



# A Manual for an Inventory of Greater Himalayan Wetlands

ICIMOD

FOR MOUNTAINS AND PEOPLE



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The International Centre for Integrated Mountain Development, ICIMOD, is a regional knowledge development and learning centre serving the eight regional member countries of the Hindu Kush-Himalayas – Afghanistan , Bangladesh , Bhutan , China , India , Myanmar , Nepal , and Pakistan  – and based in Kathmandu, Nepal. Globalisation and climate change have an increasing influence on the stability of fragile mountain ecosystems and the livelihoods of mountain people. ICIMOD aims to assist mountain people to understand these changes, adapt to them, and make the most of new opportunities, while addressing upstream-downstream issues. We support regional transboundary programmes through partnership with regional partner institutions, facilitate the exchange of experience, and serve as a regional knowledge hub. We strengthen networking among regional and global centres of excellence. Overall, we are working to develop an economically and environmentally sound mountain ecosystem to improve the living standards of mountain populations and to sustain vital ecosystem services for the billions of people living downstream – now, and for the future.

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We work in over 100 countries to tackle the most pressing problems affecting wetlands. With the support of governmental and NGO members and donors, we promote and demonstrate the positive role that wetlands can play in addressing biodiversity loss, poverty and climate change. Our work ranges from research and community-based field projects to advocacy with governments, corporates and international policy fora and conventions. Wetlands International works through partnerships and is supported by contributions from an extensive specialist expert network and tens of thousands of volunteers.

# A Manual for an Inventory of Greater Himalayan Wetlands

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# Foreword

There is a need in the Hindu Kush-Himalayan region for capacity building in integrated water resource management and for broadly applicable wetland inventory tools to support this. In response to these needs, Wetlands International and the International Centre for Integrated Mountain Development (ICIMOD) have coordinated and implemented the project 'Support for the conservation of high altitude wetlands through application of the Asian wetland inventory approach and stakeholder-led catchment management in Bhutan, China, India and Nepal' supported by the Asia Pro Eco programme of the European Commission. We gratefully acknowledge the important assistance from the EC.

The project focus on wetlands is in line with ICIMOD's emphasis on promotion of sustainable management of natural resources and ecosystem services as a basis for improving peoples' livelihoods and maintaining biodiversity integrity in the Hindu-Kush Himalayan region. Through this document and project output, 'A Manual for an Inventory of Himalayan Wetlands', the project contributes to the strengthening of regional member countries' knowledge-base on wetlands and thus their capacity to make informed decisions on wetland management. This is important not only for local communities and the wetland biodiversity they depend on for their livelihoods, but also for the many downstream stakeholders.

Wetlands International promotes wetland inventorisation as a key activity that should underpin the sustainable use of wetlands and their resources and biodiversity for people around the world. In 2002, Wetlands International pioneered a new approach to assessing wetlands that provided the potential to link inventory information to planning and practice in sectors engaged in water management across Asia – "A Manual for an Inventory of Asian Wetlands". This project has adapted and tested the Manual in the Hindu-Kush Himalayan Region taking into account the unique and challenging conditions found there.

Challenges for wetland inventory regarding classification and delineation are present in all Asian regions; in the greater Himalayan region the specific issues of remoteness and large altitude variations present additional practical challenges to both field and remote sensing methods. We hope that the availability of this Manual will stimulate greater Himalayan countries to undertake inventories to establish the status of their wetlands – so that further habitat loss and degradation do not occur and the greater Himalayan region benefits from wetlands' goods and services. The Manual should also be seen as a means to easily share wetlands inventory experiences within the greater Himalayan region. It is urgent to share lessons-learned, because the time available to people in the region to reach a sustainable level of natural resource use while achieving the development of society they want, is running short.

On behalf of ICIMOD and Wetlands International we would like to thank all teams and individuals involved in the Project and the development and production of this document and in particular our partners in this project: ARGEOPS in The Netherlands and the Centre for Ecology and Hydrology in Wallingford, UK. Furthermore we would like to thank the participants from government and civil society organisations who have contributed to the development of this approach through their encouragement and feedback, most especially from the project focal countries of Bhutan, China, India and Nepal and more widely from those that have contributed as part of the Himalayan Wetlands Initiative Forum,

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ICIMOD

# Preface

Mountain wetlands are globally recognised to be ecosystems under a broad range of pressures that threaten their integrity as significant resources of water and biodiversity, putting the services and products that millions of people depend on at risk. Adding to the problem-picture are issues concerning increasingly erratic precipitation in mountains and an increase in glacier-melt and associated lakes. Combined these are creating increasing risks of landslides and floods downstream which pose grave threats to people's lives and livelihoods, biodiversity and community economy.

The potential negative effects on Himalayan countries' ecology and economy through changes to the mountains' water resources are serious and should prompt governments to immediately initiate remedial action programmes, should these not already be underway. Many wetlands in the Himalayan region extend from one country to another, or, at least, share their catchments between two or more countries. Developing national capacity and action plans for wetland conservation and sharing information within a regional collaboration is urgently needed to minimize the impacts of threats (particularly from climate change).

In recognition of these needs, this manual on wetland inventory has been developed as an output from the project 'Support for the Conservation of High Altitude Wetlands through application of the Asian Wetlands Inventory approach and stakeholder-led catchment management in Bhutan, China, India and Nepal'. The project contributes to the conservation and wise use of high altitude wetlands by providing technical support to and assisting Ramsar Convention regional Contracting Parties. Strategic wetland inventory was identified as a priority activity by Hindu-Kush Himalayan countries participating in the Himalayan Initiative Forum, a regional group of government and civil society representatives working to promote regional cooperation in wetland conservation under this Convention.

The objective of the Greater Himalayan Wetlands Inventory Manual (GHWI Manual) is to contribute to the conservation and management of greater Himalayan wetlands by providing countries with an easily accessible tool for data-collection, on which informed management decisions can be made; for example, to ensure sustainable use of wetland services and to also take preventive action to avoid damage from glacial lake outburst floods. It structures wetland inventory information into a river basin related landscape hierarchy thus enabling wetland functioning and services to be more easily related to the basic units of river basin management – the basin, sub-basins and catchments. Furthermore it links collection and organisation of this information to innovative remote-sensing techniques enabling the delineation and description of wetlands that are otherwise too remote and time-consuming to physically visit.

The GHWI should not be seen as a static document. Updates and improvements on its content should be noted by users and discussed at regional meetings and agreed revisions should be incorporated in a later version. While the GHWI Manual is self-explanatory on the methodology it presents, it is acknowledged that there could be a need in the greater Himalayan member countries for training in wetland inventory techniques and/or a need for lessons-learned exchange opportunities. The availability and use of the GHWI Manual will hopefully boost exchange between countries at all levels towards the development of sustainable wetlands management policy and supporting technical activities.

# Acknowledgements

The GHWI Manual is the result of a partnership between Wetlands International, ICIMOD, ARGEOPS and the Centre for Ecology and Hydrology (CEH) on the project 'Support for the conservation of high altitude wetlands through application of the Asian wetland inventory approach and stakeholder-led catchment management in Bhutan, China, India and Nepal'. Wetlands International has provided overall coordination and technical guidance to the project. ICIMOD has lead and managed technical coordination and implementation in the Hindu-Kush Himalayan region. ARGEOPS in The Netherlands provided technical guidance in remote-sensing techniques. CEH in Wallingford, UK, provided input on risk assessment and integrated water resources management.

Within ICIMOD the Manual is a component of its Integrated Water and Hazards Management (IWHM) and Integrated Knowledge Management (IKM) Programmes. In this respect, many thanks are due to the following ICIMOD staff members: Prof Hua Ouyang, Programme Manager IWHM; Dr Mats Eriksson, Senior Water Specialist; Mr Rajendra Shilpakar, Water Resources Analyst; Mr Pradeep Mool, Remote Sensing Specialist; Mr Sushil Pandey, ICT Specialist; Mr Kabir Uddin, GIS Analyst; Mr Valdemar Holmgren, Wetlands Specialist (Consultant), Mr Santosh Nepal (Research Assistant); Mr Subodh Dhakal, Intern; and Ms Celeste Harris, Researcher. Thanks also to the former ICIMOD staff members Dr Xu Jianchu (Programme Manager, IWHM) and Mr Sushil Pradhan (GIS Specialist).

Within Wetlands International, the Manual's development has been supported through its headquarters office in Ede (HQ), The Netherlands and its South Asia Office New Delhi, India (WISA). Our thanks go in particular to Dr Chris Baker, Head of Programme and Strategy (HQ), Wetlands and Water Resource Management, Ms Ellen Diémé, Technical Officer, (HQ); Dr Chaman Trisal, Director (WISA) and Mr Ritesh Kumar, Sr Technical Officer (WISA).

Within ARGEOPS in The Netherlands thanks in particular go to Mr Leon Schouten and Mr Eric Van Valkengoed for supporting the application of suitable remote-sensing techniques to complement the Asian Wetland Inventory approach and the needs in the region.

Within CEH thanks in particular go to Prof Mike Acreman, Dr Gwyn Rees, and Dr Charlie Stratford.

ICIMOD is particularly pleased that the project has enabled a strengthening of collaboration with the Government of Nepal's Department of National Parks and Wildlife Conservation (DNPWC). Thereby, our thanks go to Mr Jhamak B Karki, Under Secretary, DNPWC, Government of Nepal, for facilitating national support to the project. Many thanks go also to our regional colleagues Mr Bao Daming and Mr Yan Chenggao, The Convention on Wetlands Management Office, State Forestry Administration, PR China; Dr Siddharth Kaul, Ministry of Environment and Forest, Government of India, and Mr Raling Nawang Drukdra, Department of Forests, Ministry of Agriculture, Bhutan for continuous support and constructive contributions to the project.

Our sincere thanks go to the European Union Asia Pro Eco programme, particularly to Mr Vikram Roy, Adviser, European Union, New Delhi, for co-funding the project. The project received recognition and support from the Ramsar Secretariat, we express our gratitude to Dr Guanchun Lei, former Senior Advisor, Asia Pacific, Mr Denis Landenbergue, Manager, and Ms Pragati Tuladhar, Technical Officer at the Ramsar Secretariat.

The project is grateful to all Wetlands International and ICIMOD colleagues who have assisted in various ways with the finalisation of this manual in particular the former ICIMOD Director General, Dr J Gabriel Campbell and Wetlands International Head of Programme Dr Doug Taylor for supporting the beginning of this project and Dr Andreas Schild, present Director General of ICIMOD, for his continued encouragement, and the staff of the Publications Unit who brought the project to its conclusion. Should someone have been overlooked in being mentioned here, please know that your contribution was really appreciated!

# Executive Summary

This document, the Manual for Inventory of Greater Himalayan Wetlands or GHWI Manual, has been developed to assist governments, professionals, and the public to identify wetlands of national and international importance, and to serve as a basis for prioritising their conservation in conjunction with sustainable management of natural resources, in particular, water, fisheries and forestry, and national development initiatives. There is a broad and growing consensus that wetlands are critically important ecosystems that provide locally and globally significant social, economic, and environmental benefits. Wetland inventory implementation is promoted by the Ramsar Convention (RCS 2006) as a means to

- identify the function and values of wetlands, including ecological, social and cultural values;
- establish a baseline for measuring future change in wetlands' functions and values;
- identify where wetlands are and which the priority sites for conservation are;
- provide a tool for planning and management at both practical and/or political levels; and
- allow comparisons between wetlands and management procedures at different levels of management (local, national, and international).

Furthermore, a wetland inventory can provide information to support national programmes and reporting requirements for other international treaties, such as the conventions on biological diversity, migratory species, desertification, world heritage, and climate change. Thus, a wetland inventory can supply information for many purposes and involve many different stakeholders. It is essential that any inventory provides information in a format readily usable by key stakeholders, and thus important that users of the information are consulted before any inventory is developed and implemented. The purpose of a wetland inventory and the manner in which the information will be used should be agreed between stakeholders before data collection commences.

The methodology for wetland inventory outlined in this manual uses a strategic and hierarchical approach of four levels to collect information. It is based on the Asian Wetland Inventory (AWI) developed by Wetlands International. The methodology also takes advantage of new technologies of data acquisition (e.g., remote sensing), storage, and dissemination. These provide an effective tool for collecting information for the management of natural resources derived from, or dependent on, wetlands and for meeting national obligations under international agreements.

Entry and management of inventory data at Levels 1 (river basin) and 2 (sub-basin) can be done by a regional or national organisation, whereas Level 3 (wetland complex) and Level 4 (wetland habitats) should be the responsibility of individual national agencies and organisations, see Chapter 3. The system is developed in such a way that Level 3 and Level 4 data can be hosted by the country itself according to capacity. On-site field data collection at Levels 3 and 4 can be achieved with the simple means of a pen and the data sheets provided in Annex 2.

The four-tiered data-collation and mapping levels for wetland inventory presented in this Manual are suggested to lie within the following map scales:

- 1 1: 500,000 to 1:1,000,000 scale maps for major river basins
- 2 1:250,000 to 1:500,000 scale maps for sub-basins
- 3 1:25,000 to 1:250,000 scale maps for wetlands complexes
- 4 1:5,000 to 1:25,000 scale maps for wetland habitats

With regard to computer-based data management, an interactive GIS-based dynamic web-system (the Greater Himalayan Wetlands Information System, GHWIS) has been developed by ICIMOD to visualise the complete wetland database. The system contains common GIS functionalities such as query, pan, zoom, and export, and has been developed using the open source internet mapping software MapServer. The database is linked to the metadatabase and both are integrated with the web mapping tool to serve derived map products. As of 2008, the GHWIS is under development (beta version) and hosted by ICIMOD, see Chapter 4.

The key features of the GHWI methodology are to apply a hierarchical and scalar framework to standardised categories of data including bio-geographical, socioeconomic, and cultural values of the wetland ecosystems. The framework links the mapping scales and the possible level of detail of data, while, where necessary, map production is made using secondary sources and remotely-sensed satellite data. A summary is provided of potential satellite data types applicable for wetlands resources mapping.

Although the Ramsar wetland classification is useful to provide a broad framework for rapid identification of the main wetland habitat types, it is recommended to use standard hierarchical national/regional land use and land cover classification schemes to complement the Ramsar typology. An international standard hierarchical classification system such as the FAO Land Cover Classification can also be used for wetland classification.

The Manual is prepared as follows. The main text is preceded by an Introduction (Chapter 1) and a description of the Aims (Chapter 2), the Methods (Chapter 3), and the Information Management System developed for the Inventory (Chapter 4). The largest part of the Manual is dedicated to Chapter 5 which provides step-by-step guidelines, with examples, for data collation at each hierarchical level. The associated data collection sheets for each level are presented in Annex 2.

## Acronyms and Abbreviations

AWI	-	Asian Wetland Inventory
DEM	-	digital elevation model
FAO	-	Food and Agriculture Organization
GHWI	-	Greater Himalayan Wetlands Inventory
GHWIS	-	Greater Himalayan Wetlands Information System
GIS	-	geographic information system
ICIMOD	-	International Centre for Integrated Mountain Development
IUCN	-	International Union for the Conservation of Nature
IWMI	-	International Water Management Institute
MA	-	Millennium Ecosystem Assessment
MODIS	-	Moderate Resolution Imaging Spectro-radiometer
NOAA	-	National Oceanic and Atmospheric Administration
Ramsar	-	The Ramsar Convention on Wetlands (Ramsar, Iran, 1971)
SRTM	-	Shuttle Data Topographic Mission
UNEP	-	United Nations Environment Programme
UTM	-	Universal Transverse Mercator
WCMC	-	World Conservation Monitoring Centre
WRI	-	World Resources Institute

