FACTSHEETS TII

THE ECONOMICS OF ECOSYSTEMS AND BIODIVERSITY-INDIA INITIATIVE

Ministry of Environment, Forest and Climate Change
Government of India

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अशोक लवासा
ASHOK LAVASA, IAS

सचिव
भारत सरकार
पर्यावरण, वन एवं जलवायु परिवर्तन मंत्रालय
Secretary
Government of India
Ministry of Environment, Forest and Climate Change

FOREWORD

With just 2.4% of the world's land area, 17% of the global human population as well as a large livestock population, India yet accounts for nearly 7-8% of all globally recorded species. We are a megadiverse country seeking economic development while maintaining the integrity of our biodiversity and ecosystem services. We need to ensure that our natural capital is maintained so that ecosystem services continue to support both human well-being and socio-economic prosperity.

In 2011, the Ministry of Environment, Forest and Climate Change launched 'The Economics of Ecosystem and Biodiversity – India Initiative (TII)' with the goal of making the value of India's natural heritage explicit and for factoring such values into economic development planning. Fourteen projects were commissioned under TII, with multidisciplinary teams mentored by eminent ecologists and economists, to ensure balanced application of methodological approaches within the relevant ecological and development context of each case study site.

I am now pleased to present here the fourteen factsheets that offer insights that are authentic based on a robust methodology yet startling in their revelation of the true worth of our natural capital. For instance, some of TII case studies have shown that:

- During its life time, a single vulture provides scavenging benefits worth around ₹695,000. In absence of these natural scavengers, India will have to build carcass disposal plants in virtually each of our villages and cities. It makes better economic sense to invest in vulture conservation instead of investing in carcass disposal plants!
- Ecosystem services (timber, fuelwood, NTFP, carbon, recreation) from just 10 sq. km. of the Western Ghats forests are worth over₹23 million. Failure to recognize these values would lead to distorted policies with detrimental environmental and human consequences.
- Loktak Lake in Manipur provides US$3 million worth of water for hydropower generation. However, this value is not accounted for in hydropower pricing. Factoring biodiversity and ecosystem services values in Loktak Lake will make water management more efficient
- Every ₹ invested in Chilika restoration has sustained ₹5 worth ecosystem services benefit.

I compliment all TII case studies investigators for presenting the economic benefits of biodiversity, growing costs of biodiversity loss and ecosystem degradation, and drawing together expertise from the fields of science, ecology, economics and policy to find practical solutions.

Contribution of the following persons is also appreciated: Dr. Kirit Parikh (Chairman, Scientific and Technical Advisory Group of TII and former Member, Planning Commission), Mr. Hem Pande (Former Special Secretary, MoEFCC), Mr. Susheel Kumar (Special Secretary, MoEFCC), Dr. JR Bhatt (Scientist G, MoEFCC) and Mr. Edgar Endrukaitis (Programme Director, GIZ) for their guidance and support to TII case studies. I would like to thank the Federal Ministry for Economic Cooperation and Development (BMZ), Government of the Federal Republic of Germany and the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH for their support to TII process.

I am sure the factsheets would not only provide interesting facts and figures but will also motivate us all to conserve our biodiversity for the significant services and benefits they provide.

(Ashok Lavasa)

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WESTERN GHATS – INDIA'S GREEN GOLD

PHOTO: RITESH SHARMA

Recognised as a global biodiversity hotspot and UNESCO World Heritage Site, India's Western Ghats form a watershed for as many as 58 rivers. It is also home to around 50 million people and a large number of endemic plants and animals across six states. Putting an economic value on goods and services silently provided by these giant forests will aid in their conservation.

ECONOMIC VALUATION IS A POWERFUL TOOL TO ADVOCATE AND CHAMPION CONSERVATION OF THE WESTERN GHATS

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Findings

- There is a restriction on wood removal in Uttara Kannada. Taking the restriction into account, the value of timber is **₹73,892** (**US$ 1,232**) to **₹95,524** (**US$ 1,592**) per hectare per year.
- Sawmills add a value of **15.5%** and processing adds another **44.5%** to the harvested timber.
- The fuelwood contributed **16%** to **37%** and non-timber forest products (NTFP) contributed **40%** to **63%** of the income among gathering households.
- The demand for NTFP in Uttara Kannada district is estimated at **720 million kgs**, which translates to a value of **₹32,230** (**US$ 537**) per hectare.
- The benefit from carbon sequestration in Uttara Kannada district (7,819 sq km) amounts to **₹7.56 billion** (**US$ 126m**) annually. The benefit is passed on to the global community.
- The value generated by tourism in Dandeli and Anshi Protected Area was **₹11.37 billion** (**US$ 189m**) per year for the year 2014.

PHOTO: RITESH SHARMA

Recommendations

- Sustainable harvesting, processing and marketing of Non-Timber Forest Products (NTFPs) has a large potential to generate sustainable income for local communities, which may require information generation on sustainable harvest rates and creating processing infrastructure.
- The economic benefits from tourism should be shared with the local communities through a formal institutional arrangement such as Joint Forest Management.
- Develop certification schemes for the harvest of NTFPs and other raw materials from forests.
- Build capacity of Biodiversity Management Committees and Forest Department at the range and the division levels to understand the economic value of forests and to ensure adequate financial compensation to local communities.

Implementing Partners

Indian Institute of Science, Bangalore
www.iisc.ac.in

Indian Institute of Technology, Bombay
www.iitb.ac.in

Based on The economics of ecosystems and biodiversity for the Western Ghats – Case study of Uttara Kannada

Researchers: Dr N H Ravindranath (IISc, Bangalore), Dr Haripriya Gundimeda (IIT Bombay) and Dr Indu K. Murthy (IISc, Bengaluru)

Supported by

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WHEN ELEPHANTS AND HUMANS CROSS PATHS

PHOTO: NISHANT SRINIVASAIAH

Elephants need large home ranges and have faced habitat loss, resulting in the raiding of nutritionally attractive crops, property destruction and human-elephant deaths. Electric fences and elephant proof trenches have been constructed to curtail increasing conflicts between elephants and humans in Kodagu district and Bannerghatta National Park (BNP). An economic valuation of losses incurred due to elephant raids reveals that the cost of barriers is worthwhile.

BOTH HUMAN AND ELEPHANT DEATHS DUE TO CONFLICT ARE UNACCEPTABLE

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Findings

- Coffee plantations dominate the landscape of Kodagu district, forming **21%** of its **4,102 sq km** land cover.
- BNP is **261 sq km** and among the last remaining tropical dry thorn forests of peninsular India.
- The annual loss in earnings due to elephant-human conflicts is **₹1.59 million** (**US$ 26,500**).
- Since 2004, the Forest Department has spent **₹94.3 million** (**US$ 1.57m**) to erect **322 km** of electric fences in Kodagu.
- In BNP, the types of barriers include solar fence, elephant proof trench, rubble wall, concrete wall, wire mesh, concrete moat and spike pillar.
- The cost of resident relocation would be **₹72.3 million** (**US$ 1.2m**), and there is strong opposition in both Kodagu and BNP.
- To keep elephants at bay, the locals are willing to spend approximately **₹600,000** (**US$ 10,000**) each.

PHOTO: SUKUMAR KABINI

Recommendations

- In both BNP and Kodagu, the benefit-cost ratios are high, indicating that the present barriers are useful mitigation measure.
- The barriers should be a long-term measure, continuously monitored and repaired in a timely manner when breaches occur.
- The cost effectiveness of the barriers should be evaluated based on their ability to reduce the probability of conflict. Effectiveness could be region-specific.
- The possibility of giving elephant-specific paths for movement in Kodagu district to maintain gene flow needs to be examined.
- Assess the potential of tourism in BNP to generate income.
- Cultivate crops which are not preferred by elephants (such as mulberry) in BNP.

Implementing Partner

The Asian Nature Conservation Foundation, Bangalore
www.asiannature.org

Based on The Economics and Efficacy of Elephant-Human Conflict Mitigation Measures in Southern India

Researchers: Dr Raman Sukumar (IISc, Bengaluru) and Dr Narendar Pani (ANCF, Bengaluru).

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ECONOMIC VALUATION SAVES VULTURES

PHOTO: IUCN

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Indiscrimate veterinary use of Diclofenac, an anti-inflammatory drug, has resulted in severe decline in the number of *Gyps* vultures in India. This has meant that nature's primary scavengers have been removed from our landscapes. Who then will play the role of scavengers? In the urban scenario, municipalities will have to rethink whether it is economically sound to build a new waste management system to dispose off carcasses or breed and re-introduce vultures.

A SINGLE VULTURE PROVIDES SCAVENGING BENEFITS WORTH AROUND ₹695,000 (US$ 11,583)

KNOWN IMPACTS OF VULTURE DECLINE

Findings

- Present investment value required in carcass disposal services for the next 50 years in rural areas is estimated to be around ₹351.5 million (US$ 5.85m).
- The scavenging ability of 300 pairs of vultures is close to the processing potential of a medium carcass disposal plant i.e. approximately 60 carcasses per week.
- It is economically prudent to invest in the breeding and re-introduction of vultures and maintenance of Vulture Safe Zones (VSZ) instead of investing in carcass disposal plants.
- There is a marginal price difference of ₹4 (US$ 0.06) per 30 ml vial in the cost of human Diclofenac and Indian formulations of Meloxicam. European formulation of Meloxicam is as effective as Diclofenac, but its price is significantly higher, ₹145 (US$ 2.4) per 30 ml vial.
- Despite the ban, Diclofenac continues to be used especially by para-vets, as they have little knowledge about the ban.

Recommendations

- Create a network of para-vets, villagers who promote the use of the safer Meloxicam in areas adjoining Protected Areas, and especially in and around areas of the seven proposed VSZs by the Government of India.
- Stronger and better monitoring is required of population increase in secondary scavengers and ungulate deaths due to feral dogs and other secondary/ obligate scavengers.
- Continue efforts in ex-situ Vulture conservation and recovery.

Implementing Partner

IUCN

International Union for Conservation of Nature, India
www.iucn.org/india/

Based on Economic Assessment of Ecosystem Services Provided by Vultures: Case Study from the Kanha-Pench Corridor, Central India.
Researchers: Dr N M Ishwar (IUCN), Dr Saudamini Das (IEG), Jagriti Kumari (IUCN), Dr Vibhu Prakash (BNHS) and P R Sinha (IUCN) with support from FES field team.

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WISE USE OF LOKTAK

PHOTOS: WISA LIBRARY

Loktak wetlands complex are the lifeline of the north-eastern state of Manipur. Spanning over 469 sq km, these wetlands are source of fish, edible plants and freshwater, and are the only known natural habitat of globally endangered Manipur Brow Antlered Deer (*Rucervus eldi eldi.*) Regulating the wetlands for hydropower generation has led to an alteration in the ecology of the lake ecosystem.

THE ORIGINAL HYDROLOGICAL SYSTEM OF THE LAKE STANDS ALTERED DUE TO CHANGES IN THE PAST THREE DECADES

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Findings

- The natural capital asset worth of Loktak is estimated at ₹63.8 billion (US$ 1.06 billion), considering its value in terms of fisheries, aquatic plants, freshwater, nutrient retention, and biodiversity-linked non-use values.
- Phumdi, floating mats of vegetation which are a characteristic feature of these wetlands, help maintain water quality by trapping nutrients. Replacing this function through artificial techniques may impose an annual cost of ₹113.3 million (US$ 1.9m).
- The worth of water provided from Loktak for hydropower generation is ₹183.30 million (US$ 3m). This value is not adequately accounted for in hydropower pricing. The ecological costs of lake water regime regulation are not appropriately factored in, which may lead to inefficient water management decisions.
- In order to maintain biodiversity and ecosystem services of Loktak, regulation of water regimes will need to consider multiple objectives rather than just maximisation of hydropower production. By lowering water allocation for hydropower during the lean season, critical ecosystem processes can be maintained.

Recommendations

- Sustainable management of Loktak water regimes should be based on a full range of biodiversity and ecosystem services values.
- Alternate sources for power are to be used during winter to ensure that ecosystem processes and services are maintained.
- Integrated wetland management should be pursued to ensure that ecosystem services and biodiversity can be maintained on a long-term basis.

Implementing Partner

Wetlands International

Wetland International
south-asia.wetlands.org

Based on Economics of Ecosystem Services and Biodiversity for Conservation and Sustainable Management of Inland Wetlands.
Researchers: Dr Ritesh Kumar, Kalpana Ambastha, Satish Kumar, Dr Anita Chakraborty, Kamal Dalakoti and Akoijam Yaiphaba Meetei (WISA, New Delhi).

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RESTORING KANWAR JHEEL

PHOTO: WISA LIBRARY

Kanwar Jheel is the largest floodplain wetland of Gandak-Kosi Basin of North Bihar. Spanning 67 sq km, the wetland buffers floods, recharges groundwater, sustains the livelihoods of farmers and fishermen and is an important waterbird habitat. Land-use changes triggering the transformation of this multi-functional resource towards permanent agriculture have created a trade-off between provisioning and regulating ecosystem services.

FOCUS ON WETLAND AGRICULTURE AT THE COST OF FISHERIES HAS CREATED FRICTION BETWEEN FARMERS AND FISHERS

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Findings

- The ecosystem services bundle of Kanwar Jheel operates at maximum value if the wetland is managed as it was in the 1970s. At that time, the entire wetland was inundated and a diverse land-use system was in place. This land-use system could have annually provided ₹87 million (US$ 1.45m) worth of fisheries, ₹18.42 million (US$ 307,000) worth of wetland agriculture and ₹9.07 million (US$ 15,117) worth of fuelwood.
- If the current trend of conversion of the wetland to permanent agriculture continues, there will be a significant opportunity cost in the form of lost ecosystem services. It is estimated that the annual loss for fisheries would be up to ₹74.19 million (US$ 1.2m), for acquatic plants up to ₹7.9 million (US$ 131,667) and for groundwater recharge up to ₹9.66 million (US$ 160,000). The gain from increased area under permanent agriculture would only be worth ₹12.67 million (US$ 211,168). Therefore, by changing Kanwar Jheel from a wetland to permanent agriculture, the value of lost ecosystem services are not matched by the gains from agriculture.
- In terms of wetland management, perhaps the restoration of Kanwar Jheel (towards the 1970s scenario) would be desirable for its diverse ecosystem benefits, especially for fishers. However, this would be unpopular among farmers due to loss of area available for agriculture. Therefore, ideal management would be to try and maintain a moderate hydrological regime (like the 1980s scenario), where benefits to farmers and fishers were possibly more equitable.

PHOTO: WISA LIBRARY

Recommendations

- Management of Kanwar Jheel should aim to restore hydrological regime as in the 1980s, wherein nearly 67% of the wetland was inundated for at least 6 months.
- Wetland zoning principles should be used to maximise ecosystem services and biodiversity benefits. The core of the wetland should be maintained for biodiversity, whereas a mix of fisheries and subsistence level wetland agriculture should be permitted in the rest of the wetland to address livelihood needs.
- A management authority may be constituted for Kanwar restoration with representation of all stakeholders and sectors.

Implementing Partner

Wetlands International

Wetland International
south-asia.wetlands.org

Based on Economics of Ecosystem Services and Biodiversity for Conservation and Sustainable Management of Inland Wetlands.
Researchers: Dr Ritesh Kumar, Kalpana Ambastha, Satish Kumar, Dr Anita Chakraborty, Kamal Dalakoti and Akoijam Yaiphaba Meetei (WISA, New Delhi).

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GOING THE CHILIKA WAY

PHOTO: RITESH SHARMA

Ecological restoration has brought life back in Chilika Lagoon, the livelihood base of 200,000 fishers and 400,000 farmers. It has also improved habitat quality of this Ramsar Site, including a million wintering migratory waterbirds and a healthy population of Irrawaddy Dolphins.

BETWEEN 1993 AND 2001, GOOD RESTORATION EFFORTS TOOK CHILIKA OFF THE MONTREAUX RECORD (AN ENDANGERED RAMSAR SITE)

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Findings

- Ecological restoration of Chilika sustains an annual benefit flow of ₹3.38 billion (US$ 56m) worth tourism, ₹1.46 billion (US$ 24m) worth fisheries, ₹34 million (US$ .57m) worth aquatic vegetation and ₹14 million (US$ .24m) worth inland navigation. In addition, significant benefits are received from the wetland ecosystem's ability to buffer extreme events and provide bioprospecting potential.
- Sustaining these benefits has required a programmatic expense of ₹1.6 billion (US$ 27m) since 1991 for an integrated lake basin management programme addressing various degradation drivers.
- Every rupee invested in Chilika has transformed into ₹4.9 worth of benefits through sustained flow of ecosystem services.
- Interventions aimed at improving the distribution of benefits from Chilika fisheries by strengthening Primary Fishermen Cooperative Societies have resulted in 21% increase in gross value realisation by fisher households and 13% savings in interest outgo on household debt.
- Fisher communities of Mangalajodi have stopped waterbird hunting and shifted to ecotourism, so as to benefit from improved habitat quality of Chilika. This transition has increased their income over 2.5 times in the last two decades. Besides income gains, awards and recognitions have brought considerable incentives to these communities for stewardship of Chilika.

PHOTO: RITESH SHARMA

Recommendations

- Implementation of lake basin management should be continued to ensure that biodiversity and ecosystem services are maintained on a long-term basis.
- Capacity building and finance for Fisher Cooperative Societies are required to ensure that Chilika fishers are incentivised for sustainable fisheries.
- Models of community managed ecotourism should be incorporated in wetland management so that communities gain livelihood benefits from ecological restoration.
- This experience may be used as a motivation for other coastal wetlands (e.g., Pulicat, Ashtamudi and Vembanad-Kol) waiting to go the Chilika way.

Implementing Partners

Wetland International
south-asia.wetlands.org

Chilika Development Authority
ww.chilika.com

Based on Economics of Ecosystem Services and Biodiversity for Conservation and Sustainable Management of Inland Wetlands.
Researchers: Dr Ritesh Kumar, Kalpana Ambastha, Satish Kumar, Dr Anita Chakraborty, Kamal Dalakoti and Akoijam Yaiphaba Meetei (WISA, New Delhi).

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RESTORING OUSTERI WETLAND

PHOTO: RITESH SHARMA

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Ousteri lake in Puducherry can irrigate 3,800 acres of land and plays a crucial role in recharging groundwater aquifers. It is a bird sanctuary, and has rich flora and fauna. It has suffered pressure from land-use changes in the catchment area, encroachment, siltation, pollution from industry and agriculture, overfishing, poaching, and groundwater exploitation. How much access to ecosystem services needs to be restricted for the sake of conservation?

CHANGE IN LAND-USE HAS ADVERSELY AFFECTED OUSTERI WETLAND

PHOTO: ZAREENA BEGUM

Findings

- In 2015, the recreational benefits enjoyed by visitors is estimated to be ₹5.72 million (US$ 95,333).
- Agricultural benefits amount to ₹11.5 million (US$ 191,667) per year.
- The estimated value of groundwater used for irrigation is ₹269,652 (US$ 4,494) per year.
- The economic value of biodiversity conservation is estimated to be ₹2.44 million (US$ 40,667) per year.
- Since 2004, 2,800 acres of land around the lake have been converted for commercial, non-agricultural purposes, causing water to stagnate permanently. While this enhanced groundwater recharge and recreational benefits, it has also caused eutrophication.
- Untreated wastewater from 250 industrial units upstream ends up in the wetland.
- The total economic value of ecosystem services with management is ₹19.67 million (US$ 327,834) per year and the net present value of the benefits is ₹82.89 million (US$ 1.4m).

Recommendations

- Enhance awareness and cooperation among stakeholders and explore incentive-based institutional arrangements for managing the wetland.
- Evaluate the cost of minimising effluents.
- Ensure cooperation among industries and government in order to treat effluents.
- Regulate access to ecosystem benefits such as fishing, collection of medicinal plants and bathing.
- Since tourists are willing to pay for improved facilities, increase the entrance fee to cover management costs.
- Monitor solid waste dumping and groundwater exploitation by commercial establishments.
- Ensure farmers adopt practices that minimise non-point source pollution from agriculture.
- Share revenue from ecotourism and water supply with local government bodies.

Implementing Partners

Madras Institute of Development Studies
www.mids.ac.in

Madras School of Economics
www.mse.ac.in

Based on Economic Valuation of Ecosystem Services: A Case Study of Ousteri Wetland, Puducherry

Researchers: Dr L. Venkatachalam (MIDS, Chennai) and Dr Zareena Begum I (MSE, Chennai).

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MANAGING WILLOWS IN WULAR

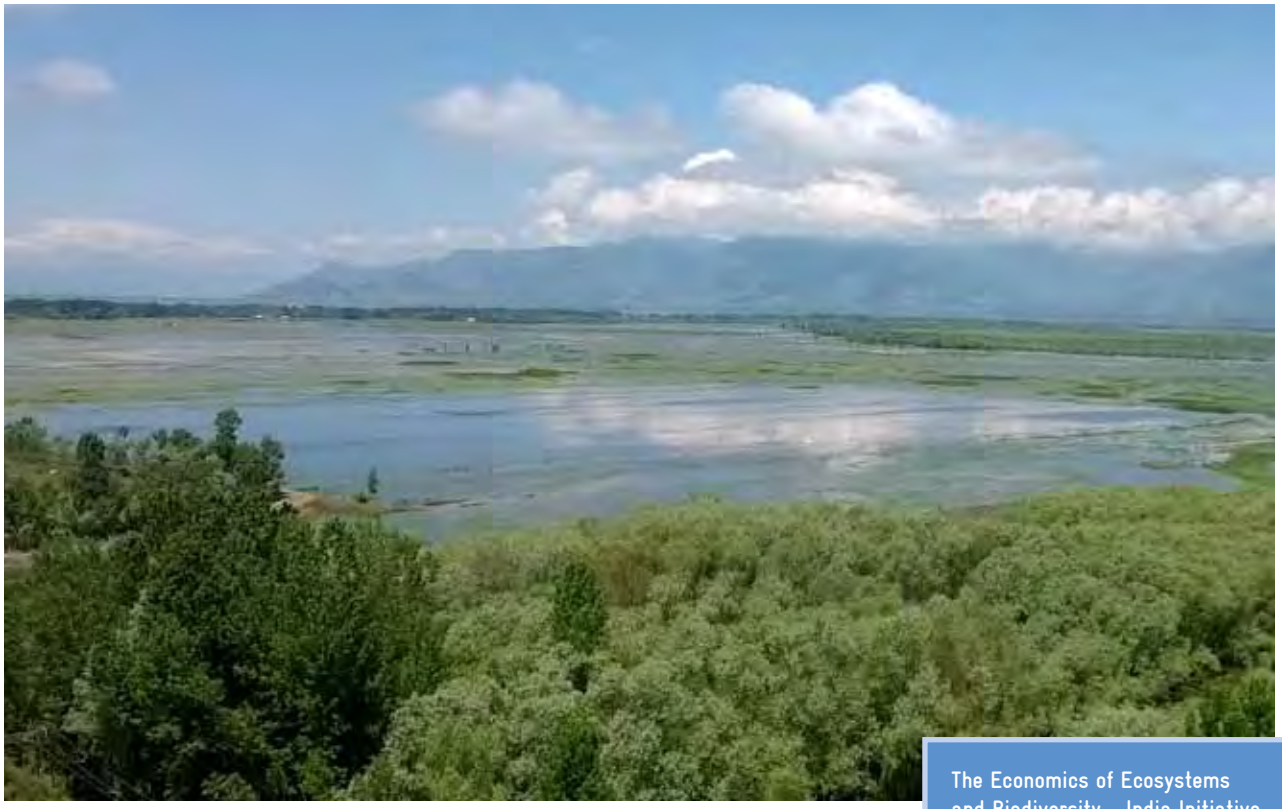


PHOTO: WTI LIBRARY

Wular lake is integral to the hydrological system of the Kashmir valley. Drainage of associated marshes, agriculture, increased siltation and plantation of willows to supply wood to sports and timber industries have reduced the lake size and increased the flood risk. A revised plan by the State Government suggests that despite high costs of dredging and permanent loss of carbon dioxide sequestration from willow removal, restoring the lake is still worthwhile.

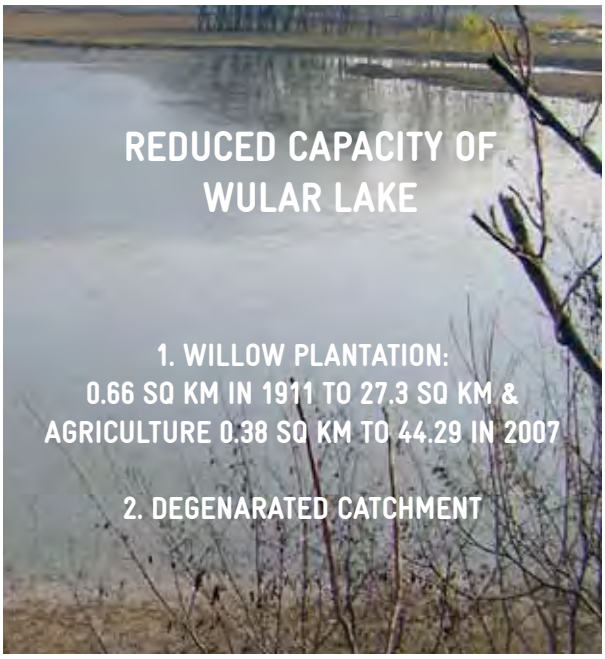
WULAR HAS REDUCED IN SIZE FROM 213 KM^2 IN 1911 TO JUST 130 KM^2 TODAY

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

JHELUM RIVER

RIVER ERIN

RIVER MADHUMATI



FLOOD

REDUCED FISH, VEGETATION & HYDROPOWER

Findings

- The impact of willow removal on siltation rates was difficult to establish. Willow roots act as a soil binder, hence their removal could lead to an increase in soil erosion.
- Loss of carbon sequestration benefits from the removal of willow trees is ₹8.09 million (US$ 134,667) per year.
- Willow removal and dredging would improve the holding capacity of Wular Lake, saving ₹1.05 billion (US$ 17.5m) on flood damage.
- One-time sale of willows will fetch ₹142.43 million (US$ 2.4m).
- Lake restoration will increase hydropower generation, yielding ₹69.6 million (US$ 1.1m) per year.
- Per year, fish production will amount to ₹3.1 million (US$ 51,666) and use of aquatic plants will earn ₹5.6 million (US$ 93,333).

Recommendations

- Willows should be removed from Wular fringes to restore hydrological functioning of the wetland complex.
- Wular tourism has to be developed in order to generate revenue.
- Funds realised from sale of willow wood should be ploughed back into wetland management.
- Willow removal may increase spread of invasive species such as alligator weed and azolla. To avoid costs of de-weeding, a plan to mitigate this threat should be part of the existing management.

Implementing Partner

Wildlife Trust of India
www.wti.org

Based on The Economic Feasibility of Willow Removal from Wular Lake, Jammu and Kashmir, India.
Researchers: Dr Rahul Kaul, Dr Ather Masoodi, Ajaz Rasool, M N Murty and J Kishwan (WTI, New Delhi).

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LITTLE RANN OF KACHCHH

PHOTO: AJAY DHAMECHA

Little Rann of Kachchh (LRK), a salt marsh spanning over 3,500 sq km, is the source for one-third of India's inland salt production. It is also the main source of ginger prawn export. The two production systems are sustained in a protected area of high biological diversity. The ecosystem services of LRK are increasingly threatened by upstream hydrological regime changes.

ANTHROPOGENIC CHANGES IN LRK ARE AFFECTING THE WETLAND ECOSYSTEM

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

Findings

- Livelihoods of 12,000 households are linked with the ecosystem services. LRK provides annual economic benefits worth ₹1.51 billion (US$ 25.3m).
- In 2014, the average annual net value of salt production from LRK was around ₹694 million (US$ 11.6m). However, the growth potential is only through low-value underground, highly saline brine water-based salt production, at much higher costs.
- *Metapenaeus kutchensis,* an endemic prawn species constitutes more than 90% of total fish biomass. The revenue from prawn fisheries was ₹746 million (US$ 12.4m) and ₹400 million (US$ 6.7m) in 2013 and 2014 respectively.
- In 2013-14, LRK biodiversity tourism generated ₹276 million (US$ 4.6m).
- Runoff, annually stored in dams and check-dams, reduces 48% of the freshwater flow into LRK.

PHOTO: RUPAL VAIDYA

Recommendations

- Existing hydrological function needs to be understood before recommending trade-off in upstream or downstream areas.
- Implement policies to improve water depth and maintain hydrological flow and balance. Dynamic hydrological regimes which underpin ecosystem services of LRK should be maintained.
- Such a large area with several streams of ecosystem services needs an integrated institution for governance in the domains of fisheries, tourism, conservation, agriculture and irrigation.
- Tourism needs to be optimised with long-term goals that ensures biodiversity is not harmed.
- Protect traditional rights of fishermen and salt workers without serious harm to ecological services.
- Currently, salt production is altering habitats and impinging upon the prawn production. These production systems need to be optimised in a sustainable manner.
- Conserve, create and manage additional habitats for migratory birds, including nesting grounds for the lesser flamingo.

Implementing Partner

cesc Ahmedabad

Centre for Environment and Social Concerns, Ahmedabad
www.cesc-india.org

Based on Economic Valuation of Landscape Level Wetland Ecosystem and its Services in Little Rann of Kachchh (LRK), Gujarat.
Researchers: Dr Arun M Dixit, Dr Somnath Bandyopadhyaya, Dr Lalit Kumar and Dr Satyasiba Bedamatta (CESC, Ahmedabad).

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ECOSYSTEM SERVICES OF KEN RIVER

PHOTO: BRIJ GOPAL

River Ken, a tributary of the Yamuna, regulates groundwater recharge and provides riparian vegetation, fish and sand. Its biodiversity, two waterfalls and the Panna Tiger Reserve are tourist attractions. In light of proposed diversion of water from Ken, it is crucial to note that any change in flow may stifle ecosystem services.

THE NEAR PRISTINE STATE OF RIVER KEN IS AN IDEAL CONDITION TO EVALUATE, QUANTIFY AND NURTURE ITS ECOSYSTEM SERVICES

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

PHOTO: BRIJ GOPAL

Findings

- Sand extracted from the lower reaches is used extensively in Uttar Pradesh. The annual value is around ₹25.75 billion (US$ 429m).
- The value of fish varies from ₹300,000 (US$ 5,000) to ₹1.7 million (US$ 28,333) at different fishing sites during winter.
- Panna Tiger Reserve, Raneh falls and a Gharial sanctuary have a combined value of ₹76.9 million (US$ 1.3m) per year.
- Invasion by the exotic common carp is already an indicator of reduced river flow.
- So far, the river has remained in near pristine state because of little urban or industrial development and a largely rainfed agriculture in its basin, but the downstream areas in Banda, Panna and Chhatarpur districts will be impacted by the proposed flow diversion.

Recommendations

- Assess impact of flow diversion on downstream areas in terms of groundwater recharge, sand, fish, riparian vegetation and water quality.
- The river has to be monitored over at least a 2-year period for flow, groundwater and human uses.
- A detailed policy should be formulated to regulate sand extraction based on its annual availability.
- Other smaller rivers should be studied to develop an appropriate methodology and framework for evaluation of river ecosystem services.
- The forests, wildlife and river are interdependent, so benefits from the forest should be accounted for in the ecosystem services of the river.

Implementing Partner

National Institute of Ecology, India
www.nieindia.org/

Based on Integrating the Economics of Wetland Biodiversity and Ecosystem Services in Management of Water Resources of River Ken.
Researchers: Dr Brij Gopal and Dr Dinesh K. Marothia (NIE, Jaipur).

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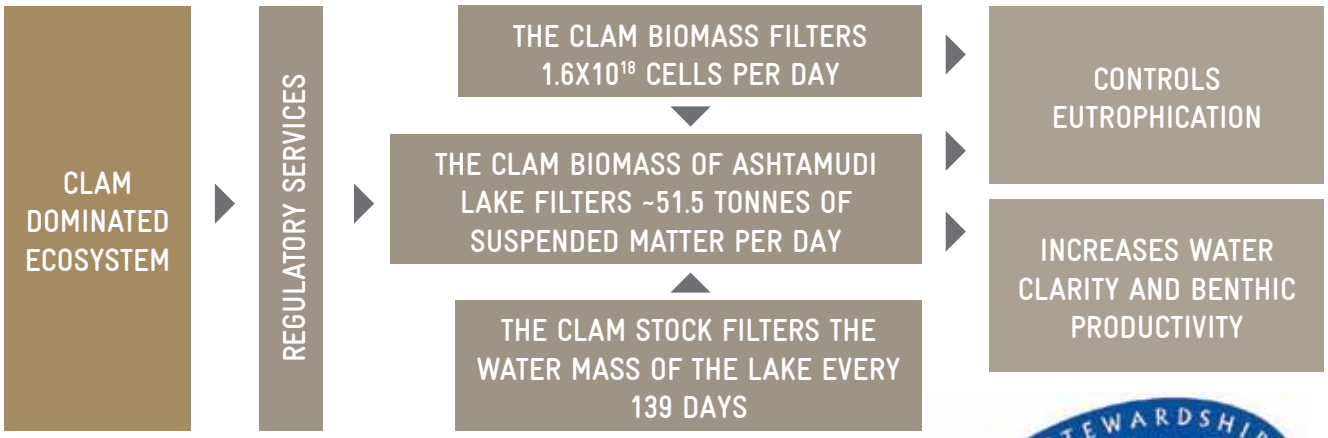
ASHTAMUDI CLAMS FETCH MORE

PHOTO: K SUNIL

Eco-labelling through sustainable fishing practices results in premium prices and ecological gains. Short-neck clam fisheries of Ashtamudi garnered an eco-label from the Marine Stewardship Council (MSC), a first in India. Clams function as bio-filters for Ashtamudi. Understanding the value chain and a comparison between pre and post management of the fishery points to the advantages of certification. Can this be replicated in other small-scale fisheries?

A HEALTHY CLAM POPULATION IN ASHTHAMUDI TAKES 139 DAYS TO FILTER THE LAKE WATER COMPLETELY

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.



Findings

- The Ashtamudi estuary, a **61 sq km** Ramsar Site, provides livelihood for about **3,000** locals.
- The estimated value of fishery resources of the lake is **₹985 million** (**US$ 16.4m**), of which **51%** comes from clams.
- The amount of nutrients released in the water where clam beds exist was thrice as much as non-clam zones. With more clams, it takes **139 days** to filter the lake water completely, as opposed to **277 days** when clam abundance is poor.
- The estimated cost of certification is **₹3 million** (**US$ 50,000**) and fishery management is **₹161.7 million** (**US$ 2.7m**).
- A change in processing and marketing of clams can improve livelihood security for fishers and boost the export value from the present **US$ 1 million**.
- With MSC certification, it is feasible to shift to new export markets such as Europe and Japan. A change in product from clam meat to whole clams can lead to **75% increase** in revenue.

Recommendations

- More fishers should be made aware of eco-labelling as a tool for resource management in small-scale fisheries.
- The Central Marine Fisheries Research Institute, in tandem with WWF, should identify similar small-scale fisheries to move them towards eco-labelling.
- Seafood trade promotion agencies such as the Marine Products Exports Development Authority could take the results of this study to processors and exporters to reap the benefits of consumer preferences and target new markets.

Implementing Partner

Central Marine Fisheries Research Institute
www.cmfri.org.in

Based on Assessment of Eco-labelling as Tool for Conservation and Sustainable Use of Biodiversity in Ashtamudi Lake, Kerala (Southwest coast of India)
Researchers: Dr K Sunil Mohamed, Dr V Kripa, Dr R Narayanakumar, Dr D Prema, Dr V Venkatesan, Vinod Malayilethu, Jenni Sharma and KK Sajikumar (CMFRI, Kochi).

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MANAGING BYCATCH

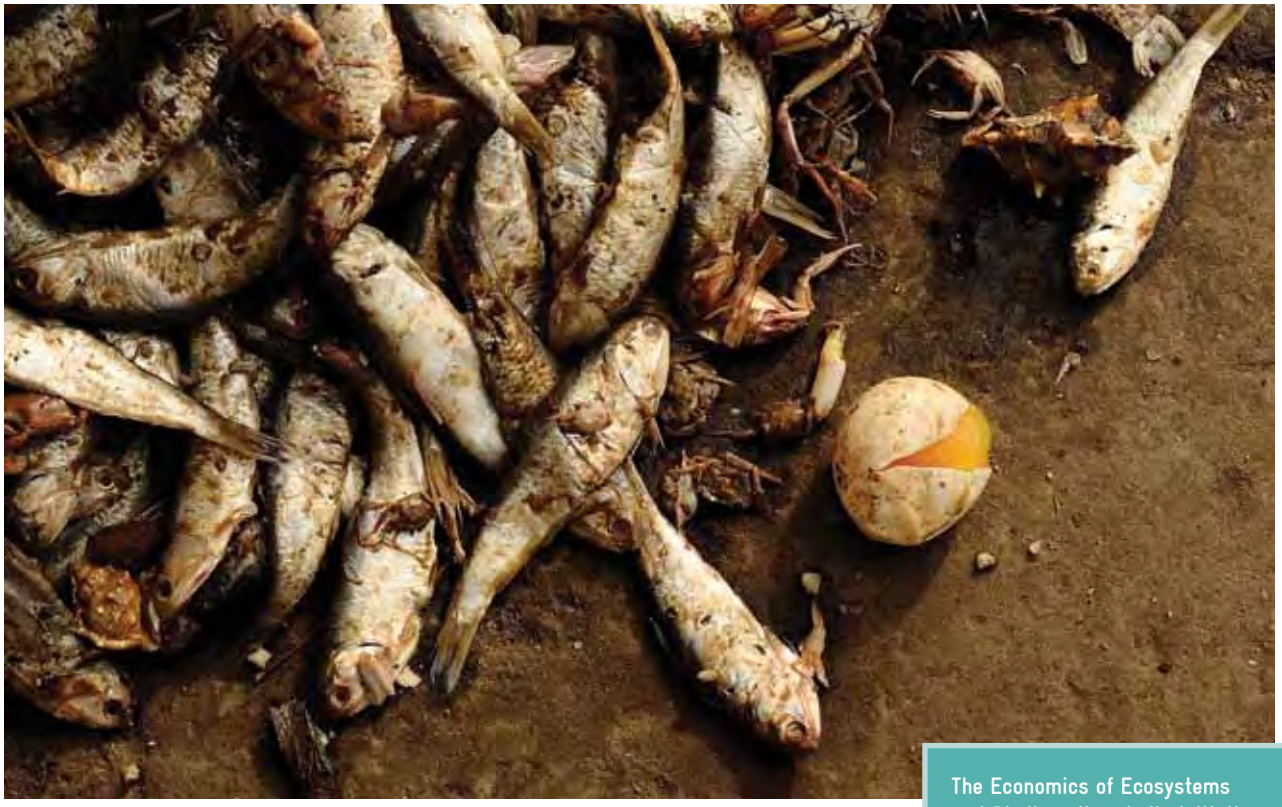

PHOTO: RITESH SHARMA

Harmful fishing techniques may result in the loss of marine biodiversity. A large number of unintended bycatch and juvenile fish has been observed in the fishery off the Andhra coast. This is largely due to the increasing number of trawlers. How can fisherfolk be incentivised to reduce bycatch? The economic and ecological value of future biodiversity loss due to bycatch is likely to be much higher than the cost of regulating fishing techniques.

IN ANDHRA, BYCATCH IS 14.41% OF TOTAL CATCH, WITH A VALUE OF ONLY 2.5%, BUT LOSS OF FUTURE BIOMASS IS ENORMOUS

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

PHOTO: RITESH SHARMA

Findings

- Nearly 59.8% of the biomass is forgone due to juvenile catch, which stifles breeding and creates a future loss.
- With little commercial value, bycatch is sold at just ₹1 (US$ 0.016) per kg to fishmeal and poultry feed industries.
- The estimates of the social cost of bycatch and juvenile species loss is ₹2.42 billion (US$ 40m) per year when we multiply the extra effort with the average cost of fishing effort.
- The present value lost due to fishing effort plus future losses amounts to ₹22.72 billion (US$ 378m) per year.

Recommendations

- Fishermen should be made aware of the consequences of unsustainable fishing in terms of livelihood loss and unintended consequences to marine biodiversity.
- To achieve the goal of 'fish better', incentivise the use of technologies that save juvenile fish and other bycatch.
- Provide a subsidy to those trawlers who are willing to adopt bycatch reduction devices. For example, 25 mm diamond shaped nets can be switched to 40 mm square shaped trawl nets.
- Implement fishing holidays or 'no-take zones' to encourage conservation.
- Regulate the use of bycatch in feed mills and encourage fishmeal industries to use sardine and or other adult low-value oil fishes.
- Conservation-friendly initiatives should be promoted.

Implementing Partner

Centre for Economic and Social Studies
www.cess.ac.in

Based on Economic Value of Biodiversity Loss: A Study of Bycatch from Andhra Pradesh Marine Fisheries**.**
Researcher: Dr Jyothis Sathyapalan (CESS, Hyderabad).

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FISHING HOLIDAY

PHOTO: R NARAYAN KUMAR

Millions of fishers along India's vast coastline eke out a living, contribute to national development and are learning to cope up with conservation of marine resources. Seasonal Fishing Ban (SFB) has been followed since the late 1980's to protect breeding fish population during peak spawning season. An economic valuation of SFB in five of the maritime states shows improved ecosystem services in the form of catch, fisher income, biodiversity, respite to the sea floor and reduced carbon emissions. These benefits outweigh the costs of a ban.

SEASONAL FISHING BAN RESTORES COASTAL ECOSYSTEMS AND SUPPORTS FISHERIES

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

PHOTO: R NARAYAN KUMAR

Findings

- About **10.36 million** fishing hours are reduced due to SFB, equivalent to **408,000 tonnes** of CO_2 emitted and a savings of **156.58 million litres** of diesel.
- In 2014, an amount of **₹8.3 billion** (**US$ 137m**) was saved on diesel during fishing ban.
- The estimated economic value (based on landing price) of the incremental growth of fish attained due to a fishing ban of **45-60 days** was a total of **₹1.07 billion** (**US$ 18m**) in the five states.
- The transaction cost, which includes information to fishermen and enforcement of the ban amounts to **₹45.78 million** (**US$ 0.76m**) in the five states.
- Estimated net social benefit due to SFB in five states was **₹1.09 million** (**US$ 18,167**).

Recommendations

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

Implementing Partner

सी एम एफ आर आइ
CMFRI

Central Marine Fisheries Research Institute
www.cmfri.org.in

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

Researchers: Dr R. Narayana Kumar, Dr J. Jayasankar, Dr Shyam S. Salim and Dr U. Ganga
Technical Advisor: Dr E. Vivekanandan, Emeritus Scientist & Consultant (CMFRI, Kochi).

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MANGROVES – GREEN COASTAL INFRASTRUCTURE

PHOTO: RITESH SHARMA

Mangroves provide food, fuel, recreation, contribute to fisheries, protect during disasters, aid in climate control through carbon sequestration and lessen coastal erosion. Gujarat has more than doubled its mangrove cover through reforestation and regeneration over mudflats. Planted mangroves have contributed to fisheries, biodiversity, and other ecosystem services. Mangrove restoration is a long-term ecological investment.

PLANTED MANGROVES DO PROVIDE VALUABLE ECOSYSTEM SERVICES

The Economics of Ecosystems and Biodiversity – India Initiative (TII) aims at making the values of biodiversity and linked ecosystem services explicit for consideration and mainstreaming into developmental planning.

PHOTO: SAUDAMINI DAS

Findings

- Planted mangrove effect on Gujarat commercial fishery was around **51 tons** of demersal, **45 tons** of crustaceans and **11.5 tons** of molluscs annually.
- Compared to the average daily catch in creeks with minimum pollution, the catch is reduced by **3.0 kg** in creeks with medium level pollution and by **4.1 kg** in highly polluted creeks.
- Planted mangroves provide benefits worth **₹95.5 million** (**US$ 1.6m**) annually through contribution to commercial fisheries and promoting soil accretion.
- When mangroves are planted using direct sowing methods, the benefits to fisheries and coastal accretion can cover plantation costs within **15 years**, even with **5%** rate of discount.

Recommendations

- In terms of cost recovery, mangroves are evergreen assets and continue to contribute to the economy. They should be looked at as long-term assets and not be evaluated just on the basis of short-term gains.
- There should be a mangrove tax on commercial fishery to share the cost of planting mangroves.
- There should be strict control on issues such as water pollution and increased effort by commercial fishers that may affect the daily catch of artisanal fishers.
- Preference should be given to less costly methods of mangrove plantation.

Implementing Partner

Institute of Economic Growth, India
www.iegindia.org

Based on Valuation of planted mangroves
Researcher: Dr Saudamini Das (IEG, New Delhi).

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- RESTORING KANWAR JHEEL
- GOING THE CHILIKA WAY
- RESTORING OUSTERI WETLAND
- MANAGING WILLOW IN WULAR
- LITTLE RANN OF KACHCHH
- ECOSYSTEM SERVICES OF KEN RIVER

COASTAL AND MARINE BIODIVERSITY

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

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

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

The Factsheets present key results and recommendations derived from TII case studies.

India, a Biodiversity Hotspot

India is one of the 17 mega-diverse countries in the world. It faces unique circumstances as well as challenges in the conservation of its rich biological heritage. With only 2.4% of the world's geographical area, her 1.2 billion people co-exist with over 47,000 species of plants and 91,000 species of animals. Several among them are keystone and charismatic species. In addition, the country supports up to one sixth of the world's livestock population. The rapid growth of her vibrant economy as well as maintaining its natural capital are both essential to maintaining ecosystem services that support human well-being and prosperity.

Indo-German Biodiversity Programme

The Ministry of Environment, Forest and Climate Change, Government of India is collaborating with the Federal Ministry for Economic Cooperation and Development (BMZ), Government of Germany and the Federal Ministry for Environment, Nature Conservation, Building and Nuclear Safety (BMUB), Government of Germany. The Indo-German Biodiversity Programme comprises the following:

- The Economics of Ecosystems and Biodiversity - India Initiative (TII)
- India Business and Biodiversity Initiative (IBBI)
- Conservation and Sustainable Management of Existing and Potential Coastal and Marine Protected Areas
- Himachal Pradesh Forest Ecosystem Services Project
- Access and Benefit Sharing Partnership Project

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