8		once/year	Gear use 3	Verbal	Forestry officia 7	Village
	Tourism operator 9		CHRONIC 3	Area use 4	Violent/ 3	Village action 8	Outside 2
	Farmers 10		(more than once/year)	Other (specify) 5	Destructive	Religious leader 9	Village
	Aquaculturists 11						
	Tourists 12						
	Other (specify) 13						
1							
2							
3							
4							
5							

(5.14) Have you personally taken part in conflict resolution initiatives?

YES 1	
NO 0	

(5.15) Does this community work with an NGO or similar organization to manage AREA X?

YES 1	
NO 0 ▶ (6.01)	

(5.16) In your opinion, how successful is this NGO in bringing positive change to the coastal area? 1 means believe it is "very unsuccessful", and 10 means "very successful."

1	2	3	4	5	6	7	8	9	10

SECTION 6 FINAL QUESTIONS

RESPONDENT: THE PERSON SELECTED AT THE BOTTOM OF SECTION 1. NO SUBSTITUTIONS ARE POSSIBLE.

RESPONDENT'S ID CODE:

(6.01) Personally, do you think you are well informed about…?

READ EACH LINE ALOUD

			Not at all informed	Not very well informed	Fairly well informed	Very well informed	Don't Know
a	The causes of coastal and marine degradation?		1	2	3	4	5
b	The consequences of coastal and marine degradation?		1	2	3	4	5
c	Ways in which we can slow down coastal and marine degradation?		1	2	3	4	5
d	Ways in which we can adapt to coastal and marine degradation?		1	2	3	4	5

(6.02) Do you know what a Marine Protected Area or MPA is?

INSERT GIZ DEFINITION OF MPA: READ SCRIPT EVEN IF RESPONDENT IS AWARE

YES	1
NO	0

(6.03) If an MPA were implemented here, would you agree or disagree that…

READ EACH LINE ALOUD

			Strongly disagree	Disagree	Neither	Agree	Strongly Agree
a	An MPA would improve the health of the coastal area.		1	2	3	4	5
b	An MPA would create a loss of income.		1	2	3	4	5
c	An MPA would increase the number of conflicts.		1	2	3	4	5
d	An MPA would benefit my household.		1	2	3	4	5
e	An MPA would benefit this community.		1	2	3	4	5

(6.04) If an MPA were implemented here, who, in your opinon, should be responsible for managing it?

CROSS ALL THAT APPLIES ▼

a	The government		
b	Local government or panchayat		
c	NGOs		
d	Local people		
e	Religious leaders		
f	Other (specify:		

MARK WITH A CROSS THE MOST IMPORTANT ▲

(6.05) All things considered, how satisfied would you be if an MPA were implemented here? 1 means you are "completely dissatisfied", and 10 means you are "completely satisfied."

1	2	3	4	5	6	7	8	9	10	

(6.06) In your opinion, what do you think are the potential benefits of an MPA?
DO NOT PROMPT

CROSS ALL THAT APPLIES ▼

a	Improved fish catch		
b	Improved coral/fish conditions		
c	Increased tourism		
d	Pride/prestige for this village		
e	Protects future generations		
f	Excludes people from other villages		
g	Stops bad gear		
h	More money and benefits from NGO or government in the future		
i	Reduced conflict		

MARK WITH A CROSS THE **THREE** MOST IMPORTANT ▲

(6.07) In your opinion, what do you think are the potential disadvantages of an MPA?
DO NOT PROMPT

CROSS ALL THAT APPLIES ▼

a	Unclear rules		
b	Outsiders breaking the rules		
c	Unfair		
d	Increased conflict within village		
e	Increased conflict with outsiders		
f	Difficulties to enforce rules		
g	Bad for fishing		
h	Less money for my family		
i	No money or support to run the MPA		

MARK WITH A CROSS THE **THREE** MOST IMPORTANT ▲

LIST OF CROPS	
RICE	01
WHEAT, MAIZE, BARLEY, MILLET, OTHER CEREALS	02
PULSES	04
COTTON	05
JUTE	06
SUGAR CANE	07
TOBACCO	08
OIL SEEDS (GROUNDNUT, LIN, CASTOR, ETC.)	09
TEA	10
COFFEE	11
RUBBER	12
SPICES	13

LIST OF ANIMALS	
CHICKEN/POULTRY	01
CATTLE (COWS/ BUFFALO)	02
SHEEP	03
GOATS	04
CAMELS	05

JOB/INDUSTRY CODES	
AGRICULTURE, HUNTING AND FORESTRY	01
TEXTILES AND HANDICRAFTS	02
MINING AND QUARRYING	03
MANUFACTURING	04
ELECTRICITY, GAS AND WATER SUPPLY	05
CONSTRUCTION	06
REPAIR OF MOTOR VEHICLES, MOTORCYCLES AND PERSONAL AND HOUSEHOLD GOODS	07
HOSPITALITY, HOTELS, RESTAURANTS	08
TRANSPORT, COMMUNICATIONS	09
FINANCE/FINANCIAL INTERMEDIATION	10
REAL ESTATE, RENTING AND BUSINESS ACTIVITIES	11
PUBLIC ADMINISTRATION, MILITARY, SOCIAL SECURITY	12
EDUCATION	13
HEALTH AND SOCIAL WORK	14
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Annex 4

Conceptual framework for a baseline study on the ecological status of selected CMPA sites

MoEF Ministry of Environment and Forestry, India – GIZ Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH

Indo-German Biodiversity Programme

Conservation and Sustainable Management of Existing and Potential Coastal and Marine Protected Areas (CSM-MPA)

Conceptual framework for a baseline study on the ecological status of chosen sites

developed by

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November 2013

Contents

1. Background and Rationale

In times of global change tropical coastal regions are under particular pressure. They receive maximum inputs of dissolved and particulate substances, they harbor valuable ecosystems like mangroves, seagrass meadows and coral reefs and the maximum of marine biodiversity, and they belong to the most heavily modified coastal zones worldwide. As a rule, more people live near the coast and depend on its natural resources in tropical than in nontropical regions. The intensive use of coastal resources can lead to lasting degradation of the ecosystems and, hence, ultimately to the loss of their economic potential.

India's coastline is entirely located in the tropics, is densely populated and intensively used. As a consequence degradation of coastal ecosystems and a depletion of natural resources are observed in many regions. While India's efforts towards conservation have concentrated largely on the land side as yet, it became more and more obvious that a sustainable management of coastal resources, hence, a protection of coastal ecosystems is required. As yet, India has a total of 611 protected areas only 31 of which (<4 %) are coastal and marine protected areas (CMPA). The few existing CMPAs are not well accepted by the local communities who find their livelihoods threatened by the CMPA-related restrictions imposed on them. Therefore, the MoEF – GIZ project on the "Conservation and Sustainable Management of Coastal and Marine Protected Areas, India (CSM-CMPA)" aims at designing and implementing CMPAs along the Indian coast with a participatory approach. As a result of an extensive fact-finding mission 8 sites in the states of Gujarat, Maharashtra, Karnataka and Tamil Nadu were chosen.

Being well known for its long history on interdisciplinary work across the social and natural sciences the Leibniz Center for Tropical Marine Ecology (ZMT), Bremen, Germany, was asked to assist in designing an evaluation concept for CMPAs and the success of management measures. As a first step a concept had to be designed for a baseline survey on the status of the chosen systems in terms of socioeconomic issues and ecosystem health. The following is a concept for ecosystem health assessment based on natural science parameters which has been developed alongside with a socioeconomic survey and in close collaboration with the involved social scientists. The resulting concepts therefore partially complement each other. Data/knowledge generated in the socioeconomic survey (e.g. on fishing effort, history of resource exploitation, perception of environmental change and ecosystem degradation) will be used in this concept. It mainly builds on the guidebook "How is your MPA doing?" published by IUCN – The World Conservation Union (Pomeroy et al., 2004). Goals and indicators from the guidebook were blended with ZMT expertise and experience and were tailored to the characteristics and needs of the chosen systems along the Indian coasts. Moreover, they were streamlined for the purpose of a rapid assessment to be carried out within two months. The result is a suite of biophysical indicators and a baseline study concept designed to evaluate the ecosystem status before implementation of the CMPA measures.

2. Chosen sites and main characteristics

In the following the chosen sites will be shortly characterised based on the fact-finding mission report and maps of the areas shown (Fig. 1-8).

2.1 Gujarat

a) Jamnagar Marine National Park & Sanctuary

Habitats:	Mangroves, coral reefs
Protection status:	National Park and Sanctuary
Threats:	• for corals: mud and sand deposits • for mangroves: logging for fuel wood, grazing by camels and cattle
Remarks:	No information available from fact finding mission
Focal species:	To be determined by local/regional experts

Figure 1: Map of Jamnagar Marine National Park & Sanctuary. Source: Google Earth.

b) Kerly – Gosa Bara wetlands

Habitats:	waterlogged wetlands (freshwater)
Protection status:	none
Threats:	Mining of building stone 'Bela patthar' at beach resulted in saltwater intrusion
Remarks:	• partly artificially created • weir constructed to prevent saltware intrusion • 1,800 ha designated as 'Reserve Forest'
Focal species	To be determined by local/regional experts

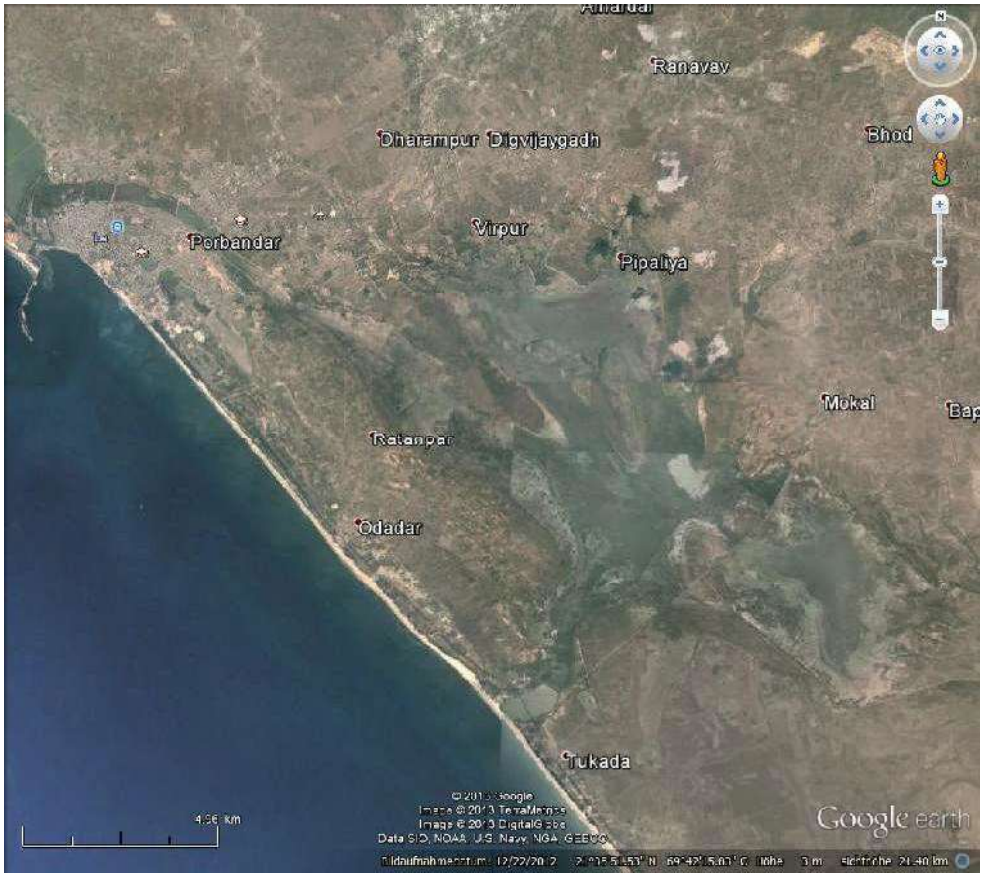

Figure 2: Map of Kerly – Gosa Bara wetlands. Source: Google Earth.

2.2 Maharashtra

a) Ansure Creek

Habitats:	estuary, mangroves on sandy and muddy shores, small patches of seagrass *Halophila* in creek
Protection status:	none
Threats:	• cooling water release of nuclear power plant and possible accidents • two large shrimp aquaculture ponds • release of untreated domestic sewage • clearing mangroves for fuel wood
Remarks:	
Focal species	To be determined by local/regional experts

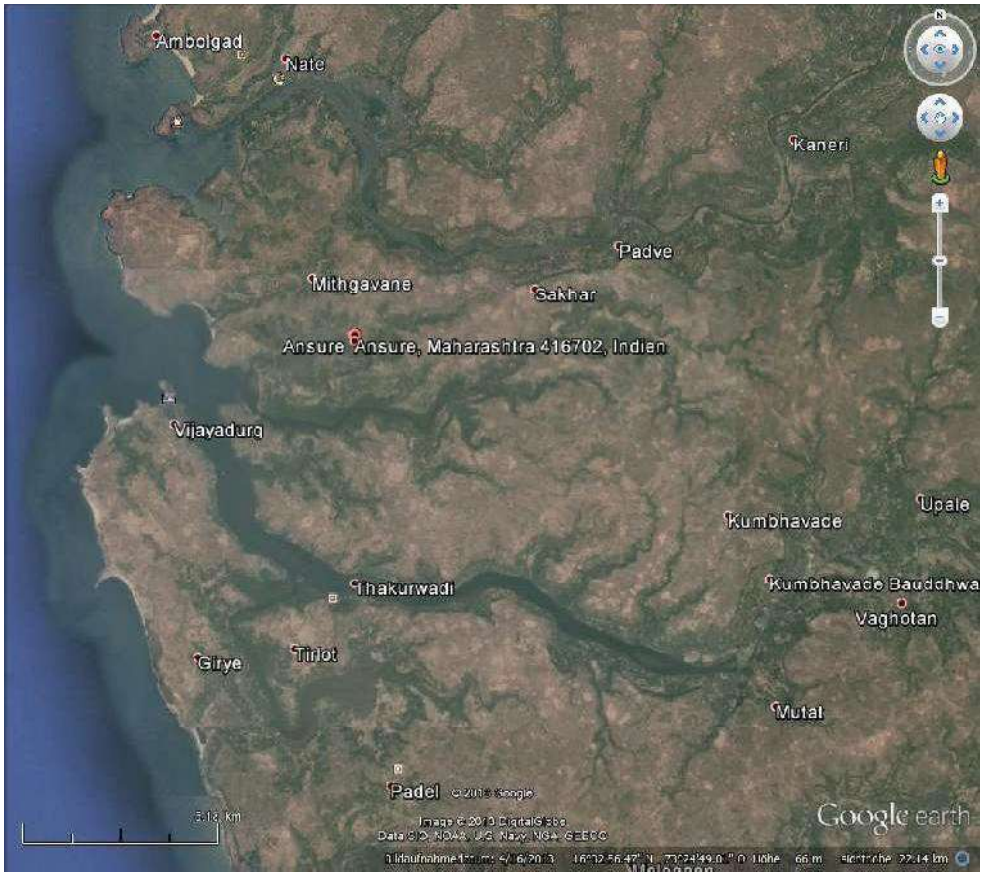

Figure 3: Map of Ansure Creek with mangroves and small patches of seagrasses. Source: Google Earth.

b) Velas – Dabhol stretch

Habitats:	50 km stretch of coast with (i) sandy beaches at Velas, Kelshi, Anjarle, Murud, (ii) muddy shores with mangroves at Savitri River, Kelshi Creek, Anjarle Creek, Dabhol Creek (Vashishti River), (iii) rocky shores at Ladghar and Burundi
Protection status:	none
Threats:	• mechanized industrial trawl fishing • power plants • shipbuilding yards
Remarks:	• very large area with multiple habitats • protection efforts focussed on protection of charismatic species, e.g. whitebellied sea eagles and nesting sea turtles • Forest Department pays for volunteers to protect nesting sea turtles and the hatchling sea turtles. Payment scheme implemented through an NGO, Sahyadri Nisarga Mitra (SNM) based in Chiplun.
Focal species	To be determined by local/regional experts

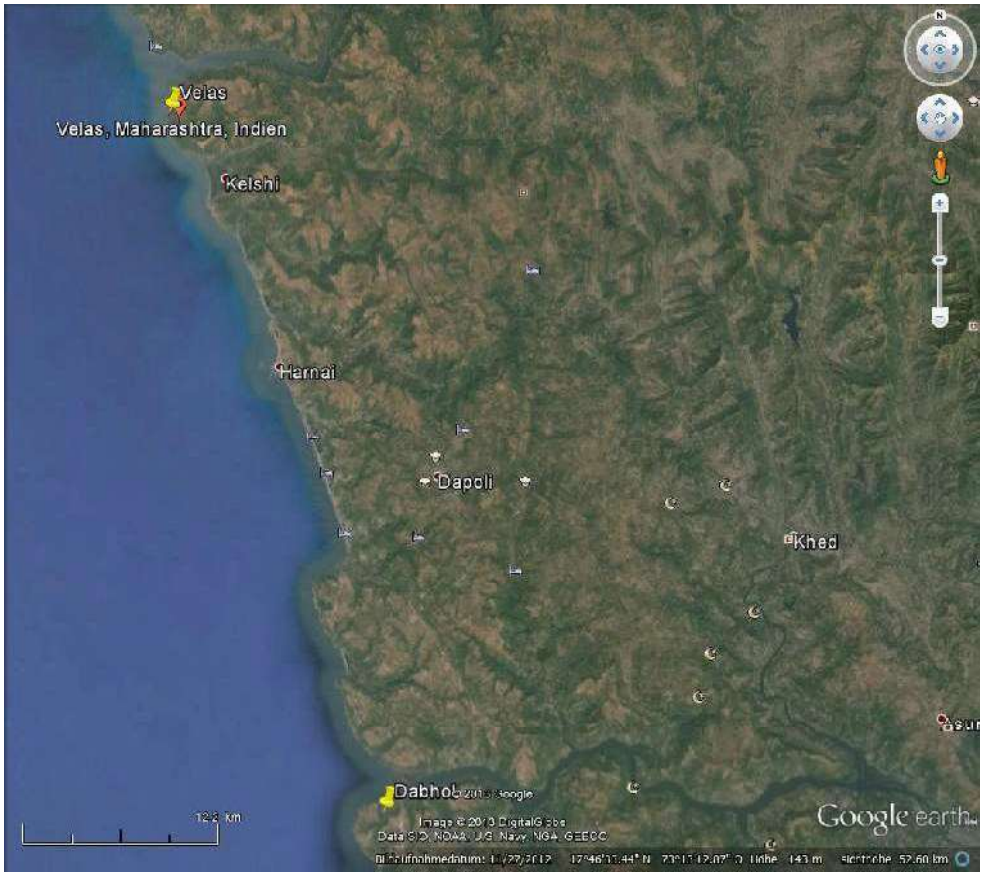

Figure 4: Map of Velas – Dabhol coastal area with estuaries, sandy beaches and mangroves. Source: Google Earth.

c) Thane Creek

Habitats:	estuary, mangroves and mudflats, salt pans
Protection status:	none
Threats:	• release of industrial effluents • domestic waste disposal • reclamation • sand dredging • clearing mangroves for fuelwood
Remarks:	Part of forest is protected and about being converted into 'Reserve Forest' with final goal of diverting into 'Wildlife Sanctuary'
Focal species	To be determined by local/regional experts

Figure 5: Map of Thane Creek estuary and mangroves. Source: Google Earth.

2.3 Karnataka

a) Aganashini River

Habitats:	estuary with mangroves
Protection status:	none
Threats:	• shell mining • sand mining • land encroachment • shrimp aquaculture • clearing of mangroves for fuel wood
Remarks:	• Communities like the area to be declared 'Biodiversity Heritage Site' • Strong objections from shell and sand mining lobbies/industries
Focal species	To be determined by local/regional experts

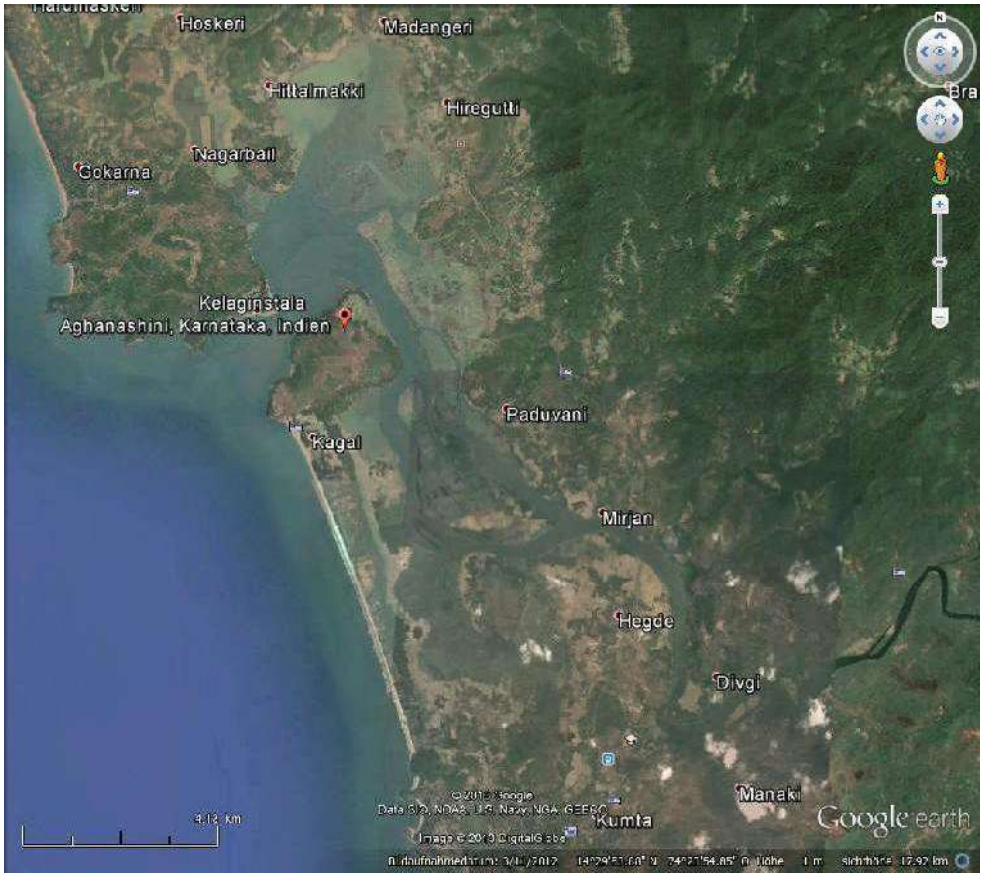

Figure 6: Map of Aganashini estuary and mangroves. Source: Google Earth.

b) Gangavalli

Habitats:	estuary with mangroves
Protection status:	none
Threats:	• sand mining • land encroachment • shrimp aquaculture • clearing mangroves for fuel wood
Remarks:	local belief that mangroves are responsible for salt water intrusion into farmlands
Focal species	To be determined by local/regional experts

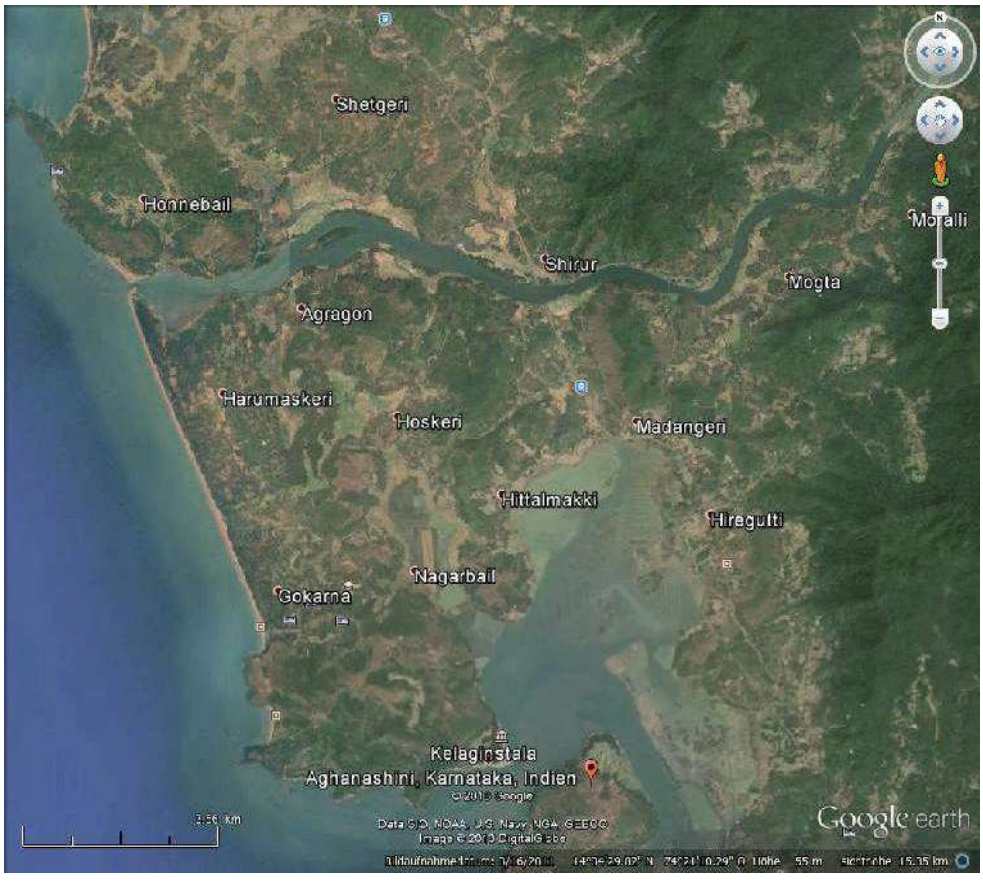

Figure 7: Map of Gangavalli estuary and mangroves. Source: Google Earth.

2.4 Tamil Nadu

a) Palk Bay

Habitats:	extensive shallow bay with mangroves, seagrass meadows and mangroves
Protection status:	none
Threats:	• shrimp aquaculture • seaweed mariculture • high fishing pressure • domestic sewage release • coral mining • harvest and trade of threatened species (e.g. coral and sea horse)
Remarks:	• very large area with multiple habitats • recommended site status: 'Biodiversity Heritage Site'
Focal species	To be determined by local/regional experts

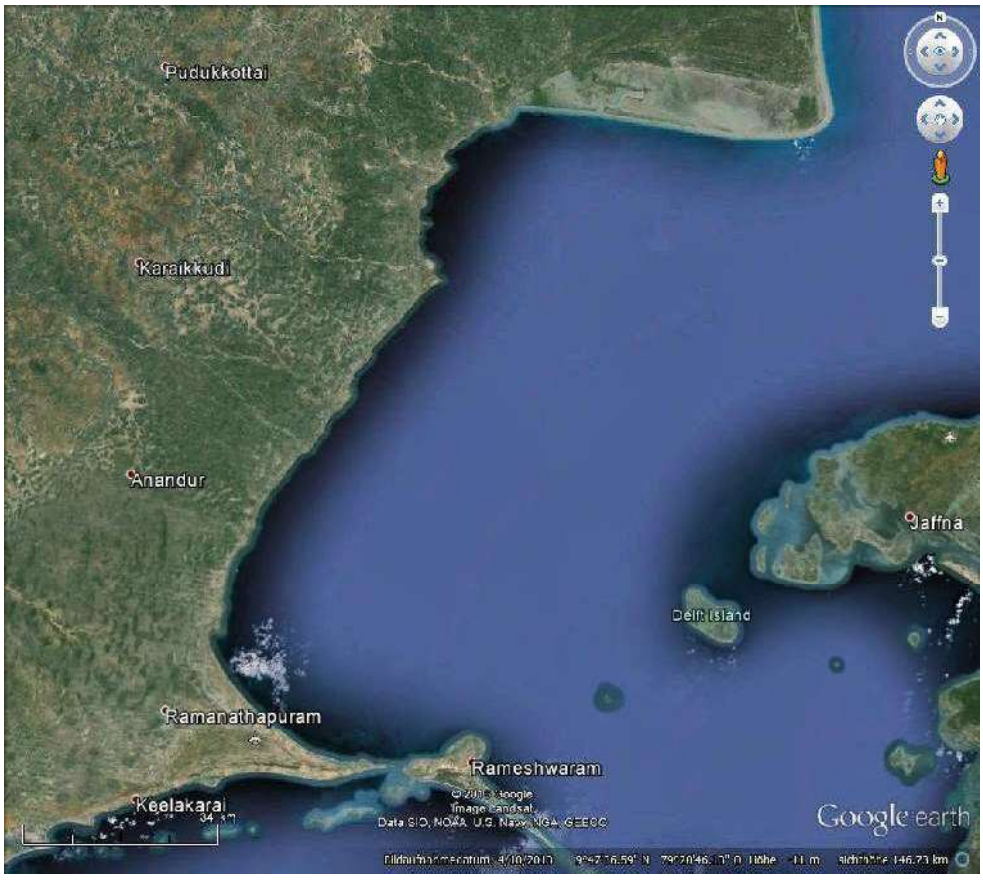

Figure 8: Map of Palk Bay with mangroves, seagrass meadows and coral reefs. Source: Google Earth.

3. CMPA Evaluation Concept

The assessment of the ecosystem status and an evaluation of the success of any implemented measure towards conservation and protection of coastal and marine areas will be done against predefined goals. Major biophysical goals are defined in the following.

Goal 1 Marine resources sustained or protected

- G1a: Populations of target species for extractive or non-extractive use restored to or maintained at desired reference points.
- G1b: Losses to biodiversity or ecosystem functioning and structure prevented.
- G1c: Over-exploitation of living and/or non-living marine resources minimized, prevented or prohibited entirely.
- G1d: Replenishment rate of fishery stocks increased or sustained within the MPA.

Goal 2 Biological diversity protected

- G2a: Resident ecosystems, communities, habitats, species, and gene pools adequately represented and protected
- G2b: Ecosystem functions maintained
- G2c: Focal species protected, incl. rare, localized or endemic
- G2d: Areas protected that are essential for life history phases of species
- G2e: Unnatural threats and human impacts eliminated or minimized inside and/or outside the MPA

Goal 3 Habitat protected

- G3a: Habitat quality and/or quantity restored or maintained
- G3b: Ecological processes essential to habitat existence protected
- G3c: Unnatural threats and human impacts eliminated or minimized inside and/or outside the MPA

In order to achieve the abovementioned goals a suite of biophysical indicators (BI) has been developed, mainly building on the IUCN Guidebook (Pomeroy et al., 2004). The matrix shown in table 1 displays how the individual biophysical indicators relate to the common goals.

The indicators are:

BI1 'Habitat distribution and human impact' (resulting from IUCN B3+B10)

BI2 'Population and community structure and composition' (resulting from IUCN B1+B2+B4)

BI3 'Water and sediment quality' (resulting from IUCN B8)

BI4 'Fishing effort' (resulting from IUCN B7)

Table 1: How the Biophysical Indicators (BI) contribute to the Goals (G).

	BI1	BI2	BI3	BI4
Goal 1				
G1a		●		●
G1b	●	●	●	
G1c	●	●		●
G1d		●		●
Goal 2				
G2a	●	●		●
G2b			●	
G2c		●		
G2d	●	●	●	●
G2e	●	●	●	
Goal 3				
G3a	●	●	●	
G3b	●	●	●	
G3c	●	●	●	

4. Indicators and Workplan

The following indicators are recommended to evaluate in form of a rapid assessment. At sites including areas with already existing protection status, it is important to collect data also from outside the protected area, but in the same environmental setting/ecosystem. Having reference/control sites, will allow to evaluate the success of the existing protection measures.

4.1 Indicator BI1 'Habitat distribution and human impact'

4.1.1 Indicator definition and meaning

A habitat is the living space of an organism, population, or community, as characterized by its biotic and abiotic properties. Priority habitats are those making up a majority of the total area represented within the study area, or being known as of high conservation and management value. Habitat types are distinguished from another by their distinct biotic and abiotic composition and structure.

Habitat distribution is the structural and spatial characterization of all habitat types within a specific area based on their physical location (e.g. depth), configuration (i.e. placement next to each other), and extent in terms of total area.

Habitat complexity is the extent (area) and diversity (number) of habitat types and distinct zones found within a specified area.

As communities of organisms are dependent on the presence of adequate living space, it is a major goal of any MPA to protect its habitats.

Human impact is the cumulative environmental effect of all extractive and non-extractive uses of living and non-living marine resources located within a specific area including e.g. fishing, tourism, aquaculture, deforestation, coastal development, seabed drilling and mining, transportation and trade.

An area under no impact is completely free of all extractive or non-extractive human uses contributing to impact. These are commonly referred to as “reserves” or “fully protected areas” or “no-take zones”. It is assumed that in a MPA experiencing reduced or no human impact the habitats and communities therein have a greater probability of being able to replenish and maintain themselves through time than areas experiencing a higher level of human impact. Thus, reducing the level of human impact experienced in an area is a common aim of MPAs.

An inventory of all habitats and areas of human impact encountered in an area forms the basis for gaining an understanding on the ecosystem and for determination of changes in habitat location, quantity and quality over time.

4.1.2 Sampling strategy and parameters

An inventory of all habitat types or at least of “priority habitats” should be carried out including compulsorily those mentioned above under site description (i.e. mangrove forests, wetlands, tidal flats, seagrass meadows and coral reefs). Furthermore, all specific areas of

human impact/land-use (see examples above) should be compiled and if possible complimented with data on coastal areas affected by fisheries (see indicator BI 4).

- Geo-referenced aerial/satellite pictures should be analyzed for different habitat types (mangrove areas, seagrass meadows, coral reefs,…) and visible areas of human land-use (e.g. shrimp ponds, deforested areas, agriculture fields…) and their specific areas be mapped and measured.
- Surveys should be carried out along transects from onshore to offshore recording the location of human impact and habitat types/zones together with data on water depth. Depending on the ecosystem, these transects are carried out by boat, snorkelling, walking…The data is entered into a base map/GIS and is used to validate ex situ habitat characterization.
- At points adequately distributed along the transects, the status of the respective habitat encountered is characterized recording measures of quantity and quality of the living organisms forming the habitat.
- Experts in taxonomy are required for species identification.

Mangrove wetland:

- Average tree height is estimated in X plots of 5m x 5m in the intertidal area using a 5 point scale (as in indication of the forest age).

  1: dominated by seedlings; 2: tree height < 3 m; 3: tree height 3 – 5m; 4: tree height 5-10m; 5: tree height > 10m

- Percentage cover of understorey (shrubs, vines) is estimated in the same plots using a 6 point scale

  1: 0-5%; 2: 5-20%; 3: 20-40%, 4: 40-60%; 5:60-80%; 6: >80%

- Apparent forest condition is characterized using a 3 point scale considering tree density, understorey cover and degree of deforestation

  1: degraded/low; 2: deteriorating/middle; 3: healthy/high

Seagrass meadow:

- Percentage cover of seagrass (all species together) is estimated in 5 quadrates of 50cm x 50cm placed randomly on the seafloor using a rapid visual assessment technique based on the Braun-Blanquet abundance score (Fourqurean et al. 2001):

  0: no seagrass; 1: 1-5%, 2: 5-25%, 3: 25-50%, 4: 50-75, 5: >75% cover of seagrass

- Apparent vitality is characterized using a 3 point scale considering percentage seagrass cover, seagrass shoot appearance and epiphyte coverage:

  1: dying/low, 2: deteriorating/middle, 3: healthy/high

Coral reef:

Depending on the area that needs to be covered and the exact purpose (overview, coverage, species list, monitoring) there are basically three methods for reef surveys, and because the fish fauna also needs to be covered a fish survey method should be added.

Percentage cover of so-called "lifeforms" (live hard coral, live soft coral, dead coral rock, macroalgae, as well as percentage cover and/or numbers of other fauna) according to UNEP/AIMS (1993) and English et al. (1994):

a) LIT Line intercept transect: 50 m transects
b) PIT Point intercept transect: 50 m or 25 m transects
c) Quadrats of 50cm x 50cm or 100cm x 100cm are used for intensive identification and area estimations (usually 4 quadrates)
d) Fish visual census: 50 m transects with identification of fish species one meter left and right of the transect line

- Apparent vitality is characterized using a 3 point scale () considering dominance of dead or live coral, amount of fouling algae, coral discoloration:

  1: dying/low, 2: deteriorating/middle, 3: healthy/high

- It is very important that water quality data from the same day are recorded (Temp, DO, salinity, pH, vertical and horizontal visibility).

For an overview and the selection of respective sites for transects the Manta Tow method is used.

All data will also be used for BI2)

Materials: boat, GPS, echosounder (for depth measurement), base maps of the area, staff knowledgeable in the recognition of distinct habitat types/zones and anthropogenic threats, GIS, access to satellite and/or aerial images, transect ropes, quadrats, multisensory and/or refractometer, thermometer, Secchi disc etc., Manta board, compass, trained personnel.

4.1.3 Expected outcome

- A table with extent (area), diversity (number) and cover (%) of habitat types and human impact areas observed
- A habitat inventory report and a descriptive and quantitative characterization of the human activities and threats
- Geo-referenced maps and/or a GIS database on the location, extent and status of all habitat types and areas of human activity (to be complimented with data from other indicators). This includes some basic water quality data, preferably from different seasons, but at the very same locations.

This allows further analysis, e.g. identification of sub-areas being under no, little or high human activity; and covering all coastal habitats.

4.2 Indicator BI2 'Population and community structure and composition'

4.2.1 Indicator definition and meaning

Population structure refers to the composition of a population of a specific species. It provides information on the contribution of different sizes and ages of individuals to the population and on the proportion of females and males. This can also include knowledge on the population´s reproductive potential.

An investigation of population structure can be restricted to specific species, so called focal species of the study. The most important parameters are focal species density and individual size. Time series data on changes in the size/age structure of a population are useful for managers to predict whether or not the population is growing over time. An increased density of focal species in the MPA through time is widely regarded as an indication for effective MPA use.

Species density and population structure should be monitored inside the MPA (protected site) and outside the MPA (reference site). An improved density at the PS may be followed by a migration of individuals to adjacent unprotected sites, increasing the accessible biomass for humans in the case of economically important species.

Given the main goal of the study to protect biodiversity, the following types of focal species should be considered:

- Endemic species: They are found exclusively at the study area or region (e.g. mangrove tree *Heritiera kanikensis*). They are naturally not found anywhere else.
- Keystone species: Their presence and role within the ecosystem has a strong effect on other organisms in the system. A keystone predator (e.g. fish) is all-important in maintaining community composition. A strong decrease of a keystone predator allows the prey population to explode which often decreases overall diversity. Species that significantly alter the habitat (e.g. burrowing crabs in mangroves or coral reef species) can also be keystone species as they may strongly affect the density of other species.
- Disturbance indicator species: They signal how disturbances may be impacting other organisms in the community (e.g. filter feeders; epiphytic algae on seagrass leaves, herbivorous fish).
- Economically important target species: They are of extractive (fishery, ornamental fishery) or non-extractive (e.g. nature tourism) economic value.
- Endangered, threatened or vulnerable species: They are more vulnerable to environmental change than others in the community and/or require careful management to sustain.

A community comprises different and interacting populations of species in the same area. The community composition refers to the number of species within the community and the relative abundance of each species in relation to the others. Important parameters which characterize the community composition are species richness, diversity, evenness and relative abundance and dominance of the different species.

The community structure refers to the number and relative abundances of all species within the community and describes how they are spatially organized, namely in which habitats or zones they occur within an ecosystem. Habitat diversity and relative habitat abundance are

important determinants of the community structure (see also BI 1). Abiotic parameters (e.g. salinity, sediment characteristics) also largely influence community structure (see BI 3).

The maintenance or restoration of the naturally occurring community composition and structure is considered to be of high importance for the integrity and functioning of an ecosystem and its resistance to disturbance. The monitoring of changes in community composition and structure and the identification of the sources of these changes inside and outside the MPA over time allows to evaluate whether or not management efforts are successful. In addition, data on community composition and structure help managers to prioritize areas requiring management efforts.

Limitations: Important factors that influence size and age distribution of a population include the regularity of spawning events, amount and location of larval settlement and recruitment events, and the degree of juvenile survivorship and recruitment in the population. However, the related data collection will largely multiply the labour, time and cost requirements.

4.2.2 Sampling strategy and parameters

In the following, methods for a rapid assessment of population and community structure and composition are given specific for each ecosystem type. Analysis of population structure specific to fishery target species is covered in BI4.

Mangrove forests, tidal flats, sandy beaches:

Sampling design:

Sampling follows a hierarchical, stratified sampling design (Raffaelli and Hawkins 1996) and should be conducted at low tide. All parameters will be measured along transects perpendicular to the shoreline from the low to the high intertidal area (Fig. 9). The length of the total transect depends on the length of the intertidal zone which is site specific. The community structure will be investigated in three zones, the low intertidal, mid intertidal and high intertidal zone. For benthic species (mussels, gastropods, crabs), four replicate plots per zone (each 1m x 1m) will be randomly chosen. The distance between plots should be at least 10m. For mangrove tree species, plots have a size of 10m x 10m (Fig. 9).

Depending on the size of the mangrove area, 6 to 10 transects (stations) should be surveyed. Summed up, the total number of plots is 72 (6 transects) to 120 (10 transects). One transect (station) can be processed within a day (with 4-6 trained persons).

Parameters to be measured:

Number of each species per plot; size, sex and biomass for each animal; trunk´s girth at breast height for each tree; height of each seedling; percentage coverage of understorey per plot.

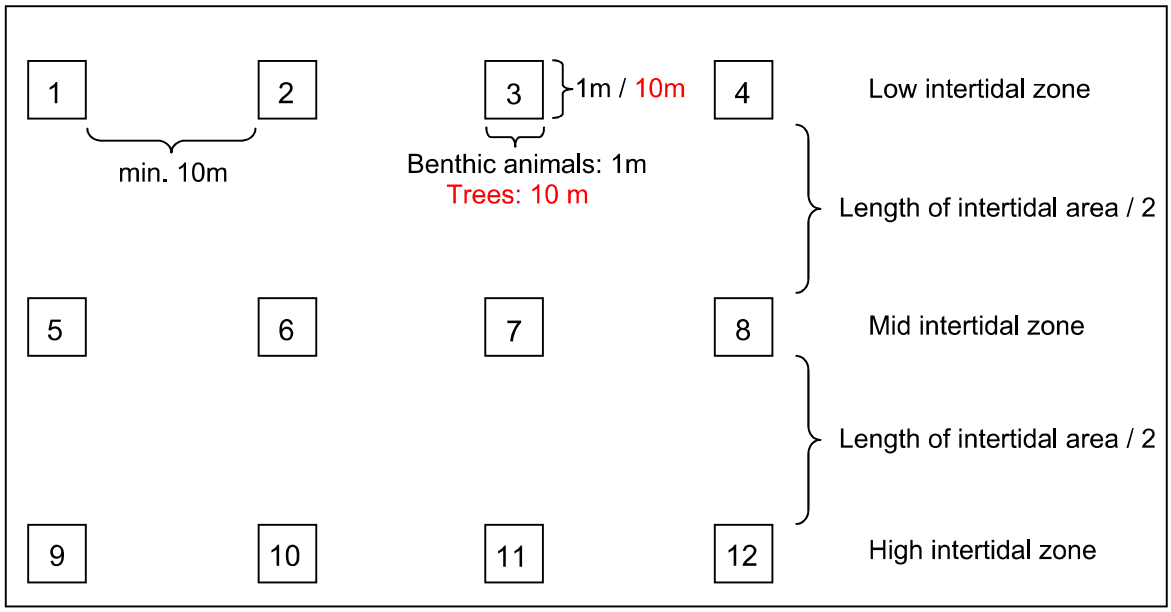

Fig. 9: Sampling design including 12 plots for determining community composition in mangrove forests. The same design can be used if only selected focal species are considered. Single plots have a size of 1m x 1m for benthic animals (mollusks, crabs) and 10m x 10m for vegetation (trees, seedlings, understorey).

Working steps:

- Select 6-10 transects (stations) at each site within and outside the MPA and measure the length of the intertidal area.
- Mark out the 12 plots per transect (1m x 1m for animals, 10m x 10m for trees).

<u>Small plots (1m x 1m):</u>

- Fence the plot with the 4 plexiglas panels to avoid that mobile animals escape.
- Collect all (or only focal) benthic species per plot, identify the species and count all individuals per species. Only epibenthic species are considered in this survey.
- Measure the size of each animal: carapace width (crabs), shell height (bivalves, gastropods).
- Measure wet weight of each animal in the field (if possible) or in the laboratory.
- Note the sex of each species (crustaceans).

Big plots (10m x 10m):

- Identify the different tree species and count the number of trees (> 1.3m height) per species and plot; measure the trunk´s girth at breast height (GBH) at a height of 1.3m.
- Count the number of seedlings and saplings (< 1.3m height) per species in the plot and measure the total height of each individual.
- Understorey plants (herbaceous plants, shrubs and vines which cover the ground): Estimate the percentage coverage in the plot (<5%, 20%, 40%, 60%, 80%, >95% of the surface covered).
- Measure pore water salinity and collect sediment in the low, mid and intertidal area (3 samples per transect; e.g. plots 2, 6, 10). Priority sediment parameters: grain size distribution, organic matter (for methods see parameter BI 3).

Materials needed during survey:

- If only specific species should be investigated: List of focal species for each of the six study sites (see chapter 2)
- GPS
- Digital camera
- Tape measure, sticks to mark sampling plots
- Form, writing materials, map
- Capture nets (for mobile species)
- 4 Plexiglas panels with a size of 100cm x 30cm
- Protective gloves
- Buckets
- Callipers, Ruler
- Balance (battery-operated)
- Stereo microscope (for identification of small species in the laboratory if necessary)

Seagrass meadows:

Sampling design:

A representative number of stations in the seagrass area is selected, depending on the size of the meadow. It is recommended to sample the same stations and plots along the transects carried out for assessing the habitat distribution (see BI1 under 4.1). At each station, the number of shoots of each occurring seagrass species as well as macroalgae is counted inside a 50cmx50cm quadrate (n=5; the same plots used for estimation of total seagrass coverage for BI 1). The 5 quadrates are placed approximately 5 m apart in a X-format (one in the middle and one towards south, west, north, east, respectively). Additionally, the maximum canopy hight of each seagrass species is measured using a ruler.

If visibility permits, also here Manta Tows for gross orientation and selection of transect sites should be used. In order to estimate the fish biodiversity, visual fish census techniques should be applied (see above section coral reefs). For biomass estimations we need access to fisheries data (fish/invertebrates landing statistics) and/or bio-acoustic data. It is very important that water quality data from the same day are recorded (Temp, DO, Sal., pH, visibility vertical and horizontal).

In order to characterize the macrobenthic community, all (or only focal) macrobenthic species will be collected in each plot. All species will be identified and individuals per species will be counted. Only epibenthic species are considered in this survey. The size of each animal will be measured, using carapace width (crabs) or shell height (bivalves, gastropods). The wet weight will be determined in the field (battery-operated balance needed). The sex of crustaceans will be recorded.

Parameters to be measured:

Number of shoots of each seagrass species per plot , canopy hight of each species.

Number of each macrobenthic species per plot; size, sex (crustaceans) and biomass of each animal.

Materials needed during survey:

GPS, quadrate, ruler, snorkelling/diving equipment, underwater writing board, transect ropes, quadrats, multisensory and/or refractometer, thermometer, Secchi-disc etc., Manta board, compass, trained personnel.

The survey strategy should start with a thorough analysis of seacharts and, if available, aerial / satellite pictures. Then the routes for the Manta Tow survey should be fixed. Only when this is finalized and evaluated, the transect locations should be selected. Here a compromise between time requirements, resolution and number of replicates has to be taken. Once the area is defined and the time slot is allocated, the respective survey method will be chosen (LIT, PIT, Quadrat, Visual census). There should be three replicates at least, the survey personnel should not change within one survey round and a particularly for the visual census a calibration must be done beforehand. For a thorough picture of the situation, the survey should be repeated in a different season and for monitoring purposes at least annually.

Materials: boat, GPS, echosounder (for depth measurement), base maps of the area, staff knowledgeable in the recognition of distinct habitat types/zones and anthropogenic threats, GIS, access to satellite and/or aerial images, transect ropes, quadrats, multisensory and/or refractometer, thermometer, Secchi-disc etc., Manta board, compass, trained personnel

4.2.3 Expected outcome

The data of the parameters to be measured (see above) during the surveys of the Indian researchers are expected to be entered in the files provided (INDICATOR_BI2.xls) or in self-created files similar to those. In addition, further literature (publications, local reports etc.) which contain information on species distribution, densities, diversity or community composition should be provided, if existing.

Analyses to be done by the ZMT researchers:

In order to describe the population structure, average density, frequency, size and biomass will be calculated for each species. A size-frequency distribution will be presented for all abundant species and/or focal species. For the analysis of the community structure, several diversity indices (e.g. species richness, Shannon diversity, evenness, Simpson´s index,

taxonomic diversity) and relative species abundance and dominance ranking will be calculated. Rare, endemic, endangered and common species will be indicated. Disturbance indicator species/keystone species may be identifiable with simultaneous sampled water and sediment quality data (see BI 3).

All calculated parameters will be evaluated and comparisons of the communities between stations and habitat types will be done with univariate and multivariate statistics.

4.3 Indicator BI3 'Water and sediment quality'

4.3.1 Indicator definition and meaning

Water and sediment quality is an abiotic and biotic (in the case of bacterial pollution) measure of the ambient environmental parameters present within the water column and in the upper part of the sediment. These parameters are important determinants of the habitats, i.e. the living conditions for flora and fauna in any aquatic ecosystem. Parameters of water quality include temperature, salinity, oxygen content, turbidity, nutrient loading (dissolved inorganic nitrogen, dissolved inorganic phosphorus), chlorophyll a distribution, and presence (suspension) and density of toxins, bacteria and other particulate matter. A simple index for the assessment of water quality (TRIX) can then be calculated from some of the parameters to be measured. For sediments parameters to be measured include porewater salinity, porewater oxygen content, porewater redox potential, organic carbon content and grain size distribution.

4.3.2 Sampling strategy and parameters

Samples/data for water quality shall be taken in a way that they:

- cover the area of the designated MPA adequately and in the case of an estuary they could ideally cover the salinity gradient from 0 to 35 psu in steps of 5 psu;
- cover tidal variations on various timescales (diel, spring/neap (lunar), seasonal) as far as practicable;
- also include reference samples/data taken outside the designated MPA (control sites).

Samples/data for sediment quality shall be taken in a way that they:

- cover the area/habitats of the designated MPA adequately and in the case of an estuary they could ideally cover the salinity gradient from 0 to 35 psu in steps of 5 psu;
- in intertidal areas cover a transect from the high to the low intertidal as far as practicable;
- also include reference samples/data taken outside the designated MPA (control sites).

The parameters to be measured are listed in table 2. It includes physicochemical measurements of the water column (and on porewater) to be measured on location. Other analyses have to be carried out in the laboratory. Parameters are subdivided into 3 categories with 1 being the highest priority. Depending on the availability of resources, first parameters of priority 1 should be measured, if possible also those of categories 2 and 3.

Table 2: Parameters to be measured, requirements for and priority of measurements.

Water quality

Priority	Parameter	Requirements
1	Temperature	Thermometer
1	Salinity	Refractometer, handheld electronic sensor
1	Dissolved oxygen	Winkler titration, handheld electronic sensor
1	pH	Handheld electronic sensor
1	Turbidity	Secchi disk, light meter
1	Dissolved inorganic nitrogen and phosphorus	Automated laboratory analysis (photometry), manual handheld titration and photometric measurement
1	Chlorophyll a	Fluorometric measurement of collected water sample, use of remote sensing data
2	Suspended matter concentration	Filtration set, drying oven, balance
2	Suspended matter organic carbon content	High temperature combustion in element analyser of filtered sample
3	Bacteria/pathogen content (E. coli)	Counting in culture media
3	Heavy metal content	Automated analysis with ICP-OES (inductively coupled plasma – optical emission spectroscopy) or AAS (atomic absorption spectroscopy)
3	Organic pollutant content	Automated analysis with GC-MS (gas chromatography – mass spectrometry)

Sediment quality

Priority	Parameter	Requirements
1	Grain size distribution	Mechanic sieving, laser particle analyser
1	Organic carbon content	High temperature combustion in element analyser
1	Porewater salinity	Handheld electronic sensor
2	Porewater oxygen content	Handheld electronic sensor
2	Poreater redox conditions	Handheld electronic sensor
2	Porewater pH	Handheld electronic sensor

4.3.3 Expected outcome

- It is expected to receive newly obtained data in an organized form, ideally in the predefined EXCEL worksheets provided.
- It is expected to calculate easy-to-use indicators of ecosystem status like, e.g. the TRIX index.
- It is expected to receive any additional data/information on the ecosystem available from archives that helps to assess the ecosystem status.

4.4 Indicator BI4 'Fishing effort'

This indicator concerns the impact of extractive fisheries on target species populations, and thus partially overlaps with BI1 'Habitat distribution and human impact' and BI2 'Population and community structure and composition'. The indicators are divided into 1) rapid assessment and 2) detailed long-term monitoring types. Rapid assessment types require data on the size distribution of target species found in catches, as well as empirical relationships to estimate growth and mortality. Longer-term monitoring will allow for refinement of estimates of population dynamics as well as the incorporation of other information required for an ecosystem based approach (EBA). Simple indicators relating to fish stocks are defined by Fröse (2004).

4.4.1 Indicator definition and meaning

Percentage of mature specimens in the catch (Target: 100%) – Species should be allowed to spawn at least once before they are caught in order to allow for recruitment. This is essential for rebuilding and maintaining healthy spawning stocks. Length at first maturity (i.e. length where 50% of individuals are mature, "L50") is determined from sampling gonad development stage in caught individuals.

Percentage of fish caught at optimum length (Target: 100% of catch is within ±10% of optimum length). Given a fish stock's growth and mortality parameters, there is a an optimum size when the cohort's biomass is at a maximum, which is typically a bit larger than length at first maturity. Optimal length can be obtained from growth and mortality parameters or empirical equations (Froese and Binohlan 2000).

Percentage of old, large individuals in the catch ("megaspawners"), i.e. fish of a size larger than optimum length plus 10% (Target: depends on fishing regime). One target may be to avoid the capture of all megaspawners. If the the catch reflects the size structure of the population, then a target of 30–40% megaspawners will represent a healthy age structure. When the amount of megaspawners in a population is low (e.g. <20%), there may be concerns for the population's ability to maintain healthy recruitment. Megaspawners are often the most experienced reproducers and can add resilience to a stock.

Catch-per-unit-effort (CPUE) over time (Target: stable or increasing). Fishing effort is a relative measure of the fishing activity in an area, and CPUE can give an indication of the relative changes in abundance in a population. Overfished populations will likely show lower

CPUE over time or in comparison to a reference area. In tropical multispecies and multi-gear fisheries it is necessary to split the overall fishing effort into the different gears used and the different resource species targeted by each gear.

4.4.2 Sampling strategy and parameters

Present state: Both rapid assessments and longer-term monitoring will depend on information about the present state of the target stocks. For each of the dominant species in the catch (10-15 species often represent >70% of total catch), a sub-sampling of individuals shall be taken at the relevant landing sites in the study area, with individual length and weight recorded. In addition, the total catch for dominant species should be recorded. Published information or empirical equations may provide an initial estimation of values for L50, growth, and mortality. When possible, the general locations of catches will aid information on species' distributions.

Change over time: For longer-term monitoring and assessment of parameters of the local population dynamics, periodic (i.e. weekly, monthly) samplings of the catches of the target species are required. The data can be used to estimate growth and mortality parameters of the populations and to derive estimates of population size and overall exploitation rate. Applying yield per recruit models to these data, allows to estimate the present yield at the actual fishing mortality rate and to obtain estimates for a fishing effort that would allow for sustained fishing of the target species. Values of total catch and effort should be recorded for each gear type and target species in order to aid in the development of models for management. When possible, historical data should be standardized in a similar manor to allow for comparison and/or reference points.

Future management: This evaluation is to be based on historical fisheries data and may show that the catch has leveled off or even decreased with an increase in effort over the years, indicating full exploitation or even overexploitation. Surplus production models may be used with these data to estimate the biological maximum sustainable yield. If economic data are also available, the economic yield of the harvest versus the costs of the fishery operation may also be estimated and the effort may be estimated, which yields the highest economic yield. A more holistic approach, such an EBA, may be desired for the long-term management, which includes the interrelationships among the functional compartments of the system, and may allow for a better understanding of the indirect effects of fisheries on ecosystem health. In recent years fisheries assessment has moved from single species to ecosystem approaches and the trophic modeling approach is being applied worldwide. This approach allows to integrate fisheries and ecological data to construct a spatially- explicit model of energy flow through the ecosystem, which may be used for several purposes: 1) to quantify and visualize the trophic linkages within the ecosystem, 2) to simulate ecosystem effects of different fisheries or environmental scenarios and 3) to explore the effect of the implementation of an MPA on the fishery and ecosystem functioning. Nevertheless, these methods require more detailed data, such as information on the diets and distributions of species.

4.4.3 Expected outcome

These results may already allow for a general classification of the state of the fishery. Initial sampling may already give some indication on whether the fishery is targeting appropriately aged individuals to ensure sustained recruitment. Longer-term monitoring of the population will need about a year to yield useful results on the exploitation level (and possibly population sizes) of the target resources exploited by the different gears. The construction of trophic models usually requires more time but should be considered as a relevant endpoint of the assessment, since the model has a great potential as tool for the exploration of different management and conservation scenarios. Since this model may also be linked to socio-economic variables (costs of fishing operation, market value of different fishery products, employment rate of fishermen in different fisheries (gill net, longline, beach seine etc.), it may be also used to explore the benefit and costs of different fishing and conservation (MPA) strategies for the stakeholders involved.

5. General sampling schedule

Three kinds of surveys:

1) Analysis of satellite pictures/GIS → BI1
2) Transect surveys across coastal habitats → BI1, BI2, BI3
    a) Habitat mapping along whole transects
    b) Sampling at defined stations along transects

The following data/samples are to be collected at each station of the survey:

Data/Sample collected	Applies to Indicator BI	Estimation of time needed (h)	Estimation of persons needed
At all stations	1,2,3		
GPS-Point	1,2,3	0,25	2
Date	1,2,3		
Time	1,2,3		
Water depth	1,2,3		
Temperature	3		
Salinity	3		
Dissolved oxygen	3		
pH	3		
Turbidity	3		
Water sample	3		
Sediment sample	3		
Further remarks	1,2,3		
Specific to mangrove forest			
Estimation of average tree height in 4 plots	1	0.25	2
Forest condition in 4 plots	1	0.25	2
Percentage cover of understorey in 4 plots	1, 2	0.25	2
Number of each macrobenthic species per plot; size, sex and biomass for each animal in 4 plots	2	1 h per focal sp.	2
Trunk´s girth at breast height for each tree and height of each seedling in 4 plots	2	2	2
Specific to seagrass meadows			
Habitat status: Apparent vitality (AV) index	1	0,5	2
Live habitat quantity: Braun-Blanquet (BB) index in 5 plots	1		
Shoot density determination in 5 plots	2		
Canopy hight in 5 plots	2		
Number of each macrobenthic species per plot; size, sex and biomass for each animal in 5 plots	2	1 h per focal sp.	
Specific to coral reefs			

3) Fisheries survey on landing sites → BI4

The following data/samples are to be collected at the main landing site of the area:

Data/Sample collected	Applies to Indicator BI	Estimation of time needed (h)	Estimation of persons needed
At primary catch landing location (bi-monthly)*	4		
Record total landing weight of the catch	4	4	2
Record the effort of each fleet (e.g. number of boat trips)	4		
Record the total catch weight of each target species for each fleet	4		
Record mean price per unit weight of target species	4		
Measure a random sampling (>100 specimens) of individual sizes (e.g. total length) and weight from main target species	4		
At primary catch landing location (seasonally)	4	8	2
Classify gonad maturity states from a subsampling of individuals of each target species across all sizes	4		

* Landings should be representative of the entire area. If landing sites differ significantly in catch, additional sites may need to be sampled.

** This may be optional if estimates of a target species' size at first maturity are already available from literature sources. However, maturity can vary by location and, thus, local estimates will be more accurate.

4) Analysis of water and sediment quality → BI3

Table X: Effort required for analysing samples taken for water and sediment quality.

Water quality

Parameter	Requirements
Dissolved inorganic nitrogen and phosphorus	2 days for 100 samples
Chlorophyll a	2 days for 100 samples
Suspended matter concentration	1 day to 1 week for 100 samples (1 day for clear water, 1 week for muddy water)
Suspended matter organic carbon content	2 days for 100 samples in element analyser
Bacteria/pathogen content (E. coli)	3-4 days for 100 sa mples (total bacteria counts or total *E. coli* counts)
Heavy metal content	Ca. 1 week for 100 samples depending on extraction procedure
Organic pollutant content	Several weeks for 100 samples depending on targetted chemicals

Sediment quality

Parameter	Requirements
Grain size distribution	1-2 weeks for 100 samples
Organic carbon content	2 days for 100 samples in element analyser

6. Relevant literature

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7. Worksheets for data acquisition

Annex 5

Assessing the Impact of Interventions by the CMPA Project on the Biodiversity at Selected Project Sites: Workshop Report

Indo–German Biodiversity Programme

Conservation and Sustainable Management of
Existing and Potential Coastal and Marine Protected Areas (CMPA)

Workshop on

Assessing the Impact of Interventions by the CMPA Project on the Biodiversity at Selected Project Sites

Mumbai, 21 – 22 July 2014

Summary Report

This report summarises the outcome of a workshop on "Assessing the Impact of Intervention by the CMPA Project on the Biodiversity at Selected Project Sites" organised by the CMPA Project in Mumbai on 21-22 July 2014. The workshop was a follow up to a consultative meeting on structure and implementation of baseline surveys for the CMPA Project, which was attended by Indian and German scientists and took place at the National Centre for Sustainable Coastal Management, Chennai, India, from 10 to 11 December 2013. During that meeting a conceptual framework for ecological baseline studies was presented by scientists from the Leibniz Centre for Tropical Marine Ecology (ZMT) in Bremen, Germany which took into account recommendations contained in the IUCN Guidebook on "Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness".

The objective of the current workshop was to examine ways of how to apply the proposed framework to the realities of the Project's pilot sites in Maharashtra and Goa. The agenda is given in Annexe 1. Participants included Maharashtra and Goa Forest Department officials, NGOs as well as scientists from ZMT in Germany. For a list of participants, see Annexe 2.

The pilot sites which were the object of the discussion during the workshop were:

- Velas to Anjarle (Maharashtra)
- Ansure Creek (Maharashtra)
- Thane Creek (Maharashtra)
- Dr Salim Ali Bird Sanctuary (Goa)

OPENING OF THE MEETING

Dr J. Michael Vakily, GIZ (CMPA team leader) and Dr Tim Jennerjahn (ZMT) welcomed the participants. Dr Jennerjahn provided a brief overview of the ZMT, which has a long-standing experience with coordinating and conducting research and capacity building projects in Asian countries, including India.

SESSION 1: INTRODUCTION

Objectives and outcomes of the workshop

Dr Vakily gave a quick overview of the institutional arrangements in place to implement the CMPA Project. He then presented the objectives and outcome of the workshop. He explained that the CMPA Project is tasked to provide proof of successful implementation of the Project using a number

of indicators that show changes over time which can be attributed to interventions carried out in the context of the Project see also Concept Note, Annexe 3). One of the indicators refers to the status of the biodiversity in a given area before and at the end of Project implementation. It would be the task of this workshop to identify for each Project site:

a) the kind of intervention that impacts directly a given form of biodiversity;
b) the component of the ecosystem that is most likely to change because of the intervention;
c) the scientific tools and the necessary capacities to measure the changes of the component thus identified.

Proposal for a baseline study on environmental indicators

Drs Tim Jennerjahn and Inga Nordhaus from ZMT took turns in presenting a comprehensive overview of the different tools available for measuring biological or ecological parameters in a given ecosystem, which eventually could be used as indicators for the state of biodiversity (see Annexe 4).

Presentation of project sites

Representatives from each site gave a quick overview of the general characteristics at the site and the conservation issues to be addressed by the Project.

Ansure Creek (Maharashtra)

Ansure Creek shows a very diverse mangrove community structures. There are 16 species of mangroves found in a stretch of 200-300 hectares in Ansure Creek. The local population makes use of these mangroves for their livelihood, by collecting e.g. gastropods, bivalves, crabs etc.

One of the more pressing problems at the site would be the uncontrolled development of Kharland bunds, which involves fencing off creeks and cutting off the flow of water. By doing so, the mangroves in that area die and the land is then cultivated to grow paddy. There seems to be need of a dialogue between all parties concerned to work towards an acceptable compromise between conservation of mangroves and utilisation of the area for agricultural purpose.

Velas- Anjarle Coast (Maharashtra)

Velas-Anjarle coast is a 60-km stretch of coast consisting of diverse habitats from sandy beaches to several creeks and mangrove vegetation. Velas is well known for its annual sea-turtle festival. The sandy beaches are used by Olive Ridley sea turtles for nesting. There are also efforts underway to provide a conducive environment for some endangered bird species (two species of vultures and the white-bellied sea eagle).

The issues faced on these sites are the problems linked to an ever increasing number of tourists and the Casuarina plantations, resulting in habitat disturbances for the nesting sea-turtles.

Thane Creek (Maharashtra)

Thane Creek, a large estuary situated between Mumbai and Navi Mumbai, is regularly being visited by large numbers of flamingos and various other species of waders. Towards its opening to the sea Indo-pacific humpback dolphins can occasionally be observed. Extensive mudflats covered by mangroves are formed along the banks of the creek. The major issues in Thane Creek are heavy industrialization and urbanization along the west and east coast of the creek. Sewage from urban and industrial areas is dumped into the creek, making it one of the most polluted areas in Mumbai. It is planned to declare Thane Creek as a Wildlife Sanctuary. In this context, the Forest Department has contacted the CMPA Project to assist in the setting up of an interpretation centre at Thane Creek.

Dr Salim Ali Bird Sanctuary (Goa)

The Dr Salim Ali Bird Sanctuary (S.A.B.S) in Goa is a declared wildlife sanctuary. It is located on the island of Chorao along the confluence of the two rivers Mandovi and Zuari. The habitat consists of estuaries, mangroves and mud flats. Besides being a bird sanctuary it also features other aquatic fauna such as otters, sea snakes, and marsh crocodiles. The Forest Department of Goa regularly carries out surveys in the sanctuary. It is planned to also bring under protection the areas surrounding the bird sanctuary. Thus, an additional 25 hectare of mangroves could soon be added to the S.A.B.S.

One of the issues possibly to be addressed by the Project at this site would be the revival of the "Khajan" system, a traditional method of rice cultivation by growing salt–tolerant species during monsoon in conjunction with aquaculture during off seasons. When this method was discontinued the areas under cultivation were taken over by non-endemic mangrove species. The Forest Department has proposed to the government of Goa to declare 1 km of area surrounding the wildlife sanctuary as a buffer zone. A decision is still pending.

SESSION 2 BASELINE PLANNING

For each site separately, participants discussed the issues presented in the previous section and analysed the actions the CMPA Project was to undertake to address these issues. To the extent that such actions were to have a direct influence on components of the coastal or marine ecosystem the participants identified those components most likely to show changes within the lifetime of the project (3 years). Using the methodologies presented by ZMT during the first session, the most appropriate tools for measuring such changes were identified for each site, taking into consideration available human resources and overall cost.

The results of the discussions are represented hereunder.

VELAS – ANJARLE COAST

Focal habitat:- Sandy Shores

Intervention	Indicator	Work plan and time line
Sand dune rehabilitation through phasing-out exotic *Casuarina* plantations	• Availability of optimal nesting habitat (% cover change of exotic vegetation cover) • Sand grain morphology profiles along the beach slope gradient.	• Mapping of habitat (10/14) • Sand profiles (10/14)
Implementation of best practice-Sea Turtle Hatchery Protocols.	• Hatchling success (Proportion of hatchlings released)	• Baseline data are available.

ANSURE CREEK

Focal habitat: Mangroves

Intervention	Indicator	Work plan and time line
Dialogue between Forest & Revenue Dept. to asses effects of Kharland bund construction	• Community structure and composition – mangroves and associated macro -invertebrate communities.	• Baseline survey (12/14) • Required equipment list to be prepared in consultation with ZMT
Introduction of zone-based management regimes	• Community structure and composition – mangroves and associated macro-invertebrate communities.	• Use mapping of the site (12/14)

THANE CREEK

Focal Habitat: Mangroves

Intervention	Indicator	Work plan and time line
Restoration of mangroves in degraded patches. Mangrove nurseries to be developed. Mapping of mudflat habitat (specifically used by waders)	• Mangrove cover, species diversity and composition of mangroves and associated species	• Baseline habitat maps (08/14) • Baseline survey of floral communities and composition (11/14) • Decision – Institution for macro-invertebrate faunal assemblages. Contract to be outsourced.

Additional studies: Identify roosting areas for flamingos foraging in the Thane creek.

DR SALIM ALI BIRD SANCTUARY

Focal Habitat: Mangroves

Intervention	Indicators	Work plan and time line
Amendment of the existing management plan based on detailed baseline studies	• Community structure and composition – mangroves and associated faunal communities in the new areas adjoining the sanctuary.	• Baseline of bio-physical, water and sediment indicators • (12/14)TOR's need to be developed in collaboration with the Goa FD to select institutions.
Restoration of the traditional Khazan system of agriculture at a pilot site in the vicinity of the sanctuary	• Habitat heterogeneity • Community structure and composition	• Baseline habitat and use maps for the Chorao island (12/14) • TOR to be developed and outsourced.
Extension of activities to mangrove areas adjoining the plan	• Community structure and composition – mangroves and associated faunal communities in the new areas adjoining the sanctuary.	• Baseline maps, biophysical indicators as above (12/14)

SESSION 3 CONCLUSIONS

Based on the survey activities previously identified, it was assessed to what extent partners with existing contracts with the CMPA Project would be in a position to carry out the identified baseline surveys, both in terms of trained personnel and equipment. In cases, where additional contractual arrangements will have to be put in place, these are recorded in the table above.

For each survey, a timeline was established taken into consideration prevailing weather conditions (esp. monsoon). Again, these deadlines are noted in the table above to allow the Project's coordinators to follow up on the work progress agreed upon for each site.

In his closing remarks, Dr Vakily thanked the participants for their constructive contributions to the discussion of project-specific baseline studies. He especially thanked Drs Nordhaus and Jennerjahn and their colleagues from ZMT for the preparation of the very detailed description of available survey tools, which was essential to achieve the intended results of the workshop.

Annexe 1

Indo-German Biodiversity Programme

Conservation and Sustainable Management of Existing and Potential Coastal and Marine Protected Areas (CMPA)

Workshop on Assessing the Impact of Interventions by the CMPA Project
on the Biodiversity at Selected Project Sites

Mumbai, 21 – 22 July 2014

Agenda

MONDAY, 21 JULY 2014

Registration

09.00 am	Registration of participants

Opening of the Meeting

09.30 am	Welcome and opening remarks • Michael Vakily, Team Leader – CMPA, GIZ • Tim Jennerjahn – ZMT • Presentation of participants

Session 1 Introduction

09.45 am	• Objectives and outcomes of the workshop (M. Vakily) • Proposal for a baseline study on environmental indicators at the suggested pilot sites (T. Jennerjahn, I. Nordhaus, ZMT) • Presentation of project sites: General description and biodiversity conservation issues
01.00 pm	Lunch

Session 2 Baseline planning

02.00 pm	Evaluation and decision on assessment approaches to be applied at each project sites • Velas to Anjarle (Maharashtra) • Ansure Creek (Maharashtra) • Thane Creek (Maharashtra) • Salim Ali Bird Sanctuary, Goa
07.45 pm	Dinner

TUESDAY, 22 JULY 2014

Session 3 Conclusions

09.00 am	• Summary of the results for each sites
	• Planning for the implementation of the baseline surveys in 2014 (time table, potential partners, necessary equipment, analysis of data, etc.)
	  ○ Velas Dabhol
	  ○ Ansure Creek
	  ○ Thane
	  ○ Goa

12.20 pm	Closing of the general part of the workshop
12.30 pm	Lunch

Annex 2-

List of Participants

No	First Name	Last Name	Organization and Contact Details
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Annex 3-

Concept Note on
Assessing the Impact of Interventions by the CMPA Project

The overall goal of the CMPA Project is to ensure that the conservation and sustainable use of biological diversity in its pilot areas are improved, while taking into account the economic well-being of the local population. In order to prove that the interventions of the Project reached the intended goal in respect to the conservation of biodiversity, the following indicator needs to be assessed both at the beginning and at the end of Project-related activities:

> **Location-specific biodiversity indicators show a positive trend across the selected project sites.**

The workshop is a follow-up to a consultative meeting on structure and implementation of baseline surveys for the CMPA Project, which was attended by Indian and German scientists and took place at the National Centre for Sustainable Coastal Management, Chennai, India, from 10 to 11 December 2013.

During the meeting, a working group on environmental baseline planning was formed to evaluate a conceptual framework for baseline studies on the ecological status of chosen sites. This framework was developed by scientists from the Leibniz Center for Tropical Marine Ecology (ZMT) in Bremen, Germany and takes into account the recommendations contained in the IUCN Guidebook on "Natural and Social Indicators for Evaluating Marine Protected Area Management Effectiveness".

The document suggests that the assessment of the ecosystem status and an evaluation of the success of any project intervention in support of conservation and protection of coastal and marine zones should be done against the following predefined biophysical goals:

Goal 1: Marine resources sustained or protected
Goal 2: Biological diversity protected
Goal 3: Habitat protected

It is suggested that the achievement of these predefined goals could be evaluated with the help of the following biophysical indicators:

BI1 Habitat distribution and human impact
BI2 Population and community structure and composition
BI3 Water and sediment quality
BI4 Fishing effort

The authors had provided for each of the biophysical indicators a detailed description of the definition and meaning of the indicator, sampling strategies and parameters to be measured, as well as expected outcomes.

The members of the working group expressed their general agreement with the framework proposed during the consultative meeting, as it follows well established international standards for carrying out such tasks.

The objective of the current workshop is to examine ways of how to apply the proposed framework to the realities of the project sites represented in the workshop (Maharashtra, Goa and Gujarat).

Using the documents presented during the consultative meeting in December 2013 participants to the workshop will have to focus – for each site separately – on the following questions:

a) How will a selected intervention strategy by the CMPA Project affect the biodiversity in a given site?
b) What is the indicator that represents best this identified biodiversity (Single focal species? Group of species? Abiotic factors? Proxy?…)?
c) How can this indicator be measured, keeping in mind that the project period is limited to some three years, and that the selected indicator must show significant changes (positive or negative) after that period?
d) Can the changes observed be attributed (at least to a meaningful level) to activities invoked by the Project?

Once these points have been clarified, the group will have to agree on a standard protocol to be applied to the sampling of the data (frequency, accuracy, etc.)

Thus, the expected outputs of the workshop are (for each site):

1. Identification of the indicators to be measured;
2. Standardised sampling protocol for each indicator;
3. Requirements for carrying out the sampling (equipment, personnel, etc.)
4. List of enumerators in charge of the sampling at each site.
5. Timetable for the first sampling exercise.

Annex 4-

Conceptual framework for a baseline study on ecological status of chosen sites

presented by

Tim Jennerjahn & Inga Nordhaus

developed by

Tim Jennerjahn (coordinator), Inga Nordhaus, Lucia Herbeck,

Marc Taylor, Andreas Kunzmann, Matthias Wolff

Leibniz Centre for Tropical Marine Ecology

Bremen, Germany

Indo-German Biodiversity Programme
Conservation and Sustainable Management of Existing and Potential Coastal and Marine Protected Areas (CMPA)

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Outline

1. Background and Rationale
2. CMPA Evaluation Concept
3. Indicators and Workplan
   - Indicator BI1 'Habitat distribution and human impact'
   - Indicator BI2 'Population and community structure and composition'
   - Indicator BI3 'Water and sediment quality'
   - Indicator BI4 'Fishing effort'
4. Expected Outcome
5. General Sampling Schedule and Effort

1. Background and Rationale

- Global change: tropical coasts are under pressure
- India's coast: entirely tropical, densely populated, intensively used
- Conservation concentrated on land side
- MoEF and GIZ project aims at implementing CMPA's
- ZMT asked to assist in designing baseline surveys (socioeconomic and natural sciences) and an evaluation concept of success of project interventions
- First step: baseline survey (natural sciences)

2. CMPA Evaluation Concept

Based on IUCN Guidebook "How is your MPA doing?" by Pomeroy et al. (2004) and ZMT experience

With respect to project aim 3 major biophysical goals defined:

Goal 1: Marine resources sustained or protected
Goal 2: Biological diversity protected
Goal 3: Habitat protected

3. CMPA Evaluation Concept

In order to achieve project goals a suite of 4 biophysical indicators (BI) has been developed:

BI1: 'Habitat distribution and human impact' (IUCN B3+B10)
BI2: 'Population and community structure and composition' (IUCN B1+B2+B4)
BI3: 'Water and sediment quality' (IUCN B8)
BI4: 'Fishing effort' (IUCN B7)

3. CMPA Evaluation Concept

Biophysical indicators contributing to goals:

	BI1	BI2	BI3	BI4
Goal 1				
G1a		●		●
G1b	●	●	●	
G1c	●	●		●
G1d		●		●
Goal 2				
G2a	●	●		●
G2b			●	
G2c		●		
G2d	●	●	●	●
G2e	●	●	●	
Goal 3				
G3a	●	●	●	
G3b	●	●	●	
G3c	●	●	●	

Goal 1: Marine resources sustained or protected

Goal 2: Biological diversity protected

Goal 3: Habitat protected

3. Indicators and Workplan

BI1 'Habitat distribution and human impact'

BI2 'Population and community structure and composition'

BI3 'Water and sediment quality'

BI4 'Fishing effort'

For all these:

- Indicator definition and meaning
- Sampling strategy and parameters
- Expected outcome

BI 1 Habitat distribution and human impact

Indicator definition and meaning

Habitat
- Living space of an organism, population or community
- Characterized by biotic and abiotic properties

Priority habitats
- Present majority of total area
- Areas of high conservation value

Habitat distribution/ complexity
- Structural and spatial characterization of all habitat types within a specified area
- Location (e.g. depth), configuration and extent

BI 1 Habitat distribution and human impact

Human impact
- Cumulative environmental effect of all extractive and non-extractive uses of living and non-living marine resources (in an area)
- e.g. Fishing, aquaculture, deforestation, coastal development, mining, transportation

Area under no impact
- Completely free of all extractive and non-extractive human uses
- Reserves / fully protected areas / no-take zones

BI 1 Habitat distribution and human impact

Sampling strategy and parameters

- Inventory of all habitats and areas of human impact
- Basis for determination of changes in habitat location, quantity and quality over time

- Analysis of aerial/satellite pictures
- Surveys along transects from onshore to offshore
- Record of organisms forming the habitat

BI 1 Habitat distribution and human impact

BI 1 Habitat distribution and human impact

Sampling strategy and parameters

MANGROVES
- Average tree height
- Percentage cover with understorey
- Forest condition

SEAGRASS MEADOWS
- Percentage cover of seagrass
- Apparent vitality

CORAL REEFS
- Percentage cover of „lifeforms"
- Apparent vitality

BI 1 Habitat distribution and human impact

MANGROVES
- Average tree height
  Indication of forest age

- Quadrats of 5m x5 m
- Number depends on forest size
- 5 point scale

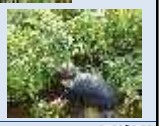
1 Dominance of seedlings
2 Tree height < 3 m
3 Tree height 3 – 5 m
4 Tree height 5 – 10 m
5 Tree height > 10 m

BI 1 Habitat distribution and human impact

MANGROVES
- Percentage cover of understorey
  Shrubs, vines

- Same quadrats
- 6 point scale

0 %
1 - 5 %
5 – 25 %
25 – 50%
50 – 75%
75 – 100%



BI 1 Habitat distribution and human impact

MANGROVES
- Apparent forest condition

- Same quadrats
- 3 point scale
- Dependent on
  - tree density and height
  - stem diameter
  - understory cover
  - degree of deforestation

1 Degraded/low
2 Deteriorating/ middle
3 Healthy/high

http://www.panoramio.com

BI 1 Habitat distribution and human impact

SEAGRASS MEADOWS
- Percentage cover of seagrass
  – Braun-Blanquet Score (BB)

- 5 quadrats of 0.5m x 0.5m
- Braun-Blanquet abundance score (BB)
- 6 point scale

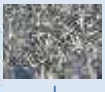
0 %
1 - 5 %
5 – 25 %
25 – 50%
50 – 75%
75 – 100%

BI 1 Habitat distribution and human impact

SEAGRASS MEADOWS
- Apparent vitality (AV)

- Same 5 quadrats
- 3 point scale
- Dependent on seagrass cover, shoot appearance, epiphyte coverage

1 Degraded/low
2 Deteriorating/ middle
3 Healthy/high



BI 1 Habitat distribution and human impact

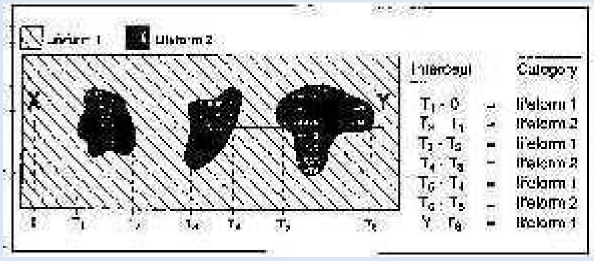
CORAL REEFS
- Percentage cover (PC) of „lifeforms"; Live hard coral, live soft coral, macroalgae, sand etc.

- LIT Line intercept transect (50m)
- Calculate PC for each lifeform
  Sum: 100%
- Alternatively use 6 point scale for most important lifeforms

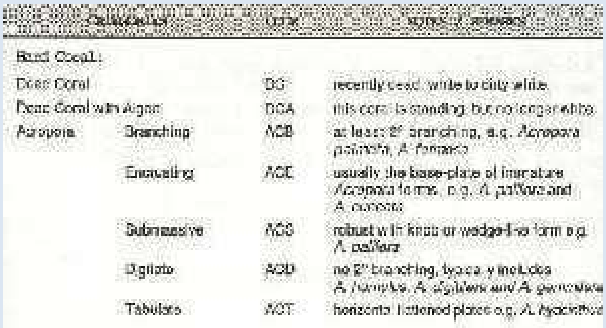
0 %
1 - 5 %
5 – 25 %
25 – 50%
50 – 75%
75 – 100%

BI 1 Habitat distribution and human impact

CORAL REEFS
- Percentage cover (PC) of „lifeforms“;

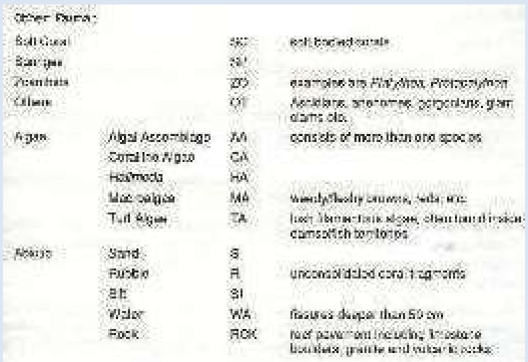


BI 1 Habitat distribution and human impact



Categories	Code	Notes / Remarks
Hard Coral:		
Dead Coral	DC	recently dead, white to dirty white
Dead Coral with Algae	DCA	this coral is standing, but no longer white
Acropora Branching	ACB	at least 2° branching, e.g. Acropora palmata, A. formosa
Encrusting	ACE	usually the base-plate of immature Acropora forms, e.g. A. palifera and A. cuneata
Submassive	ACS	robust with knob or wedge-like form e.g. A. palifera
Digitate	ACD	no 2° branching, typically includes A. humilis, A. digitifera and A. gemmifera
Tabulate	ACT	horizontal flattened plates e.g. A. hyacinthus

BI 1 Habitat distribution and human impact



Other Fauna:			
Soft Coral		SC	soft bodied corals
Sponges		SP	
Zoanthids		ZO	examples are Platythoa, Protopalythoa
Others		OT	Ascidians, anemones, gorgonians, giant clams etc.
Algae	Algal Assemblage	AA	consists of more than one species
	Coralline Algae	CA	
	Halimeda	HA	
	Macroalgae	MA	weedy/fleshy browns, reds, etc.
	Turf Algae	TA	lush filamentous algae, often found inside damselfish territories
Abiotic	Sand	S	
	Rubble	R	unconsolidated coral fragments
	Silt	SI	
	Water	WA	fissures deeper than 50 cm
	Rock	RCK	reef pavement including limestone boulders, granite and volcanic rocks

BI 1 Habitat distribution and human impact

CORAL REEFS
- Apparent vitality

- At the same transects
- 3 point scale
- Dependent on dominance of dead or live coral, amount of fouling algae, coral discoloration

1 Dying/low

2 Deteriorating/ middle

3 Healthy/high

BI 2 Population and community structure and composition

Indicator definition and meaning

➢ Population structure

Composition of a population of a specific species

- Density, biomass
- Females vs. males
- Size and age of individuals
- Reproductive potential

BI 2 Population and community structure

➢ Which species?? Focal / target species

- Endemic species — Exclusively found at the study area/region
- Keystone species — Presence and role within the ecosystem has a strong effect on other organisms
- Disturbance indicator species — They signal how disturbances may impact other organisms
- Economically important species — Extractive or non-extractive economic value
- Endangered/vulnerable species — More vulnerable to environ. change than others

BI 2 Population and community structure

- **Community composition** — Number of species within the community and the relative abundance of each species in relation to the others
  - Species richness
  - Diversity — e.g. Shannon diversity H´, Simpson index, taxonomic diversity
  - Evenness — e.g. Pielou´s evenness J´
- **Community structure** — Number and relative abundances of all species and how they are spatially organized (in habitats, zones)
  - Composition
  - Spatial distribution

BI 2 Population and community structure

- An increased density / biomass of focal species in the MPA: indication for effective management and MPA use.
- Improved density inside MPA may be follwed by a migration of individuals to adjacent unprotected sites.
- The maintenance or restoration of the natural community composition and structure is of high importance for the integrity and functioning of an ecosystem and its resistance to disturbance.
- Data on community composition and structure help managers to prioritize areas requiring management efforts.

BI 2 Population and community structure

Sampling strategy and parameters

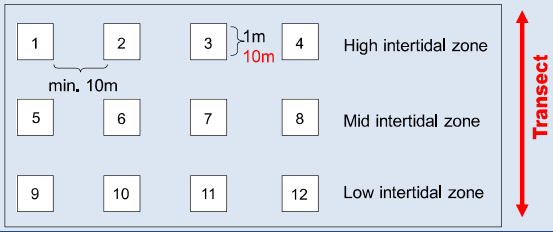
- **Time series data**
  - Size/age structure of a population
  - Community composition and structure
  - MPA (protected site) vs. reference site outside MPA
  - Surveys along transects from onshore to offshore

BI 2 Population and community structure

MANGROVES

Sampling strategy

Benthic animals: 1m x 1m quadrats Trees: 10m x 10m quadrats



BI 2 Population and community structure

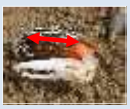
MANGROVES
- Number of trees and seedlings per species
- Trunk´s girth at breast heigh (GBH)

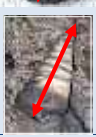
In each quadrat (10m x 10m):
- Count the number of trees and seedlings per species
- Measure GBH of trees at a height at 1.3 m
- Measure total height of seedlings / saplings < 1.3 m

BI 2 Population and community structure

MANGROVES
- Number of (focal) benthic species
- Size, sex and wet weight of individuals

In each quadrat (1m x 1m):
- Count the number of focal / all benthic species
- Measure size: carapace width (crabs), height (bivalves, gastropods)
- Measure wet weight; note sex



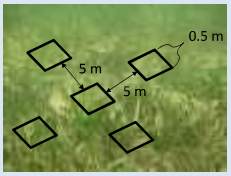


BI 2 Population and community structure

SEAGRASS MEADOWS

Sampling strategy

- Depending on the total area, choose x representative stations along x parallel offshore transects
- At each station, place 5 quadrats of 0.5m x 0.5m spaced ~5 m apart (see BI 1)



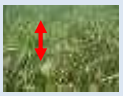
BI 2 Population and community structure

SEAGRASS MEADOWS

- Seegras shoot and macroalgae number
- Maximum canopy hight

In each quadrat:

- Count the number of shoots of each occurring seagrass and macroalgae species
- Measure the maximum canopy hight of each seagrass species



BI 2 Population and community structure

CORAL REEFS

Sampling strategy

- PIT Point intercept transect (50m or 25m)
- 5 – 10 quadrats of 1m x 1m

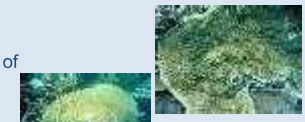
BI 2 Population and community structure

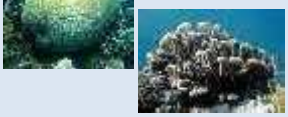
CORAL REEFS

- Number of individuals per species
- Coral size and volume

In each quadrat:

- Count the number of individuals of each hard coral
- Measure size of each hard coral
- Encrusting species: length, width
- Massive and submassive corals: diameter, height





BI 3 Water and sediment quality

Indicator definition and meaning

Water quality

Water and sediment quality is an abiotic and biotic (in the case of bacterial pollution) measure of the ambient environmental parameters.

Sediment quality

These parameters are important determinants of the habitats, i.e. the living conditions for flora and fauna in any aquatic ecosystem.

BI 3 Water and sediment quality

Sampling strategy and parameters

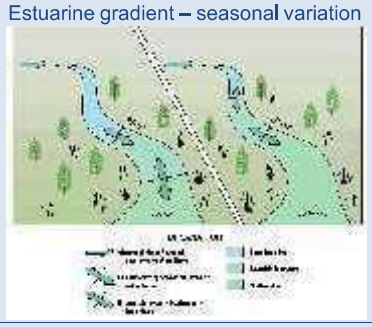
Samples/data for water and sediment quality shall be taken in a way that they:

- Cover MPA area/habitats, in estuary cover salinity 0-35 psu in 5 psu steps
- Cover tidal variation (diel, lunar, season) Transect from high to low intertidal
- Include reference sample outside MPA

BI 3 Water and sediment quality

Sampling strategy and parameters

Estuarine gradient – seasonal variation

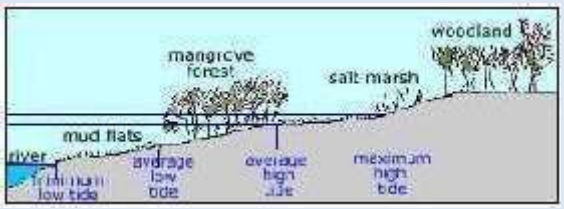


www.water.usgs.gov

BI 3 Water and sediment quality

Sampling strategy and parameters

Habitats – high to low intertidal



www.cleveland-h.schools.nsw.edu.au

BI 3 Water and sediment quality

Sampling strategy and parameters

Habitats – high to low intertidal

www.biodiversitybc.org

BI 3 Water and sediment quality

Sampling strategy and parameters

Water quality		
Priority	Parameter	Requirements
1	Temperature	Thermometer
1	Salinity	Refractometer, handheld electronic sensor
1	Dissolved oxygen	Winkler titration, handheld electronic sensor
1	pH	Handheld electronic sensor
1	Turbidity	Secchi disk, light meter
1	Dissolved inorganic N and P	Automated laboratory analysis (photometry), manual handheld titration and photometric measurement
1	Chlorophyll a	Fluorometric measurement of collected water sample, use of remote sensing data

BI 3 Water and sediment quality

Sampling strategy and parameters

Water quality		
Priority	Parameter	Requirements
2	TSM conc.	Filtration set, drying oven, balance
2	TSM OC content	High temperature combustion in element analyser of filtered sample
3	Bacteria/ pathogen content (E. coli)	Counting in culture media
3	Heavy metal content	Automated analysis with ICP-OES or AAS
3	Organic pollutant content	Automated analysis with GC-MS (gas chromatography – mass spectrometry)

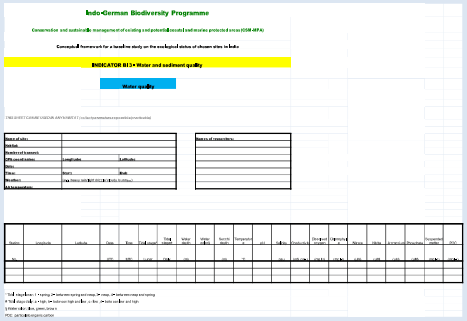
BI 3 Water and sediment quality

Sampling strategy and parameters

Sediment quality		
Priority	Parameter	Requirements
1	Grain size distribution	Mechanic sieving, laser particle analyser
1	Organic carbon content	High temperature combustion in element analyser
1	Porewater salinity	Handheld electronic sensor
2	Porewater oxygen content	Handheld electronic sensor
2	Porewater redox conditions	Handheld electronic sensor
2	Porewater pH	Handheld electronic sensor

BI 3 Water and sediment quality

Data sheets


Indo-German Biodiversity Programme

Conservation and sustainable management of existing and potential coastal and marine protected areas (GSM-MPA)

Conceptual framework for a baseline study on the ecological status of chosen sites in India

INDICATOR BI3 • Water and sediment quality

Water quality

BI 4 Fishing effort

Indicator definition and meaning

% of mature specimens in catch

Length at first maturity ("L50") is determined from sampling gonad development stage in caught individuals.

% of fish at optimum length

There is an optimum size when cohort's biomass is at maximum, typically a bit larger than length at first maturity.

BI 4 Fishing effort

Indicator definition and meaning

% of old/large individuals

"Megaspawners", fish >optimum length+10 %; Healthy structure = 30-40 % megaspawners; <20 % healthy recruitment endangered

Catch-per-unit-effort

CPUE gives an indication of relative changes in abundance in a population. Overfished populations will show lower CPUE over time.

BI 4 Fishing effort

Sampling strategy and parameters

Present state

- Each dominant species: subsampling of individuals, length+weight recorded
- Record total catch for dominant species
- Empirical equations: L50, growth, mortality

BI 4 Fishing effort

Sampling strategy and parameters

Change over time

- Periodic (weekly, monthly) sampling of target species catches
- Derive estimates of population size and overall exploitation rate
- Apply yield per recruit models to estimate effort for sustained fishing

BI 4 Fishing effort

Sampling strategy and parameters

Future management

- Use surplus production models to estimate maximum sustainable yield
- Estimate economic yield vs. costs of fishery operation
- Use trophic modelling to explore MPA effect on fishery/ecosystem functioning

BI 4 Fishing effort

Data sheets

Data/Sample collected	Time needed (h)	Persons needed
At primary catch landing location (bi-monthly)*		
Record total landing weight of the catch	4	2
Record effort of each fleet (e.g. number of boat trips)		
Record total catch weight of each target species		
Record mean price per unit weight of target species		
Measure (>100 specimens) of individual sizes (e.g. total length) and weight from main target species		
At primary catch landing location (seasonally)**	8	2
Classify gonad maturity states from a subsampling of individuals of each target species across all sizes		

4. Expected Outcome

- To receive obtained data in an organised form, ideally in the predefined EXCEL worksheets provided
- To calculate easy-to-use indicators of ecosystem status, e.g. the TRIX index
- Tables with extent (area), diversity (number) and cover (%) of habitat types and human impact areas observed
- A habitat inventory report and descriptive and quantitative characterization of the human activities and threats
- Maps and/or GIS database on location, extent and status of habitat types and areas of human activities

5. General Sampling Schedule and Effort

For all sites

Data/Sample collected	Applies to Indicator BI	Time needed (h)	Persons needed
At all stations	1,2,3		
GPS-Point	1,2,3	0,25	2
Date	1,2,3		
Time	1,2,3		
Water depth	1,2,3		
Temperature	3		
Salinity	3		
Dissolved oxygen	3		
pH	3		
Turbidity	3		
Water sample	3		
Sediment sample	3		
Further remarks	1,2,3		

6. General Sampling Schedule and Effort

In mangrove sites

Data/Sample collected	Applies to Indicator BI	Time needed (h)	Persons needed
Specific to mangrove forest			
Estimation of average tree height in 4 plots	1	0.25	2
Forest condition in 4 plots	1	0.25	2
Percentage cover of understorey in 4 plots	1, 2	0.25	2
Number of each macrobenthic species per plot; size, sex and biomass for each animal in 4 plots	2	1 h per focal sp.	2
Trunk´s girth at breast height for each tree and height of each seedling in 4 plots	2	2	2

6. General Sampling Schedule and Effort

In seagrass sites

Data/Sample collected	Applies to Indicator BI	Time needed (h)	Persons needed
Specific to seagrass meadows			
Habitat status: Apparent vitality (AV) index	1	0,5	2
Live habitat quantity: Braun-Blanquet (BB) index in 5 plots	1		
Shoot density determination in 5 plots	2		
Canopy hight in 5 plots	2		
Number of each macrobenthic species per plot; size, sex and biomass for each animal in 5 plots	2	1 h per focal sp.	

6. General Sampling Schedule and Effort

BI3: Effort required for analysing samples

Water quality	
Parameter	Requirements
Dissolved inorganic N and P	2 days for 100 samples
Chlorophyll a	2 days for 100 samples
TSM concentration	1 day to 1 week for 100 samples (1 day for clear water, 1 week for muddy water)
TSM OC content	2 days for 100 samples in element analyser
Bacteria/pathogen content (E. coli)	3-4 days for 100 samples (total bacteria counts or total E. coli counts)
Heavy metal content	Ca. 1 week for 100 samples depending on extraction procedure
Organic pollutant content	Several weeks for 100 samples depending on targetted chemicals
Sediment quality	
Parameter	Requirements
Grain size distribution	1-2 weeks for 100 samples
Organic carbon content	2 days for 100 samples in element analyser

Thanks for your attention!

The ZMT 'Natural Science' Team

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Fisheries

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Inga Nordhaus
Mangroves

Matthias Wolff
Fisheries

Workshop on "Assessing the Impact of Interventions by the CMPA Project on the Biodiversity at Selected Project Sites", Mumbai, July 21-22, 2014