Sarovar

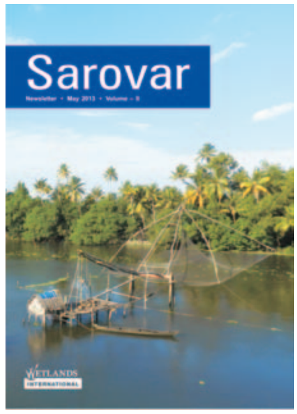
Newsletter • May 2013 • Volume – II

WETLANDS INTERNATIONAL

About WISA

Wetlands International – South Asia Society (Regd.) (WISA) is a non government organization with a mission to sustain and restore wetlands, their resources and biodiversity, WISA's office at New Delhi, India was established in 1996 as a part of global network of offices of Wetlands International (WI) with a mandate to promote wetland conservation and wise use in South Asia region. WI is a global non-profit organization which works on wetland conservation and restoration through 19 regional offices in over 100 countries supported by a headquarters based in the Netherlands. WI is also one of the five International Organization Partners of the Convention on Wetlands (Ramsar Convention). In 2005, WISA was registered as a legal entity under the Societies Registration Act of Government of India.

The strategic directions and policies of WISA are set by a General Body which comprises eminent experts and conservation planners. Currently, Dr. Ashok Kundra (former Secretary to the ministeries of Mines and Special Secretary, Environment and Forests, Government of India) is the President of the Society. Mr. S. K. Pande (Former Director General, Forests and Special Secretary, Government of India) is Vice-President. Dr. Ajit Pattnaik (Chief Executive, Chilika Development Authority) is the Treasurer. The Governing Body of the Society includes the office bearers; Dr. Sidharth Kaul (former Advisor, Ministry of Environment and Forests) as a nominee of the General Body and Ms. Jane Madgwick (Chief Executive Officer, Wetlands International as ex-officio representative of WI – Headquarters). Dr. Ritesh Kumar (Conservation Programme Manager) holds the current duty charge of the Office of Director.



Sarovar is the newsletter of the Wetlands International - South Asia Society (Regd.).

Contents

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The editorial panel welcomes contributions of articles and information. These may be sent to: editor@wi-sa.org

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DR. ASHOK KUNDRA
President

From the President's Desk

It gives me immense pleasure in placing in your hands the second volume of our newsletter 'Sarovar'.

The release of this volume coincides with the theme of International Day of Biological Diversity, which is celebrated on May 22 each year to mark the day of adoption of Convention on Biological Diversity (CBD). The theme this year is "Water and Biodiversity", coinciding with the United Nations designating the year 2013 as an International Year for Water Cooperation. Incidentally, the theme for World Wetland Day this year also was "Wetlands take care of Water".

It needs no reiteration that water underpins human well-being, including food, water and energy security, as well as ecosystem health and biodiversity. Availability of water in sufficient quantity and quality is critical to functioning and integrity of wetlands, in particular their ability to support biodiversity and livelihoods of dependent communities. Degradation of wetlands can significantly alter the water cycle and the interlinked carbon and nutrient cycles, thereby enhancing water insecurity. Wetlands are indeed 'natural infrastructure' solutions for water managers. Yet, in the process of formulation of sectoral policies, interconnections and interdependencies of wetlands and water are lost sight of.

Integration of wetlands into water management should not be seen from a narrow perspective of allocating flows to meet the ecosystem requirements. The imperative is to explicitly consider their ecosystem services in the design of water policies and interventions.

The lead article in this issue examines the challenges and opportunities that water and wetland managers and decision makers have in integrating wetlands and water management in Indian context. This is based on our experience of wetland restoration projects implemented in the last decade. Another contribution is on water and wetland management of Lake Chilika which provides practical example of integrating wetland and water management. We have also included in this issue brief updates on our projects which relate to the theme of this volume.

WISA continues its efforts towards sustainable management of wetlands and their mainstreaming in sectoral policies, particularly those related to water management and food security. Our initiatives, particularly in the wetlands of Gandak-Kosi floodplains in Bihar present striking evidences on the impacts of invidious water-food-energy nexus on wetlands.

Water and Wetlands are at the heart of transition to Green Economy. Action at all levels and by all stakeholders is needed if the opportunities and benefits of water and wetlands are to be fully realised and the consequences of continuing wetland degradation are fully recognized. Your continued support will help us towards conserving wetlands for a sustainable future.

We look forward to receiving your feedback as well as contributions for the forthcoming issues.

Happy reading!

New Delhi, May 2013

Integrating management of water and wetlands in India
Challenges and Opportunities

The crisis of water in India which threatens even our basic right to drinking water and puts millions of livelihoods at risk is well recognized. Our rapidly industrializing and urbanizing economy pose significant challenges to water management, already constrained by limited potential for augmenting water supply, falling groundwater tables and declining surface and ground water quality. Wetlands provide several benefits to water management, particularly in the areas of groundwater recharge, natural water storage, non-structural mechanisms for flood management, and water quality improvement. **Prof. E.J. James** (Member, National Wetland Regulatory Authority and Vice Chancellor, Karunya University) and **Dr. Ritesh Kumar** (Conservation Programme Manager, WISA) explore the challenges and opportunities in India for water and wetland sector managers and decision makers in integrating wetlands within water management.

Water and wetland management interlinkages

Wetlands are ecosystems wherein water plays a dominant role in controlling the environment and the associated plant and animal life. Water and sediments provide the physical templates within which these ecosystems evolve and function. In order to maintain their ecological health, wetlands require sufficient water of adequate quality, at the right time and in the right pattern. This necessitates consideration of water needs of wetlands in any plan for water use and management within the river basins and coastal zones they are located in.

The need for water managers to connect to wetland management is based on the fact that these ecosystems are the primary sources wherein water and related ecosystem services are derived. Wetlands are crucial in maintaining the water cycle. Water-related ecosystem services provided by wetlands at different scales (for example clean water provision, waste water treatment, groundwater replenishment) offers significant opportunities to address water management problems with sustainable, and in most instances, cost effective solutions. These services can also support man-made infrastructure to deliver water supply, sewage treatment and energy. Wetlands are indeed 'natural infrastructure' solutions for water managers. The objectives of water management can only be met sustainably, if the role of wetlands are recognized and managed appropriately.

The linkages between water and wetland management are, however, very weakly recognized and integrated in

Gobind Sagar Lake, a reservoir on River Sutlej Himachal Pradesh planning and decision making. The two sectors have historically focused on individual management objectives, the former at meeting water, food and energy security and the latter at ensuring biodiversity conservation, and in limited manner livelihoods of dependent communities. It is only since the mid-nineties that trends towards managing wetlands for a wide range of interacting environmental, social and economic objectives which support sustainable livelihoods and human well-being can be observed. Similarly, water managers face the challenge of ensuring sustainability of interventions by minimizing negative ecological, social and economic impacts. Integrating wetlands within water management through cooperative planning and management processes within the two sectors is a logical pathway for benefitting from water-wetlands interlinkages.

However, integration of wetlands into water management is addressed not just by building in an allocation of flows to meet the ecosystem functioning requirements. This only secures water for biodiversity conservation, but fails to capitalize on the ecosystem services to meet water management objectives. The challenge is to explicitly consider wetland ecosystem services in design of water policies and interventions, with due reference to the ecological thresholds. The cross scale disconnect between resource users and policy making institutional structures needs to be addressed appropriately by creating opportunities for polycentric and adaptive governance systems incentivizing multi-functional ecosystem use and stewardship.

Water and wetlands: the field reality of integrated management

As per Space Applications Center Report of 2011, the area of wetlands in India is 15.26 million hectares, roughly equivalent to 4.6% of her total geographical extent. Of the 0.75 million wetlands, 73% have area less than 2.5 ha (the smallest unit which could be mapped at a scale of 1:50,000).

While not explicitly recognized, several wetlands indeed form a critical part of India's water infrastructure. The high altitude wetlands of Himalayas serve as headwaters of ten largest rivers of Asia, basins of which support nearly one-fifth of global population. Recharge of aquifers by Yamuna floodplains plays an important role in water supply for the city of Delhi. The Bhoj wetlands are the major source of potable water supply for the city of Bhopal, Madhya Pradesh. Over 450 km long canals linked to Harike Lake in Punjab provide irrigation and drinking water to parts of southern Punjab and adjoining desert state of Rajasthan. The combination of aquaculture and agriculture practised in East Kolkata Wetlands enable treatment of over 600 million litres of sewage daily and produce nearly one third of Kolkata city's fish requirement while providing employment to nearly 20,000 peri-urban poor households. Loktak Lake in Manipur is the source of water for the largest hydropower project in the northeastern region of India. Wular Lake, through its large water storage capacity protects the entire Kashmir valley from floods. The role of ponds and tanks as source of water to India's 0.64 million villages is well recognized.

However, evidences also indicate that the state of wetlands, their biodiversity and ecosystem services rarely become an objective of water management. Bathymetric surveys of Harike Lake in 2010 indicated that the wetland had lost 83% of its water holding capacity since the last 54 years owing to rapid siltation. Continued discharge of pollutants from upstream townships brought into Harike by Rivers Sutlej and Beas have led to extensive proliferation by aquatic plant invasives. Regulation of water for hydropower in Loktak has converted a naturally pulsating wetland into a reservoir, causing severe degradation of the habitat of globally endangered deer species, *Rucervus eldii* which inhabits the wetland, and loss of migratory fish species. Conversion of over 70% of marshes associated with Wular Lake has reduced its capacity of regulate hydrological regimes, leading to increased instances of floods and droughts within Kashmir. Increased upstream abstraction of water and reduced availability downstream is one of the major factors leading to domination of high salinity tolerant mangroves species (such as *Avicennia marina*) and drastic reduction in salinity sensitive species along the coasts of Andhra Pradesh and Tamil Nadu. Similarly, reduction in freshwater flows is a major factor behind decline of mangrove species *Heriteira fomes*, characteristic of Sunderbans.

Structural approaches have been the major pathways of water resources development and management in India. Increasing demands for food production and burgeoning population have been met through design and operation of water regulating structures as dams, barrages, canals, embankments. These approaches provide little scope for considering the role of natural ecosystems as wetlands which perform several of these functions with co-benefits in the form of biodiversity and livelihoods for dependent communities (See Box on water management in Mahanadi Delta).

One of the major factors limiting integration within the two sectors is an overall low impetus on integrated management of wetlands. As a matter of fact, national programmes for wetlands started taking shape only in the eighties, mainly with India's accession to Ramsar Convention in September 1982. A dedicated national scheme was launched in the seventh plan period (1985-1990). The National Wetland Committee was constituted in 1992 to advise the government on

Mahanadi Delta: From flood dependant to flood vulnerable

The Mahanadi Delta, located within the north-eastern coastline of Odisha at the confluence of Mahanadi River with the Bay of Bengal Odisha is a region with several highly critical conservation areas (Bhitarkanika with the highest mangrove diversity in the country; Gahirmatha- one of the largest rookery of Olive Ridley Turtles globally; and Chilika Lake supporting one of the largest congregations of migratory waterbirds in Palearctic flyway and habitat of Irrawaddy Dolphins) located within a dense population deriving sustenance mainly from agriculture supported by rich fertile soils and abundant freshwater. The delta is also frequented by floods and cyclones which play an important role in its overall buildup.

Historically, the communities living within the delta evolved farming system which adequately distributed crop failure risks emerging through recurrent floods and droughts. Most importantly, the strategy recognized floods and resulting inundation patterns to be beneficial to the crops due to their capacity for natural fertilization of agriculture lands. The delta was subject to intensive hydrological regulation during the eighteenth century colonial rule. The dynamic fluvial environment was constrained by embankments and hydraulic structures to provide a regulated water supply to irrigated fields and thereby ascertain revenue. In 1957, the Hirakud Dam was constructed on the Mahanadi River for hydropower generation and as a major sediment trap for an intercepted catchment area of 83,500 km^2. Weirs were constructed at the head of the Mahanadi Delta to capture the downstream hydropower water release to irrigate 1.36 million hectares. Subsequently, the Bhargabi and Daya distributaries were embanked to Chilika as a flood preventive measure in irrigated areas. Later development in the delta emphasized on the extension of these activities without reviewing their long-term implications and taking into consideration views of the communities.

As an outcome of the water resource management which has failed to understand the role of fluvial regimes, the communities have been rendered flood vulnerable rather than flood dependant. With the flow connectivity severely impeded by embankments, the delta faces severe waterlogging which leads to lower agricultural productivity as well as diseases attributed to stangnant waters. Assessment based on remote sensing imageries indicate that the extent of wetlands has declined considerably due to loss of connectivity with the river regimes and changing land use pattern, especially in the central deltaic region. During the period 1975 – 2010, nearly 30% of wetland area has been lost. Small land holdings and limited opportunities for occupation diversification form major reasons for high poverty incidence in the region.

policy guidelines, identification of priority wetlands, monitoring implementation of management plans and building inventory of wetlands. In 2001, a National Lake Conservation Plan was introduced to address pollution issues in urban and semi-urban environments through interception, diversion and treatment of pollution load entering the lake. As on December 2012, 115 wetlands and 40 lakes were provided financial assistance under the two schemes. These, however, represent a small fraction of the wetlands requiring attention. Similarly, despite having a rich and diverse wetland regime, only 26 Ramsar Sites have been designated till date. Of these less than 10 are managed on the basis of systematically formulated management plans. Cross sectoral institutional arrangements, as are required for effective management have not been developed for a majority of states. Only seven states have constituted distinct wetland authorities as on date.

Following a review, the national government approved merger of the two schemes into a unified scheme titled National Plan for Conservation of Aquatic Ecosystems to be operational in the 12^{th} plan period with an overall allocation of 900 crores. The financing pattern has been changed to the central governments and the respective state governments sharing the cost in the ratio of 70:30 (90:10 in the case of northeastern states). Modalities for implementation of the plan were still being worked out at the time of writing of this article. While this reorganization does provide an opportunity for enhancing effectiveness of investments, there are financial consequences for the state governments which till date have been depending on national government support.

It is therefore not surprising that there are only handful cases of hydrological functions of wetlands being recognized and water allocations made to ensure conservation of their biodiversity and ecosystem services. Use of wetlands as solutions for water management objectives still seems to be a distant proposition. In 2002, when the Government of Odisha decided to operationalize Naraj Barrage, the likelihood of altering freshwater flows into Lake Chilika triggered the Chilika Development Authority and Department of Water Resources to undertake assessments of environmental flows required for sustaining this rich biodiversity and ecosystem services derived from the Ramsar Site. The recommendations of stakeholder led assessment were used as a basis for determining operations of the barrage. In Keoladeo National Park, Rajasthan, consecutive years of low inflows coupled with lower numbers of migrating waterbirds prompted the state government to intervene

Developing water policy for Loktak Lake

The floodplain wetlands of Manipur River known as Loktak Lake complex (including Loktak, Pumlen, Ikop, Kharung) are lifeline of Manipur State. Ecological and livelihood security of the communities is inextricably linked with the ecosystem services derived from the wetland system which is spread over 469 km^2 within a basin of 6,872 km^2. These are the largest source of fisheries, edible plants and freshwater for the state. *Phumdi,* floating heterogeneous masses of soil, vegetation and organic matter at various stages of decomposition are a characteristic feature of the lake. The southern portion of Loktak forms the Keibul Lamjao National Park (KLNP) composed of a continuous mass of floating *phumdi* occupying an area of 40 km^2 and natural habitat of globally endangered ungulate species *Rucervus eldii*. Based on its high ecological and socioeconomic importance, Loktak was designated by Government of India as a Wetland of International Importance under the Ramsar Convention in 1990.

Ecosystem services and biodiversity of Loktak Lake complex are under stress due to lopsided developmental planning within the basin. Water resources development projects for flood mitigation, agriculture and hydropower generation have led to modification of hydrological regimes. In particular was the construction of Ithai barrage downstream of Loktak in 1984 entailing regulation of lake levels for hydropower generation.

The barrage converted a naturally fluctuating wetland into a reservoir leading to inundation of peripheral areas, loss of migratory fisheries, reduction and degradation of national park habitat, and decline in water quality. Rapid growth of population in the hills has led to expansion in area under shifting cultivation enhancing lake siltation. Inundation of peripheral areas due to constant water levels forced an occupation shift from traditional agriculture – fisheries based livelihood systems to fisheries. Declining resource base with increasing population pressure forced propagation of harmful fishing practices ultimately leading to *phumdi* proliferation and choking of the central sector of the lake. Despite an overall decline in health of lake ecosystem, water abstraction for hydropower generation has been on a continuous increase, because of its relatively visible impacts on the regional economy. The hydropower pricing mechanism in place at present does not recognize lake water as an input to production process, and thereby incentivizes an ecologically unsustainable production system.

The Government of Manipur constituted Loktak Development Authority (LDA) in 1986 as a nodal agency for conservation and management of the Lake. In 1997, the Authority in collaboration with Wetlands International-South Asia initiated systematic monitoring of the various wetland features which culminated in management plan integrating Manipur River Basin. A key component of the restoration strategy is revising management of Ithai barrage to include considerations for ecological requirements of the wetland along with the needs of hydropower.

Implementation of management plan was initiated in 2008 with financial support of Planning Commission. Investments have led to several positive impacts in the form of restoration of open water area in the central sector, reduction of silt loading through catchment management, enhanced flow regimes and improvement of water quality. A water allocation plan for Loktak has also been formulated based on identification of water management objectives and scenario assessments. However, despite being accepted by the State Government, the plan has not been implemented as an agreement with NHPC is yet to be arrived at. This greatly undermines the sustainability of investments made in wetland restoration so far. With increasing variability in climate, intensifying agriculture, and reduced hydrological connectivity within the wetland complex, there is a pressing need to secure allocation of water for Loktak, as well as restore hydrological regimes to address water security needs of Manipur River Basin.

and seek regular inflows through canal linked with River Yamuna. Hydrological assessments for over a decade have created the basis of revision of Ithai barrage operations linked with Loktak Lake, however, actual implementation still needs further policy dialogue and state government action (See Box on Loktak Lake).

Policy environment for integrated management of water and wetlands

India does not have a separate wetland policy. The National Environment Policy of 2006 provides the overarching architecture for managing wetlands. The linkages of water and wetland management are well-recognized and articulated in the policy document. Significant emphasis is placed on integration of conservation and wise use of wetlands into river basin management involving all relevant stakeholders, particularly local communities to ensure maintenance of hydrological regimes and conservation of biodiversity. The policy also underlines the need for integrating wetland management within sectoral development plans for poverty alleviation and rural development.

In 2010, the Ministry of Environment and Forests introduced the Wetland (Conservation and Management) Rules as the regulatory framework for addressing the developmental pressures on these ecosystems. Its ambit includes Ramsar sites, high altitude wetland sites (located at an elevation of 2,500 m amsl or more) with area of 5 ha and more, sites or complexes below 2,500 m with an area of 500 ha and more, wetlands designated as World Heritage Sites, and those specifically included under the provisions of these rules. A Wetland Regulatory Authority has been constituted for the purpose of enforcement and seting thresholds for activities to be regulated. The state governments have been entrusted with the task of identification of wetlands to be included under these rules. Activities prohibited include *inter alea* reclamation and conversion to non-wetland uses, solid waste dumping and waste water discharge, and constructions of permanent nature except boat jetties. Withdrawal of water or changes in the course of inflows and outflows can only be done with prior approval of the authority. Consultations with state governments for notification of wetlands under the said rules and mechanisms for implementation of provisions are being carried out by the Ministry. The regulatory framework for coastal wetlands is contained in the Coastal Regulation Zone notification as updated in 2011. Mangroves, coral reefs and other ecologically sensitive areas have been accorded the highest conservation priority in the notification.

The National Water Policy (2012), in a strategic shift from the previous versions, removes prioritization of water for various uses and instead emphasizes on integrated water resources management optimizing water use for all usages. The need to provide water for sustenance of ecosystems is also recognized, and therefore reference to minimum environmental allocation in rivers. However, at no point are ecosystems as wetlands recognized as a part of the water cycle. Their role on delivering various water management objectives has been completely ignored while suggesting strategies for managing floods, augmenting water availability and assessing impacts of developmental projects.

The narrow outlook towards wetlands is also reflected in our climate policy. India's National Action Plan on Climate Change includes wetlands as a part of the National Water Mission. Actions proposed include their inventory and sustainable management. However, the policy fails to recognize the ways wetlands can contribute to the goals of mitigation and adaptation. Moreso, the risks of mal-adaptation, i.e. adaptation options which are likely to have adverse impacts on wetlands find no reference.

Eighty percent of India's water is used for irrigation. While the focus of public investments since Independence has mainly been on development of surface water sources, private investments by millions of individuals have made groundwater as the main source for drinking as well as irrigation. Policies to support agriculture growth through a regime of power subsidies has made India the world's largest groundwater user. A cumulative outcome has been the invidious nexus of mutual dependence between water, food, energy, wherein the positive growth in agriculture is being supported by unsustainable trends in groundwater and electricity, to the extent that even growth in agriculture sector is being constrained. This nexus has several consequences for wetlands. Worldwide, agricultural expansion and intensification are the biggest drivers of wetland ecosystem transformations, frequently at the expense of biodiversity and regulating functions. Several of wetlands in the country, especially those located within rural landscapes, have gone through and are undergoing changes in land use to permanent agriculture (for example, Kolleru Lake, Andhra Pradesh; Vembanad-Kol Backwaters, Kerala; Wular Lake, Kashmir; Rudrasagar Lake, Tripura etc.). Evidences of excessive groundwater draft constraining water availability are already being observed in floodplain wetlands of North Bihar.

With agriculture - wetland interactions not being referred within National Agriculture Policy or within the national planning processes, the likelihood of action on these aspects remains meagre. The fact that wetlands are not recognized as a land use category and often clubbed in various wasteland categories (of the Department of Revenue and Land Administration) makes the task of management all the more arduous.

It is not difficult to conclude that the policy environment in general does not provide strong support to the cause of integrating wetlands in water management. Equally important to note is the fact that water and agriculture are state subjects as per the constitution of India, and therefore the possibility of tackling the integration majorly lies with the state governments. However, wetlands do not appear high on the priority list for most of the states for various reasons including lack of baselines to plan restoration programmes, technical and financial resources for integrated management, and political will to address conservation-development tradeoffs that are related to wetlands and water management.

Role of science base

Cooperation between water and wetland management sectors is often limited due to inability to describe, quantify and communicate interests, objectives and operational requirements. Wetland managers need sufficient understanding of the technical and operational aspects of water resources management to understand the methods of articulating and quantifying their requirements in metrics and parameters used by water managers. Further, they also need to know the mechanism for defining operating rules and flow regimes that represent the optimal allocation of water between multiple uses, including ecosystem maintenance. Similarly, water managers require quantitative understanding of the hydrological services of wetlands, and the water regime required to maintain these services.

The science base on Indian wetlands as available to date is largely focused on structural aspects, mainly related to physical status and biodiversity. This has no doubt supported development of a strong rationale and strategy for wetland protection and management. However, in the face of unprecedented increases in food insecurity, the growing concern in meeting basic human needs of water, poverty reduction and safety from environmental hazards, there is need for a complimentary human-centric approach that takes account wider aspects of livelihoods and human well-being. Such a science agenda is based on coupling the often contradictory policy areas by focusing the hydrological management and associated management of wetlands on outcomes rather than ecological or other typologies. Such outcomes needs to be structured around ecosystem services, e.g. cleaner water, reduced flooding, slower climate change, improved human health. Emphasis is also required on economic analysis to examine the efficiency of investments associated with wetland management compared with the expenditure across different sectors, not always working in the same direction.

Having a better and systematic understanding of hydrological services of wetlands, and ecological processes that create the necessary basic conditions for delivery of these services in the context of wider landscape underpins this agenda. For example, beneath the fact that wetlands act as "sponges for floodwaters" is a complex relationship between wetland water regimes and hydrology of the wider catchment, meriting careful analysis and consideration before being extrapolated into a generic policy guidance.

Way forward

Integrating wetlands within water management in India needs to build on a range of strategies. Firstly, the overall priority to wetland conservation in the country needs to be enhanced significantly, including support to cross sectoral institutional arrangements, and increasing investment of technical as well as financial resources into integrated management planning. Inventorying ecosystem services, particularly those related to water, forms the basic building block of recognizing their importance in water management. Hydrological values of wetlands need to be considered as a prioritization criterion within national and state schemes. River basin management planning processes should involve wetland managers in early stages to ensure that projects do not have negative impacts on wetland ecosystems, and build in adequate allocations for maintaining wetland functioning. Wetlands should be considered within the range of solutions for augmenting water supply, flood protection, groundwater recharge and others. Developing the capacity to manage wetlands connecting sectors and landscapes requires specialized training. There is a pressing need to develop an advanced center for integrated wetland management with appropriate courses. Investments are also required into research and knowledge base on ecosystem functioning, and management of ecosystem services tradeoffs related with water and wetland management.

Water and India's International Biodiversity Commitments

Dr. J.R. Bhatt, Advisor, Ministry of Environment and Forests
jrbhatt@nic.in

Flamingos in Lake Chilika (Photo: Ward Hagemeijer)

India is one of the recognized mega-diverse countries of the world. With only 2.4% of world's land area, the country accounts for nearly 8% of the recorded plant and animal species of the world. International cooperation through ensuring implementation of biodiversity conventions forms a part of our national strategy for biodiversity conservation.

In the context of water and biodiversity, India's commitments under Ramsar Convention and Convention on Biological Diversity stand out. India ratified the Ramsar Convention on Wetlands in 1982. This commits us to ensure wise use of wetlands, particularly those identified as Wetlands of International Importance under the Convention (Ramsar Sites). India has designated 26 sites so far. Wise use is defined within the Convention text as 'maintenance of ecological character through implementation of ecosystem approaches, within the context of sustainable development'. Ecological character is further defined as 'the combination of ecosystem components, processes and services that characterize the wetland at any given point in time.' Contracting Parties to the Ramsar Convention are expected to manage their Ramsar Site, so as to maintain their ecological character, and in doing so, retain those essential ecological and hydrological function which ultimately secure provision of ecosystem services. With water playing a fundamental role in governing ecological character, it is pertinent that wetland management plans are integrated within management of river basins and coastal zones.

The Convention of Biological Diversity emerged from the 1992 Earth Summit as a commitment for maintaining and securing the web of life which is fundamental to human existence. The Convention establishes three main goals: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources. India become a party to the Convention in 1994, and currently is the President of its Conference of Parties. At the tenth meeting of the Contracting Parties held in October 2010 in Nagoya, Japan, the Strategic Plan for Biodiversity 2011-2020 was adopted as an overarching framework for biodiversity for the entire United Nations systems. The mission of the new plan is to "take effective and urgent action to halt the loss of biodiversity in order to ensure that by 2020 ecosystems are resilient and continue to provide essential services, thereby securing the planet's variety of life, and contributing to human well-being, and poverty eradication".

Key features of the strategic plan are the 20 targets, popularly known as Aichi Biodiversity Targets which address the five strategic goals (full text of the targets is available at www.cbd.int). Some of the targets which have relevance for water management include Target 11 (seeking conservation of at least 17% of terrestrial inland water areas and 10 % of coastal and marine areas), target 14 (conservation of ecosystems proving essential services including services related to water), and target 6 (all fish and invertebrate stocks and aquatic plants). Similarly, reference to water management is implicit in Target 8 related to pollution and Target 9 related to invasive alien species. Of the various recommendations adopted at the 11th Conference of Parties meeting is the need to use water cycle as means to forge linkages within the various targets, specifically focusing on the role of biodiversity in supporting the entire cycle.

The success of meeting these commitments lies in the extent to which water and biodiversity managers are able to build on the intersectoral interlinkages, specifically focusing on the role of biodiversity in hydrological pathways. This provides opportunities for water managers to use ecosystems as wetlands and forests as natural infrastructure in meeting various water management objectives. To biodiversity managers, linkages with water management would ensure availability of water, of adequate quantity, quality and at required temporality to meet ecosystem functioning requirements.

Water management and wise use of Chilika

Dr. Ajit K. Pattnaik, Chief Executive, Chilika Development Authority
ajitpattnaik13@gmail.com

Water, Biodiversity and Ecosystem Services interlinkages in Chilika

Chilika is a dynamic assemblage of shallow to very shallow marine, brackish and freshwater habitats. The presence of unique salinity gradient enables the wetland to support a wide range of biodiversity and support livelihoods of dependent communities through its ecosystem services. Hydrological regimes provide the template on which the components and processes of wetlands are structured enabling it to deliver these ecosystem services. The interrelationship of water regimes to biodiversity and ecosystem services can be expressed in several ways and at multiple scales.

Water regimes and fisheries. The ability of Chilika to support highly productive fisheries which is a source of sustenance for nearly 0.2 million fishers is closely related to its hydrological regimes. Nearly 86% of the fish species presently found in the wetland are migratory and dependant on the riverine and marine habitats for a part of their life cycle. Hydrological connectivity of Chilika with the Bay of Bengal, tributaries of River Mahanadi River and streams of western catchments provides the necessary biophysical condition for maintenance of this diversity. The flood flow pulses and spatial and temporal gradient in salinity established in Chilika during the year provide migration cues to anadromous, catadromous and resident species to move towards their breeding grounds and facilitate auto-recruitment in to the lake. Inflow of freshwater during monsoon aids in flushing out the anoxic conditions by inundating the areas rich in nutrients and providing a conducive environment for growth of fish food organisms which in turn influence the recruitment of juveniles to nursing areas and addition to fish stocks. The traditional fishing systems practiced in Chilika took advantage of the differing water depth.

Water regimes and waterbirds. Chilika is known for harbouring a wide range of bird species, which apart from being a key component of her biodiversity is also a tourist delight. It is considered as one of the largest wintering ground of migratory bird in Asiatic subcontinent. Water regimes play an important role in creating the necessary habitat conditions for water birds in Chilika.

Chilika Lake

Though entire shallow zone of Chilika is used by waterbirds as habitats, Nalaban and Manglajodi stand out in terms of congregation sizes. The cyclical pattern of emergence and inundation of Nalabana plays an important role in regulating food availability and creation of habitats for waterbirds. The island is completely submerged during monsoon, emerging during winter and then being exposed till late summer. This cycle regulates the growth, survival and reproduction of invertebrates and submerged plants used as food by the visiting birds.

Waterbirds also play an important role in nutrient cycle within Chilika. Guano deposits are important sources of nitrogen and phosphorus in the lake. As per studies done by Bombay Natural History Society, ducks and geese annually add 33.8 t of nitrogen and 10.5 t of phosphorous (in the form of guano) to the lake which helps in high biomass production of phytoplanktons, zooplanktons & macrophytes and lucrative fisheries in Chilika.

Water regimes and vegetation. Depth of water has a major influence on distribution of macrophytes in aquatic systems, including Chilika. Free floating and submerged forms are generally found in deeper water areas, whereas emergent and submerged floating forms are present in shallow waters near shoreline areas. The peripheral areas of northern sector which are shallow and predominantly freshwater is dominated by emergent vegetation (most notably *Phragmites karka*) and submgered *(Hydrilla verticillata, Valesneria spiralis). Eichhornia crassipes*, a freshwater invasive is confined to the river confluence areas in northern sector. The vegetation in the central and southern sectors is mostly of submerged brackish water type represented by the dominant genus of *Najas sp., Potamogeton sp.*, the rich seagrass meadows along the shoreline are predominate due to less fluctuation in the salinity. The outer channel area having marine influence has very less vegetation as compared to other sectors, mostly limited to submerged patches of Seagrass & *Ruppia maritima*.

Water regimes and Irrawaddy Dolphins. Chilika is one of the few lagoons in the world that support Irrawaddy Dolphin (*Orcaella brevirostris*). The species is known to have unique hydrological condition preferences, particularly shallow water upto 2 meters deep with sea grass meadows in the near shore areas. Protected, inshore, shallow estuarine waters are critical habitats of this species. These conditions are mostly found in the outer channel and central & southern sector wherein this species is known to concentrate. Restoration of hydrological regime along with revival of connectivity with sea has witnessed an increase in population and habitat expansion of dolphins. Being at the top of the food chain dolphin is a good indicator of the health of the lake ecosystem. The significant observations made during the survey for population estimation during 2013 are sighting of 8 dolphins from Northern sector which is an indication of the expansion of their habitat.

Monitoring water regimes of Chilika

The water regimes of Chilika can be broadly classified into three sub-systems. The freshwater flows are received through the tributaries of the River Mahanadi and the streams of western catchment. Flows from the Bay of Bengal form the third sub-system, which connects to Chilika through the lake mouths (at Magarmukh and Gabakund) and the Palur Canal in the extreme south.

River Mahanadi is the principal source of freshwater for Chilika. It creates a complex arc like delta beginning at Naraj (near Cuttack), dividing into three distributaries, namely Kuakhai, Kathjodi and Birupa. Daya and Bhargabi, which are distributaries of Kuakhai bring the Mahanadi flows to Chilika. The highly ravenous and gullied western catchment is drained by 47 streams, of which eight, namely Badaghati, Badanai, Badasankha, Kansari, Kusumi, Mangalajodi, Salia and Tarimi are the major ones. The flow in these streams is mainly during monsoons.

A systematic hydrological monitoring system has been in place in the lake basin since 1999. A network of 47 monitoring stations provides information on the water and sediment from the river and streams draining into Chilika. In addition, tide gauging stations have been put in place at Sipakuda, Satpada and Magarmukh. Data on water quality is sampled from 30 locations within the lake.

The analysis of the data for the period 1999 – 2010 indicates that Lake Chilika annually receives 5178 million cubic metres of freshwater from the river systems of which 75% is contributed by the Mahanadi Delta river system. The flows received from Mahanadi delta system form around 6% of the undivided flows upstream of Naraj. The Lake is also subject to sedimentation from its extensive catchments as well from the sea. The average annual sediment loading into the lake is of 0.8 million Metric Tonnes, of which Mahanadi system contributed 76%. Lake is filling with sediment 3–5 times as fast as 100 years ago at the margins of the northern and southern sectors, and 30% higher at the margins of the central sector.

The longshore sediment transport continues northwards throughout the year. High annual littoral sediment drift (of the order of 1.2 million cubic meters) causes along the east coast tend the sea inlet to continually shift northwards leading to development of a long narrow channel running parallel to the coast. The inlet condition is rendered unstable due to reduction in tidal prism with increasing length of the channel.

Assessment of water quality parameters indicate that Lake Chilika is a shallow, well-mixed, nutrient rich water body that is generally turbid and remains alkaline throughout the year. The lake in general, is well oxygenated throughout the year due to its large size, high photosynthetic activity and wind churning effects. A unique salinity gradient from the northern sector to southern sector during monsoon and post-monsoon, and towards outer channel in the pre-monsoon period is maintained in the Lake.

Chilika Development Authority, in its efforts towards increasing reliability and comprehensiveness of wetland monitoring system, is putting in place a real time water quality monitoring system which would significantly enhance efficiency and reliability by reducing human error as well as enhancing capabilities to characterize and monitor the dynamic hydrological environment at appropriate temporal and spatial scales.

Recent advances in communication and sensor technology have catalyzed progress in remote monitoring capabilities for water quality on real time basis. The Authority, in consultation with premier scientific institutes of the country has deployed sensors mounted on floating buoys at 10 strategic locations representing the 4 ecological sectors of the wetland system. Each buoy is designed to have 10 sensors i.e. Salinity, Temperature, Conductivity, Dissolved Oxygen, pH, Depth, Turbidity, Chlorophyll-a and Blue green algae.

Linking water to Chilika management

The management of Lake Chilika aims at achieving wise use. Given the influence of hydrological regimes on ecological character of Chilika, the management planning for Chilika adopts an integrated water resources management approach.

Over the years, Chilika Development Authority (CDA), with support from central and state government and working in collaboration with a range of international and national agencies has undertaken the following interventions to implement IWRM for conservation and wise use of the wetland system:

- **Institutional arrangements.** Chilika Development Authority was instituted by the Government of Odisha in 1991 under the aegis of Department of Forest and Environments to undertake ecosystem restoration. The governance mechanism of the CDA has been designed to ensure collaboration between various state government departments entrusted with management of natural, human and financial resources of the state, including the basin and coastal zone linked to the wetland system. The Governing Body of the Authority, the apex body which takes the policy decisions with

Buoy mounted sensor for water quality monitoring in Chilika respect to wetland management is chaired by the Chief Minister signifying the high priority accorded by the state to wetland conservation and enabling cross sectoral integration. The body draws its members from the Secretaries of the concerned state government departments, political representatives, community representatives and external experts to support broad based management of Chilika. The authority has effectively adopted a model of networking wherein it coordinates delivery of various elements of implementation plan through the various state government departments. An extensive partner and collaborators network has also been developed over a period of time which provides strategic input to wetland management.

- **Maintaining hydrological connectivity.** Chilika underwent a phase of rapid degradation during 1950 – 2000 owing to increasing sediment loads from the catchments and reduced connectivity with the sea. This formed the background for inclusion of Chilika into the Montreux Record in 1993. In September 2000, a major hydrological intervention was carried out by opening a new mouth to the Bay of Bengal which helped improve salinity levels, enhanced fish landing, decrease of invasive species and overall improvement of the lake water quality. The mouth is maintained through periodic dredging and extensive monitoring to ensure that the connection to the sea is maintained.

  Further, a 22.6 km lead channel has also been dredged in the northern sector to ensure that the sediments received from the Mahanadi River are flushed out from the wetland. The Palur canal has also been dredged to ensure hydrological connectivity with the sea in the Southern Sector. These interventions help in maintaining the hydrological connectivity of Chilika with the river basin as well as coastal zone.

- **Conserving catchments to regulate flow regimes.** The lake basin from which Chilika receives direct freshwater inflow extends to an area of 3,860.54 km^2. Management of this direct catchment forms an important strategy for IWRM implementation. The catchment has been delineated into 6 watersheds, 16 sub-watersheds and 218 micro-watersheds to administer management programmes based on hydrological units. Based on assessment of land use and capability, 570.73 km^2 area has been identified as most erosion prone. CDA has worked with the communities to develop and implement a participatory watershed management programme. The communities are facilitated to formulate site specific microplans building on their indigenous knowledge and skills, supplemented through learning from various trainings. Under the aegis of the programme, appropriate land management practices are introduced through development of cost effective and sustainable technologies which are convenient to implement and maintain by stakeholders. A land use and land cover change assessment concluded in 2012 underlined the impact of catchment conservation programmes. The overall forest cover in the basin which had declined from 1,255.43 km^2 to 1,099.46 km^2 during 1972 to 1990 was observed to increase to 1,267.27 km^2 in 2011.

- **Environment flows.** The construction of Naraj Barrage over Kathjori under the Orissa Water Resources Consolidation project in 2003 to assist in stabilizing irrigation supply and managing floods was a major intervention affecting the inflow of freshwater into Chilika. Since the barrage provided an opportunity for flow control, an environmental flow assessment was undertaken to determine, from joint environmental and socioeconomic perspective, the preferred inflow regime to Lake Chilika from Naraj Barrage. This resulted in a multi-disciplinary study employing a range of methods including detailed 2 dimensional hydrodynamic lake modelling, rainfall – runoff and sediment modelling, rapid rural appraisals, lake sediment coring and isotope analysis and GIS analysis of remote sensing data. The investigation adopted a scenario-based approach, assessing the likely implication of four scenarios:

  - A hypothetical " do –nothing" condition
  - Multi – objective: a scenario designed to minimize detrimental floods, but maintain freshwater inflows into Chilika
  - Sediment control: a scenario designed to minimize sediment loading reaching Chilika from Mahanadi River
  - Euroconsult II: a scenario recommended by an investigation from the mid 1990s predicated on sediment control.

  The assessment concluded that on balance, it is more important to maximize freshwater inflows to Chilika than to minimize sediment loads (which can be managed by on-going dredging of the lead channel and maintenance of the sea mouth for efficient flushing of sediment). In particular, the freshwater inflows from Naraj served an important role in flushing the brackish water from the lake during each monsoon, creating a conducive salinity gradient critical for productive and economically valuable lake fisheries and for survival of several key species. The socioeconomic assessments brought out the productive role played by medium floods in supporting agricultural productivity within the floodplains and maintaining fisheries in the lake. Based on the assessment, an operation rule for barrage was developed which ensures that current levels of freshwater inflows are maintained whereas the incidence of major damaging floods is significantly reduced. CDA is proactively engaging with the Department of Water Resources to ensure that the flow levels as recommended by the environmental flows assessment are maintained.

- **Communication, Education, Participation and Awareness:** Participation of stakeholders, particularly local communities is crucial for integrated water management. With the existing Wetland Interpretation Center at Satpada as nucleus, CDA is implementing a range of community education and awareness programmes with an effort to create a better understanding and community partnership for managing wetland resources at local levels. Implementation of Guidelines for Dolphin Watching and Bird Watching are some of the key outcomes of the engagement process. Creation of boatmen associations, bird protection committees, and water shed associations have further enabled local resource stewardship.
- **Integrated management planning framework.** In October 2012, CDA and Wetlands International South Asia developed a management planning framework to guide wetland management. Development of the framework is based on assessing the status and trends in ecological character of Chilika, identifying the threats to changes in ecological character and management objectives that need to be pursued for ensuring conservation and wise use of wetland systems. The framework provides the mechanism for linking Chilika management to river basin and coastal zone management.
- **Research and development.** Adaptive management forms a key feature of integrated water resources management. Given the range of drivers and pressures that act on Chilika at multiple spatial, temporal and political scales, management needs to be prepared for and accommodative of uncertainties and challenges and allowing for modification based on continuous site monitoring and assessment of new information. CDA in collaboration with expert agencies has initiated the following research programmes which will provide further information on hydrological regimes and ecosystem management interlinkages:
  - **Regional coastal process assessment:** Supported under the World Bank supported Integrated Coastal Zone Management Project, this study aims to develop baseline information on the sediment shelf, in particular sediment budget for the entire Orissa coastline. The project will provide further information on the overall sediment related processes in Chilika.
  - **Chilika Climate vulnerability assessment:** This three year research project supported by International Development Research Center and implemented in partnership with Wetlands International South Asia will focus on assessing the impacts of climate change on ecosystem processes of Chilika and related livelihoods. Details of project

Chilika Management Plan being released by Mr. Naveen Patnaik (fourth from Right), Chief Minister, Government of Odisha (in the presence of Mr. Anada Tiega, Secretary General, Ramsar Convention

Fish productivity and waterbird diversity are linked with water regimes

implementation in the last year are included in a separate article in this newsletter.

- **Ecosystem health assessment:** Supported under the UNEP Global Partnership on Nutrient Management, the project aims at development of a nutrient health report card that can be used for ecological monitoring as well as stakeholder dialogue.

Besides these, long term assessments have also been initiated for waterbirds, invasive species and fisheries to detect long term trends and implications for management.

Challenges

Water management within the River Mahanadi Basin and the coastal zone cuts across several sectors and stakeholders. Most often, the human needs from water resources are met through regulating hydrological regimes, whereas ecosystem functioning is more aligned to unregulated natural regimes. This creates complex ecological as well as socio-political trade-offs. The current management plan is thereby aimed at increasing hydrological connectivity within the floodplains so as to ensure optimal water- sediment exchange. It also aims to manage the land use system, in particular reduce the use of chemical fertilizers and pesticides considering the influence on biodiversity that resides in the wetland system.

Climate change is expected to have implications for several of wetland features. More intense rainfall spells are also projected in a warmer atmosphere, increasing the probability of extreme rainfall events. State level assessments based on down scaling of general circulation models also confirm the trend. The basin is predicted to receive comparatively higher level of precipitation in future and a corresponding increase in evapo-transpiration and water yield. Given the fact that much of the river flows are concentrated during the months of monsoon, enhanced flows would exacerbate flood conditions as well as pose a serious risk to the current flood regulation infrastructure. The Bay of Bengal has recorded the maximum annual sea level rise of 2.42–4.87 mm within the Indian coast. Sea level rise has implications for salinity as well as livelihoods of coastal communities in Chilika. A key response strategy in Chilika management is to assess the vulnerability of Chilika to these changes through scenarios, and develop an adequate response strategy to secure wise use.

Building Constituencies in Wetland Conservation: A Landmark Judgment from Calcutta High Court

Dr. Dhrubajyoti Ghosh, Kolkata
ghoshdj.in@gmail.com

Inadequate constituency is one of the major weaknesses in asserting the importance of wetlands in conservation thinking and activities in our country. Everyday all over the country we are losing wetlands to real estate interest systematically and most unlawfully. Yet not many of us, forget political persons, have taken it up as a matter of concern.

Consider the following facts. There is no wetland policy in India or any Indian state. Wetlands are neither in the State List nor in the Central List, not even in the Concurrent List. Out of 48 responsibilities of the Ministry of Environment and Forests, only one is indicative of wetland matters, that too as a part of biodiversity conservation: it reads *biodiversity conservation including that of lakes and wetlands.*

Between 1984 to 2011 not a single question on disappearance of urban or peri-urban wetland/water body has been debated in the Lok Sabha. During this time four starred and 16 un-starred questions were asked on wetland conservation, where in one case disappearance of large areas of wetlands in general was accepted although absence of corroborative data on this loss was also conceded.

In West Bengal a small step in the right direction deserves mention. On February 3, 2012 the Hon'ble High Court of Calcutta came up with a landmark judgment on wetland conservation. This ensued as wetland activism acquired a new phase of visibility in 2008–09, with Gana Udyog (a local NGO) fighting to save the Hind Motors Wetlands, and Sri Tapan Dutta (a remarkable environmental activist) leading the struggle for saving Joypur Beel from destruction by Anmol (a construction company). Tapan Dutta was killed by unknown assailants. DISHA, along with some other activist groups, entered the fray in support of Gana Udyog. In 2010, there were efforts, primarily led by FHLER and DISHA (both NGOs), to link the various local struggles for saving wetlands and water bodies. These efforts led to the realisation that there was a need to sensitize the judicial system about the universal nature of the malaise. This resulted in a Public Interest Litigation (WP 606 of 2011) filed by FHLER and DISHA at the High Court at Calcutta. The PIL led to a judgment on 03.02.2012, where a two-judge bench presided by the then Chief Justice directed the state government to form a *High Powered Committee* to suggest specific recommendations and policy prescriptions so that "there may not be any occasion for future grievances of this sort." The Court also issued the following direction:

> "… the Committee should not only prepare a report on the specific cases as made out in the writ petition but also take preventive measures so that the infractions of law complained of in the present petition are not repeated, and even if they are repeated, prompt remedial and preventive measures may be taken by the appropriate designated authorities".

The country will watch with interest the functioning of this High Power Committee on wetland conservation, or how seriously the state government relates itself with the functioning and recommendations of the committee.

Encroachment in wetlands of Hind Motor Complex, Kolkata

Management Planning for Kaabar Taal, Bihar

North Bihar is replete with floodplain wetlands known variously as *mauns, chaurs* and *taals*. These ecosystems are a characteristic feature of the inter fluvial regimes of Gangetic plains which are completely inundated during monsoon, shallow with a maximum depth of 1.5 m, and mostly dry by March - June.

The wetlands of North Bihar are central to water and food security for the agrarian economy of the region due to their ability to buffer floods, provide water for drinking and irrigation, and recharging groundwater aquifers. The diverse and dynamic assemblage of fish, invertebrate and crustaceans provides the basis of rich fishery which supports livelihoods of 4.9 million fishers of the state. Wild rice, makahana (*Euryale ferox*), singada (*Trapa natans*), and edible mollusc (*Pila globosa*) are some of the main wetland products harvested for local consumption by the dependent communities. Water and wetlands form an integral part of local culture, with several festivals (as *Chaath*), local practices (as *Jahursheetal*) and folklores linked to these ecosystems.

Despite their immense contribution, these wetlands have been subject to a range of developmental pressures, mostly related to the needs of providing water and food to an increasing population and lack of understanding of values and functions of these ecosystems. With a major proportion of wetland areas only seasonally inundated, extensive conversion for permanent agriculture is common. Over 3,000 km of embankments constructed to control floods (over 70% of state's geographical area receives flood inundations) have significantly reduced connectivity of wetlands with riverine enviroments. Increase in use of chemical fertilizers and pesticides have also led to excessive nutrient loading leading to species invasion.

Concerned over the rapid decline of wetlands, the Government of Bihar has recently initiated management planning for Kaabar Taal, Bariela and Kusheshwarsthan under the World Bank Technical Assistance. Wetlands International – South Asia has been entrusted the task of formulating the management planning framework for Kaabar Taal. The plan is being formulated adopting an approach which recognizes the inter connectedness of wetland features with riverine processes taking into account the external, natural and induced factors. The plan aims to provide a pathway for maintaining ecological character while providing for sustainable utilization of lake resources for the benefit of stakeholders, particularly local communities.

Assessments conducted for wetland delineation revealed its interconnections with fluvial processes. The Kaabar wetland complex is a part of the extensive floodplain wetland regime formed in the lower reaches of Gandak-Kosi interfan in north Bihar. The complex is constituted of a series of shallow permanent as well as intermittently inundated wetlands formed in the depression between River Burhi Gandak and paleochannel of River Bagmati. During monsoon, with over bank flows of River Burhi Gandak, the discrete areas of Kaabar Taal, Nagri Jheel, Vikrampur Chaur coalesce to form a single complex extending to over 6300 ha. With retreat of monsoon, the permanently inundated areas reduced to mainly two small patches, Mahalaya and Kochalaya within Kaabar, exposing 5600 ha of land presently converted mainly for use as rice paddies. A part of the complex covering mainly areas of Kaabar Taal, has been declared in 1989 as a bird sanctuary under the provisions of Wildlife (Protection) Act.

Assessments have highlighted addressing resource use conflicts as a major challenge for management. Prior to fifties, with wetland extent in excess of 8,900 ha with lowland areas inundated for large parts of year, and abundant fish recruitment from the rivers, fisheries was the main economic activity and the fishers predominant resource users. Fishers belonging to *Sahni* community depended on fisheries and hunting of migrating waterbirds for livelihoods. The rights of *sahnis* are based on British period judgment dated August 1895, wherein they were permitted to use nets in the entire Kaabar area on payment of rents to the landowners. An informal territorial demarcation of the capture fishing area existed, with each village fishing only within its boundaries. The deeper areas were used for net fishing, whereas traps were used in the marsh areas located in the margins.

Agriculture was limited only to upland areas in the wetland. However, a strong and politically well-represented farmers' lobby ensured that wetland area is drained for use as agriculture, resulting in construction of canal system, connecting various marshes to the River Burhi Gandak. As the areas under permanent inundation receded, more and more areas were brought into farming. Embankment breaches in 1987, 2004 and 2007 brought in extensive amounts of highly productive silt into the Kaabar complex further filling up the area and facilitating agriculture in the entire wetland complex barring few small patches of permanent inundation.

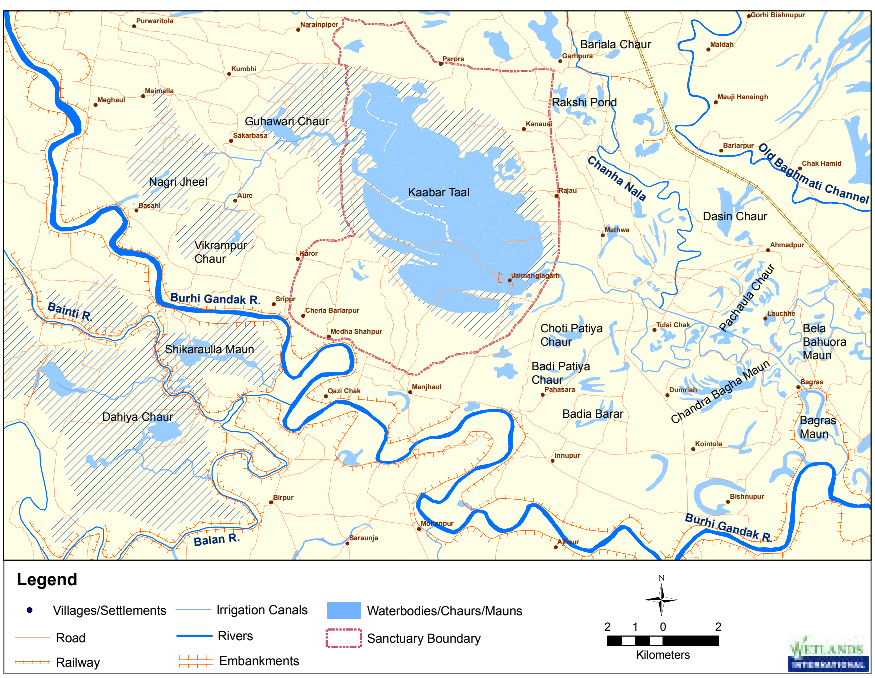
With changes in inundation pattern and decline in connectivity with riverine environments, competition grew alongwith conflicts on fishing rights. The fisheries transformed from high value mix of Indian Major Carps in the seventies and eighties to low economic value air-breathing and minnows at present. Use of very small mesh size nets and traps (*chhatijals*) has further impacted species recruitment. The prospect of secure production through culture techniques has gradually shifted the focus of fishers to collective fishing in the *mauns* and *chaurs* associated with Kaabar.

The gradual extension and intensification of agriculture within Kaabar has almost completely crowded out capture fisheries within the wetland. The outcomes has been in the form of conflict between farmers and fishers, the former supporting further wetland conversion wherein the latter demanding more water into the wetland to increase inundation areas. The resource conflict has a distinct connotation in terms of power relationship, with the farmers belonging to relatively affluent sections of the society, and the fishers to the lowest strata.

A further worrying trend is that of increasing groundwater extraction. The survey indicated that 36% of the landowners had installed borewells, with depths in excess of more than 200 feet at present as compared to 30 – 40 feet prior to 2005. While the Gangetic floodplain aquifers have comparatively higher water potential, there are obvious limitations to the extent of development. Recent assessments undertaken by Central Ground Water Board as well as by scientific organizations have indicated high arsenic and iron contamination within several parts of Begusarai District.

Meanwhile, the number of migratory birds coming to the wetland has been on a decline as inundated areas have shrunk. The final proclamation of the sanctuary is yet to be done as the private claims on land are not settled. The sanctuary boundaries have also not yet been demarcated.

A management plan based on evaluation of wetland features and governing factors is under advanced stages of finalization. WISA is also working with the World Bank and Government of Bihar towards developing a cross sectoral institutional arrangement for wetlands.



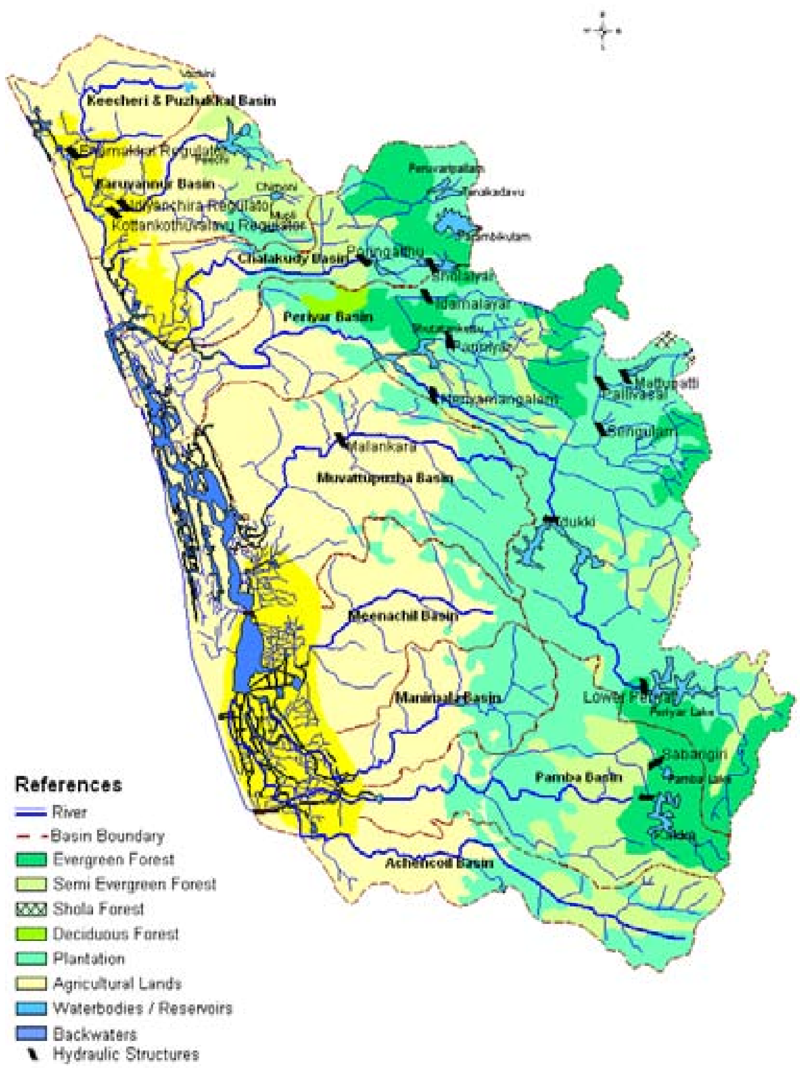
Mainstreaming wetlands in developmental planning – the case of Vembanad Kol Backwaters, Kerala

The picturesque Vembanad Kol forms a part of the extensive chain of backwaters in the coastal state of Kerala. A designated Ramsar site, the wetland is located alongwoth the state's largest urban settlement (Kochi city) and industrial belt (Udyogmandal estate), most productive agriculture areas (Kuttanad and Kol) and center of backwater tourism. The rivers flowing into the wetland provide two thirds of the total installed power capacity of the state. However, sectoral developments have led severe impacts on the wetland ecosystem. WISA is developing a management framework for the backwater system with support of Mangroves for Future – an initiative for coastal resilience managed by IUCN and Ministry of Environment and Forests.

Expanding area under agriculture to support higher food production was one of the key policy objectives of the state. Economic incentives for plantation crops since the 70s have led to large scale conversion of forested areas into cash crops. Floodplain systems of Kuttanad and Kol, which had higher levels of natural fertility and crop productivity, were identified as potential areas for reclamation for paddy cultivation. Special incentives were provided for land development by the government and by the turn of 20th century, 231 km^2 were already converted into paddy fields. Reclamation of wetlands for rice cultivation continued till 1950. Reclamation in the Kol wetland area date back to early 18th century, wherein these natural lakes were reclaimed for cultivation of

Backwaters of Kerala, along with their catchments within the Western Ghats constitute hydrologically and ecologically a composite system. Vembnanad-Kol wetlands are a complex system of coastal backwaters and reclaimed agricultural lands with an intricate network of natural and manmade channels extending to an area of over 1200 km^2.

Establishment of Cochin Port in 1838 was one of the earliest developmental activities which catalyzed the urbanization and industrial development within wetland area. The port was created through dredging of the sea outlet for a major natural harbour and subsequent reclamation to locate the port facilities. Wellingdon Island extending to 6.5 km^2 area was created during 1838 – 45 to house the berths, wharves and other facilities. Kochi harbour, a railway terminal and an airport are located on this island. Cochin is the fastest growing maritime gateway to peninsular India. An all-weather natural Port, it is located strategically close to the busiest international sea routes from the Gulf to Singapore and Europe to the Far East circuits.



single crop. Polders, locally called *padashekharams* were constructed within Kuttanad and Kol lands to enable agriculture development. Presently, Kuttanad has over 1,100 padashekharams with sizes ranging from 2 ha to 1,000 ha whereas Kol has over 100.

Expansion of agriculture within wetlands triggered the need for freshwater and regulation of floods. A major intervention towards this objective was the Thottampalli spillway, constructed in 1955, to divert the monsoon flows of Achencoil, Manimala and Pamba directly to the sea which would otherwise have flown to the Vembanad lagoon. Further hydrological interventions were aimed at prevention of salinity intrusion within the agricultural lands created through reclamation of wetlands. Within the Kol lands a series of regulators were constructed at Ennamekulam, Iddiyanchira and Kottenkottuvalavu were constructed to serve as a spillway for the floodwaters as well as regulators to control entry of saline water into the Kol lands.

Thannermukkom Barrier was constructed in 1976 for protecting saline water intrusion into Kuttanad and control tidal action within its polders. Originally conceived as a composite project with Thottampally spillway for flood diversion and salinity control in 1955, construction of the barrage was delayed upto 1975 due to objections from the Cochin Port Trust on the grounds on silting up of the harbour. However, a full scale commissioning of barrage could not take place as the incomplete portion of barrage was covered with sand, silt and clay by the agriculture farmers. Apart from these, several other smaller structures have been constructed for controlling salinity intrusion within the water supply schemes.

Backwaters also emerged as the core of tourism development in the state. Houseboats remain the hallmark of backwater tourism, with more than 200 operating within the Vembanad.

Explosive surge in investments for creation of tourism related infrastructure has created severe stresses on the backwaters. The wetland periphery is presently dotted with resorts and hotels to cater to the tourists. The natural banks of the wetland, once covered with thick mangrove forests, have been cleared off to present an uninterrupted view of the backwaters. The mangroves of Kumarakom, which served as breeding and nesting grounds of Pond Herons, Little Cormorants and Darters have been converted into tourist complexes. Increase in number of houseboats within the backwaters has added to the pollution loading and dumping of garbage.

The impacts of these developments on Vemaband backwaters are apparent. The area of the Vembanad Lagoon, estimated to be 365 km^2 in 1834 was reduced to 179.25 km^2 by 1983. With expansion of settlements and tourism infrastructure within the wetland periphery, the areas are being further converted for alternate use. Degradation of the catchments due to clearing of forests and urbanization has led to extensive siltation and concomitant loss of water holding capacity of the wetland. The water holding capacity of the lake has been observed to have declined by 77.2% during 1834 to 1984. Loss of water holding capacity has led to enhanced flooding in the peripheral regions of the backwaters.

Prevention of salinity intrusion and tidal fluxes has led to clogging of the channels in Kuttanad area. The opportunity cost of loss of water holding capacity has been estimated to be Rs. 350 millions annually. Continued discharge of industrial effluents and sewage into the river and the backwaters has led to severe water quality deterioration.

Construction of Thottampally spillway has led to diversion of nearly one – tenth of the monsoon flows of the Achencoil, Manimala and Pamba away from the wetland to the sea thereby reducing water availability and changing flushing patterns within Vembanad. Thaneermukkom barrage has led to alteration in the flushing, circulation and mixing patterns within the wetland. Apart from loss of fisheries, changes in salinity patterns has also led to invasion of freshwater weeds, which used to be otherwise naturally eliminated from the lake in periods of high salinity. Thirteen euryhaline fish species prevalent earlier in the southern portion were reported to be rare after construction of the barrage. Expansion of tourism in the backwaters has been accompanied by large scale conversion of mangroves for construction of tourist resorts and coconut plantations. There have been significant decline in catch of fish and live clams.

Evaluation of wetland features indicate the need for a rationalized approach to address the problems of sectoral development. An integrated management approach to ensure the benefits of development are accrued to the stakeholders particularly local communities needs to be adopted. A broad management framework has been proposed which emphasizes on land and water management, biodiversity conservation, sustainable resource development and livelihoods to maintain ecological integrity while providing sustained economic benefits. It has been proposed to establish Vembanad Kol Management Authority to coordinate activities within river basins integrating coastal processes. The authority needs to have the responsibility for institutional and financial arrangements promoting communication education public awareness and monitoring evaluation of activities within overall policy framework to be developed and supported by appropriate legal framework. The authority also needs to be entrusted with monitoring and evaluation of the wetland ecosystem and ensure adaptations in management as may be required.

Adapting to climate uncertainty in Chilika

Sustained provision of ecosystem services and maintenance of rich biodiversity of Chilika is linked with coastal and freshwater hydrological processes that govern the wetland system. Climate change has induced several uncertainties on maintenance of hydrological regimes of the wetland system and sustaining livelihoods of dependent communities. 'Strengthening livelihood security and adapting to climate uncertainty in Chilika Lagoon, India' is a three year project under the Climate Change and Water Programme of International Development and Research Centre (IDRC) aims to enhance climate preparedness to wetland management through development of response options and strategies for reducing climate related risks as well as increasing community preparedness for changes in wetland ecosystem services.

Assessing climate change vulnerability

Wetland vulnerability refers to the relationship between exposure to a particular risk event, impact of that event on a wetland and the ability of the wetland to cope with the impacts or the efforts needed to minimize the impacts. Inclusion of ecosystem services within the definition of ecological character is the key direct social connect into the concept , bringing emphasis on the benefits people receive from the wetlands, choices and trade-offs made in determining and setting priorities on ecosystem services, and institutional arrangements and governance structures that influence the process.

Assessing vulnerability of wetland ecological character can therefore be decoupled into two interlinked components: viz biophysical vulnerability and social vulnerability.

The biophysical vulnerability assessment focuses on ecological character in more physical sense, akin to the conventional physical vulnerability assessment. Social vulnerability assessment on the other hand focuses on the exposure of communities living in and around the wetland system to the impacts of hazards. Livelihood systems become the entry point of social vulnerability analysis. Since, ecosystem components and processes underpin provision of ecosystem services, a choice on the latter implicitly indicates a desirability, and in certain circumstances, subjects conditions on the state of the former through a social decision making process.

Biophysical vulnerability

The methodology used for biophysical vulnerability assessment is schematically presented in Fig 1. System boundaries were defined with reference to the key governing ecosystem processes. The status and trends of ecological character elements were assessed in three categories (excellent, good or poor) based on setting limits of acceptable change (using information on known natural variability , or the broad state that needs to be maintained to support good ecological health of the wetland system).

The prioritization process further used a set of criterions to narrow the range of ecological character elements. For Chilika, three sets of criteria were used: administrative/ regulatory requirements (obligations under Ramsar Convention, National Wetland (Conservation and Management) Rules, 2010, Orissa Marine Fisheries Regulation Acts, 1988); ecological (criticality in supporting important ecosystem services, ability to be an integrative indicator of ecosystem state, species conservation status, key stone species) and social (importance for community livelihoods).

The risk of adverse change is based on risk perception, which is derived from an analysis of sensitivity and adaptive capacity of high and medium priority ecological character element. The analysis is based on information generated from the existing monitoring systems, trends discerned from wetlands in similar geographic setting,

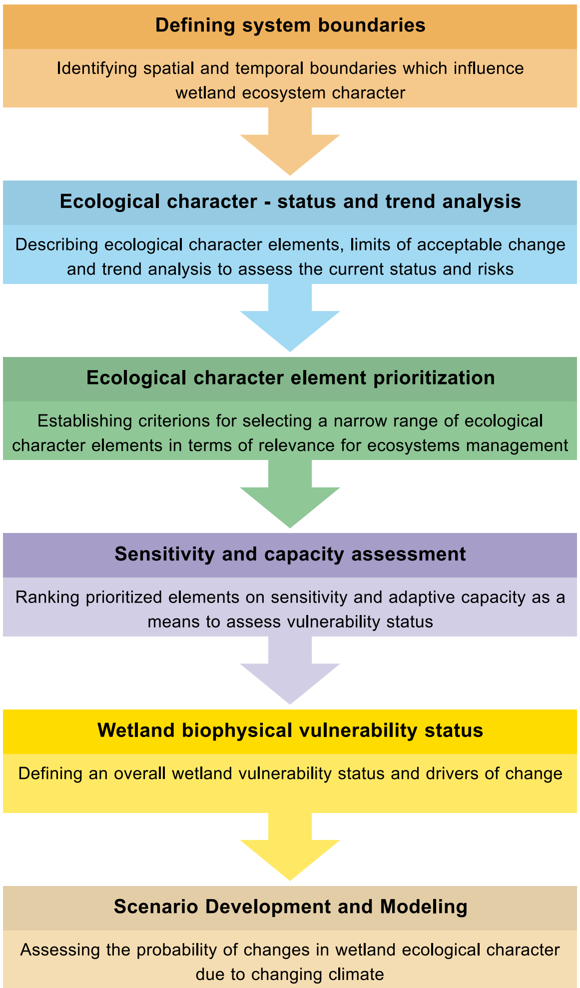


Fig 1: Biophysical vulnerability assessment

and expert and community consultations. The sensitivity capacity assessment is presented in Fig 2. Based on the analysis, six ecological character elements, namely salinity, sea-lagoon connectivity, freshwater inflow, inundation regime, macro-invertebrate, and sea grass distribution have been identified as being in high risk category. The focus of further modelling is to create a better understanding the likelihood of changes in these elements due to changing climate.

Social Vulnerability

Socio-economic vulnerability assessment of the current coping and adaptation mechanism was conducted through participatory risk appraisals in 60 villages of the Lake Chilika Basin. Based on the geo-morphological set up, in Mahanadi floodplain system, three clusters of total 24 villages representing high and low waterlogging areas were selected.

Analysis revealed a close relationship of geo-morphological setting and livelihood systems. Monsoon emerged as a stress period in coastal areas wherein fishing is banned within the lake, and the marine fishing hazardous due to choppy conditions. In Mahanadi floodplains, the post monsoon period aggravates waterlogging and promotes local migration for wage labour. In the western catchments, the summer season with low water availability is a stress period. Hence, within the basin, wage labour forms the primary occupation of a majority of the households (41.09%) followed by agriculture farmers (34.54%) and fishers (19.6%). Communities in the coastline depend on fisheries and related activities for livelihoods (54.91%).

Repeated exposure to hazards by coastal communities and the requirement to venture sea and lake for livelihood have made communities strengthen their traditional methods of predicting hazards and using technology (mobile phones, radio/ TV) as a means for early warning. The community has also apparently developed mechanisms to interpret complex weather related information from Block Disaster Management cell. The reach of more sophisticated forecast / early warnings as through the Indian Meteorological Department or State Disaster Management Authorities was almost negligible in the area. Grainbank and fuelbanks are used as coping strategies by over 70% of the communities. Use of insurance as risk transfer mechanism was not observed to be popular. Life insurance was subscribed to by nearly 15%.

There is emerging emphasis on Disaster Risk Reduction Planning through the state administration. Orissa was one of the first states to constitute a State Disaster Management Authority for the purpose. On an overall, 30% of the villages reported having a Disaster Management Plan, with the proportion highest in coastal villages. However, in no case was fund allocation made to implement the disaster management plans.

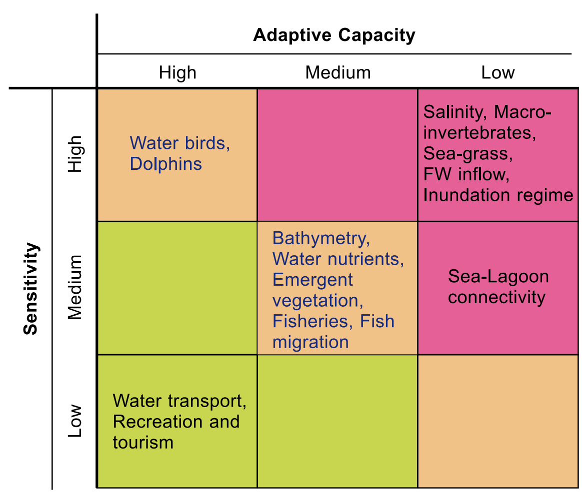


Fig. 2: Sensitivity and adaptive capacity of ecological character elements to climate change

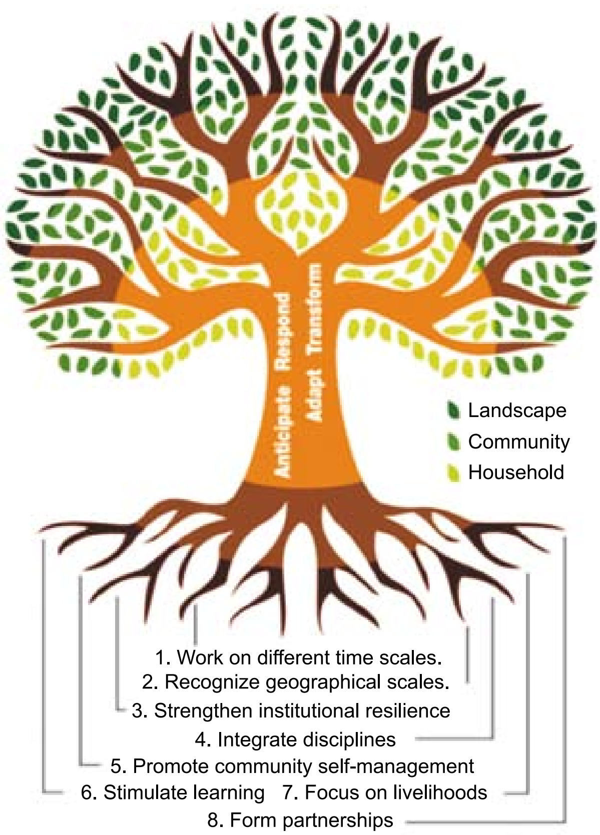
Future steps

Future implementation of the project would involve setting up of demonstration pilots within select communities living within the lake basin. The adaptation pilots would help provide insights into the strategies that need to be integrated into the wetland management plan as a means to reduce livelihood vulnerabilities due to changing climate. The biophysical vulnerability assessment would seek to develop scenarios of change for the high risk variables, assess whether the current monitoring and evaluation systems are geared towards detecting these changes and identify specific strategies that need to be included in the wetland management planning framework.

Partners for Resilience

Although there is growing awareness that improving the management of ecosystems and natural resources plays an essential role in reducing human vulnerability to disasters, there has been a lag investing in disaster risk reduction in general, and in ecosystem-based solutions for risk reduction in particular. WISA is demonstrating interated appproaches for disaster risk reduction through the five year DGIS funded initiative 'Partners for Resilience'. The initiative aims at reducing the impact of natural hazards on the lives and livelihoods of local communities through use of approaches integrating ecosystem management and restoration, disaster risk reduction and climate change adaptation. Mahanadi Delta, Odisha and Gandak-Kosi floodplains, Bihar have been identified as field implementation areas wherein fragmented hydrological regimes, environmental degradation and increased frequency and intensity of weather related events have rendered the livelihoods of communities vulnerable.

The approach for building resilience is based on eight principles which support the ability of the communities to anticipate, respond, adapt and transform in the face of increasing risks with interventions at household, community and landscape levels.



The basis of direct intervention in the target villages is village level risk reduction plan enabled by the participation of a network of 21 NGOs working in the two project areas. A Participatory Risk Assessment (PRA) tool was developed by partners in 2011 using a broader approach for risk assessment – particularly focusing on the risk context as a means of understanding the geophysical, ecological and social context of systemic and non-systemic risk that impact community resilience. The tool also allows analysis of trends related to ecosystems and climate change while evaluating elements and assets at risk, and local capabilities to respond to these risks'.

Implementation of the risk reduction plans have been initiated in 103 villages reaching out to 26,000 households. Financial resources for physical implementation of activities under the plans are mainly leveraged by the Gram Panchayats through the on-going developmental schemes. The communities have used the risk reduction plans as a basis to converge interventions, as well as seek alternate ecosystem based options (for example, investing in mangrove restoration as coastal defence and improving hydrological connectivity as against raising embankments). Disaster preparedness is being strengthened through establishment of grain banks, family survival kits and raising plinth of houses and community infrastructure. Community water management institutions are being strengthened and revitalized. Project is also working on reducing risks within agriculture in partnership with knowledge centers as Krish Vigyan Kendra.

The partnership is also working for improving the institutional environment for disaster risk reduction at national and state levels through improving policies, documentation and sharing of best practices and enabling participation of CSOs and local government institutions in policy influencing processes. The focus in 2012 was on enhancing comprehensiveness of District Disaster Management Plans (DDMP) being prepared as per the recommendations of Disaster Management Act, 2005 by seeking integration of ecosystem restoration and climate change adaptation elements.

Progressing the Conservation of Waterbirds and their Habitats in the Central Asian Flyway

Dr. Taej Mundkur, Flyway Programme Manager, Wetlands International
taej.mundkur@wetlands.org

The Central Asian Flyway (CAF) covers a large continental area of Eurasia between the Arctic and Indian Oceans and the associated island chains. The Central Asian Flyway covers at least 279 migratory waterbird populations of 182 species, including 29 globally threatened and near-threatened species that breed, migrate and spend the non-breeding (winter period) within the region. These include the Spoon-billed Sandpiper *(Eurynorhynchus pygmeus)*, Siberian Crane *(Grus leucogeranus)*, Sociable Plover *(Vanellus gregarius)*, Northern Bald Ibis *(Geronticus eremita)* and the Dalmatian Pelican *(Pelecanus crispus)*.

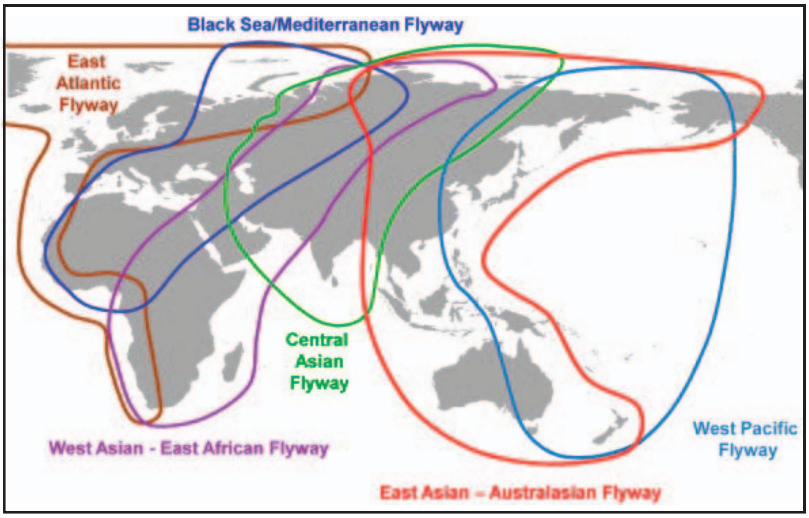
Following a successful international workshop hosted by the Indian Ministry of Environment and Forests in New Delhi in June 2005, the CMS launched an Action Plan for the Conservation of Migratory Waterbirds for the Central Asian Flyway developed with technical support from Wetlands International. The Action Plan focuses on species and habitat conservation actions, implementation of single species action plans for selected species, management of human activities, including hunting, eco-tourism, research and capacity building. It also aims to provide an umbrella for the creation of a flyway wide network of internationally important sites for migratory waterbirds as the basis for improving the management of these and other species. Although the Action Plan has been operational for the last six years, the Range States have not finalised a legal and institutional framework to implement it.

A major step was taken on 12 December 2012, when representatives of the 17 of out 30 Range States (Afghanistan, Armenia, Bahrain, Bangladesh, Bhutan, Georgia, Kazakhstan, Kyrgyzstan, Mongolia, Pakistan, Qatar, Saudi Arabia, Sri Lanka, the United Arab Emirates, the United Kingdom, Uzbekistan and Yemen) came together to decide on the way forward for the Action Plan development in Abu Dhabi, United Arab Emirates. The meeting was also attended by the African-Eurasian Waterbird Agreement (AEWA) and CMS Secretariats, Bird Life International and Wetlands International and observers from Norway and South Africa. The meeting was generously hosted by the United Arab Emirates Government and the Environment Agency Abu Dhabi.

The meeting unanimously agreed that the preferred option would be to include the CAF under AEWA, an inter-governmental agreement developed under CMS and that had successfully been in operation for over 15 years. The meeting also issued a formal declaration requesting the Parties to AEWA to consider extending the geographic area of that Agreement to encompass the entire CAF region and to take responsibility for the CAF Waterbird Action Plan. The proposal to including southern Asia is a practical and appropriate mechanism and well justified


Photo : © Sergey Dereliev, UNEP/AEWA

CAF meeting Abu Dhabi Dec 2012



Indicative Map of the Central Asian Flyway Region

given the large number of shared waterbird populations between the two fyways.

It was also agreed that over 2013-2014, the CMS and AEWA Secretariats will need to work together to ensure that further preparatory steps were taken to enable the AEWA Parties at their next Meeting of Parties to be held sometime in 2015 to take an informed decision on the extension of the Agreement area. In the meantime, it was agreed that the Secretariats would work with Wetlands International to revise the Action Plan and to encourage development of regional scale projects with input from Bird Life International, Wetlands International and others.

Although the meeting largely focussed on the institutional framework for the CAF Action Plan, there was discussion of the key conservation priorities, including the importance of monitoring of waterbirds using the International Waterbird Census. Kazakhstan proposed that it would be highly desirable to start/strengthen collaboration with Wetlands International straightaway on the development of national monitoring schemes and not wait until 2015.This was seen to be important so that data from central Asian countries could be feed into AEWA and help determine global population trends.

In the meantime, the CMS West/Central Asian Flyway Site Network that links sites from the breeding grounds of the small remaining population of Siberian Cranes in northern Russia through their staging grounds in Kazakhstan, Azerbaijan, Uzbekistan, Turkmenistan, Afghanistan and Pakistan to non-breeding grounds in Iran and India is to continue to provide an international framework for international cooperation.

Fortunately, there have been many important wetland and waterbird conservation actions in several countries in the region that address priorities identifed in the CAF Action Plan. In addition, there are several recent fyway-scale developments that provide the basis of promoting conservation of migratory species and their habitats, including:

- Conservation Action Plans developed and implemented for selected threatened species, including, Siberian Crane, White-headed Duck *(Oxyura leucocephala)* , the Lesser Flamingo *(Phoenicopterus minor)*, the Spoon-billed Sandpiper *(Eurynorhynchus pygmeus)*.
- Critical Sites Network Tool - an interactive web-based tool that identifes 3,000 sites in African-Eurasian region, including part of the CAF (developed under the UNEP/GEF Wings over Wetlands project);
- Flyway Training Kit – a comprehensive wetland and waterbird management training resource, available in several languages (also under the UNEP/GEF Wings over Wetlands project);
- Important Bird Areas programme promoted by Bird Life International;
- International Waterbird Census promoted by Wetlands International; and
- West/Central Asian Flyway Site Network established with a focus on Siberian Crane (also under a UNEP/GEF project) that can be expanded into a larger network for all migratory waterbirds.

Implementation of these activities required to achieve conservation action on the ground will need to be supported by strengthening human capacities and mobilising additional fnancial resources in the short-term. Resources will need to be secured from governments in the region and beyond and would beneft from being complemented by innovative funding streams from the corporate sector, public and other sources. Wetlands International is keen to continue to play its role and seeks to work with interested parties to move this important initiative forward.

More information on Abu Dhabi Meeting and Action Plan is available on the CMS website www.cms.int

Mission:

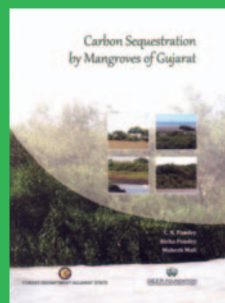
To sustain and restore wetlands their resources and biodiversity

Recent Publications on Wetlands

Integrated Management Planning Framework for Conservation and Wise Use of Chilika
Available from wi.southasia@wi-sa.org

Towards Conservation and Management of Mangrove Ecosystems in India
Available from IUCN-India Office, New Delhi

TEEB-India:
Scoping Report Inland Wetlands
Available from wi.southasia@wi-sa.org



Carbon Sequestration by Mangroves of Gujarat
Available from GEER Foundation, Gujarat

Coral Reefs in India
Status, Threats and Conservation Measures
Available from IUCN-India Office, New Delhi

The Economics of Ecosystems and Biodiversity for Water and Wetlands
Available from www.ramsar.org

Wetlands International - South Asia
A-25, (2nd Floor), Defence Colony
New Delhi-110 024, India
Tel: +91-11-24338906, 32937908
Email: wi.southasia@wi-sa.org
URL: http://south-asia.wetlands.org

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