- Making a Difference –

Scientific Capacity Building & Enhancement for Sustainable Development in Developing Countries

Final Report

Project Reference Number: CBA2014-05NSY(B&ES)-Gopal

Capacity Building for Conservation of Biodiversity and Ecosystem Services of Wetlands in Relation to Global Changes

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ASIA-PACIFIC NETWORK FOR GLOBAL CHANGE RESEARCH

20 YEARS Bridging Science & Policy for a Sustainable Asia-Pacific

रक्षये प्रकृतिं पांतु लोकाः

Project Reference Number: CBA2014-05NSY(B&ES)-Gopal

Title of the Project

Capacity Building for Conservation of Biodiversity and Ecosystem Services of Wetlands in Relation to Global Changes

Final Report submitted to APN

OVERVIEW OF PROJECT WORK AND OUTCOMES

Non-technical summary

Wetlands are very rich in their biodiversity and provide numerous benefits to human kind. They provide water, food (fish and rice) and many other resources, regulate water regimes, water quality and climate, and are hubs of cultural and recreational activities. Yet, wetlands are threatened by changes in land use/land cover, inappropriate water resources management and climate change, largely because their biodiversity and benefits are not accounted into the development projects. This stems largely from the poor understanding of their benefits, a general lack of capacity for and complexities in assessing the biodiversity of wetlands and linking it to various ecosystem services. The project focused on capacity building of relevant stakeholders (including policy makers) for rapid assessment of biodiversity and ecosystem services of wetlands in the Ganga-Brahmaputra basin. Three Workshops were organised in Kolkata, Guwahati and Kathmandu where the biodiversity and ecosystem services of three wetlands were discussed and interactions were made with the local communities. Guidelines for rapid assessment of major groups of biodiversity and main ecosystem services were prepared. A Policy Brief highlighting the ecosystem services of different kinds of wetlands and the relationships with biodiversity was disseminated at a concluding Workshop with the participation of a few senior policy makers.

Keywords

Kholsi beel (wetland); Deepor Beel, Nagdaha lake; Ramsar site; Biodiversity Assessment; Ecosystem Services; India; Nepal

Objectives

The main objectives of the project were:

1. To enhance the understanding of the ecosystem services of wetlands in relation to their significant biodiversity among wetland managers, land and water resources managers and policy makers;
2. To build capacity of wetland managers to assess biodiversity and associated ecosystem services and monitor changes caused by change in land use/land cover and other anthropogenic activities in and around the wetlands
3. To develop guidelines for rapid assessment and monitoring of biodiversity and ecosystem services of wetlands; and
4. To build capacity of policy makers to appreciate and integrate wetland biodiversity concerns and ecosystem services into their development projects

Amount received and number years supported

The Grant awarded to this project was:

US$ 40,000 for one Year

Activity undertaken

Major activities during the project included the following:

1. An Inception Workshop was organized at the start of the project in New Delhi during 25-26 July 2014 with the participation of all project partners and few invited experts to discuss the details of the project activities and seek suggestions for the contributors to guidelines and resource persons at the workshops.
2. First Capacity Building Workshop was organized in Kolkata (19-21 February 2015) with active collaboration of the Central inland Fisheries Research Institute (CIFRI) at Barrackpore. Extensive

interactions were made between the participants and many experts from the area, besides the presentations by the resource persons. A field visit was arranged to Kholsi beel where detailed interactions took place with the local fishing community, fisheries officers and local government representatives. Biodiversity assessment was demonstrated by sampling in the beel and the main ecosystem services of the beel – provisioning for fish and hydrological regulation (flood control function and water quality) were discussed with the community.

3. The second workshop was arranged immediately thereafter in Guwahati (23-25 February 2015) in collaboration with the Regional centre of CIFRI. The Additional Chief secretary of the State Government joined the opening session and expressed interest in organizing such workshops for the officers of the State Government. During the field visit to Deepor beel – a Ramsar site – detailed interactions occurred with the local community and Village level organizations, and later with the officials of the Forest and Wildlife Department responsible for the management of the Ramsar site. Various management problems were discussed in detail.
4. The third workshop was organized with the help of the Kathmandu University, Dhulikhel (Kathmandu) during 12-14 March 2015. Besides the University representatives, Mr Ganesh Shah, former Minister of Environment of the Government of Nepal also joined the Workshop. Field visit was arranged to a wetland – Nagdaha lake – which is under anthropogenic pressure but of cultural interest because of a temple on its shore. Again the local community joined in large numbers and discussed the issues such as erosion, water quality, water table decline, etc. Field methods for biodiversity were demonstrated by Prof. Subodh Sharma and his team.
5. In the first few months of the project, a web page was designed with a database capability for setting up an online network of individuals and institutions interested in wetlands, their biodiversity and ecosystem services, anywhere in Asia. It was hosted on a web site at www.aquaticecosystems.org/network/. It was widely publicized for people to enter their profiles and start interaction by searching for other researchers with similar interests.
6. Guidelines for Rapid Assessment of Biodiversity and Ecosystem Services of Wetlands were prepared. They cover simple methods for sampling, identification and quantitative assessment of major groups of wetland biodiversity, and he assessment of a few more obvious ecosystem services. Also five Posters were prepared for identification of wetland biota in the field.
7. A Policy Brief was prepared and printed.
8. Towards the end of the project, a Policy Workshop was organized in New Delhi (9-10 June 2015) where the outputs (publications mentioned above) were formally released by the Director General of the Indian Council of Agricultural Research, New Delhi. The Secretary, Ministry of Water Resources and the Additional Secretary, Ministry of Environment, Forests andClimate Change were apprised of these publications as they could not join the workshop's opening session at the last moment. The Workshop discussed the project activities, preparation of the Report, and plans for future.

Results

The three capacity building workshops brought together more than 170 young researchers, senior scientists and experts, wetland managers, representative of NGOs and Government organizations, and policy makers to understand and discuss the issues related to wetland biodiversity and ecosystem services in relation to various management problems, particularly in the wake of global change. They experienced three very different kinds of wetlands – a small wetland in peri-urban setting of Kathmandu (Nepal), a large beel (oxbow lake) close to River Hooghly near Kolkata and an important Ramsar site of northeast India – the Deepor Beel in the floodplain of River Brahmaputra but close to the urban complex of Guwahati – the capital of Assam. Each of them has very different characteristics, hydrology, biodiversity, human uses and impacts and hence, issues of management.

All are affected by changing land use in their catchments. In Nagdaha (Kathmandu), the water quality degradation because of agriculture and water use in the immediate surroundings is s major issue of concern. In the two large wetlands, their connectivity with the river is of major interest because if regulates the fishery resources (a major ecosystem service that is also linked with livelihoods) and water quality among other ecosystem services. There were several other problems caused by human activities and the human-wildlife conflict in the case of Deepor beel.

An online network has been set up for interested people to join and interact with people and institutions working of different biota, wetlands and issues of interest to them. Useful relevant resources such as the outputs of this project will also be disseminated through this website.

Guidelines for rapid assessment of major groups of biota (macrophytes, phyto- and zooplankton, macroinvertebrates, waterfowl, herpetofauna and fish) and a few more obvious ecosystem services (harvestable plants and fish, hydrological regulation, water quality, and recreation) have been prepared. It is hoped that these guidelines will be revised and enlarged from time to time. A policy brief disseminated among policy makers and managers has received good attention. Most policy makers suggested that the guidelines and the policy brief should be disseminated widely in printed form for ready access. A positive feedback shows interest in similar capacity building activity among more people from different sectors and regions as the wetland researchers and managers in Sri Lanka and Bangladesh also communicated their interest in joining the workshops bu could not do so due to lack of resources.

Relevance to the APN Goals, Science Agenda and to Policy Processes

Wetlands are recognised by the Ramsar Convention to be important for their critical role in water cycle and climate change. Wetlands are rich in biodiversity and their conservation contributes to the goals of the Convention on Biological Diversity as well as sustainable development. Integration of the wetland concerns into national policies for water resources and other development projects is critical for sustainable development. This project contributed to raising awareness and better understanding of the linkages between wetland biodiversity and ecosystem services among the policy makers and other stakeholders. It addressed directly the Goals 2 and 3 of the APN, its Strategy 2 of the Third Strategic Plan, and. contributed to its activities identified under its Biodiversity and Ecosystems Framework in accordance with the CAPaBLE programme's objective to "enhance scientific capacity in developing countries to improve decision-making" .

Self evaluation

The project was overall quite successful as too many researchers and NGOs wanted to join the capacity building workshops and generated interest also in neighbouring countries (Sri Lanka, Bhutan, Bangladesh). Even the Ramsar Convention Secretariat was represented by its Regional Adviser, Dr Lew young. We recognized the need for more details and extended hands-on training in the field as also desired by the participants. The interest among policy makers was evidenced by the presence of senior people. It is of utmost importance that the interest in the subject is sustained by reaching out to people in all parts of India and other Asian countries.

Potential for further work

Similar capacity building workshops are required in many parts of India and neighbouring countries for long-term impacts. The Guidelines for the assessment of both biodiversity and ecosystem services need elaboration with specific case studies for which focused research is required. Case studies documented with actual field data will accelerate the process of integration of wetland issues into national policies and actual management of wetlands.

Publications

Gopal B. 2015. Integrating wetland conservation into development projects needs assessment of biodiversity and ecosystem services. Policy Brief. National Institute of Ecology, New Delhi.

Gopal B (Ed). 2015. Guidelines for rapid assessment of biodiversity and ecosystem services of wetlands. National Institute of Ecology, New Delhi.

Acknowledgments

We gratefully acknowledge the financial support from the Asia-Pacific Network for Global Change Research (APN-GCR), Kobe, Japan. Our thanks are also due to Dr Linda Anne Stevenson (Head, Scientific and Communication Affairs), Ms Christmas de Guzman (Programme Fellow) and all other staff of the APN for their continued support and help with various requests and queries. We are grateful to our partners, Dr A.P. Sharma (Director, Central Inland Fisheries Research Institute (CIFRI), Barrackpore, Kolkata (ICAR)), Prof. Subodh Sharma (Kathmandu University, Dhulikhel, Nepal) and Dr Sudipto Chatterjee (Conservation Sciences-India, New Delhi) for their active collaboration and support for successful conduct of the Workshops. CIFRI and Kathmandu University provided us all required facilities of the Institute/University for stress-free and most economical organisation of the workshops. They contributed the most by way of the services of their scientists and other staff, planning field visits, providing necessary equipment and all the necessary facilities for the workshops. CIFRI also provided accommodation to the resource persons and participants on highly reduced rates.

The success of the three capacity building workshops owes most to the scores of stakeholders from the local community and local administration (mostly village level) who spared their time for spending a day with the participants, interacting and sharing with them their understanding and knowledge of the wetland systems. They are thanked profusely for enriching our efforts and for various arrangements during our visit.

In Guwahati, the officers of the Forest and Wildlife are thanked for their time to discuss the issues confronting them in managing the Deepor beel. In Delhi, the workshop was facilitated by Delhi University, Prof. V.P. Singh, Head of the Botany Department, and Prof. K.S. Rao, Secretary General; of the National Institute of Ecology. The Policy workshop was facilitated by the officers of the National Academy of Agricultural Sciences (NAAS) and the Indian Council of Agricultural Research, particularly Dr A. Arunachalam. Grateful thanks to these organisations and individuals. We are indebted to Dr S. Ayyappan (Director General, ICAR), Mr Davinder Kumar (Addl Chief Secretary, Govt of Assam) and Mr Ganesh Shah (former Minister of Environment, Govt of Nepal) and Dr Lew Young (Regional Adviser, Ramsar Convention) for advice, support and interaction with the participants in the Workshops. We thank also the Secretary, Ministry of Water Resources, river Development and Ganga Rejuvenation, and the Additional Secretary, Ministry of Environment, Forests and Climate Change, government of India, for their interest, encouragement and support. Both could not join the Policy Workshop as they had a last minute meeting with their Ministers. Several other senior scientists and policy makers who joined in the final workshop (listed in the Appendix A6) are thanked for their precious time and unequivocal support and guidance.

We thank the resource persons, Dr Tek B. Gurung, Dr Smriti Gurung, Dr C.M. Sharma, Dr Rajesh Rai, Prof. P.C. Bhattacharjee, Dr Asad Rahmani, Dr Deepayan De, Dr M.A. Hassan, Dr B.K. Bhattacharjya, Dr D. Debnath, Dr Partha Jyoti Das, Prof. Ashwini Wanganeo, Prof. D.K. Marothia, Dr K.K. Vass, Dr Suresh Rohilla, Prof. K.S. Rao, Dr Nazneen Zehra, Ms Archana Chatterjee, Dr Suman Kumari and Dr M.K. Bandyopadhyay for time, advice and support. They are also thanked for presentations at the workshops. We acknowledge gratefully all individuals – too many to be named individually – who helped is with different activities of the project such as website designing, hosting, literature search, preparation of the documents, editing, printing, and secretarial assistance.

TECHNICAL REPORT

Preface

Wetlands are known as 'hotspots' of biodiversity and provide us numerous benefits – from water and food to climate change mitigation. However, despite global commitments to the objectives of the Ramsar Convention, wetlands continue to be impacted by anthropogenic pressures. We are convinced that wetland conservation needs capacity building among various stakeholders to appreciate and assess their biodiversity and the interlinked ecosystem services. This report documents our collaborative efforts towards this need through four workshops in India and Nepal and developing guidelines for rapid assessment, with the financial support from the Asia-Pacific Network for Global Change Research (APN).

Table of Contents

1.0 Introduction

1.1 Background

Throughout the history of their evolution, humans have depended upon nature – its physical (non-living) components – water, air, solar energy and soils – and the living organisms on the Earth. Humans learned to grow food, domesticated animals, developed science and technology to utilize Earth's hidden resources, and gradually tamed nature. Although several cultures called for living with nature and conservation of nature's resources, and the impact of humans on the Earth was highlighted (Marsh 1864), there has been increasingly greater concern about the degradation and loss of nature since the mid-twentieth century. While efforts were initiated to awaken people to their dependence on the nature, and to mitigate environmental problems (e.g., the United Nations Conference on Human Environment, Stockholm, 1972), a utilitarian view of nature was put forward to increase people's interest through the notion of 'nature's services' or 'environmental services' (SCEP 1970). Ehrlich and Ehrlich (1981) introduced the term 'ecosystem services' which was defined by Daily (1997) as "the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfil human life". The concept was formulated as "a deliberate attempt to draw ecological processes into the domain of economics (Edwards & Abivardi 1998). As the economic development activity is the root cause of degradation, it became important to consider the conventionally non-valuated resources also as goods and services and quantify them in economic terms.

Millennium Ecosystem Assessment (MEA 2005a) defined ecosystem services simply as "the direct and indirect benefits derived by humans from the functions of the ecosystems" and categorised them into Provisioning (food, timber, fuel, water, and other goods), Regulating (regulation of biogeochemical cycles including climate), Supporting (e.g., soil formation) and Cultural (aesthetics, cultural activities) services. As elaborated by the MEA (2005), all aspects of human well being depend upon these ecosystem services (Figure 1). During the past decade, numerous studies have discussed these services of different ecosystems at various spatial scales and valuated them in monetary terms using a variety of methods (Kareiva et al. 2011, Ninan 2012, Martin-Ortega 2015).

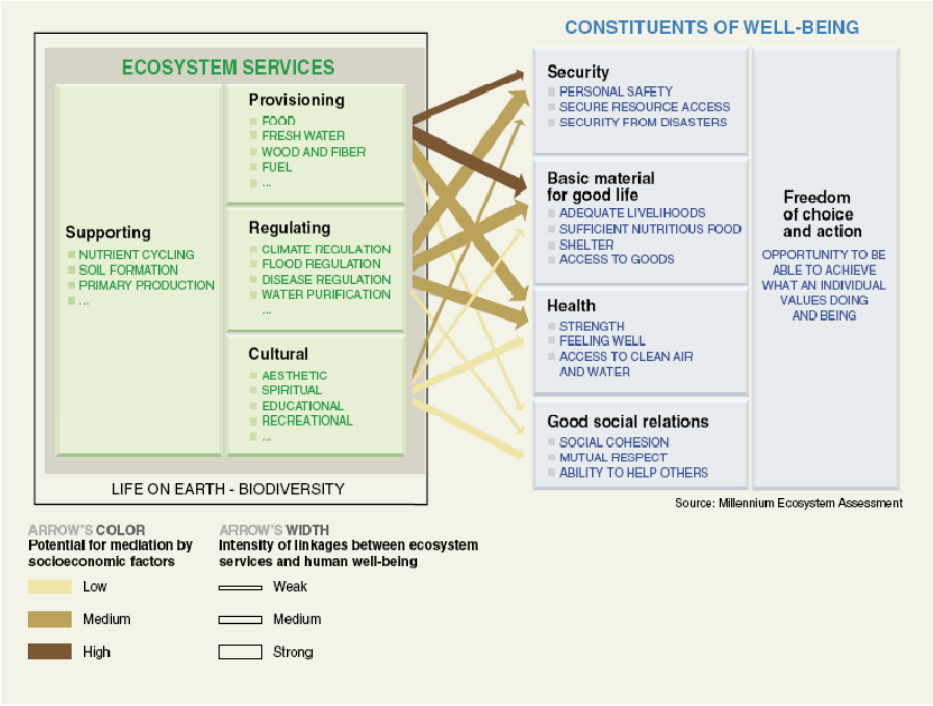

Figure 1. Relationship between ecosystem services and human well being (from MEA 2005a)

1.2 Biodiversity & Ecosystem Services Linkages

All ecosystem functions result from various biological processes involving interactions between the non-living (soil, air, water and energy) and living (biodiversity) components (Table 1). Therefore, most of the ecosystem services are linked directly or indirectly to one or more components of biodiversity (Figure 2). Further, the biodiversity is governed by a number of drivers which affect these processes and functions and consequently, the ecosystem services (Figure 3).

The linkages between biodiversity and ecosystem services have been discussed at length by many researchers such as Balvanera et al. (2006), Feld et al. (2009) and de Bello et al. (2010), and international organisations such as the CBD (Leadley et al. 2010), the Ramsar Convention (2011) and the UNEP's TEEB (Elmqvist et al. 2010). The provisioning, regulating and cultural services obtained from the biodiversity, however, differ from region to region based on economic, socio-cultural and other factors (see Ninan 2012). Quite often the same plants or animals are differently valued in different societies. Whereas the direct use or consumptive values are easily appreciated and linked with one of the other component of biodiversity, the values of other biodiversity elements, which form the base of the food chain or an important link in the food web, are readily ignored. The role of biodiversity in providing regulating, supporting and even recreational services is usually difficult to appreciate and hence, neglected. However, it should be realised that the value of regulating services itself lies in their impact on the variability in the supply of the provisioning and cultural services (Elmqvist et al. (2010).

Table 1. Biological processes related to different ecosystem functions

Ecosystem Functions	Biological Processes
Primary production:	Photosynthesis Plant nutrient uptake
Decomposition:	Microbial respiration Food web dynamics of soil biota
Nitrogen cycling:	Nitrification Denitrification Nitrogen fixation
Hydrologic cycle:	Plant transpiration
Soil formation:	Mineral weathering Soil bioturbation
Biological control:	Succession (Plant community) Predator-prey interactions

The rapidly growing interest in the assessments of biodiversity and ecosystem services of different ecosystems is evidenced by the establishment of two international programmes in recent years. The Economic of Ecosystems and Biodiversity (TEEB), a programme hosted by the UNEP, focuses on economic valuation (TEEB 2010) and has great interest in water and wetlands (Russi et al. 2013). The Intergovernmental Platform on Biodiversity and Ecosystem Services (IPBES) was launched only in 2012 as an independent intergovernmental body "for assessing the state of the planet's biodiversity, its ecosystems and the essential services they provide to society" by synthesising relevant information and knowledge and strengthening capacity for the effective use of science in decision-making (http://www.ipbes.net/about-ipbes.html).

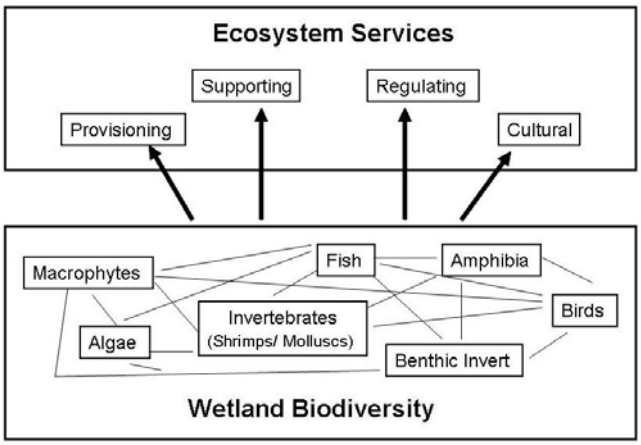

Figure 2. Common components of biodiversity, their interactions, and linkages with ecosystem services

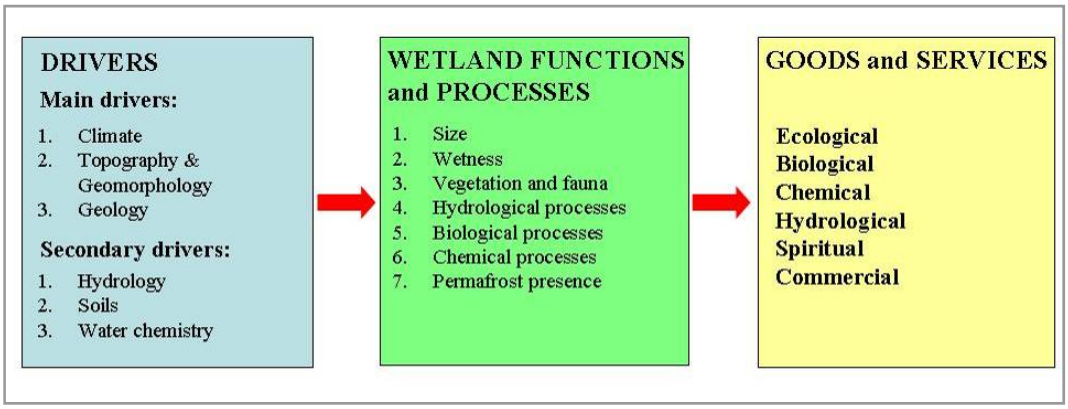

Figure 3. Drivers which affect various processes and ecosystem functions and in turn, the ecosystem services

1.3 Wetlands

Wetland ecosystems are of special significance. They harbour a large biodiversity disproportionate to their areal extent, and provide ecosystem services that are critical to the entire life on the Earth. Their conservation was likened to 'killing two birds with one stone' (Gopal 1997) as it met the objectives of both the Ramsar Convention and the Convention on Biological Diversity. Biodiversity of wetlands throughout the world, together with the factors controlling its richness and decline, has been discussed in several publications (Gopal et al. 2000, 2001, 2009). Wetlands provide water and water-related ecosystem services, such as food (fish, prawn, rice and many other plants), waste-water purification, hydrological regulation of floods and droughts, carbon sequestration and climate regulation, storm protection, erosion control, etc. Wetlands enhance aesthetics and support a wide range of livelihoods besides various cultural/recreational activities. Wetlands may hold important spiritual values for some cultures. Thus, wetlands contribute to human wellbeing, cultural identity and economy (MEA 2005b, Finlayson et al. 2005, Russi et al. 2013).

Long before the concept of ecosystem services became popular, wetlands were well known for their many functions and values (e.g., Greeson et al. 1979) which were also assessed for their importance in the management of wetlands (Larson et al. 1989, Larson 1995). With our increased knowledge of wetlands, their functional assessments have become quite elaborate (Maltby 2009). Since Costanza et al. (1989) estimated the economic value of world's wetlands numerous studies have examined different ecosystem services of a wide range of wetlands and assessed their economic values (e.g., Barbier et al. 1997, Schuijt & Brander 2004, DeGroot et al. 2006).

Notwithstanding the importance of their ecosystem services, wetlands are the most threatened ecosystems as they bear the brunt of all human activities – both in and around them. Wetlands are among the most threatened ecosystems (Gopal 2008, Brinson et al. 2008). Their hydrological regimes, which are the main drivers of their characteristic functions, are altered directly and indirectly by water abstraction and host of catchment-based activities, and other habitat alterations resulting in loss or degradation. Other global changes such as land-use/land cover change, atmospheric pollution and above all climate change impact upon the wetlands. Wetlands are regulators of climate change but are also affected by it through both global warming and changes in precipitation regimes (Gopal & Junk 2001, Tockner & Stanford 2002, Brinson & Malvarez 2002, Junk 2002, Brinson et al. 2008, Gopal et al. 2008, Polunin et al. 2008, Junk et al. 2013).

1.4 Current Status of Wetlands in South Asia

South Asia – comprising mostly of the Indian subcontinent, is rich in the diversity of wetlands and various kinds of wetlands are highly rich in their biodiversity (Gopal and Krishnamurty 1992). Wetlands have been an integral part of the socio-cultural ethos of the people to the extent that many natural wetlands are held sacred. Millions of people depended for millennia on the wetland resources for food, fibre, fuel, forage, medicine, and above all their livelihoods, and hence, traditionally managed them to sustain the benefits from them. While natural wetlands have been lost to conversion and reclamation, humans have also created numerous wetlands for various reasons (Gopal 2013). Today, human-made wetlands account for nearly 50% of all the wetland area in India (SAC 2012). The wetlands in the Ganga-Brahmaputra river basin, particularly those in the Eastern Himalayan region (a global biodiversity hotspot and a Freshwater Ecoregion), are important not only for their biodiversity (Allen et al. 2010) but also because these are threatened by the hydrological alterations due to numerous hydropower projects and climate change in the region (see Gopal et al. 2010).

It is noteworthy that all countries of South Asia are a Party to the Ramsar Convention and have designated many important wetlands under the Convention as being of international importance. Numerous ecological studies on wetlands and their biodiversity have been made since long before the Ramsar Convention and many wetlands have been the subject of detailed conservation and management programmes (e.g., Prasad et al. 2002). During the past few years many studies have been made also the valuation of wetlands for different ecosystem services (Parikh and Datye 2003, Wattage & Mardle 2007, MFSC 2011, Kumar & James 2012, Sharma et al. 2015) and a TEEB-India Initiative addresses the wetlands as well (MOEF-CC & GIZ 2014). Yet, these ecosystems are considered, in general, in most developing countries as wastelands or undesirable (often nuisance) places in land-use classification systems. This remains the single most important factors responsible for the degradation and loss of wetlands. In all development projects, related to both land water resources, wetland ecosystems do not find a place and are invariably impacted by hydrological changes, pollution and are even physically eliminated. This is a major policy failure as the policy- and decision-makers generally do not appreciate the true values of wetlands and the importance of their interconnections with other ecosystems. In spite of these developments, the current situation stems from the lack of capacity for and the complexities in appreciating and assessing various ecosystem services of wetlands and linking them to their biodiversity or ecological/hydrological characteristics. This is particularly true for the developing countries such as those in South Asia.

Therefore, a project was conceptualised with the overall long-term goal of building the capacity of early career policy makers, wetlands and natural resource managers, NGOs, consultants, members of civil society and wetland researchers to understand the value of wetland biodiversity and its linkages with their ecosystem services and to integrate the wetland concerns into land use and water resources projects.

1.5 Objectives

The main objectives of the project were:

1. To enhance the understanding of the ecosystem services of different kinds of wetlands in relation to their significant biodiversity among wetland managers, land and water resources managers and policy makers;

2. To build capacity of wetland managers to assess biodiversity and associated ecosystem services, and to monitor changes caused by change in land use/land cover and other anthropogenic activities in and around the wetlands;

3. To develop guidelines for rapid assessment and monitoring of biodiversity and ecosystem services of wetlands; and

4. To build capacity of policy makers for mainstreaming these assessments into the broader policy discourses, particularly those related to land use and water resources projects.

2.0 Methodology

The project had two major components: (a) conducting three capacity building workshops for various stakeholders and (b) preparation of the guidelines for rapid assessment of biodiversity and ecosystem services and background resource material for the participants. Other activities of the project were (a) the setting up of an online networked database of individuals and institutions interested in wetlands throughout South Asia at the start of the project and (b) preparation of Policy Brief and organisation of a policy workshop towards the end of the project.

► A two-day Inception workshop was organised, in July 2014, with the participation of the project partners, and a few invited experts, to fine tune and finalise the activity plan and roles of partners, to get expert inputs into the rapid assessment framework, and identify specialists, resource persons and the stakeholders for participation in the four workshops.

► A short project brief was prepared and widely circulated, through email lists, inviting expression of interest in contributing to, supporting and participating in the project activities. A number of experts were invited to prepare guidelines for rapid assessment of major groups of wetland biodiversity (namely, macrophytes, phytoplankton, zooplankton, macro-invertebrates, fish, birds, amphibia and reptiles) of their respective interest within the next 5-6 months. At the same time, applications were invited for a suitable part-time researcher to assist with the preparation of the background resource material and a state-of-the-art review of the subject.

► Appropriate professionals were contacted to design and host a webpage for setting up the online *South Asian network* of individuals and institutions with expertise and interest in wetland biodiversity and ecosystem services assessment. The webpage was to facilitate individuals to register and enter their profile with interests, activities and publications for a searchable database.

► As already decided during the planning of the project, three capacity building workshops were organised in Kolkata, Guwahati and Kathmandu (Figure 4). The dates for the workshops were decided after taking into consideration the weather, convenience of project partners, availability of facilities and resources. Two workshops in Kolkata and Guwahati were planned back-to-back in order to save time and funds in travel.

► Following up on a stakeholder mapping exercise at the Inception Workshop, we prepared an extensive list of potential participants which included state level officials of the concerned Departments (Forest, Wildlife, Fisheries, Water, Irrigation and Tourism), wetland managers, researchers from various institutions, NGOs and civil society organisations. Officials at the highest level were requested for nomination of participants. An announcement was widely circulated and Intending participants were asked to submit an application stating how they would benefit from the

workshop (Appendix A2). Participants were selected based on their engagement with wetlands, potential for future contribution and available resources and facilities for optimal interaction.

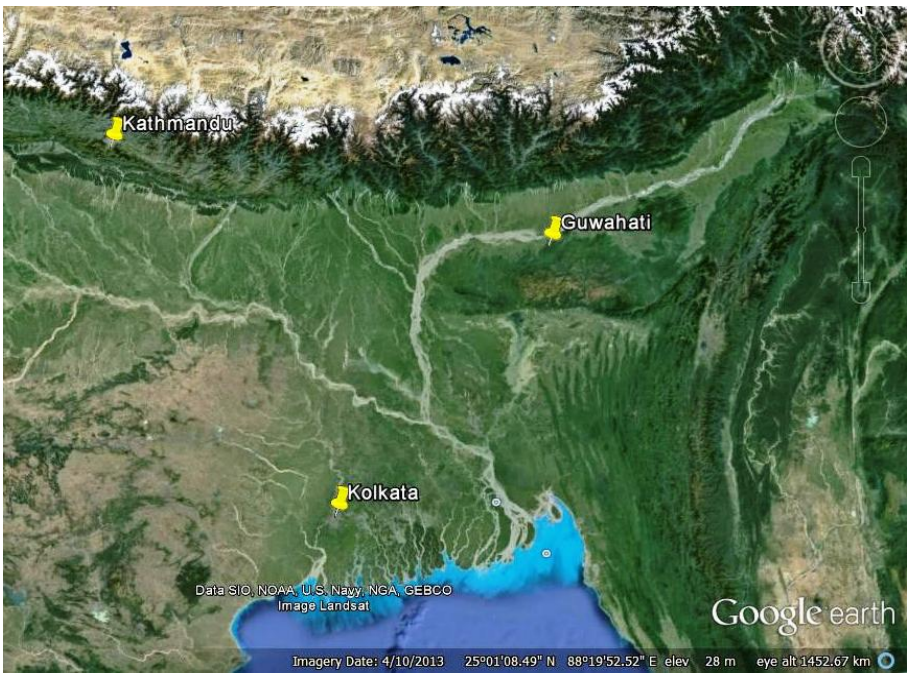

Figure 4. Location of the three capacity building workshops in Ganga-Brahmputra basin in Eastern Himalaya

► Based on the advice of the partners and experts at the inception Workshop, a list of Resource persons was prepared for making presentations at the workshops. Resource persons were also drawn from the State/region where the workshop was conducted, keeping in view their familiarity with the wetland issues and language in the area that helped in interaction with the local communities and other stakeholders.

► A somewhat similar agenda was formulated for each of the three workshops that would allow interaction with senior policy makers and managers who were able to participate and interact for a day only. The three-day programme was divided into 5-6 sessions where presentations were made by experts and resource persons on wetlands, their biodiversity, threats and management problems, methods for assessment of biodiversity and ecosystem services. Economic valuation for ecosystem services was briefly discussed as a tool for integrating wetland concerns through cost-benefit analysis of the development projects. The workshops allowed for maximum interaction between participants and resource persons and amongst the participants themselves.

► The participants were provided with copies of the Draft Guidelines for Biodiversity Assessment and 50 publications on the subject, including selected methods for ecosystem services assessment from the TESSA Toolkit version 1.2 (Peh et al. 2013). Posters on common plants, plankton, macroinvertebrates and fish were prepared for helping in the identification of organisms in the field. A poster on Kholsi beel was also prepared to explain integrated management of such wetlands.

► Recognising that it is necessary to examine the linkages between biodiversity and ecosystem services in consultation with the local communities, the participants interacted with the people dependent upon the wetland selected for the field study. This participatory approach has been emphasised time and again by all concerned organisations (see Peh et al. 2013). Within the limited time and resources, only unstructured discussions with the community were possible.

Therefore, the second day of each workshop was devoted to a whole day field visit to the selected wetland where the biodiversity assessment methods were demonstrated, and wetland benefits and problems were discussed in intensive interaction with the local communities and wetland managers. Researchers from the project partners had made prior visits to the wetlands and contacted the local community and officers of local government (village panchayats, cooperatives and societies) to invite them for interaction during our visit. A short note on the wetland was also prepared for introducing each wetland to the participants. During the field visit, the community representatives organised a formal meeting with the participants and later joined in further interaction on the wetland site. As a courtesy and expression of gratitude to the local community, they were invited for lunch with the participants.

► An iterative process was followed by feeding the learning from one workshop into the next one. Participants were asked to provide their written feedback about the workshop focussing on its usefulness and application within their work agenda and suggestions for improvement. However, they had the option to sign it or not.

► A final workshop was organised in Delhi during 8-9 June 2015 with special focus on policy makers. The objective of this workshop was to disseminate the experiences and recommendations from the three capacity building workshops in the form of publications and a policy brief to the policy makers for further uptake and up-scaling into the policy processes.

► It is worth placing on record that that about a month after the Workshop in Kathmandu, a disastrous earthquake struck Nepal on 25 April 2015. It caused enormous loss of life and extensive damage to property. Our project partner in Nepal was also affected. This event caused disruption in the project activity as well and Nepalese policy makers could not join us in the final workshop. The project completion got delayed by a month.

3.0 Results & Discussion

3.1 Project Inception workshop:

The 2- day meeting (New Delhi, 25-26 July 2013) brought together the four partners for the first time to discuss the project in detail among themselves and with a few invited experts (Figure 5; for a list of participants, see Appendix A1). The Project leader, Dr Brij Gopal, briefed the invitees about the background, the objectives and proposed activities. He sought suggestions for fine tuning the activity plan, the target stakeholders, and the resource persons for both preparing the guidelines and making presentations at the workshops. The role of each of the partner organisations was discussed and agreed upon. Prof. Subodh Sharma offered to get the guidelines for macroinvertebrates prepared. Prof. A.P. Sharma offered help with the fishes. Prof. A.R. Rahmani (BNHS) was asked to help with the waterfowl. Other potential authors for the guidelines were suggested. Dr Sudipto Chatterjee offered to get a review prepared with the help of a research fellow o be engaged at his University. A schedule for preparing the Draft guidelines, and the tentative structure of the three workshops were finalised. The proposed web-based network was discussed and it was felt that to begin with, a simple database should be designed where individuals can enter information about their activities and interests and can search for other people or institutions with similar interests. Relevant resources on the wetland biodiversity and ecosystem services can be added later if it does not infringe copyrights. Project activities and publications will also be disseminated through this page. Members agreed to communicate their suggestions for the structure of the database. The Agenda of the Workshop is included in Appendix A1.

Figure 5. Views from the Inception Workshop in New Delhi

3.2 ***South Asian network "Wetland Biodiversity and Ecosystem Services"***

A web page was designed with the help of a professional web designer along technical inputs for the relevant database on wetlands in South Asia and other neighbouring countries. The database includes fields for entering information and search for kinds of aquatic ecosystems, geographical regions, organisms, ecosystem processes and ecosystem services. Personal information and contact details are provided by the user and a returned by search for any one or more of the fields. Users can also upload their CV and publications for the use of others. Only registered users can add information but anyone can search the database. Information and resources related to the subject from across the region will be placed on the web as more funds for web management become available. The online database dedicated to wetlands is expected to facilitate interaction among individuals from within South Asia and elsewhere. The success of the portal depends upon the individuals joining the network online and submitting relevant information. The webpage with the database is hosted at www.aquaticecosystems.org/network/.

3.3 Capacity Building Workshops

► ***First Capacity Building Workshop (Kolkata; 19-21 February 2015)***

The first Workshop had two significant features. First, it was organized by the NIE and the CIFRI as an event to mark the World Wetland Day 2015 which had its theme, Wetlands for Our Future. As Prof. A.P. Sharma (Director, CIFRI and partner in the project) and Prof. Brij Gopal remarked in their welcome and introductory addresses, what could be more befitting than a capacity building programme to conserve the wetlands for our future and to ensure the future of wetlands in the hands of our younger generation. The NIE and CIFRI dedicated the series of capacity building workshops and other project activities to the 'Wetlands for Our Future'. Second, the workshop was honoured by the gracious participation of Dr Llewellyn (Lew) Youmg, Senior Regional Adviser, Asia-Oceania, Ramsar Convention Secretariat (Figure 6).

The Workshop participants (List in Appendix A3) included research scholars and senior scientists from several universities, representatives from the Govt Dept of Fisheries, West Bengal Biodiversity Board, Zoological Survey of India (ZSI), Indian Council of Agricultural Research (ICAR), NGOs and Kholsi Fishermen Co. Op. Society.

The first session started with a welcome by the Director, CIFRI, who elaborated upon the decades-long work of the Institute on wetlands, and their biodiversity across the country with particular focus on fisheries as their major provisioning service. Prof. D.K. Marothia (President, NIE) welcomed the participants on behalf of the NIE and briefly recounted the research, training and management work of the NIE in the field of wetlands and other aquatic ecosystems over the past 35 years. Dr M.A. Hassan (CIFRI) spoke briefly about the World Wetland Day and its theme for 2015. Dr Brij Gopal welcomed the participants and described the background of the project and structure of the

Workshop. Prof. Subodh Sharma (Kathmandu University) welcomed the participants and spoke briefly about the project and the workshop planned by them for the next month. Several senior scientists attending the workshop – Dr J.R.B. Alfred (former Director, ZSI), Dr S.D. Singh (Asst Director General, ICAR), Prof. N.C. Datta (formerly Kolkata University) and Prof. S.C. Santra (Kalyani University) made brief statements about wetlands, their status in the region, the studies made in the past and the need for their conservation. The participants then introduced themselves briefly.

Dr Lew Young, as the Chief Guest of the Session, then addressed the participants. He appreciated the APN-supported capacity building programme on wetlands and the efforts of the NIE, CIFRI and Kathmandu University in coming together for this important activity. He apprised the participants with the Ramsar Convention, its role in wetland conservation, its wise use approach, the concept of ecological character, and its guidelines for rapid assessment of biodiversity and its work on valuation of wetland ecosystem services. The session ended with a vote of thanks and was followed by tea for all participants and guests.

During the rest of the day, seven presentations made. Dr Brij Gopal introduced the wetlands, their characteristics, problems and management issues, and later discussed the macrophyte diversity. Dr S. Chatterjee gave an overview of wetland studies. Dr Deepayan De discussed he ecosystem services and spatial land management around wetlands with the examples of his work on East Kolkata wetlands and Deepor Beel in Assam (both being Ramsar sites). Prof. Subodh Sharma and Dr Smriti Gurung (Nepal) made presentations about the macroinvertebrates and other faunal groups. Prof. Sharma highlighted the importance of macroinvertebrates especially for the assessment of water quality, besides their role in the ecosystem services. Dr M.K. Bandyopadhyay (CIFRI) then discussed the methods for sampling zooplankton – an important constituent of fish food in wetlands. Lastly, Dr Hassan briefed the participants about the Kholsi beel wetland and the programme for the next day's field visit to the wetland. He advised them to be prepared for getting into the wetland for some hands-on experience. Dr Brij Gopal gave some advice on the interactions with the local community to learn from their experiences and viewpoints about the wetland and approaches to its management.

Figure 6. View from the first Workshop (left) and a Group Photo) of some participants

The second day (20 February 2015) was devoted to the study of Kholsi beel (an oxbow lake) in District Nadia (West Bengal). Excellent arrangements were made by the local fisher community and their Cooperative Society in the community hall (more than 60 of them had joined), with the assistance from CIFRI, Barrackpore. The diversity of fish and the fishing nets was displayed. CIFRI scientists had displayed posters on different plant

and animal groups as well as on the management plans for the Kholsi beel. The participants were welcomed by the local community. Prof. Brij Gopal greeted the community and thanked them for the arrangements made and their time spared for exchange of ideas. He stressed upon the importance of wetlands for their indirect benefits such as cultural, recreational benefits and their role in climate change and discussed the important role of community participation in sustainable wise use of wetlands. He introduced also the experts to the community. Dr. M. A. Hassan (CIFRI) elaborated on the importance and need of integrated manage-ment model for sustainable use of the wetland.

Sri Vishnupada Mondal, member of fishers community raised the issues such as depth reduction, accumulation of organic load, pesticide loaded surface run off from catchment, disease outbreak, intensive growth of submerged macrophytes across the wetland, absence of major floods (loss of connectivity with the river), narrow and shallow link channel, reduction of native fish population, litigation, ownership rights, and extinction of several fishes. Sri Subroto Chakroborty, District Fishery Officer, highlighted the issues like increase in population around the wetland and concomitant increase in fishing pressure in the wetland affected the biodiversity. He also expressed concern over drastic vertical and horizontal shrinkage of wetland area affecting productivity and agricultural activity on the exposed part of the wetland further endangered the biodiversity of wetland because of pesticide use. Absence of regular flood pulse since last few decades affecting exchange of germ plasm was considered to be the major concern. The priority to agriculture facilitated installation of river lift irrigation facility in seasonally closed wetland jeopardizing aquatic life including fishes during lean season. Dr Hassan translated the talks from both sides (community and participants). Here were also queries raised by the participants and experts. CIFRI scientists assured the fisher community to interact with them regularly and provide necessary help. Then the participants and the members of Fishers Cooperative Society had their lunch together (served by the community).

Figure 7. Interaction with the Fisher community of Kholsi beel

Figure 8. Variety of fishing nets (right) and releasing fish seed in the beel during the survey (left)

The afternoon after lunch was devoted to demonstration of field methods, sampling and identification of the biodiversity, and discussions in the field. A brief report on the field survey of Kholsi beel is placed in A4.

On the third day (21 February), we started with a discussion on the observations made in the field. Then a detailed presentations was made by Prof. P.C. Bhattacharjee on waterfowl, herpetofauna and mammalian wildlife. Dr Suman Kumari (CIFRI) discussed the methods for sampling and identification of phytoplankton and Dr Hassan made a presentation on fish diversity. Dr Brij Gopal discussed the ecosystem services and their assessment in general. He was followed by Prof. D.K. Marothia who presented in some detail the methods of economic valuation of ecosystem services. Another short presentation was made by Dr R.A. Khan (ZSI) on wetland biodiversity. Final session in the afternoon was devoted to general discussion of the subject with brief statements by some of the participants.

►*Second Capacity Building Workshop (Guwahati; 23-25 February 2015)*

Next day after the first workshop, the resource persons traveled to Guwahati for the second workshop which was hosted by the Regional Centre of CIFRI in their premises.

Forty participants included research scholsrs from universities and research institute, NGOs (Wildlife Trust of India and Aaranyak), ICAR and one faculty member from Rajshahi University, Bangladesh. The policy makers were represented by Dr R.P. Agrawal (retd Addl Principal Chief Conservator of Forests – inclarge of wetlands) and Mr Davinder Kumar, IAS - the Additional Chief Secretary of the State who held the charge of Environment, Forests and Water Resources (see Appendix A5).

The Workshop started with an opening session chaired by Prof. A. P. Sharma (Director, CIFRI, Barrackpore). Prof. D. K. Marothia (President, NIE) welcomed the Additional Chief Secretary and the participants, and made his opening remarks about the project and ecosystem services of wetlands. Prof. Brij Gopal, NIE explained the objectives and structure of the workshop. Dr. Tek Bahadur Gurung, Executive Director, National Council of Agricultural Research, Kathmandu, Nepal and Prof. Subodh Sharma, Kathmandu University, Nepal also made opening statements. The Additional Chief Secretary to the Govt of Assam, highlighted the importance of wetlands particularly in the state. He referred to Kaziranga and Manas world heritage sites besides Deepor beel - the Ramsar site. He recognised the need for such capacity building for the officers in his State. Dr B. K. Bhattacharjya, Head, ICAR-CIFRI Regional Centre, Guwahati presented the vote of thanks.

Figure 9. Views from the Opening Session of the Workshop at CIFRIRegional Centre, Guwahati

The workshop was organized into six sessions. In the first session, Prof. Brij Gopal and Dr. Sudipta Chatterjee dealt with the definitions and general characteristics of wetlands and their importance. The second and third session dealt in details about the assessment of wetlands biodiversity (plants, algae and faunal groups) with presentations by Prof. Brij Gopal, Prof. Subodh Sharma, Prof. P. C.

Bhattacharjee (Gauhati University), Dr. M. A. Hassan, Dr. B. K. Bhattacharjya and Dr. D. Debnath (CIFRI, Guwahati). The fourth and fifth sessions dealt with assessment of ecosystem services (Prof. Brij Gopal and Prof. D. K. Marothia). The last session was on biodiversity, ecosystem services and global change in which all resource persons participated. Dr. Partha Jyoti Das (Aaranyak, Guwahati) made a presentation on the status of Deepor beel based on their work with special focuss on hydrological interventions.

The second day (24 February) was devoted to a whole-day field visit to Deepor beel situated near Guwahati. It started with an interaction of the participants with the fishers and office-bearers of Deepor Beel Pachpara Samabai Samittee Limited (fishers' cooperative society) at Ajara Keotpara village with Sri Punya Ram Das (President of the society), Sri Khagen Chandra Das (Secretary) and Dr. Bhupen Das (Chief Advisor). They responded to many queries of the participants. In the marathon interactive session spanning three hours, the participants learnt that Deeper beel, which has a present water-spread area of about 4 sq. km is the source of livelihood of the people living in the surrounding villages. The society and the fishers reportedly take care of conservation of fish stocks of the beel in their own interest. During the south-west monsoon months (mid-April to mid-August), the fisher community reportedly carries out fishing only in shallow areas of the beel (outside a certain protected/ marked deeper/ core area) so that the gravid fishes are not caught during the breeding season of most major fishes. The society takes care of the protected area, and implements management rules for fishing. Most of the society members considered encroachment of the beel area for housing and industries to be a serious problem. People were also concerned with the declining connectivity of the beel with the River Brahmaputra. The society members talked at length about the problem of water hyacinth which they remove by organising a community weed removal programme. The Chief Advisor of the society urged higher authorities to provide security/ fund to the Deeper beel. The railway line which passes through Deeper beel causes untoward incidences in the areas, especially for the wild elephants who visit the beel regularly for water and food (*Euryale ferox*). Noise pollution from the trains also affects the migratory birds.


Figure 10. Fish market near Deepor beel (left); Director, Wildlife Sanctuary discussing with participants (right).


Figure 11. A view of Deepor beel (left); and meeting wih the officers of the FisherCoop Society at Anjara (right)

After lunch with the local fisher community, the participants moved to the Deepor beel wildlife sanctuary where Mr Dibdya Dhar Gogoi, DFO and in-charge of the sanctuary, interacted with them at length explaining various problems and management issues facing the Ramsar site. The biodiversity of the beel was also sampled from this area and discussed with the resource persons. Finally, the participants were invited to the office of Aranyaak where Dr Partha Jyoti Das and his team again discussed many other issues of Deepor beel.

► ***Third Capacity Building Workshop (Kathmandu, 12-14 March 2015)***

The third workshop was organized in collaboration with the Kathmandu University, Dhulikhel (Kathmandu). The workshop was attended by 35 participants, mostly graduate students from universities in Nepal, several fishery officers in Nepal (including the Executive Director of the National Council of Agricultural Research, Govt of Nepal), a few researchers from India, and a student from Bhutan (Appendix A6). Besides the University representatives, Mr Ganesh Shah, former Minister of Environment of the Government of Nepal also joined the Workshop.

The Workshop was structured similar to the earlier two workshops. In the absence of the Vice-Chancellor, the Registrar of Kathmandu University (Dr Bhola Thapa) chaired the opening session. He called for maintaining nature and sustainable development to solve problems related to biodiversity loss. He also highlighted his concerns about the new hydropower projects which pose challenges to biodiversity conservation. Prof. Subodh Sharma and Prof. Brij Gopal welcomed the participants and briefed them about the background and objectives of the workshop, They made observations about the Ramsar Convention, the World Wetland Day and its theme for 2015, and then about the biodiversity-ecosystem service linkages. Dr Smriti Gurung briefed about the structure of the workshop.

Figure 12. Participans of the CB-WBES Workshop in Kathmandu (Nepal)

During the technical sessions on the first and the third day, following presentations were made. Some of these were the same as in the previous workshops and for others, different resource persons were brought in. The programme of the Workshop is given in Appendix A6.

1. Wetland Biodiversity and Macrophytes - Prof. Brij Gopal
2. Nepal's Wetlands Inventory and Macroinvertebrates - Prof. Subodh Sharma
3. Zooplankton and Phytoplankton Collection Methods - Prof. Ashwini Wanganeo
4. Wetland Water Fowl and Herpetofauna - Dr Mrs.NazneenZehra

5. Fish diversity in Nepal - Dr.Bibhuti Ranjan Jha
6. Wetland biodiversity and Diatoms in Nepal - Dr. Smriti Gurung
7. Wetland Ecosystem Services & Valuation – Prof. Brij Gopal
8. Differences in demand for watershed services: Understanding preferences through a choice experiment in the Koshi Basin of Nepal - Dr. Rajesh Rai
9. Management, Conservation, Law and Policy Issues in Ramsar Sites - Dr Archana Chatterjee
10. Fish Toxicological Study in Lakes - Dr.Chhatra Mani Sharma
11. Community participation and success stories on wetland conservation and management in Nepal - Dr.Tek Bahadur Gurung

At the end of the first day's presentations, Prof. Subodh Sharma briefly introduced the Nagdaha lake which was to be visited the next day. He advised the participants to come prepared for fieldwork and demonstration of biodiversity sampling in the lake.

The second day was utilized for field studies and interaction with the local community around Nagdaha lake – a periurban wetland located in Lalitpur district of Kathmandu Valley. The lake is under anthropogenic pressure but of cultural interest because of a temple on its shore. Several members of the local community joined the interaction meeting and were led by the President and Treasurer of the local organization. A few business persons from the area (hotel owner, boat renter) were also present. Prof. K.S. Rao led the discussion from the participants view. Whereas the businessmen were interested in the benefits from the lake and cared only about its aesthetic values, other community members talked about political influence. Collectively, they said that many NGOs and INGOs came for the conservation of the lake but none of their plans were successful. Attempt for fish farming had failed because non-native fish species were introduced which did not grow naturally in the pond. Still, they introduce their fingerlings each year for reducing the weeds in the lake. The community was interested in learning more about the harmful weeds and conserving the useful plants. The recreational use of the lake for boating had increased without any effect on the lake. Boating activity was well managed and life jackets were made compulsory. The Village Development Committee earned a total annual revenue of NRs 3 lakh (=US $ 3000) from boating and the annual festival of the Snake God in the lake. The VDC also adds some amount to it to carry out conservations programs. They plan constructing a boundary around the lake to minimize the harmful activities like bathing and washing of clothes. They also highlighted te need for raising awareness about conservation among the younger generation. Later, field methods for sampling biodiversity were demonstrated by Prof. Subodh Sharma and his team. Prof. Brij Gopal guided the students to examine macrophytes in and around the lake.

After presentation on the third day, the closing session was chaired by Mr. Ganesh Shah, hon'ble ex- Minister of Environment, Science and Technology, who exhorted the participants for conservation, especially the aquatic ecosystems. Detailed report on the Workshop, together with a student's report on the field visit are given in appendix A6 & A7.

Figure 13. Views of the lake (above), field work and meeting with the community at Lake Nagdaha

All participants were presented a Certificate at the end of each workshop (Appendix A8).

3.4 **Rapid Assessment Guidelines and Policy Brief**

Guidelines for Rapid Assessment of Biodiversity and Ecosystem Services of Wetlands were prepared by inviting several experts. The Guidelines includes an Introduction, simple methods for sampling, identification and quantitative assessment of macrophytes, microphytes (phytoplankton & periphyton), zooplankton, macroinvertebrates, fish, waterfowl and herpetofauna, and finally the assessment of a few more obvious ecosystem services. Five Posters were prepared for identification of wetland biota in the field to complement the Guidelines.

A 16-page, profusely illustrated Policy Brief was also prepared. It is titled, "Wetland Conservation for Biodiversity and Ecosystem Services Needs a Shift in Land and Water Resources Policies". The summary of the policy brief reads:

> *Historically wetlands were integrated into the socio-cultural ethos of the people of South and Southwest Asia. However, during the past century wetlands have been lost and degraded primarily because they were labelled as wastelands and did not receive attention in the development plans. Wetlands are treated as dustbins for wastewaters and solid wastes. Conservation of wetlands for protecting their biodiversity, specific biophysical characteristics and obtaining optimum benefits (ecosystem goods and services) from them requires a major shift in policies related to land and water resources.*

3.5 Wetland Policy Workshop

Towards the end of the project, a Policy Workshop was organized in New Delhi (9-10 June 2015) with several policy makers from different sectors and wetland managers and experts were present (List of participants in appendix A9). The results of the project, particularly the experiences of the three workshops were presented. The state of the three wetlands, with reference to their biodiversity and ecosystem services and especially their value to the local communities were also discussed. The outputs (the Guidelines, Posters and the Policy Brief) were formally released by Dr S. Ayyappan, Director General of the Indian Council of Agricultural Research, New Delhi. The Secretary, Ministry of Water Resources and the Additional Secretary, Ministry of Environment, Forests and Climate Change, who could not join the workshop's opening session at the last moment due to meetings with the Ministers, were also apprised of the workshop findings and publications.

On the second day, project partners and a few resource persons met to discuss the project activities, preparation of the Report, and plans for future.

Figure 14. Dr A. Ayyappan, Director General, ICAR, releasing the policy brief in New Delhi on 9 June 2015.

4.0 Conclusions

Capacity building refers to the improvement in the ability of individuals to perform their functions effectively and efficiently towards achieving their goals. It requires a better understanding of the wider perspective of their subject. It is not the ability to do something themselves but to appreciate what needs to be done, how can it be done. For example, in case of wetland conservation one cannot expect a researcher, a manager or a policy maker to be an expert in examining all components of the biodiversity of a wetland or to assess or valuate all kinds of ecosystem services. However, it is necessary that they understand the different components of wetland biodiversity, their roles in the functioning of wetlands and their contribution to various ecosystem services so that they take care of these components in their research, management plans and development plans. For a policy make it is not enough to consider the fish without caring for their food organisms, and similarly, a researcher cannot interpret the dynamics of plankton or invertebrates without keeping in mind the role of predation by fish.

Thus, the project succeeded in bringing together a wide range of stakeholders, from young researchers to high level policy makers and experienced scientists and managers as well as the local communities. The project generated great interest even outside India and Nepal as many people from neighbouring countries expressed interest in participation, and a few indeed participated. The US Forest Service asked their scientist, Dr Gordie Reeves, a freshwater specialist, to attend the workshop in Nepal during his visit to USAID-Nepal. Even the Ramsar Convention took notice of the capacity building activity and deputed is senior Regional Adviser, Asia-Oceania, Dr Lew young who joined the first workshop for two days (including the field work in Kholsi beel). It is noteworthy that about 120 participants and also some resource persons attended the workshops on their own costs, and the local communities willingly and actively joined in the interactions besides providing logistic support for field studies. The project was successful to a great extent in its communication and dissemination activity, thanks to the support of the APN staff also.

We are sure that the presentations made at the three workshops 'enhance the understanding of the ecosystem services of wetlands in relation to their significant biodiversity' among the participants. Another objective of the project was related to the capacity for assessment of biodiversity and associated ecosystem services. We are aware of the statement by the CBD/Ramsar (2006) in their guidelines for the rapid assessment of biodiversity that

"*The complex nature and variability of wetland ecosystems means that there is no single rapid assessment method that can be applied to the wide range of wetland types and for the variety of*

different purposes for which assessments are undertaken. Furthermore, the extent of what is possible in a given case will depend on the resources and capacities available".

Seen in this context, and within the limitations of time (just three days), the project could certainly communicate the methods available for the for assessment of wetland biodiversity. The season, time of the day and the place were also important factors in determining what can be observed in the field. Further, it requires longer-term hands-on practice to understand and appreciate the diversity. It should be appreciated that the policy makers and managers at middle or senior level cannot spare enough time away from their work for intensive training. Special efforts have to be made to get even the junior level officers for adequate training and capacity building by providing them long leave and financial support.

Monitoring the changes in biodiversity requires its assessments at frequent intervals – from days to a year – depending upon the purpose, the group of organisms, and he nature of anthropogenic impacts. This was explained to the participants during presentations and discussions in the field. Similarly, the assessment of ecosystem services and their valuation were also covered in the presentations, and discussed in the field. The three wetlands visited in the field had different biodiversity components of major interest o the local community who also recognised different kinds of problems. In Kholsi beel fisheries were the major services of the system, together with the provision for water. The role of other biota in sustaining the fisheries was also recognised though excessive growth of macrophytes in shallow areas was seen as a problem. The community recognised the siltation and loss of hydrological connectivity as major degrading factors. Proper land use management in the catchment and on the island in the middle of the beel was seen as a mitigating solution. An integrated management plan developed by the CIFRI scientists is under discussion with the community (see Poster in the appendix).

Deepor beel has undergone huge changes over decades. It lies close to the river Brahmaputra, to the capital city of Guwahati, and also to the airport. Roads and railways cross the wetland which has shrunk in size enormously. There are encroachments for housing and industrial activity, garbage dumping and many other problems. Yet it is a Ramsar site and a part is the wildlife sanctuary for its very high biodiversity. Local communities depend heavily upon fisheries, paddy cultivation and many plant resources. The communities value the provisioning services most though they recognise its cultural and recreational (ecotourism) values also. The community is conscious of the regulation of its hydrological connectivity with the river and the impacts of human activities. It was felt that a detailed assessment of ecosystem services and their valuation will greatly help adopt appropriate policies for the conservation of Deepor beel.

Nagdaha lake near Kathmandu is like the Deepor beel a periurban wetland but quite small and impacted by the urban development, agriculture and erosion in its catchment. As opposed to the other two wetlands with greater importance of fisheries, Nagdaha wetland is valued by the community most for recreational use (boating). Though bathing, washing and cleaning are common uses but the community views them as polluting activity that are sought to be regulated. The community makes effort to keep the water clear of macrophytes and pollution by constructing wall all around the lake with an eye on boating requirements. Hydrological impacts of the retaining wall and catchment activities are not clear. The location of a temple on the shore adds to its cultural value.

These biodiversity and ecosystem services were discussed with the participants in detail to bring ou the large variety of situations and the importance of following a participatory approach to take along the local community for sustainable management.

The Guidelines provide the methods for rapid assessment though some groups of plants and animals cannot be easily identified in the field even up to a higher taxic level (order or family). We hope these methods can be reviewed, improved and elaborated in due course of time. Similarly, the Policy Brief has been widely disseminated through the web but needs to be brought to the attention of

policy makers and managers through many short meetings where examples of local wetlands can be discussed. We feel the need for a larger policy document with many case studies of different kinds of wetlands.

Finally, the project initiated an online network that can provide a database of individuals and instiuturions/organisations engaged with or interest in an aspect of biodiversity, any ecosystem service and any kind of wetland anywhere in Asia. It is for the individuals to populate it and use it for exchanging information and resources related to wetlands. All outputs of the project will be placed on the website of the network.

5.0 Future Directions

We are aware of the limitations of our project activities conducted within a short period and in a small part of the East Himalayan region which itself has enormous diversity. We need to understand the diversity of wetlands across the country and in different climate zones, with different socio-economic, cultural milieu, and we need to reach out to policy makers and resource managers at national level in all countries of the region. Therefore it is necessary to conduct many more similar exercises. I may be re-emphasised that "no single rapid assessment method can be applied to the wide range of wetland types" (CBD/Ramsar 2006).

We wish to emphasise that the European Union recognises that "the current scientific knowledge and empirical evidence does not provide a robust basis to make definite statements about whether securing the provision of ecosystem services will also guarantee biodiversity conservation, and vice versa" (http://www.connect-biodiversa.eu/). Hence, studies on comprehensive economic valuation of ecosystem services are urgently required to convince policy makers and integrate them into the national policies.

We hope that the project results can be further improved and expanded geographically with the following activities:

- The web-based network of individuals and organisations (including NGOs), along with a database of available methods for biodiversity and ecosystem services assessment, should be strengthened and continued for communication without barriers.

- The Guidelines for rapid assessment of biodiversity and ecosystem services may be periodically revised and elaborated with further experience. The guidelines may be adapted by the NGOs if required.

- Many short meetings should be arranged for policy makers and managers where examples of local wetlands may be discussed to sensitise them to need for taking wetlands into consideration. This could be done through a larger project involving a larger number of institutions and NGOs to cover a wider range of wetland types in different parts of South Asia over a 2-3 year period.

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Appendix

LIST OF APPENDICES *(These are compiled in a separate file)*

A1. Report of the Project Inception Workshop with Programme and List of Participants

A2. Circular & application form inviting participants, and the feedback form

A3. Report of the First Capacity Building Workshop with Programme and List of Participants

A4. Report on Kholsi Beel visited during Kolkata Workshop

A5. Report of the Second Capacity Building Workshop with Programme and List of Participants

A6 Report of the Third Capacity Building Workshop with Programme and List of Participants

A7. A student participant's report on field visit to Nagdaha (Kathmandu)

A8. Copy of the Certificates issued to the participants

A9. Report of the Policy Workshop with Programme and List of Participants

A10. List of Power Point Presentations at the Workshops

A11. Funding sources outside the APN

A12. List of Young Scientists

A13. Glossary of Terms

Appendix A11. Funding sources outside the APN

There was no direct funding from any other source. However there was huge in-kind support from the partner organisations.

National Institute of Ecology, New Delhi

The project implementing organisation did not receive any project overheads and had to cover all administrative expenses for office assistants, office supplies, communication, etc. The Secretary General Prof. KS Rao spared substantial time for the organisation of inception and Policy workshops in Delhi, and for managing the accounts of the project. The NIE's in-kind contribution is estimated at InRupees 450,000 (=US$ 7500).

Central Inland Fisheries Research Institute (ICAR), Barrackpore, Kolkata

As a partner organisation, the CIFRI took on itself a large share of responsibility in many ways. The Director Prof. A.P. Sharma, provided all required resources of the Institute for the organisation of the Workshop that included free conference facilities, resources for preparing and managing the field visit, taking care of the resource persons, scientists and other participants, providing Institute's Guest House and hostel at nominal rates, and even contributing technically and financially to the preparation of the posters.

The in-kind contribution of the Institute – India's oldest and premier research institute in the field fisheries under the Indian Council of Agricultural Research - is difficult to assess. It has been guess-estimated at InRupees 750,000 (=US$ 12,500).

Kathmandu Usniversuty, Dhulikhel, Kathmandu, Nepal

Kathmandu University provided all basic facilities for holding the workshop - Seminar room, audio-visual facility, and supporting manpower. Besides this, Prof. Sharma devoted considerable time in contacting people, soliciting support and participation, convincing the University to join as a partner and provide free facilities, and of course in preparing for the field visit by making advance survey and contacts with the community. At the cost of taking a risk of underestimating the valuable contribution, the value of in-kind contribution of the University cannot be less than NepRupees 500,000 (=US$ 5000).

University of Delhi, Delhi

The University of Delhi's Botany Department provided facilities for holding the Project's Inception Workshop. The Workshop facilities alone may be estimated at Rs 40,000 or so (= US$ 650).

Appendix A12. List of Young Scientists

The list of young scientists (postgraduate and research students) joining the workshops is indicated separately in the list of participants with the Workshop Reports.

All participants took active part in the field studies. In Kathmandu they were asked to submit short notes about the field observations. Some of them sent these through emails later. These are compiled together in a file separately. One such detailed report has been mentioned in our report above, and the student's report is appended separately.

It is important to note that Ptof. Sharma got the approval of the University that the participation of their students will earn one credit in their course work. This definitely reflects the interest in and success of the workshops and the project as a whole.

The overall feedback was satisfactory. Some are scanned and submitted separately on the CD and in the hardcopy.

Appendix A13. Glossary of Terms

(acronyms and abbreviations)

APN	Asia Pacific Network for Global Change Research
CBD	Convention on Biological Diversity
CIFRI	Central Inland Fisheries Research Institute, Barrackpore, Kolkata (West Bengal)
DFO	Divisional Forest Officer
EU	European Union
ICAR	Indian Council of Agricultural Research, Government of India
IPBES	Intergovernmental Platform for Biodiversity and Ecosystem Services
MOEF-CC	Ministry of Environment, Forests ad Climate Change, Government of India
MOWR	Ministry of Water Resources, River Development and Ganga Rejuvenation, Government of India
NCAR	National Council of Agricultural Research, Government of Nepal
NIE	National Institute of Ecology, India
Ramsar	Ramsar Convention
TEEB	The Economics of Ecosystems and Biodiversity
UNEP	United Nations Environment Programme
UNESCO	United Nations Educational, Scientific and Cultural Organisation
VDC	Village Development Committee
WWF	World Wide Fund for Nature