Identifying Ecosystem Service Opportunities in Kochi

Technical scoping report for the INTERACT-Bio Project

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1 Introduction

INTERACT-Bio (Integrated Action on Biodiversity) is a 4-year project designed for improving the utilization and management of nature within fast-growing cities and the regions surrounding them. India is one of the three project countries, and Kochi is the first Indian city where the project is working.

For the scoping process in Kochi, we apply the Ecosystem Service Opportunities (ESO) framework, focusing on Steps 2 and 3 of the step-by-step guidelines (Rode and Wittmer 2015, see also Rode et al 2016). The structure and materials used reflect a modified version of the framework, which was adapted based on recent application experiences in several countries (Mexico, South Pacific, etc.).

1.1 Vision and aims of the INTERACT-Bio project in Kochi

The broad mission of the project is to provide expanding of urban communities in Global South with nature-based solutions and associated long-term benefits. It aims to integrate biodiversity considerations in city-region planning by 1) connecting national and subnational government decision makers, 2) strengthening the city-regions to integrate biodiversity and nature-based solutions into land use, infrastructure and development planning, 3) to develop supporting policy instruments, and 4) mainstreaming biodiversity considerations across sectors at the subnational and national level.

Broad aims / Mission statement

We want to address… (current management issues/ threat of …, in relevant area…that is arising because of…)	We want to contribute to the broader/long-term goals of… (what kind of biodiversity, ecosystem service and/or development outcomes we want to set in place	We want to achieve the specific/short-term goals of … (how we want to reduce the issue/threat by using appropriate policy instruments)
Kochi is home to mangrove bird sanctuary and Vembanad lake, the largest Ramsar wetland in South India. These biodiversity sites are facing challenges from rapid urbanization and unplanned growth, clogging and blocking of natural canals due to waste and lack of coordination (ICLEI-INDIA). The environmental issues also cause severe problems for the population in terms of health, loss of livelihoods, and quality of life.	Very broadly, the project intends to provide urban communities in the Global South with nature-based solutions and associated long-term benefits. For Kochi, the following goals turned out as relevant based on stakeholder consultations, • Improved resilience • Reduction in pollution • Improved water supply • Greening of environment • Awareness generation • GIS based Land use (land cover map of the city)	The focus will be on two ecosystems: Mangalavanam, Vembanad (Kerala backwaters, including Kochi lake) *The more specific aims and desired outcomes will be a result of this scoping.*

2 Understanding the local context

The ICLEI-team is preparing a comprehensive scoping report for the setting of India and the specific situation in Kochi. The present section of this report is unlikely to add new elements to the ICLEI analysis. It was primarily intended to provide UFZ with a basic understanding of the situation prior to the first visit and before engaging in the more specific scoping of "ecosystem service opportunities" (see section 3) via workshop and expert consultations. The information of this section is based on several reports made available by ICLEI, notably Thomson (2002) and DTCP (2010).

2.1 Stakeholders

The project started out with Kochi Municipal Corporation as the main partner and stakeholder. For the consultation process as well as the first and second workshop, stakeholders in the sense of actors with an interest in broader environmental issues in and around Kochi were identified. They consisted of scientists, NGOs, and representatives of local authorities. A systematic stakeholder mapping should be conducted once a more specific thematic focus has been agreed (e.g., mangrove conservation). The ESO guidelines propose the following template structure for stakeholder mapping, which could be adapted to the local purpose.

Template: Stakeholder Mapping Table

Stakeholder name/group	Attitude to the relevant conservation goals	Conflicts with other stakeholders [with whom, in what sense?]	Collaboration with other stakeholders [with whom, in what sense?]	Current status of engagement and person(s) to contact

2.2 Environmental context

Kochi is a leading city in the South east coast of India, in Ernakulam district of the state Kerala. It is the sea mouth of seven major rivers draining into the Arabian sea and so known as the 'Queen of Arabian Sea'. It is built on a cluster of islands and peninsulas. The city has two main seasons, dry and wet season and the average temperature is between 22°-32°C. It experiences a tropical climate with intense solar radiation and abundant precipitation causing very high humidity throughout the year. The rainfall is mainly from the Southwest and Northeast monsoon. Kochi is crisscrossed by a network of canals. The city landscape is mainly composed of backwaters and wetlands. The wetlands are covered during rainy season when Pisciculture is carried out, and during the summer they are dry and favors paddy cultivation (Pokkali farming).

Mangalavanam

Mangalavanam is located at the heart of Kochi, is a symbolic relict of the original ecological set up of Kochi. The ecologically sensitive area covers up to 2.74 hectares. It contains various mangrove species and areas with trees, shrubs and vines that thrive in brackish water and also found in river estuaries. The plants, animals and microorganisms are adapted to live in tropical inter-tidal zone. It is a bird sanctuary and home to many native and migratory birds. Marine and freshwater aquatic organisms are found in abundance. A small population of butterflies and vertebrates are also found here. It serves as a main roosting site for flying foxes. Mangalavanam is known to be functioning as 'the green lungs of the city', important in stabilizing the land along the coast and backwaters. It is situated in the middle of the city surrounded by the Bharat petroleum campus in the northeast, old Ernakulam railway station on the south and the National institute for Oceanography(NIO) and the Central Marine Fisheries Research Institute(CMFRI) on the west. The once dominant Mangrove is now disappearing, mainly because of dredging, filling, silt build-up, and waste dumping (mainly solid waste-plastics) clogging the water bodies as well as continued construction around the core area.

Vembanad

Vembanad had the second largest lagoon in India, a 900 kilometres long intricate network of lagoons, lakes, canals, estuaries and deltas of several rivers that flow into the Arabian Sea. It runs through several districts; the area around Kochi it is called the Kochi lake. The waterbody is separated from the Sea by barrier islands. The crisscrossed canals are used for navigation (as a national waterway) and they play a vital role in the socio-economic and environmental situation of the city. The backwater ecosystems help in controlling floods, preventing salinity intrusion, ground water recharge and serves as a breeding, feeding and nursing place of shrimps and fishes. It is home to 20,000 waterfowls and an ideal habitat for shrimps. It hosts about 100 native bird species and a lot of migratory birds in the seasonal time. It is also now a favorite tourist destination.

The backwaters are facing serious anthropogenic pressures due to the developmental activities. The city does not hold enough land space for all the development activities which are increasingly moved to areas outside the city borders. Changes in land use, water and air pollution, improper disposal of wastes, conventional sewage system, development of slums, and reduction of green spaces are the major cause of environmental degradation. Another challenge in the city is salt-water intrusion due to rising sea level. Percolation of effluents from septic tanks and dispersion trenches pollute the ground water. Air pollution is caused by emissions from vehicles, adulteration of fuel, violation of emission norms, poor maintenance of roads, and unfiltered emissions from the industries (mainly outside the city).

According to DTCP (2010), the existing sewage treatment plant serves only 1% of the urban population and the rest of the sewage enters into the backwaters. It contains organic and inorganic pollutants causing diseases and fecal contaminants. Most of the industries (over 50 large and medium sized firms) are located

outside the city limit alongside the backwaters between Angamaly and Kochi. Most of the trade effluents from the industries are dumped into the river, making the water highly polluted with toxins and acidic with ammonia, fluorides and phosphates. The effluent and sewage discharge increase the nutrient content of the water causing eutrophication. This leads to the loss of wet land plants and other aquatic organisms, reducing their ability to release oxygen content through the roots and to resolve metals and arsenic. Pollutants released form the surrounding industries severely reduced the productivity in fishing, aquaculture and paddy cultivation. Dredging of the bottom of backwaters by commercial sand mining has caused severe ecological imbalance and development projects such as the harbor development, construction of new bunds and bridges, building new road ways, etc. are converting ecosystems and reducing biodiversity. Sedimentation, dumping of silt from rivers, soil erosion, and construction activities have caused water logging and reduced the water holding capacity of the ecosystem. These issues also prevent ground water recharge affecting the water supply.

2.3 Socio-economic and cultural context

A large part of the city population originally depended on the waterbodies for food and livelihood, as farmers and fishermen. More and more of the agricultural land is now converted into residential and industrial area. The city of Kochi is becoming a leading industrial city with a boom in the IT, tourism, banking and finance sectors as well as increased port activities. It is the industrial capital of Kerala and in the process of becoming one of the major Indian cities (socalled METRO city). Recently the metro rail has been laid in the city which is hoped to meet the increased transportation demands. Large investments in the industry come from foreign investors, mainly from the Middle East. The Cochin international port, the harbor and cargo terminal serve as a trade point for Southern India. The industries around are mainly producing chemical and petrochemical products, pesticides, rubber, fertilizer and leather. There are also a number of refineries found around the city.

Culturally, the state is known for its environmental beauty and called “GOD’s OWN COUNTRY”. The state was initially colonized by the Portuguese, followed by the Dutch and then the British. Kochi is the second most populated city in the state. The main language spoken here is Malayalam. Mostly people are following their traditional ethnic life style.

Kochi has witnessed serious land use change in the past decades. Commercialization of the backwaters accelerated the industrialization in Kerala. There was a huge amount of public and private investors in the backwaters. Pokkali rice agriculture is the major economic activity of the rural communities in the low-lying wetlands. Many traditional Pokkali farmers have changed or stopped their practices. Some of them sold their lands to private investors who build residential and tourist housing. Due to ecological problems (in particular low water quality) in the backwaters around Kochi, the tourism industry has already started moving south.

Traditionally people highly value their environment, yet the increasing population and development demands pose enormous challenges and have started to change traditional values and practices. Political and social movements in Kochi have existed for a long time. Strikes, protests and marches for or against many issues have been ubiquitous in Kerala because of the comparatively strong presence of labour unions. However, there is a lack of awareness on issues around conservation and use of natural resources, so that social movements have so far not addressed these topics. [i]

2.4 Political, institutional, and policy context

The institutional setting for sustainable development and environmental policy involves responsibilities at many levels, from national level (e.g., Ministry of Environment, Forest and Climate change), Kerala state level, local district level, and the level of the municipality (Kochi municipal corporation, Cochin Environmental Protection Agency). Besides governmental authorities, NGOs and research organizations play an important role, such as the National ecological training institute-NETI, Central Marine Fisheries Research Institute-CMFRI, Kerala Forest Research Institute-KFRI, Salim Ali Centre for Ornithology and Natural History.

Thomson (2002) argues that the unsustainable development path and irrational use of resources is mainly caused institutional and government failures, weak political and social mobilizations, loopholes in the policies, no proper implementation or monitoring of policies. The structure of property rights, customary rights, fishing rights, rights on wetlands, etc. is not managed well. For example, in Mangalavanam, the ownership of the region is split among Southern railways, Kerala forest department, the city corporation of Cochin, police department, revenue department and Bharat petroleum as well as small areas under private ownership. This creates confusion and no proper maintenance of the region. In Vembanad, uncontrolled mining of shells from lake beds, sewage effluents and heavy load of organic material released by industries, tourism causing commercialization and disturbing the lives and livelihood of the people, fishermen using illegal nets affecting the breeding of fishes, garbage from households disposed into backwaters, etc. are some of the issues affecting the ecosystem of the backwaters. Various laws and policies are already put forth by the governments, but they are not sufficiently complied with nor adequately enforced or monitored.

Policy and planning on land use and development follows a large number of framework and legal instruments, which are again functioning at different governance levels. The following table provides a non-exhaustive overview of relevant policy and management laws and guidelines from the national, state, and municipal level.

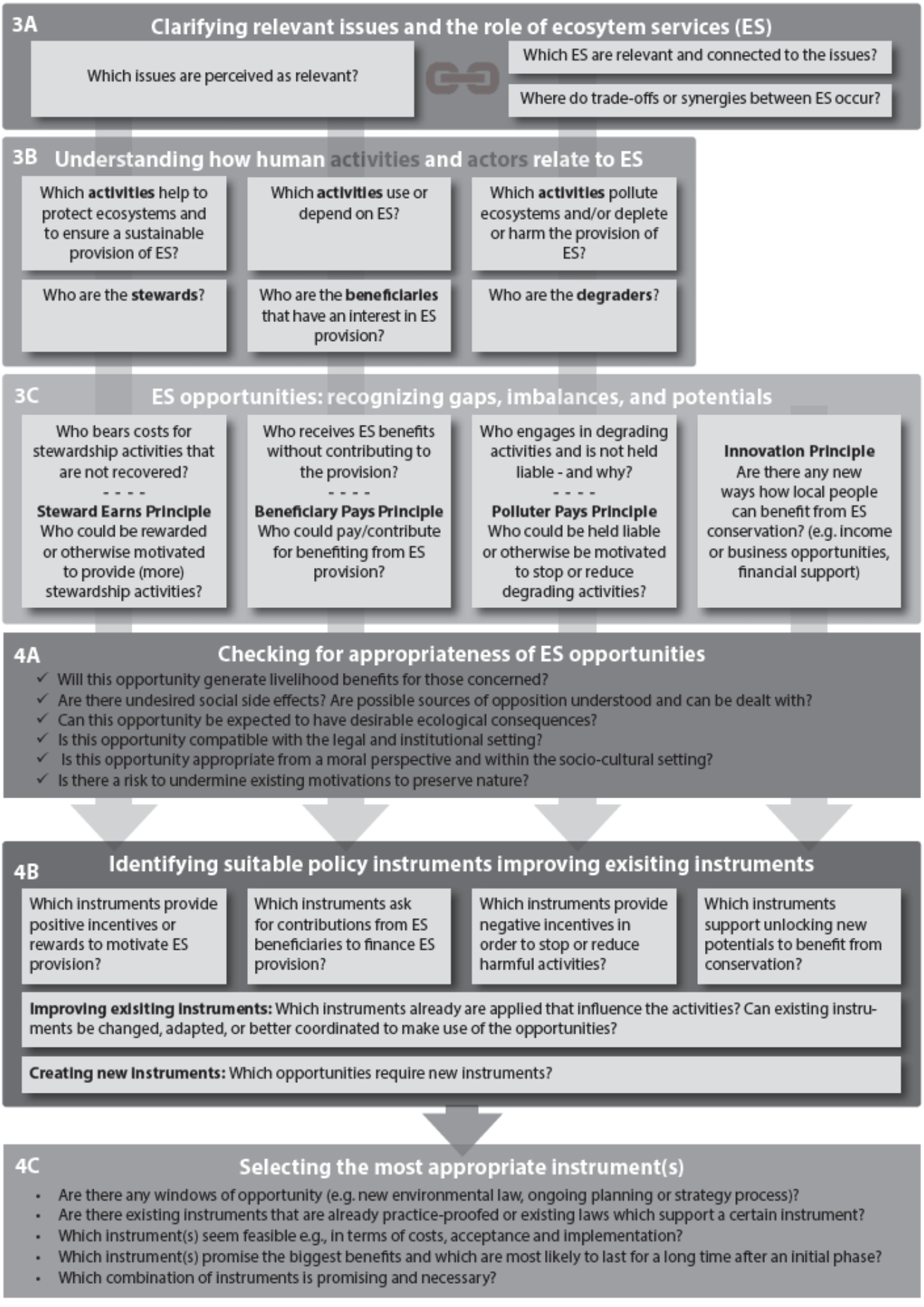
National level	State level (Kerala)	Municipal level
National Land Utilisation Policy	Kerala State Policy for Compensation and Transparency in Land Acquisition, 2015	Urban and Regional Development Plans Formulation and Implementation (URDPFI) Guidelines
National Urban Housing and Habit at Policy	Draft Land Policy 2009, Kerala	Model Regional and Town Planning and Development Law

The right to Fair Compensation and Transparency in Land Acquisition Rehabilitation Resettlement Act, 2013	Kerala conservation of paddy land and wetland act,2008 (and amendment bill)	Model Municipal Law (MML), 2003
National slum policy,2001	Industrial policy for kerala	Urban/Metropolitan Planning/ Development Act, Improvement Trust Act, Industrial Development Act, Cantonment Board Act, Major Ports Act
National Policy for inland water transport,2001, ministry of shipping, government of India	Kerala Town and Country Planning Act, 2016	Cochin port trust
National environmental policy 2006, Ministry of environment and forest	Kerala Building Rules	Smartcity,2016
National urban housing and habitat policy,2007	Kerala Municipality Building rules – 1999, Amendment Rules, 2013	The City development plan, Municipal Corporation of Kochi
National wetland conservation programme,2009	Kerala Port Policy	Centre for heritage, environment and development, Kochi
The green India mission	Tourism policy of Kerala	
Biodiversity Act,2002	Kerala Housing and Habitat Policy 2007	
Action plan on climate change,2008	Kerala Parks, Playfields and Open Spaces Act	
The wildlife protection act,1972	Kerala land conservancy act,1957	
National forest policy, 1998	Kerala state environment policy,2009	
National Water policy,2002	Kerala coastal zone management-CRZ	

3 Scoping ecosystem service opportunities

This section covers the core part of the UFZ scoping. Figure 1 presents the scoping framework, based on an adapted version of Rode and Wittmer (2015). The questions raised in Steps 3A and B were answered within group work sessions during the stakeholder workshop on March 28, complemented by information from discussions with the Cochin Municipal Corporation and consultations with KFRI scientists. This information is presented in sections 3.1 and 3.2. The actual "ecosystem service opportunities" as defined in Step 3C of the framework were not assessed with stakeholders. For now, some opportunities will be included as part of the "ideas how to improve the situation", as reported in Section 3.3 (which again resulted from the workshop and expert consultations). More specific opportunities for selecting and planning suitable policy instruments (Step 4A-C) could be assessed more systematically with stakeholders in a follow-up workshop setting.

The ecosystem service opportunities framwork



3.1 Relevant issues and ecosystem services

Mangalavanam and other mangrove patches within Kochi jurisdiction

A. Clarifying relevant issues and the role of ecosystem services (ES)

What are the important issues?

Few mangrove patches remaining in and around Kochi, remaining ones tend to be degraded/polluted

Mangalavanam as well-known piece of nature in city center is increasingly polluted and disturbed

Which ecosystem services are relevant and connected to the issues?

- education (birds, biodiversity): nature interpretation center, education camps
- recreational use: nature walks (locals and tourists)
- aesthetic and inspiration for arts
- pollination through insects, birds and bats
- biological control of predator activities
- provision of food, raw material, fresh water and medicinal resources
- carbon sequestration
- prevention of erosion
- buffer against flood events
- prevent salt water intrusion
- local climate regulation and reduction of heat stress
- improve air quality
- water purification
- biodiversity habitat
- maintenance of genetic diversity

Where do trade-offs occur and how?

Most trade-offs between polluting activities and ecosystem services

Where do synergies occur and how?

Many synergies between the ecosystem services provided by healthy mangroves

Vembanad Lake (Backwaters)

A. Clarifying relevant issues and the role of ecosystem services (ES)

What are the important issues?

- Pollution of the lake and canals (oil spills, waste, toxics from commercial activities and construction, sewage) harming biodiversity and human health
- Siltation from dredging / removal of silt by port harming backwater fisheries (access of fishers to the fishing ground) and aquatic ecosystem is distracted (microorganisms die) – no baits for fishing and as food source

Which ecosystem services are relevant and connected to the issues?

- clean/fresh water provision (BUT drinking water for Kochi is coming from other source);
- provision of food: fish, grains, prawn, crabs, mollusks
- provision of raw materials: clam, sand, gravel, clay, calcium-carbonate, timber, fuel wood
- provision of medicinal resources, germ plasm, cosmetics and fertilizers
- Water purification (reduced by too much pollution, close to tipping point) & phytoremediation of heavy metals
- Mangroves as wind break protects local agriculture (paddy)
- Mangroves prevent erosion and hold soil together
- Mangroves provide storm and flood protection
- Mangroves as breeding/spawning ground for fish
- Carbon sequestration
- Tourism: bird watching, boat tours, agricultural tourism picking up
- Biodiversity habitat (incl. migratory species) and gene pool, RAMSAR site
- Birds and insects as pollinators for paddy
- Birds and frogs as pest control

Where do trade-offs occur and how?

- Between polluting activities and ES
- Between intensive agri-/aquacultural production and non-provisioning services
- Between non-ecological aspects of tourism (e.g., oil spills, too high capacity) and habitat

Where do synergies occur and how?

- Fishing and Pokkali benefits from water purification and healthy mangroves (windbreak, breeding and spawning ground)
- Eco-tourism benefits from aesthetic value and habitat function

3.2 Relationship of human activities and actors with ecosystem services

Mangalavanam and other mangrove patches within Kochi jurisdiction

B. Understanding how human activities and actors relate to ecosystem services					
Which activities contribute to the provision of ES? (by conserving biodiversity or managing ecosystems) Who are the actors?		**Which activities benefit from or rely on ES? Who are the actors that use or depend on ES and have an interest in their provision?**		**Which activities degrade or pollute ecosystems and/or deplete or harm the provision of ES? Who are the responsible actors?**	
activities	actors	activities	actors	activities	actors
• mangrove management	• coastal zone authority / Indian coast guard / navy (national) • protected areas managed by forest department	• fishing (mangrove for breeding and nursery)	• fisherman and communities consuming fish • fishing industry • boat tour operators	• Cochin shipyard port activities • Kochi LNG (liquid natural gas) terminal construction for offshore storage and transport destroy mangroves	• households with sewage • constructors • Indian navy (dredging) • Indian coast guard (dredging) • Indian national railways (cut down mangroves
• Management and protection of Mangalavanam	• Kerala Forest Department • Kochi Municipal Corporation	• Leisure trips, including boat tours (for pleasure, recreation, physical & Mental Health)	• Public visitors • Tourism operators • morning walkers	• Incompatible land use in surrounding area (with high buildings)	• Corporation GCDA • Railway • Developers • High court • KMC • Govt. of Kerala • Private builders
• Eco-friendly tourism	• DTPC • Private Agencies	• Nature Camps and education activities	• Students • general public • neighborhood • KFD	• Light and noise pollution in surrounding area	• Local public and households • high court building • traffic
• Research	• KFRI • CUSAT • SACON • Colleges	• Climate protection efforts	• Agencies responsible for climate protection • Global community	• Improper drainage system and destruction of natural drainage	• Govt. bodies • Local bodies
• Buffer zone protection	• Kerala State	• birdwatching	• bird watchers • tourism operators	• Introduction of exotic plants and predators	• Forest Department • Natural invasion
• Controlling pollution (5890)	• Kerala state pollution control board • KMC			• Waste disposal: toxic, solid and liquid	• general public • KMC • Businesses (for instance fishing net factory)
• Regulations (CRZ/ RAMSAR agreement / Coastal zone management rule)	• Govt. of India • United Nations			• siltation of surrounding blocking tidal activities	• public works Dept. • KMC
• good railway stations (stopped)	• Indian railways				

Vembanad Lake (Backwaters)

B. Understanding how human activities and actors relate to ecosystem services					
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activities	actors	activities	actors	activities	actors
• mangrove conservation, management (potentially also restoration, but not yet happening)	• coastal zone authority • Indian coast guard / • navy (national) • forest department • private land owners • Forest Dept. • KCZMA • LLMC	• tourism relies on attractive landscapes (boat tours), bird population (bird watching), clean water	• boat tour operators • bird watchers	• crude oil transportation: oil spills from pumping and leakage	• Cochin shipyard port (port activities)
• Ecological agriculture (mainly traditional Pokkali)	• Farmers • Agriculture Dept. (via promotion and subsidies)	• Agriculture / food: production and consumption (local and export) • Paddy farming depends on pollinators	• Fishermen • Farmers • Local communities • consumers • Government authorities responsible for fisheries	• Overfishing and destructive fishing (fishnet mesh size)	• Fishermen relying on the practices
• community work on sustainable practices for clam and rejuvenated fish population	• community-led enterprise-based conservation (ATREE)	• eco-consumption	• traditional Pokkali farmers	• (Overuse of) chemical fertilizer and pesticides	• farmers relying on the practices
• Policies and legislation	• Govt.	• Fishing (subsistence, commercial, game fishing)	• Fishermen • Game fishing organizers	• Aquaculture monoculture (also with antibiotics)	• Fish farmers
• Social Forestry (Mangrove)	• Forest/ BMC local	• Germ plasma conservation		• Industrial discharge (incl. toxic waste)	• industries • new commercial activities at city outskirts
• manual dredging	• LSGD	• Industrial operations in the Kochi outskirts		• waste dumping and sewage disposal	• general population • industries • local authorities
• Waste Management	• LSGD	• biodiversity conservation efforts	Environmental authorities and NGOs	• shipping and dredging	• port trust • ship yard • tourism boats

• Bank protection	• LSGD	• Industrial extractive activities (how do they benefit?)	cement and construction industry	• Legislation without scientific vision • Lack of clarity and violation of law	• Govt. • Policy makers • general public
• Wetland area monitoring	• Local level monitoring committee	• recreation	• local population and tourists	• dredging	• Indian navy • Indian coast guard
• Legal monitoring of CRZ area	• Secretary of LSG • District Collector	• Coir geo textile	• LSGD	• Mangroves destruction	• Indian national railways • Kochi LNG liquid natural gas terminal
• Mangrove monitoring and research	• KUFOS • CUSAT • CWRDM	• Medicinal resources	• pharmaceutical industry • public health	• oil spilling	• tourism boat operators
• Water quality enhancement	• SPCB • CPCB • CUSAT • NIO • NGOs • Academic institutions			construction on the shores causing erosion ; conversion and filling	• private companies • private individuals • constructors
				• Sand mining	• Local population
				• un-authorized construction	• Govt. of India
				• Depletion of ground water	•

3.3 Ideas how to improve the situation

The following ideas were generated during the workshop and expert consultations.

Idea	How to implement	Who could implement	Time frame
General			
Better waste management of solid, liquid, hazardous and biomedical waste	Decentralized management of organic waste at ward level; In situ filtration effluent treatment plant at ward level; Amendment in Municipal Building rule, e.g. management system mandatory for shopping mall, buildings, hospital, industry	Govt of Kerala LSG SPCB	2 years
Monitoring & evaluation of wetland ecosystems and biodiversity hotspot (GIS based)	To identify ecologically fragile area and integrated to GIS platform; Regular monitoring surveillance using GIS mobile app or cloud; Establishment of a permanent monitoring station; Formation of task force	LSG Academic research platform, Cochin corporation, PCB state wetland authority, universities, fisherman communities	2 years – long-term

Policies to conserve and to restore green areas / trees in city	Mapping and monitoring of green spaces/trees inside Kochi; relate to heat stress and air pollution; awareness raising; find out which areas real estate are planning to buy and convert; discuss with builders the benefit of green spaces		
Increase environmental awareness / literacy creation from students to policy makers	Enhance capacity building, education & participation & awareness, including at all school levels, utilize ICT (effective) educational tools etc.	Govt India, Govt of Kerala, LSGDS, Kochi Municipal Corporation, Community groups Local groups, NGO, Research Institute	1 year – long-term
Zero waste disposal and discharge to the estuarine system	Proper implementation of waste collection and sewage treatment system	KMC, LSGDs, PCB	Long term
Ecosystem service assessment	Multi-disciplinary team conducted study	KMC lead (Support by ICLEI, etc)	2 – 3 years
Formulate and implement "green/sustainability" criteria for public buildings	Build on the "green audit" requirement for universities; check options to include criteria for all public buildings (schools etc.); check "green protocol" developed by KMC	KMC	1 year
Cleaning/desilting of canals and restoration of banks		INTERACT-Bio project, with KMC	6 months
Related to Backwaters			
Better support Pokkali paddy cultivation	Policy implementation and financial assistance for Pokkali farmers	Farmers, SHGs	Long-term
Management and action plan for policy formulation regarding Backwaters	Participatory process for shared vision, strategy, and action plan; Implementation through Acts, Rules, Notifications	KMC	1 year
Related to Mangroves			
Mapping of mangrove areas in and around Kochi, including ownership of land.		INTERACT-Bio project with KMC, KFRI, other research partners	3 months
Create network of mangrove landowners	Core group of mangrove stakeholders	KMC and other stake	
Policies for protection of Mangroves	Bann cutting of mangroves through different legal and incentive measures	LSGDs, SHGs	Long-term
Acquire private mangroves/ wetland area by state govt.	Implement GO (RT) 166/06/ forest dated 25 – 03 - 2006 Check exact content of legislation and amount of compensation ; contact Wildlife Trust of India on good practice experiences	Govt. of Kerala; KFRI	2 years
Specifically related to Mangalavanam			
Buffer zone and expansion of Mangalavanam protected area	Reclaim 7 hectares from housing corporation & add 10 h of marshy land	Legal notice Declaration	1 year
Stop Sewage flow into ecosystem	Sewage treatment plant at source; connect to other canals	KMC	Six months
Stop light and noise pollution	Antiglare windows and walls in all high rise buildings near to mangrove ; Establishing honking free zone	KMC	Three months

4 Lessons and recommendations for the INTERACT-Bio project

Based on the conversations with the Kochi Municipal Corporation (Dr. Rajan, the mayor) and experts, the workshop results as well as internal discussions among the INTERACT-Bio team, UFZ would like to share some concluding thoughts, lessons and recommendations with respect to further project activities.

UFZ was impressed by the strong support from and close relationship with the Kochi Municipal Corporation (KMC) provides great enabling conditions for the project. It is also an excellent window of opportunity – and already a noteworthy success of the project - that several biodiversity-related aspects were included in the recent KMC budget. It is understood that the project is now expected to deliver a first quick and tangible/visible outcome, and various options have been considered during the UFZ visit (e.g., desilting a canal and planting trees to stabilize the bank, a butterfly garden). UFZ understands and acknowledges this need for a visible outcome, and would be glad to participate and advise in the decision process if this helps.

We would like to support two lines of action (see below). As institutional basis for both of them, the advice from KFRI experts to build a core advisory group of influential stakeholders seems promising. This core group will be able to help identify and ensure the participation of actors who are particularly relevant for advancing targeted actions within 1 and 2. It was mentioned that CMFRI, Cochin University, Kerala Forest Department, district administration (district collector), and the Kochi municipality opposition leader could be part of this core advisory group.

1. Building a network, action agenda, and communication material for mangrove conservation in the Greater Cochin Area

One focus of the project can be mangroves conservation. In that case, however, it is advisable to not only focus on Mangalavanam, which is a very small area with limited potential impact of conservation activities from an ecological – and ecosystem services - point of view. Mangalavanam without doubt also has some cultural and emblematic value for the city. And yet, there is a risk that a focus on the area ends up primarily as public relations campaign that could even defer more effective action to conserve biodiversity and ecosystem services in and around Kochi. We therefore support the idea to frame mangrove conservation efforts more broadly, with Mangalavanam as a sort of “light house” for mangrove advocacy and education. Since mangrove patches within narrow city boundaries seem limited and characterized by strong development pressures, the scope could be set to include all remaining mangrove forest in the Greater Cochin Area.

As discussed in the project team, a first task to that end includes a detailed mapping and identification of land owners for these areas. Then, the project can initiate and facilitate a network formation of mangrove landowners, for sharing knowledge, good management practices, and ideas for conservation. Stakeholders to

participate in the process should include relevant public authorities (e.g. Forest department) and knowledge holders from research and practice. For instance, KFRI can share data on "ecologically fragile land" policy, and the Wildlife Trust of India can share experiences on mangrove conservation and restoration in other parts of India.

To support these efforts, the project can further involve professors from Kochi University or colleges and discuss potential collaborations for further studies and capacity building. This includes biodiversity experts for baseline assessments and monitoring activities as well as environmental/ecological economists. The project can also develop targeted information material to popularize and make the case for mangrove conservation, aimed primarily at City counselors and public authorities (policy brief) but also wider audiences. This could be done based on the novel IPBES framework of "multiple values for Nature" (see e.g. Pascual et al 2017), including appropriate communication of ecosystem service values, and relying on latest knowledge on biodiversity communication strategies (e.g. from South Africa).

UFZ can offer to provide the technical backstopping/supervision for the concept and implementation of such a communication approach and material (e.g., a brochure). ICLEI /UFZ will need to clarify how to organize this task and who could provide resources for the more time-consuming research activities and/or research assistance. This may also be an opportunity to build relevant capacity in India.

2. Supporting KMC in developing a management and action plan for Sustainable Backwaters

Building on the interest of the Kochi Municipal Corporation (KMC) and the inclusion in the current budget, the project should help KMC prepare a management and action plan for the Backwaters. This will involve identifying the relevant stakeholder groups in order to take an inclusive, participatory approach. The results of the second exercise of the April workshop on "human activities and actors related to ecosystem services" provide a good starting point for further specification of possible actions and policies for a sustainable development and ecosystem conservation in the backwaters. One option is that a targeted group of stakeholders takes this thinking forward based on Steps 3C to 4C of the "ecosystem service opportunities" guidelines (Rode and Wittmer 2015), for instance in a workshop setting. It was mentioned during the consultations that there is a large amount of knowledge available on the ecological status, threats, and conservation options for the backwater ecosystems. The project should build on this knowledge by including the relevant knowledge holders (and potentially also with a literature review). The management and action plan should specify concrete implementable management activities and policy options, (some of) which could be included in the 2019 budget for implementation.

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Annex 1: Template with guiding questions for section 2

Environmental context

- What are the general environmental conditions of the area of interest? e.g.
  - Land use, land cover and habitat types
  - Other natural features (hydrological, geological, etc.)
  - Habitats and species with special conservation significance
  - Current and historical trends in land use/cover
  - Current and historical trends in land, air and water quality
  - Location of environmental hotspots, sensitive or threatened areas.
- **What are the main pressures on and threats to ecosystem conservation?** What are their causes (e.g. impacts of particular economic activities)? To what extent are the causalities (scientifically) verified (e.g. contamination through pesticides)?
- What conservation activities are already in place? What are the main objectives and measures of already existing conservation plans? Are the objectives appropriate and are the measures being implemented? If not, what are the barriers?

Socio-economic and cultural context

- Current level of development and infrastructure and development potential in the area
- Current land use (including potential environmental impacts)
- Sources of income and employment (economic sectors, main activities)
- Important public and private investments
- Distribution of wealth and income across the population (including the poverty line)
- Cultural characteristics of the local population (demography, language, class structure, ethnicity, religion, relevant traditions)
- Education (literacy level, school system)
- Status of community involvement - Is it participatory? Are women, minorities, poor people, et al. represented? Are there networks to assist communication and stakeholder coordination?
- **How do people perceive their environment and what is their attitude towards conservation measures? Which conservation measures are contested and by whom?**
- **Is there important traditional knowledge of natural resource use?** Who has the rights of access to traditional knowledge and its application?

Political, institutional, and policy context

- Who is in charge at local level, in particular of environmental management? Which organisational structures govern environmental protection and ecosystem conservation? **What influential political institutions are there and who leads them (formally and informally)?**
- Are there important national or international policies that influence local development and conservation objectives?
- What is the local system of land tenure, ownership (property rights, resource use rights) - both formal and customary/ de facto?
- **Which policy instruments for ecosystem conservation exist already?**
  - Legal instruments (conservation laws, protected areas, land use restriction, etc.)
  - Economic instruments (payments, tax reductions, etc.)
- **Which local, regional or sectoral development plans and policies are relevant for conservation?** (e.g. policies for regional economic, agricultural or infrastructure development, "perverse" subsidies with negative effects on biodiversity conservation)
- **What local political support is there for biodiversity conservation?** Which international, national and local actors are involved in conservation? Are there currently any conflicts over policies or laws?

- **Are there currently any "windows of opportunity" to improve environmental policies?** (e.g., formulation of a sustainable development plan, ongoing policy reform, public debate)