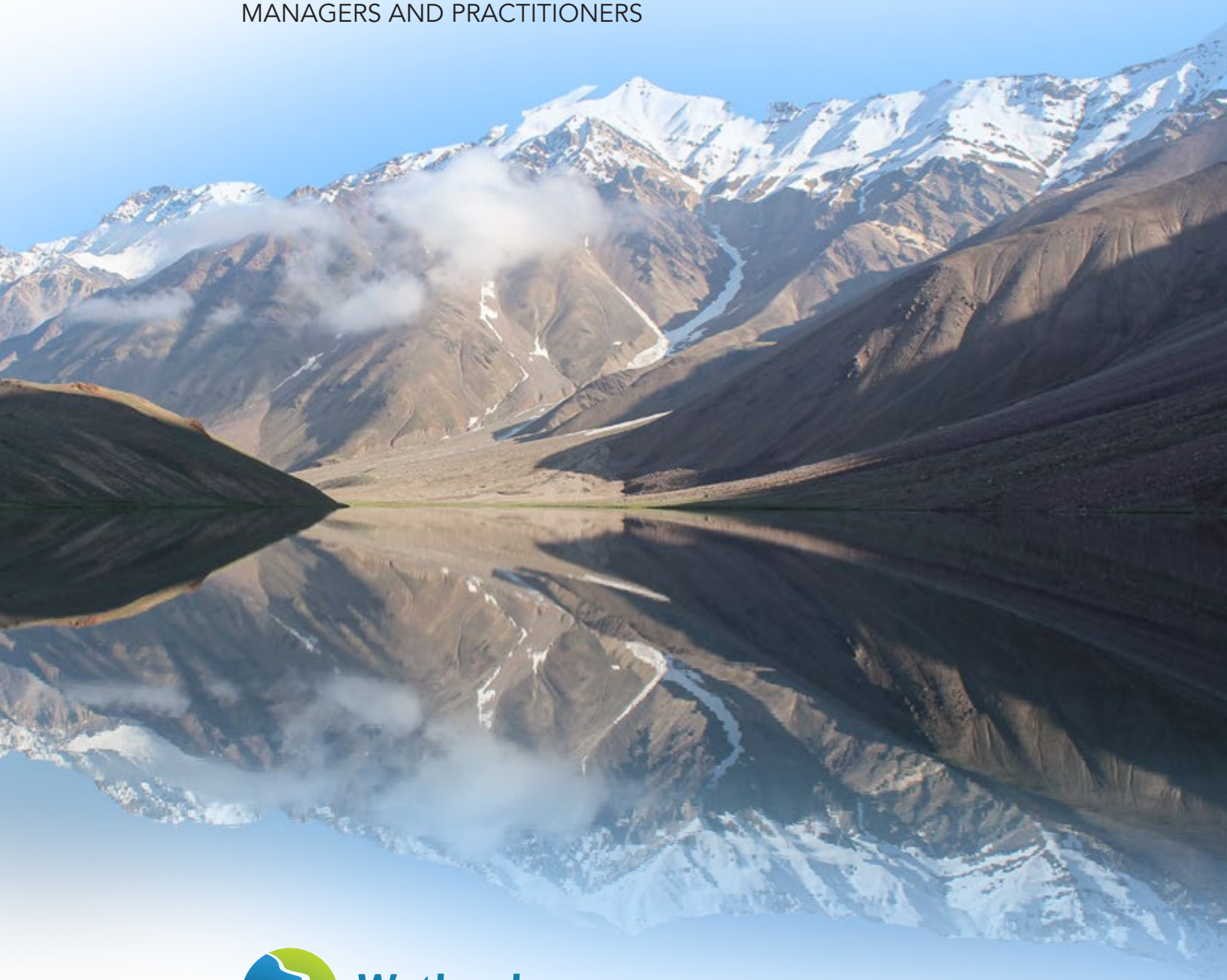
Ministry of Environment, Forest and Climate Change

MANAGEMENT OF **HIGH-ALTITUDE WETLANDS**

A GUIDEBOOK FOR WETLAND MANAGERS AND PRACTITIONERS



Wetlands INTERNATIONAL

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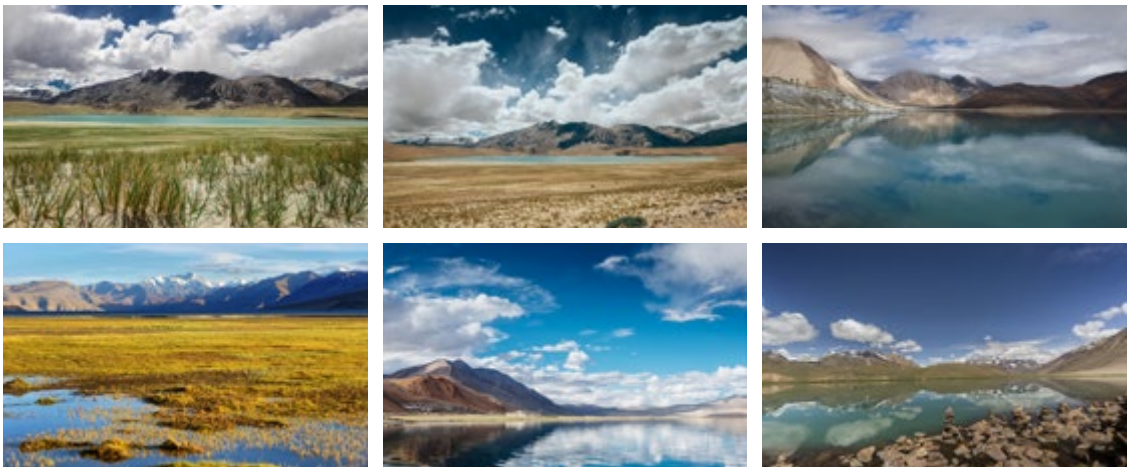

A GUIDEBOOK FOR WETLAND MANAGERS AND PRACTITIONERS

Wetlands International South Asia

मंजु पाण्डे
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Message

The High-Altitude Wetlands of the Himalayas are unique and sensitive wetland ecosystems which play a critical role in moderating the water regimes, the climate system and providing habitat for diverse species. Several migratory birds depend on these wetlands to complete their annual sojourn between the temperate and tropical regions. Ensuring that these wetlands remain healthy and well conserved is critical not only for the Himalayan region, but also for regional and global biodiversity. Yet, these ecosystems are under threat from intensified tourism, infrastructure development, grazing pressures and climate change.

Wetlands conservation is a high priority for the Ministry of Environment, Forest and Climate Change and a central government scheme to support state governments in formulating and implementing management plans for priority wetlands has been in operation since 1986.

Integrated management of wetlands, with due consideration to their biodiversity and ecosystem processes, as well contribution to developmental objectives, is the need of the hour. Governance mechanisms have to be capable of coordinating actions of multiple sectors and stakeholders. The state of any wetland is linked to management of the landscape within which it is located.

While framing management plans for High-altitude Wetlands, we need to take into account the role these wetlands play in sustaining biodiversity and cultural values as well as hydrological regime regulation within landscapes. As these wetlands are very sensitive to anthropogenic disturbances, they need to be monitored closely and systematically.

I am pleased that Wetlands International South Asia team has unpacked the nuances of management of High-altitude Wetlands in this guidebook, covering aspects of setting up a management planning process, developing an integrated management plan, implementing management, and review and adaptation. The guidebook also contains sections on designating these wetlands to the List of Wetlands of International Importance under Ramsar Convention, as well as notification under the Wetlands (Conservation and Management) Rules, 2017. All of these aspects form core elements of the Ministry's National Plan for Conservation of Aquatic Ecosystems (NPCA) under which state governments can access funds for wetlands conservation, on the basis of integrated management plans.

I encourage all State Wetlands Authorities, site managers and stakeholders of the Himalayan States to make use of this guidebook in designing and implementing management plans for high-altitude wetlands.

Sep. 01, 2021

(Manju Pandey)

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PREFACE

High-Altitude Wetlands are unique ecosystems in the snow-clad areas which are 3,000 meters or more above the mean sea level and are glacial in origin. These ecosystems are important sources of freshwater for many rivers and have cultural value for local people. Several of these wetlands are also breeding areas for number of resident and migratory birds which are specific to this region. The near pristine ecological state of the wetlands renders high sensitivity to anthropogenic stressors, such as intensifying tourism and unregulated landuse land cover change.

The value of High-Altitude Wetlands for water security deserves specific attention. This is especially as at least 1.1 billion people in India are without access to safe drinking water, and the situation is only projected to worsen with a changing climate. The role of wetlands in ensuring water and climate security is yet to be accorded high priority in national policies and programmes.

Given the fact that most of the impacts of climate change in the country would be water mediated, the role of High-Altitude Wetlands conservation acquires high significance especially their integration into conservation and development planning at river basin scale. While several guidelines have been developed for managing different aspects of wetlands conservation, their application in the context of High-Altitude Wetlands needs careful consideration.

This guidebook, developed by Wetlands International South Asia, based on experiences of work in the Himalayan region will be useful for all interested in conserving the wetlands nested within the lap of mighty Himalayas. We look forward to receiving feedback from the users of this document, which will help us to improvise and update the guidebook.

Dr Sidharth Kaul

President

FOREWORD

High-Altitude Wetlands represent a category of highly sensitive and fragile ecosystems, which despite being studded deep in the Himalayan region, play a significant role in keeping the rivers flowing and mitigating and adapting to climate change. Ensuring that these wetlands do not fall prey to economic development is crucial for ecological and economic security of the entire Himalayan region.

In the recent times, there have been several important developments related to wetlands conservation in India. In 2017, the Wetlands (Conservation and Management) Rules were enacted and it is desired that all-natural wetlands of the country are notified and regulation structured as per the Rules. The MoEFCC has also introduced guidelines for management planning of wetlands, with an emphasis on converging the full range of wetlands ecosystem services and biodiversity values in developmental planning at levels. The application of these guidelines and regulatory framework needs careful attention in the case of High-Altitude Wetlands for several reasons, including the fact that active management may not be required and relevant for several of these wetlands which are still in pristine conditions. While the core focus of this guidebook is on formulation of integrated management plans for High-Altitude Wetlands, aspects of management implementation, review and adaptation, notification under the Wetlands (Conservation and Management) Rules, 2017 and Ramsar site designation are also discussed.

Guidebooks are a reflection of existing knowledge and best practices, and thereby are inherently dynamic. We therefore intend to keep this guidebook as a living document, and update based on feedback received from user groups, emerging lessons and best practices and new knowledge on the High-Altitude Wetlands of India.

This guidebook has been developed under the GEF-MoEFCC-UNDP supported SECURE Himalaya project, wherein Wetlands International South Asia was entrusted with preparation of management plan for key high-altitude wetlands of Sikkim and Himachal Pradesh, and was requested to develop a standard operating procedure for management planning for these wetlands which could be relevant to the entire country. The draft underwent an extensive review by Wetlands Authorities and Forest and Wildlife Departments of Himalayan states and UT, as well as by several organizations working in different conservation issues in the Himalayan region. A national consultation was held jointly by UNDP and Wetlands International South Asia on November 20, 2020, wherein the guidebook was presented and discussed with MoEFCC's wetlands and wildlife divisions and state government representatives.

Conservation of high-altitude wetlands is a priority for Wetlands International South Asia. The organization looks forward to working with MoEFCC, state and union territory governments, research agencies, local communities and civil society organizations to ensure that the pristineness of these ecosystems is ensured. This guidebook is expected to catalyse efforts in this direction.

ACKNOWLEDGMENTS

We are grateful to the Ministry of Environment, Forest and Climate Change, Government of India and United Nations Development Programme for entrusting Wetlands International South Asia to develop this guidebook on management of High-Altitude Wetlands for wetland managers and practitioners.

We highly value the feedback from Mr Soumitra Dasgupta, Additional Director General of Forest (Wildlife); Ms Manju Pandey, Joint Secretary (Wetlands Division); Mr Jigmet Takpa, Joint Secretary & UNCCD National Focal Point; Dr Amit Mallick, Inspector General of Forest on the guidebook. We also thank Mr Bharat Lal, Additional Secretary, Department of Drinking Water and Sanitation, Ministry of Jal Shakti for highlighting cross-sectoral management needs of HAW. We thank Dr Savita (Principal Chief Conservator of Forests - HoFF, Himachal Pradesh Forest Department) for advising Wetlands International South Asia to develop this guidebook for wetland managers and practitioners.

We sincerely thank the Board Members of Wetlands International South Asia for guiding us while writing the guidebook. Special mention is made of the support and guidance received from Dr Sidharth Kaul (President, Wetlands International South Asia) for valuable insights into High-Altitude Wetlands ecosystems and management needs.

We thank Dr Ruchi Pant (Head NRM & Biodiversity, United Nations Development Programme) for commissioning the assignment and extending support in development of this guidebook.

We express our sincere thanks to Mr Rob McInnes (Director, RM Wetlands & Environment Ltd), Late Dr R S Rawal (Former Director, GB Pant Institute of Himalayan Environment & Development) and UNDP-India (SECURE Himalaya team) for reviewing the guidebook and suggesting improvements. We thank all the participants of the virtual consultation held in November 2020 for providing feedback and comments on the document. The suggested editions have been duly incorporated in the guidebook.

We express our gratitude towards the members and officials of State Wetlands Authority, Forest Department, Science & Technology Department for sharing valuable information and insights from the Himalayan region which helped us in contextualising the guidebook as per the need of target audience.

We are grateful to GB Pant Institute of Himalayan Environment & Development, Wildlife Institute of India, Zoological Survey of India, Botanical Survey of India, Nature Conservation Foundation and World Wide Fund for Nature (WWF) for providing technical inputs on status and trend of key HAW and their governing features.

Last but not the least, we are thankful to the leaders of Panchayat Raj Institutions and Dzumsa (in Sikkim), members of local community based organisation and civil society organisations for sharing their perspective and opinions on management of HAW. Field interactions with the local wetland custodians helped us in infusing participatory approaches in this guidebook.

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ABBREVIATIONS

AMSL	Above Mean Sea Level
BOD	Biological Oxygen Demand
CAF	Central Asian Flyway
CBD	Convention on Biological Diversity
CEPA	Communication, Capacity Building, Education, Participation and Awareness
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CBO	Community Based Organisation
CSO	Civil Society Organisation
CBO	Community Based OrganisationCPCB Central Pollution Control Board
CPCB	Central Pollution Control Board
DEM	Digital Elevation Model
DO	Dissolved Oxygen
DDMP	District Disaster Manangement Plan
DWC	District Wetland Committee
EC	Electrical Conductivity
ECD	Ecological Character Description
GHG	Green House Gases
GIS	Geographic Information System
GLIMS	Global Land Ice Measurements from Space
GLOF	Glacial lake outburst flood
GOI	Government of India
GPS	Global Positioning System
HAW	High-Altitude Wetland
HCVA	High Conservation Value Area
ICIMOD	International Centre for Integrated Mountain Development
IHR	Indian Himalayan Region
IMD	India Meteorological Department (Department of Earth Sciences, Government of India)
IUCN	International Union for Conservation of Nature
LAC	Limit of acceptable change
LISS	Linear Imaging Self Scanner
LULC	Land use Land cover
MCM	Million Cubic Meter
MOEFCC	Ministry of Environment, Forest and Climate Change
NPCA	National Plan for Conservation of Aquatic Ecosystems
RAWES	Rapid Assessment of Wetland Ecosystem Services
R-METT	Ramsar Site Management Effectiveness Tracking Tool
PRI	Panchayat Raj Institutions
PSS	Pokhri Sanrakshan Samiti
SAC	Space Applications Centre
SAPCC	State Action Plans On Climate Change
SWA	State Wetlands Authority
TDS	Total Dissolved Solids
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UV	Ultra violet
WIAMS	Wetlands Inventory, Assessment and Monitoring
WII	Wildlife Institute of India
WRIS	Water Resources Information System
WWF	World Wide Fund for Nature
ZSI	Zoological Survey of India

Introduction

ABOUT THIS GUIDEBOOK

Nested in the high Himalayas, the high-altitude wetlands (HAW) are unique ecosystems which play an important role in providing water, food and climate security and cultural identity to the entire Indian Himalayan region and beyond. These wetlands sustain biological diversity by providing crucial habitats to a range of species, including migratory birds which depend on these ecosystems to complete their annual sojourn between the tropics and the temperate regions. Given the fact that most of the impacts of climate change in Himalayan region would be water-mediated, the role of HAW demands urgent attention and integration into climate change and other sectoral strategies.

Conservation and wise use of wetlands figure prominently under various Indian national policies, programmes and action plans, such as the National Environment Policy (2006), National Water Policy (2012), the National Action Plan on Climate Change (2008) and its various missions, the National Biodiversity Action Plan (2008 with Addendum in 2014), the National Wildlife Action Plan (2017), and the National Action Plan for Conservation of Migratory Birds and their Habitats along Central Asian Flyway (2018-2023) to mention a few. Wetlands conservation also contributes to India's commitment under multi-lateral environment agreements such as the Ramsar Convention on Wetlands, the Convention on Biological Diversity, the Convention on Migratory Species (Bonn Convention), the 2030 Agenda for Sustainable Development Goals, the Paris Agreement under United Nations Framework Convention on Climate Change, and the Sendai Framework on Disaster Risk Reduction (Box 1 and 2).

The Ministry of Environment, Forest and Climate Change (MoEFCC) is the nodal agency within the Government of India for policy and programming aspects of wetlands. The goal of the Ministry's National Wetlands Programme (titled the National Plan for Conservation of Aquatic Ecosystems, NPCA) is to 'develop and maintain a network of healthy wetlands which contribute to human well-being through their diverse ecosystem services, as well as sustain diversity and populations of wetland-dependent species'. The programme's purpose is "to mainstream the full range of wetlands biodiversity and ecosystem services within developmental plans and programmes at various levels". India is also a signatory to the Ramsar Convention of Wetlands, and has committed to wise use of all wetlands in her territory.

The MoEFCC has identified integrated management planning of wetlands as a tool to enable cross-sectorally coordinated action for conservation of wetlands. A framework for management planning based on diagnostic evaluation of wetlands has also been recommended within the guidelines for the National Wetlands Programme.

HAW are distinct wetland types, having high sensitivity to climatic changes, very limited human presence, unique biodiversity forms, hydrological regimes influenced by glacial action, and limnology reflecting the composition and weathering pattern of local geologies. The diagnostic wetland evaluation, as recommended in the national guidelines, may need a different approach in the context of HAW, given limitations of data availability for several aspects. Furthermore, a careful consideration needs to be given to analyse whether or not management intervention is required in these wetlands, as the natural processes governing these ecosystems take place at a very large scale (such as cryosphere level changes influencing hydrological regimes), and direct anthropogenic pressures, as is common with wetlands located in the lower elevations, are very limited.

The Government of India (GoI) and United Nations Development Programme (UNDP), with support from the Global Environment Facility, are implementing a new programme in the high altitude Himalayas titled "SECURE Himalaya - Securing livelihoods, conservation, sustainable use and restoration of high range Himalayan ecosystems", to ensure conservation of locally and globally significant biodiversity, land and forest resources in the high Himalayan ecosystem, while enhancing the lives and livelihoods of local communities. The ambit of the project includes supporting formulation of integrated management plans for high conservation value HAW. This guidebook has been prepared under the aegis of this programme, to enable those responsible for managing HAW in translating the national guidelines and available best practices in setting up and implementing an

NESTED IN THE HIGH HIMALAYAS, THE HIGH-ALTITUDE WETLANDS (HAW) ARE UNIQUE ECOSYSTEMS WHICH PLAY AN IMPORTANT ROLE IN PROVIDING WATER, FOOD AND CLIMATE SECURITY AND CULTURAL IDENTITY TO THE ENTIRE INDIAN HIMALAYAN REGION AND BEYOND.

effective wetland management programme.

This guidebook provides practical illustration of various steps for integrated management planning of HAW. Following aspects are covered:

- Understanding the management context
- Setting up a management planning process
- Formulating an integrated management plan
- Implementing an integrated plan
- Reviewing and evaluating management effectiveness
- Designation of HAW to the List of Wetlands of International Importance under the Ramsar Convention
- Notifying HAW under Wetlands (Conservation and Management) Rules, 2017

TARGET AUDIENCE

This guidebook has been developed keeping in view the needs of wetlands managers entrusted with the task of formulating and implementing integrated management plans, and the Wetlands Authorities of the Himalayan States and Union Territories responsible for reviewing and approving these plans. The guidebook also focuses on the need of MoEFCC's National Wetlands Programme (NPCA).

These guidelines will also be useful for:

- Local site-based entities who participate in management planning process (Civil society organisations (CSOs), Local Panchayat Committees, Private sector)
- Knowledge institutions who provide data and information on HAW
- Government agencies which implement programmes related to HAW
- GoI Ministries which provide funding support to implementation of management plan
- Other National and International private and government funding agencies

GUIDEBOOK STRUCTURE

This guidebook is structured in seven sections:

SECTION 1

HAW: the management context - contains an introduction to HAW, their values, threats and management needs, and management principles and approaches.

SECTION 2

Setting up a management planning process - contains an introduction to management planning process, stakeholder involvement, and communication strategy.

SECTION 3

Developing an integrated management plan - elaborates a diagnostic approach and step-by-step guidance on preparation of a management plan.

SECTION 4

Implementing management - contains discussions on the ways in which intersectoral coordination can be achieved, activities phased and different stakeholders informed of management plan implementation progress.

SECTION 5

Reviewing and evaluating management - elaborates steps for assessing management effectiveness and adapting management plans.

SECTION 6

Designating High-Altitude Wetlands as Ramsar Sites - provides information on designating HAWs to the list of Wetlands of International Importance under the Ramsar Convention.

SECTION 7

Notifying High-Altitude Wetlands under Wetlands Rules, 2017 - elaborates steps for notification of HAW under Wetlands (Conservation & Management) Rules, 2017 under the Environment (Protection) Act, 1986.

BOX 1. HIGH-ALTITUDE WETLANDS AND SUSTAINABLE DEVELOPMENT GOALS

The 2030 Agenda for Sustainable Development built around 17 goals and 169 targets provide a comprehensive roadmap for a sustainable future. India has expressed complete alignment of national developmental agenda with the SDGs in statements to the High-level Political Forum on Sustainable Development.

The wise use of HAW directly contributes to the following goals and targets:

- SDG 1.1 – HAW can provide opportunities for poverty reduction through sustainable tourism and other options
- SDG 1.5 – Well conserved HAW can build resilience of mountain communities to climate-related extreme events
- SDG 6.6 – HAW management directly contributes to protection and restoration of water-related ecosystems.
- SDG 8.9 – HAW can support implementing policies for sustainable tourism
- SDG 11.4 – Well conserved HAW contributes to safeguarding cultural and natural heritage
- SDG 13.1 – HAW conservation directly contributes to strengthening resilience and adaptive capacity to climate-related hazards and natural disasters (such as GLOFs)
- SDG 15.1 – HAW conservation and wise use is in line with international agreements such as the Ramsar Convention, CMS and CBD.
- SDG 15.4 – HAW is an integral part of conservation of mountain ecosystems and their biodiversity.

BOX 2. HIMALAYAN WETLANDS INITIATIVE

In order to promote regional cooperation for the conservation and wise use of the wetlands in the greater Himalayan region, a series of regional meetings and workshops (Urumqi, 2002; Kathmandu, 2003; Sanya, 2004; Evian, 2004; Delhi, 2006 and Changwon, 2007) have been organized since 2002 by WWF, Wetlands International and ICIMOD which took the form of a 'Himalayan Wetlands Initiative' forum. Through these meetings, a regional dialogue was established with governments in the region, inter-governmental organizations such as Ramsar Convention Secretariat and International Centre for Integrated Mountain Development (ICIMOD), international environmental organizations (WWF International, Wetlands International, and IUCN), as well as universities, academic institutions and civil society partners.

Constructive and participatory process promoted by the forum resulted into a common agreement to gain the forum as a formal regional initiative of Ramsar Convention. In 2005, Ramsar COP9 officially recognized 'Himalayan Wetlands Initiative' as an important potential regional initiative defined by Ramsar Resolution VIII.30, and has encouraged this initiative to be further developed for its official recognition towards Ramsar COP10 in 2008. The dialogue however has been stalled due to geo-political differences and the Ramsar regional initiative on Himalayas remains in a draft stage.

FURTHER READINGS

Ramsar brochure - Scaling up wetland conservation, wise use and restoration to achieve the Sustainable Development Goals, 2018 https://ramsar.org/sites/default/files/documents/library/wetlands_sdgs_e_0.pdf

Review of the Himalayan Wetlands Conservation Initiative by Guangchun Lei (Ramsar Convention Secretariat) for Asia Regional Meeting, Beijing, China, May 2005. https://www.ramsar.org/sites/default/files/documents/library/mtg_reg_asia2005_ts3a.pdf

SECTION 1

High-Altitude Wetlands

The Management Context

2.1 HIGH-ALTITUDE WETLANDS AND THEIR DISTRIBUTION IN INDIA

High-Altitude Wetlands (HAW) is a generic term used for wetlands located at an elevation of 3,000m amsl and beyond. As defined by the Ramsar Convention, wetlands are 'areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres'.

In India, HAW are located within the higher reaches of the Himalayas (in the Middle, Greater and Trans-Himalayan regions) - in Jammu and Kashmir, Ladakh, Himachal Pradesh, Uttarakhand, Sikkim and Arunachal Pradesh. An inventory of HAW prepared by the Space Application Centre in 2011 based on 2006-07 satellite images has indicated presence of 4,699 wetlands spanning 0.13 million ha in area (Fig 1). A majority (42%) of these wetlands are less than 2.25 ha in area. This inventory, however, is restricted as not all HAW have been covered.

The HAW are well-distributed across the Western and Eastern Himalayas, with the clusters being relatively larger in the former. The Leh-Ladakh region has clusters of HAW which include Pangong Tso (a transboundary wetland between India and China), Tso Moriri and Tso Kar, a saline lake.

This region also has extensive marshes and wet-grasslands, Chushul and Hanle marshes of Ladakh being examples. Chandertal is a popular trekking destination in Himachal; Suraj, Bhrigu, Dashair, Manimahesh, Ghadasaru being the other significant HAW of the Himalayan state. Kedar Tal, Shasra, Vasuki Tal, Roopkund and Hemkund are some of the major HAW of Uttarakhand.

In Eastern Himalayas, the Khangchengyao range in Sikkim is dotted with glacial lakes which form the headwaters of Teesta River. Gurudongmar, Cholamu, Tsomgo, Khangchung chho, Lhonark are other prominent HAW of this state. Bhagajang, Nagula, Thembang Bapu and Pangchen Lumpo are some of the significant wetland complexes of Arunachal Pradesh (Fig. 2).

2.2 HIGH-ALTITUDE WETLANDS TYPES

HAW are highly diverse due to large geological and topographical variations in the Himalayan region (Fig. 3). Located at the interface of terrestrial and aquatic ecosystems, wetlands are distinguished by a combination of features, including permanent or temporary inundation, saturated soils, and biota adapted to flooding. The hydrology of wetlands creates unique conditions, particularly soils developed under low-oxygen conditions, which forces the biota, primarily the rooted plants to adapt

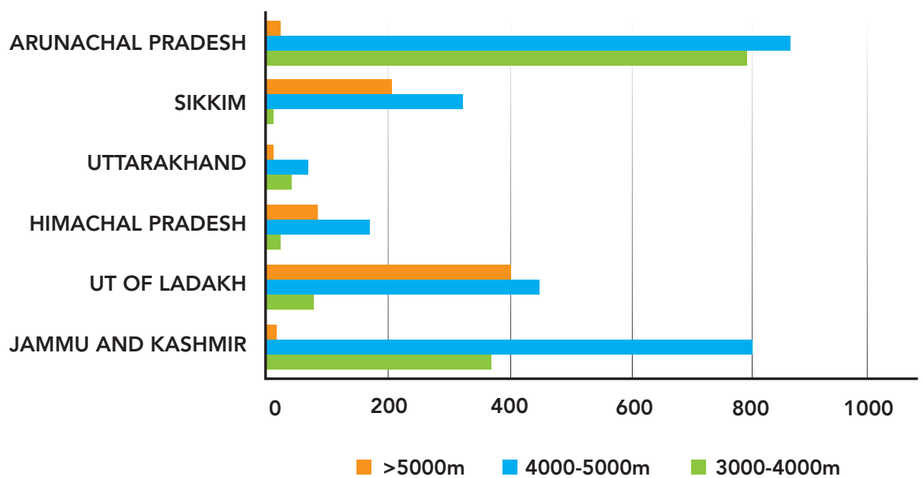


FIGURE 1. DISTRIBUTION OF HIGH-ALTITUDE WETLANDS WITHIN INDIAN HIMALAYAN REGION

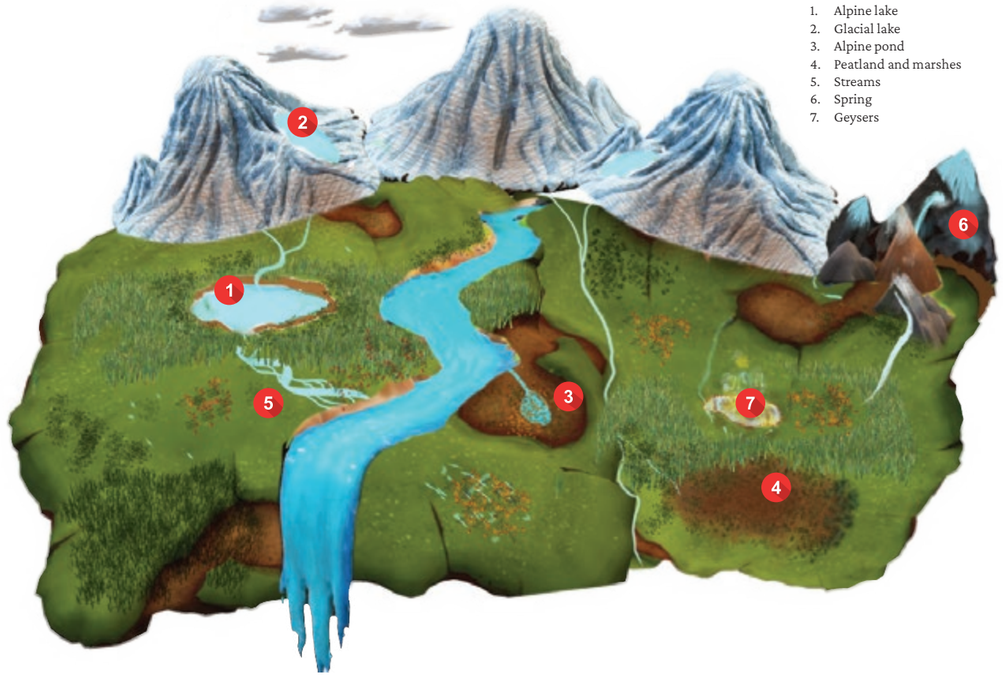


FIGURE 3; AN ILLUSTRATION ON DIFFERENT HIGH-ALTITUDE WETLAND TYPES

1. Alpine lake
2. Glacial lake
3. Alpine pond
4. Peatland and marshes
5. Streams
6. Spring
7. Geysers

to prolonged soil saturation. Slow weathering and decrease in productivity along elevation gradient reduces successional rates within these ecosystems.

Within the Himalayas, the HAW are those parts of the landscape which are permanently or temporarily saturated with water, and are the key delineators of these ecosystems. The variations in water source (surface water or groundwater), hydrodynamics (unidirectional or reversing flow, horizontal or vertical flows) presence of anaerobic soils and dominance of hydrophytic vegetation help explain the differences amongst different HAW types. Usually, the following types of wetlands are found in the Indian Himalayan Region:

ALPINE LAKES are relatively large bodies of open-water, receiving water from glacial melt, runoff or from sub-surface sources, such as springs.

GLACIAL LAKES have origins in glacial activity, being formed when the glacier erodes the land or melts creating a depression which is filled in by meltwater. In terms of their location with respect to glaciers, these lakes can be:

- supra-glacial if, formed on glacier surface
- englacial if, formed within glacial ice
- proglacial if, located in front of the glacier (a proglacial may be ice-contact if it is contiguous with the glacier, or distal when located at a distance)
- peri-glacial if, located inside or surrounding the glacier), and
- tarn or cirque, if, formed in relict cirques. A cirque is an amphitheatre like valley formed by glacial erosion

ALPINE PONDS are lakes with smaller area, usually below 2 ha.

MARSHES AND SWAMPS are wetlands dominated by vegetation in the form of sedges, grasses, or macrophytes (marshes), or woody vegetation (swamps). Impermeable soil or geologic layers cause water to collect in these habitats.

PEATLANDS are a category of wetlands (mostly vegetated) wherein accumulation and burial of organic matter creates layers of peat. Mire is the

HIGH-ALTITUDE WETLANDS (HAW) IS A GENERIC TERM USED FOR WETLANDS LOCATED AT AN ELEVATION OF 3,000M AMSL AND BEYOND.

IMAGE 1
TSOMORIRI LAKE IN LADAKH REGION
(Credit – Dr Pankaj Chandan)

IMAGE 2
SAHASTRATAL IN UTTARAKHAND
(Credit – Dr Ishwari Datt Rai)

IMAGE 3
TSO BREY TSO I – BHAGAJANG WETLAND COMPLEX IN ARUNACHAL PRADESH
(Credit – Jaya Upadhyay)

IMAGE 4
ALPINE MARSHES NEAR STARTSAPUK TSO WETLAND IN LADAKH REGION
(Credit – Dr Pankaj Chandan)

term used for peatlands wherein peat is actively being formed. Peatlands which are raised above the surrounding landscape and receive water only from precipitation are termed as bogs. Peatlands situated in depression and receiving water that has been in contact with mineral bedrock or soil is termed as fen.

STREAMS are wetlands with flowing water, draining off a glacier or a wetland, and flowing within a channel.

SPRINGS are natural discharge points occurring where sloping ground and impermeable strata intersect with the groundwater table. These wetlands are groundwater fed, and are valued for their water quality.

GEYSERS are a rare form of spring which are geothermal discharging explosive flow of hot water (with temperatures exceeding 500º Celsius at various instances) from confined aquifers.

A summary of distinguishing characteristics of these wetland types is in Table I *(on page no. 30-31)*.

IMAGE 5
GLACIAL STREAMS IN UPPER CHANDRA VALLEY *(Credit – Dhruv Verma, Wetlands International South Asia)*

IMAGE 6
PEAT BOG SYSTEM IN CHANDERTAL REGION OF HIMACHAL PRADESH
(Credit – Dhruv Verma, Wetlands International South Asia)

IMAGE 7
HOT WATER SPRING IN CHANGTHANG REGION *(Credit – Wiki Commons)*

2.3 IMPORTANCE OF HIGH-ALTITUDE WETLANDS

If the Himalayas are known as the 'water towers of the world', HAW influence the way these waters flow downstream and provide the basis of water, food and climate security of the entire downstream region. The water and carbon regulation functions of these wetlands within the headstream form the basis of multitude of benefits downstream, as is depicted in the Figure 4 below.

IF THE HIMALAYAS ARE KNOWN AS THE 'WATER TOWERS OF THE WORLD', HAW INFLUENCE THE WAY THESE WATERS FLOW DOWNSTREAM AND PROVIDE THE BASIS OF WATER, FOOD AND CLIMATE SECURITY OF THE ENTIRE DOWN-STREAM REGION.

Water-regime regulators

HAW regulate water regimes by several mechanisms including converting variable precipitation into a stable flow, slowing the passage of water from ice / snowpack to streams, improving groundwater recharge and sub-surface drainage, and supplying stream-flows during dry periods. The water-regime regulation by these wetlands provides, as well as sustains, the critical base flows of the major Himalayan Rivers such as the Ganga, Brahmaputra and the Indus, basins which support nearly one-fourth of global population.

Local climate regulators

HAW, especially those having large open water areas, tend to have a higher rate of heat and radiation absorption, thus making the surrounding regions relatively cooler or warmer than the other parts of the landscape. HAW also influence cloud-formation, precipitation and evaporation.

Carbon sinks

Soils of several HAW such as peatlands store high amount of carbon, making them important carbon sinks. Presence of perennial vegetation cover, permanent waterlogged conditions, low temperature and atmospheric pressure provide conducive conditions for carbon accumulation in wetland soils. The extent of peatlands in Indian Himalayas, however, remains to be comprehensively assessed.

Species and habitat

HAW bring diversity in landscapes, thus providing enabling conditions for a range of plant and animal species to survive. Faunal species occurring at high altitude exhibit a striking number of adaptations in terms of morphology, physiology and behaviour while the floral species adapt to low temperatures, arid conditions, high ultraviolet radiation, and a short growing season. Diverse plant species found in HAW include several of ethnobotanical importance.

HAW provide water in an otherwise dry landscape, and this is one of the reasons why the surrounding areas of these wetlands are inhabited by remarkable faunal species including endangered Snow Leopard *(Uncia uncia)*. Populations of ungulates including Tibetan Gazelle, Tibetan Argali (*Ovis amon hodgsoni)*, Tibetan Wild Ass *(Equus kiang)* and Blue Sheep inhabit the HAWs of Tso Lhamo plateau region of Sikkim for foraging and breeding. Rare species including Eurasian Lynx *(Lynx isabellina)*, Pallas's Cat *(Otocolobus manul)*, Red Fox *(Vulpes vulpes)* and Tibetan Wolf *(Canis himalayensis)* inhabit these wetlands especially in the Leh-Ladakh region, Spiti valley and Tso Lhamo plateau. Small mammals like Woolly Hare *(Lepus oiostolus)* and Himalayan Marmot *(Marmota himalayana)* are also dependant on these wetlands. Occurrence of Scutiger boulengeri and S. sikkimensis in Gurudongmar marks one of the extreme altitudinal extents for amphibians in India.

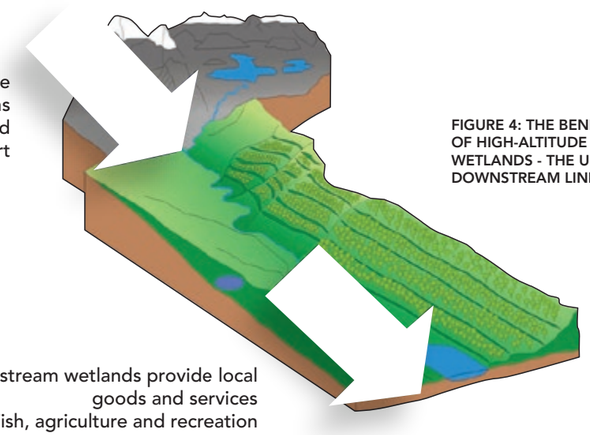


FIGURE 4: THE BENEFITS OF HIGH-ALTITUDE WETLANDS - THE UPSTREAM DOWNSTREAM LINKAGES

Congregations of migratory birds cross the Himalayas during annual migration along the Central Asian Flyway, and Himalayan wetlands are critical for many residents and/or endemic species. These wetlands are important summer breeding grounds for waterbirds and act as stopover sites during migrations for species like the globally threatened Black necked crane, Bar headed geese and Ruddy shelduck. The Bar-headed Goose *(Anser anser)*, Whooper Swans *(Cygnus cygnus)* and Common Cranes *(Gruidae spp.)* are iconic high-flyers that surmounts the Himalayas during migration and serve as a model system for derived physiological adaptations for high-altitude flight. HAWs of critical significance as migratory birds' habitats include large wetlands such as Tsokar, Tso Moriri, Tso Lhamo, smaller wetlands such as Kyagar Tso and floodplain meadows of Hanle, Chushul and Gurudongmar.

Cultural and spiritual values

Despite being located within sparsely populated areas, HAW have immense livelihood, cultural and spiritual significance for communities downstream. HAW are considered sacred by the Buddhist community, especially in the districts of Tawang, West Kameng, West Siang of Arunachal Pradesh. Gurudongmar wetland complex is also deeply imbued into the cultural ethos of Sikkimese and is a sacrosanct place for Buddhist pilgrims. Seasonal transhumance trans-Himalayan agro-pastoralism is practised by several indigenous communities including Lachenpa and Lachungpa of Sikkim whereas traditionally nomadic pastoralists of Himachal Pradesh *(Gaddi)* and Sikkim *(yak herders or Dokpa)* are directly dependent on the pasture's associated with HAW for livestock husbandry and collection of medicinal, aromatic and edible plants.

Owing to their aesthetic beauty, surrounding landscape and high reverence, these wetlands have emerged as major tourists' attractions. Flow of tourists to many of these HAW has increased tremendously providing livelihood support to a large section of local communities of the Himalayan states such as Jammu and Kashmir, Sikkim and Himachal Pradesh. Over two lakh tourists visit the Gurudongmar wetlands complex of Sikkim every year and similar is the trend with wetlands of Leh-Ladakh including Tso Moriri, Pangong Tso. Chandertal wetland of Himachal Pradesh has also emerged as a major tourist attraction.

CRYOSPHERE, CLIMATE SYSTEM, GEO-MORPHOLOGY OF THE REGION AND LOCATION WITHIN ECOLOGICAL NETWORKS INFLUENCE HAW FUNCTIONS AND SERVICES.

2.4 STRUCTURE AND FUNCTIONING OF HIGH-ALTITUDE WETLANDS

Wetlands ecosystem evolve and function within a landscape, with presence and movement of water rendering it's character and function distinct from other parts of the landscape. For the Himalayan HAW, key landscape influences are from:

- the cryosphere (which influences the quantity and timing of the glacial melt into the wetland),
- the climate system (high ultraviolet radiation levels, freezing and thawing cycle, and high diurnal and seasonal variation in temperatures regulating the physical, chemical and biological processes taking place within the wetland),
- the geo-morphology of the region (especially the topography and the rocks, weathering of which influences water chemistry of the wetland), and
- the location within ecological networks (such as flyways, which determine the pattern of use of the wetland habitat by migratory species).

A generic conceptual model of HAW functioning is presented in Fig 5, though the relative importance of landscape influences varies with specific wetland and local context. The sum total of interactions between ecosystem components, processes and services of a wetland is referred to as its ecological character – maintenance and enhancement of which is the purpose of wetland management.

The arc-like Himalayan region has clear west to east hydrologic and topographic gradients. Snow covered areas and snow-water equivalents are higher in the west and gradually declining towards the east. Within the foreland regions, the rainfall is higher

FIGURE 2. HIGH-ALTITUDE WETLANDS OF INDIA

Wetlands INTERNATIONAL

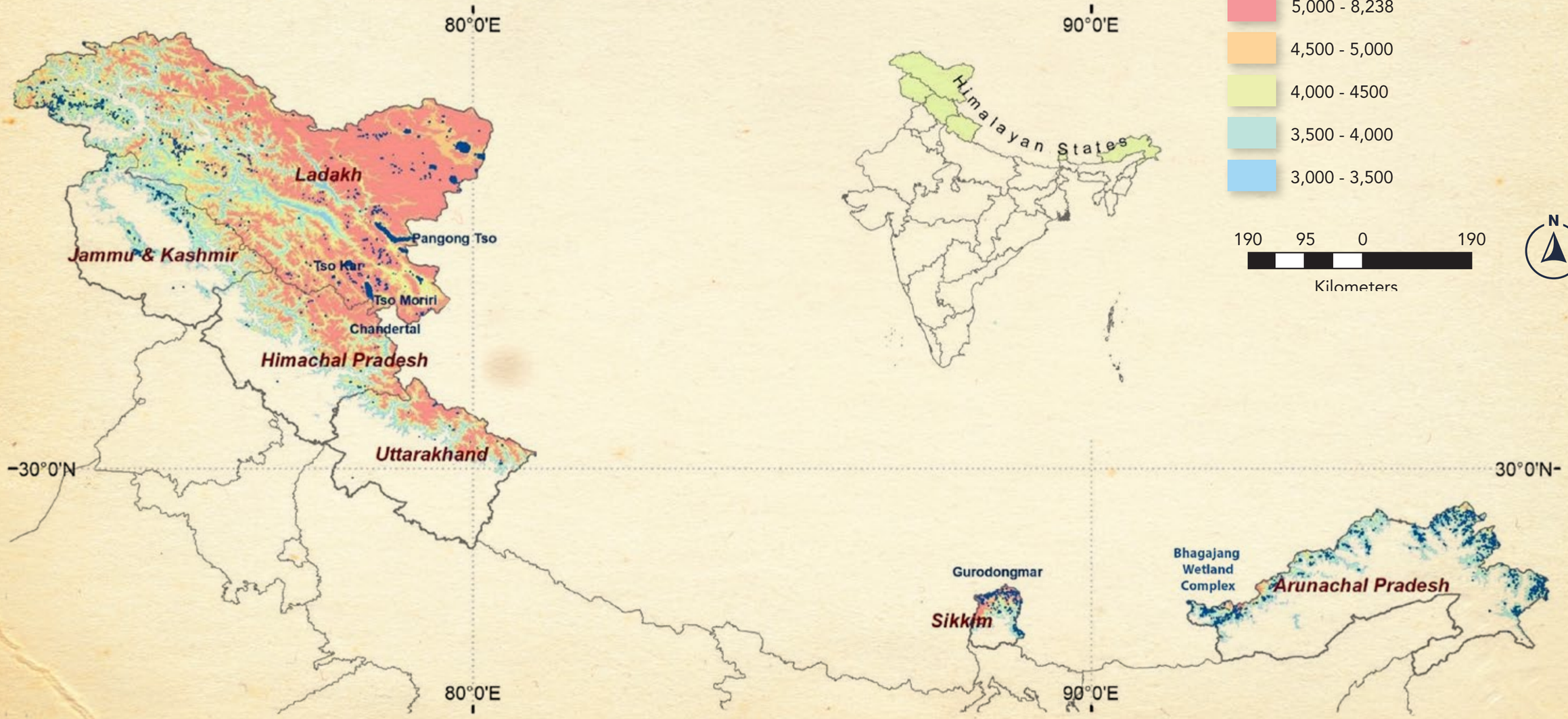


TABLE 1. CHARACTERISTIC FEATURE OF DIFFERENT HIGH-ALTITUDE WETLAND TYPES

WETLAND TYPES	KEY CHARACTERISTICS				
	MAJOR WATER SOURCES	HYDROLOGICAL REGIME (HYDRO-DYNAMICS AND HYDROPERIOD)	VEGETATION COVER	DEPOSITION OF ORGANIC MATTER	ECOLOGICAL COMMUNITIES
Lakes	Glacial/Snow melt Precipitation Springs	• Vertical • Permanent	Sparse Along the margins	Low	• Phytoplankton • Zooplankton • Vegetation communities (sedges, grasses) establish during growing season • Lichens (at higher altitudes) • Fishes (at lower altitudes)
Glacial lakes	Glacial melt Precipitation	• Horizontal • Permanent	Sparse and seasonal presence along the margins	Low	• Psychrophilic and psychrotrophic (cold adapted) bacterial communities • Phytoplankton • Zooplankton • Vegetation communities (sedges, grasses)
Peatlands	Precipitation Snow melt	• Seasonal/ temporary standing water with permanently wet soils • Vertical	Dense	High	• Vegetation communities dominated either by mosses such as Sphagnum • Sedges and grasses
Alpine ponds	Snow/glacial melt or springs	• Permanent/ Seasonal/ temporary standing water with permanently wet soils • Horizontal/ vertical	Sparse Along the Margins	Low-Medium	• Phytoplankton • Zooplankton • Lichens (at higher altitudes) • Vegetation communities dominated by sedges or grasses along the margins • Fishes (at lower altitudes)
Marshes and swamps	Snow/glacial melt Springs	• Permanent/ seasonal/ temporary • Horizontal/ Vertical	Dense	Medium	• Phytoplankton • Zooplankton • Vegetation communities dominated by sedges, grasses, scrubs or • Shrubs • Fishes (at lower altitudes)
Springs	Groundwater flows/aquifers	• Permanent/ • Seasonal • Horizontal/ vertical	Sparse or dense along the wet perimeter	Low	
Hot springs/ Geysers	Groundwater flows/aquifers	• Permanent • Vertical	None	Low	• Hyper-thermophilic microbes (esp. *Bacillus*) • Cyanobacteria
Streams	Glacial melt/ Precipitation/ Groundwater baseflows/ Springs	• Permanent/ Seasonal • Horizontal (groundwater seepage)	Submerged or along within the channel	Low	• Phytoplankton • Zooplankton • Mosses • Emergent or Submerged Hydrophytes (at lower altitudes) • Fishes (at lower altitudes)

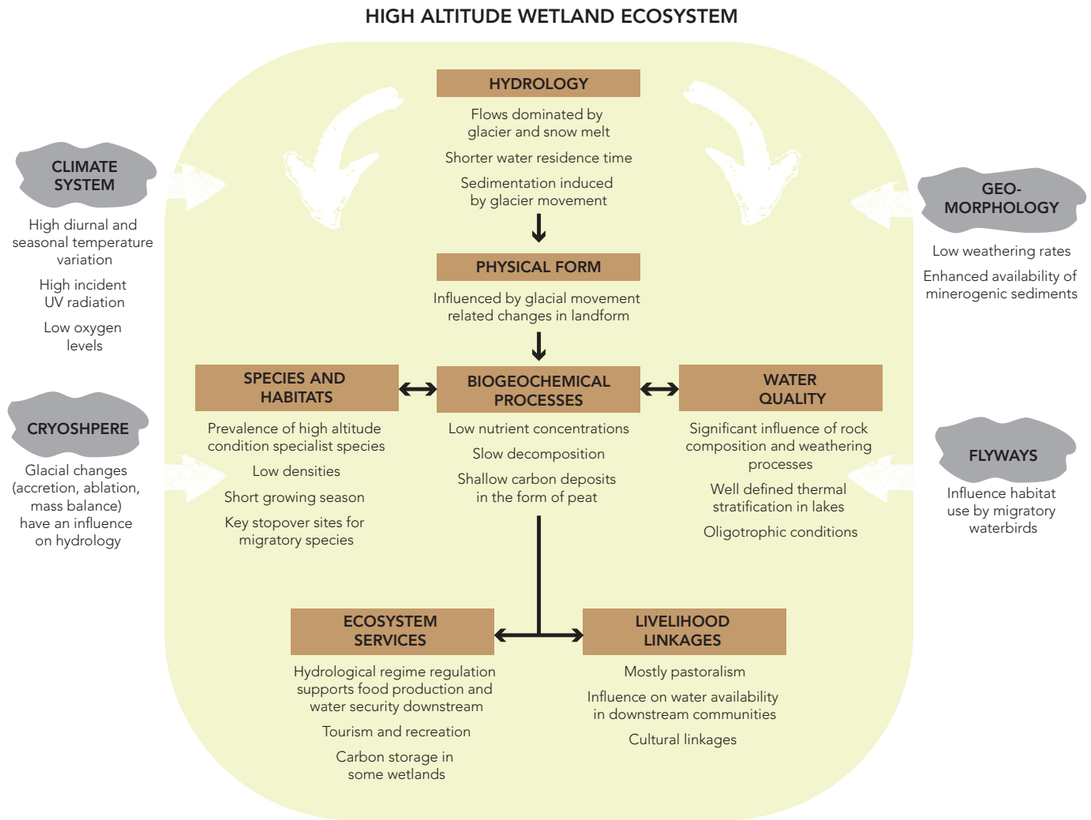


FIGURE 5. GENERIC MODEL DEPICTING FEATURES AND GOVERNING FACTORS OF HIGH-ALTITUDE WETLANDS

in the east, owing to close proximity to moisture sources in the Bay of Bengal. Snow and glacial melt and runoff generated from rainfall are some of the key hydrological processes influencing wetlands formation and change. For the wetlands in the western and north-western Himalayas, the water is sourced from the seasonal storages in the form of snow and ice. Wetlands in the central and eastern Himalayas, in contrast, have a higher dependence on monsoon rainfall, and experience only a small water-level rise during spring. The changes in water levels can be more easily observed in wetlands which have significant open water areas such as lakes and ponds.

Glacial dynamics have an important influence on the functioning of HAW, especially of glacial lakes which originate from present and past glaciers. The advance and retreat of large ice masses may also lead to formation of new lakes and growth and coalescence of existing ones, and changes in the drainage routeways. Most of the HAW are polymictic in nature, have a pronounced thermocline and remain frozen for most part of the year. The extremity of climate and low productivity renders these wetlands an oligotrophic character.

Ice marginal or ice contact lakes and distal proglacial lakes exhibit differences in geomorphology and sedimentology. Ice marginal lakes have a unique lacustrine character which is controlled by the location of glacier margin, elevation and topography of surrounding landscape, location and elevation of overflow channel, and volume of sediment supply. Sudden changes in water depth owing to opening and closing of outlets or episodic outburst floods render high water variability in proglacial lakes as compared with distal lakes. This has an implication for dissolved oxygen concentration and development of discrete water layers of different temperatures (thermal stratification) which in turn affects mixing potential of water and sediment.

KYAGAR TSO, A SALINE HIGH-ALTITUDE WETLAND IN LADAKH *(Solovyova/ iStockphoto)*

Bathymetry, or water depth, strongly influences sediment dispersal. Ice marginal lakes often have 'underflows' directed into low points on a lake floor.

Over long periods of time, slow decomposition over poorly developed and prolonged saturated soils causes wetlands to accumulate organic matter in their substrate, thus leading to formation of peat. These wetlands function as important carbon stores, with the carbon layer lying below a layer of vegetation.

The biota within the HAW are influenced by the extremes of altitude, intense UV radiation, wide daily and annual temperature ranges, strong winds and short growth periods. Low temperatures and higher radiation levels reduce the vegetation cover predominantly to grassland and shrubs, many of which are endemic in nature and still dominated by native plant species. Presence of permafrost allows growth of vegetation by providing water at the beginning of their short growing season while playing an important role in the water holding capacity of soil. Slow weathering and decreasing productivity along the elevation gradient further reduces the succession rates in these wetlands.

HAW function in part through interaction with adjacent landscapes, and with other wetlands forming an ecological network. The relatively young Himalayan mountain ranges have opened up new southward routes of migration and colonisation into what was hitherto an island. At the eastern end, through the Assam gate came the Chinese and Malayan elements. From the west, came some Palearctic and Ethiopian elements. The Himalaya acted as two-way highways linking Western Africa to Southeast Asia. A range of HAW within Himalayas act as stop over habitats for palearctic species migrating from west. Similarly, on the east, species migrating from East or South East Asia use these wetlands as stop over sites with the species later spreading over the entire Indian sub-continent constituting Central Asian Flyways.

Human communities form an integral part of the ecosystem functioning. Though most of the HAW are situated far away from human settlements, several wetland sites are considered sacred and their pristine environment draws tourists and adventure seekers. Thus, the surroundings of several HAW see spikes of human activity, which may disturb the habitat, and lead to pollution. Nomadic pastoralists use the grasses and sedges adjoining wetlands for cattle grazing. The human interface, wherever it exists, has a bearing on several ecosystem components and processes, such as nutrient pathways and habitat conditions.

REGIONAL CLIMATE CHANGE IS LEADING TO RAPID AND FUNDAMENTAL CHANGES IN HAW ECOSYSTEMS. SUCH CHANGES ARE BEING AMPLIFIED BY HUMAN-INDUCED THREATS.

2.5 THREATS TO HIGH-ALTITUDE WETLANDS

HAW are highly sensitive and fragile ecosystems. Regional climate change is leading to rapid and fundamental changes in these ecosystems. Such changes are being amplified by human-induced threats such as conversion to agriculture, unregulated tourism and related pollution, changes in grazing regimes and linear infrastructure development.

Climate Change

HAW are highly sensitive to cryospheric changes. There is well-established evidence of retreat of glaciers in most parts of the Himalayan region. With retreating glaciers, the number of glacial lakes has also increased, creating a positive feedback loop for further glacial retreat. The rise in glacial lakes, especially those which have been dammed by moraines and debris, has also increased the risk of Glacial Lake Outburst Floods (GLOFs). In the long

term, the glacial lakes are expected to decrease as glaciers retreat.

Snowmelt, glacial melt waters and, to some extent, runoff from rainfall shape the hydrology of wetlands in the trans-Himalayan region. The dependence on seasonal water storage in the form of snow and ice is particularly high for wetlands located in western and north-western Himalayas, and these wetlands are highly likely to be sensitive to cryospheric changes. An early supply of glacial meltwaters is likely to leave less runoff during the summers, which is the period of biological activity in these landscapes, as has been reported from the upper Indus basin. A gradual increase in precipitation received in the form of rainfall will also have consequences for sediments, as snow and glacial melt waters are largely devoid of sediments. Trends towards increasing rainfall have been projected for select basins in western Himalayas.

ECOSYSTEM MANAGEMENT ENTAILS APPLICATION OF ECOLOGICAL PRINCIPLES TO RESOURCE MANAGEMENT TO PROMOTE LONG-TERM SUSTAINABILITY OF ECOSYSTEMS AND THE DELIVERY OF ESSENTIAL ECOSYSTEM GOODS AND SERVICES TO SOCIETY.

The Himalayan region has extensive permafrost, which has the potential to contribute to wetland formation by retarding downward movement of water, especially in low-gradient, mineral soil environments. The current knowledge on extent of permafrost in India, as well as entire Hindu Kush Himalayan region, is limited, yet the thawing of the permafrost may create a positive feedback for wetlands, as well as altering the landscape through processes such as land-subsidence and landslides. Peatlands are particularly sensitive to climate change, and even short-term changes have an impact on peat quality and their contribution to carbon and nitrogen mineralization processes.

Unregulated tourism

HAW are highly popular and increasingly sought after tourist destinations. For most of these wetlands, the period of peak tourist activity coincides with periods of high biological activity (such as breeding periods of wetland-dependant birds, thawing of wetland and re-establishment of vegetation). Ill-managed tourism which does not take into account the fragility of these ecosystems leads to several pressures from disturbance of habitats due to pollution.

Changes in grazing regime

Several indigenous communities of Indian Himalayas such as Gaddi of Himachal Pradesh and Dokpa of Sikkim graze their cattle within marshes and wet grasslands. Short growing season coupled with extreme climate slows regeneration making these wetlands highly susceptible to degradation by changes in grazing regime and consequently leading to siltation and nutrient deposition within these wetlands.

Disturbance to breeding and nesting grounds of waterbirds

In several HAW such as in Sikkim and Ladakh, feral dogs have come to occupy regions around HAW disturbing breeding and nesting grounds of waterbirds and even feeding on their eggs. Waste generated by tourists and in certain instances by Army camps provide easy access to food and promoting further range spread of these animals.

TOILET SET UP FOR TOURISTS AT A CAMPING SITE IN CHANDERTAL
(Dhruv Verma/Wetlands International South Asia Library)

Conversion for agriculture

Several HAW landscapes, especially those at lower elevations are being converted for agriculture. This is particularly significant amongst the marshes of the Western Himalayas and wet grasslands of the Eastern Himalayas. Programmes for promoting intensive agriculture in the high-altitude regions also tend to divert water away from wetland.

Linear infrastructure development

There has been a spurt in construction of roads and highways in high altitude areas impacting land use and enhancing access to these wetlands. Tourism has increased manifolds in several HAW with tourists visiting round the year, stressing the sensitive ecosystem which has limited capability to handle human interference.

2.6 NEED FOR MANAGING HIGH-ALTITUDE WETLANDS

Management is generically defined as 'a process of planning, decision making, organizing, leading, motivation and controlling the human resources, financial, physical, and information resources of an organization to reach its goals in an efficient and effective manner'. Ecosystem management entails 'the application of ecological principles to resource management to promote long-term sustainability of ecosystems and the delivery of essential ecosystem goods and services to society'.

India, as a signatory of the Ramsar Convention, is committed to achieving wise use of all wetlands in her territory. Wise use of wetlands is defined in the text of Ramsar Convention as 'the maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development'. Ecological character is 'the combination of ecosystem components, processes and services that characterize a wetland'. Ecosystem Management of wetlands thus seeks to achieve the goal of 'maintenance of ecological character' or 'wetland wise use'.

Though sounding counter-intuitive, wise use as a wetland management approach is much wider than use of a wetland. The phrase 'in the context of sustainable development' recognizes that development, which may be inevitable in some cases, is not an objective for every wetland. Wherever development is to take place, it has to be facilitated in sustainable ways by approaches elaborated in the Ramsar Convention. 'Ecosystem approaches' include the elements elaborated by the Convention on Biological Diversity – integrated management, stakeholders' participation in decision-making, transparency about trade-offs, and equitability of the outcomes. In totality, wise use is about 'maintaining the capability of the wetland' to support human well-being at present and in future, rather than 'use' or 'development' at present.

ECOSYSTEM MANAGEMENT OF WETLANDS SEEKS TO ACHIEVE THE GOAL OF 'MAINTENANCE OF ECOLOGICAL CHARACTER' OR 'WISE USE'.

Being inherently dynamic, the ecological character of wetlands is always changing due to natural causes (such as ecological succession or seasonality) or human-induced (such as impeded natural outflows of a wetland). The ambit of ecosystem management interventions is determined by an assessment of whether or not the ecological character change is 'adverse' and reducing the capability of the wetland ecosystem to provide ecosystem services and sustain biodiversity values. There are three likely situations, each requiring a different management response:

- **The change in ecological character is due to natural causes – and is not adverse:** the role of management is to monitor the wetland as a prospective strategy to be informed of any impending adverse change. There is no active intervention required beyond monitoring.
- **When the change is adverse and human-induced:** management is aimed at addressing the underlying anthropogenic drivers so that the capability of wetland to provide ecosystem services and sustain biodiversity is not compromised. Management comprises a range of active interventions along with continuous monitoring of wetland ecological character.
- **When the change is adverse and due to natural causes:** management is aimed at altering habitat conditions to slow down or mitigate the change, without fundamentally altering the ecological character. Management

THE MANAGEMENT OF HAW DOES NOT ALWAYS IMPLY DOING SOMETHING OR PHYSICALLY INTERVENING IN THE WETLAND. A DECISION OF NOT INTERVENING IS VERY MUCH A PART OF MANAGEMENT TOWARDS ACHIEVING THE GOAL OF WETLAND 'WISE USE'.

PARTIALLY FROZEN GURUDONGMAR WETLAND IN NORTH SIKKIM *(Roop Dey / istockphoto)*

comprises a limited set of active interventions (limited ecological interventions) along with continuous monitoring of wetland condition.

Thus, management of HAW does not always imply doing something or physically intervening in the wetland. A decision of not-intervening is very much a part of management towards achieving the goal of wetland wise use.

2.7 PRINCIPLES AND APPROACHES FOR MANAGING HIGH-ALTITUDE WETLANDS

HAW provide a range of in-situ benefits (such as habitats for a range of resident and migratory species, and tourism and recreation opportunities) as well benefits at wider landscape scale (through their ability to influence water regimes and carbon and nutrient cycles). At the same time, HAW are sensitive to local landscape changes (such as pollution or overgrazing) as well as changes taking place at regional scale (particularly within the cryosphere). It is therefore important to frame management of these wetlands, taking into account the entire basin, with its land, water, ecosystem components and processes, and stakeholder values and capacities. The following principles and approaches therefore are relevant for managing HAW:

ADAPTIVE MANAGEMENT PRINCIPLE ENCOURAGES WETLANDS MANAGERS TO BE OPEN TO ASSESSMENT OF EFFICIENCY OF MANAGEMENT INTERVENTIONS AND PRACTICES, AND REVISE MANAGEMENT WHEN THE DESIRED OBJECTIVES ARE NOT ACHIEVED.

Systems thinking: HAW comprise complex interactions between their biotic and abiotic components, and their ecological and social subsystems. It is not possible to understand the dynamics of these wetlands merely by understanding the constituent parts (such as behaviour of inundation regime or limnology) in isolation of other components and processes. Non-systemic thinking, focused on few ecosystem services and biodiversity values, often compromises the overall wetland functioning.

Management based on ecologically derived boundaries: Management of HAW should take into account ecologically derived boundaries, built on consideration of linkages within different landscape elements through ecosystem processes. Hydrologically, such boundaries should include the source glacier wherein ice-melt is received into the wetland, and also include the downstream stretches wherein the hydrological regimes are influenced by the wetland. As the HAW seldom function in isolation, it is important to take into account the overall wetland regime which are connected hydrologically (such as through connected flows), by species-mediated interactions (such as migration), and geomorphological processes (such as sedimentation and scouring) as a minimum.

Adaptive management: HAW are highly dynamic and complex. The science and knowledge base on these ecosystems is still evolving, and there are high uncertainties as well as unpredictability associated with outcomes of various management interventions. Any management intervention, at best, remains an experiment; monitoring and evaluation of which gives insight on the way ecosystems behave and respond to different drivers of change. Adaptive management principle encourages wetlands managers to be open to assessment of efficiency of management interventions and practices, and revise management when the desired objectives are not achieved. Also, recognizing the varying temporal scales and lag-effects that characterize ecosystem processes, objectives for ecosystem management should be set for the long term.

Collaborative decision-making: The functioning of HAW affects and in turn is affected by a range of sectors (such as water management, tourism, culture, wildlife conservation, disaster management) and stakeholders (such as pastoralists, tour operators, religious and cultural groups, wildlife managers, scientific and research community, sectoral policy and decision-makers). These operate at scales ranging from local (wherein pastoral communities and tour operators), regional (such as protected areas spanning landscapes), state (such as state government departments), national (such as the MoEFCC) and international (such as the Ramsar Convention, CMS, CBD, and the UNFCCC).

Building the aforementioned principles forms the core of integrated management of HAW. Integrated management has an emphasis on coordinated and interconnected wetland management considering interactions of land, water, species and society. This is in difference to top-down prescriptive management, wherein the management frame (problems, objectives and actions) are governed by specified guidelines, with a focus on standardization, and wherein the governments take the central place in management decisions. Integrated management is led by a diagnostic approach – wherein the knowledge of the ecosystem interactions shapes management objectives and management actions, and wherein management is continuously evolving as new information is generated. In Table 2 the difference between prescriptive and diagnostic wetland management is brought out.

TABLE 2. DIFFERENCES BETWEEN PRESCRIPTIVE AND DIAGNOSTIC WETLAND MANAGEMENT

	PRESCRIPTIVE MANAGEMENT	DIAGNOSTIC MANAGEMENT
Wetlands description	Described in terms of standard wetland features	Available information is analysed on the basis of knowledge on wetland ecosystem functioning
Prioritization	Usually not done	Wetland features are prioritized with respect to management objectives
Threats	Identified based on a generic list	Identified on the basis on evaluation of different wetland features and their governing factors
Management Objectives	Generically defined	Defined in terms of wetland features and respond to threats and values
Action Plan	Drawn from a generic list	Developed on the basis of management objectives
Monitoring systems	Responds to a prescribed data set. Focused on activities and physical achievements	Core feature of management plan. Monitoring information is used to relate different wetland features, clarify interactions and modify management
Review and adaptation	Done at a stipulated period	Is guided by new information and improved understanding of ecosystem functioning and assessment of management effectiveness

FURTHER READING

National Wetland Atlas: High Altitude Lakes of India moef.gov.in/wp-content/uploads/2019/09/National Wetland Atlas High Altitude Lakes of India.pdf

ICIMOD - The Changing Himalayas; Impact of Climate Change on Water Resources and Livelihoods in the Greater Himalayas https://lib.icimod.org/record/26471

The Hindu Kush Himalaya assessment: mountains, climate change, sustainability and people https://link.springer.com/book/10.1007/978-3-319-92288-1

SECTION 2

Setting up a Management Planning Process

2.1 THE MANAGEMENT PLANNING PROCESS

Wetland management entails application of resources (technical, financial and human) to ensure that the ecological character of wetlands is maintained. A management planning process is the thinking part, which precedes actual management. The planning process is captured in a management plan which seeks to answer the following questions:

- Why is managing the wetland necessary?
- What is the wetland like?
- What is important within the wetland?
- What do we want to achieve from managing the wetland?
- What must we do to achieve our management goal?

WETLAND MANAGEMENT ENTAILS APPLICATION OF RESOURCES (TECHNICAL, FINANCIAL AND HUMAN) TO ENSURE THAT THE ECOLOGICAL CHARACTER OF WETLANDS IS MAINTAINED.

A MANAGEMENT PLANNING PROCESS IS THE THINKING PART, WHICH PRECEDES ACTUAL MANAGEMENT.

Typically, a wetland management plan serves the following purpose:

- Identifies legislation and policies that govern the management planning process and the outcomes
- Shares decision-making and communicates these decisions to all interested individuals and groups
- Collates relevant information about the wetland and its ecological character
- Identifies the important features, and develops management objectives related to these features and actions to achieve the objectives
- Identifies institutional arrangements that will enable implementation of actions for achieving the management objectives
- Identifies monitoring arrangements that will enable management to be aware of the condition of these features
- Justifies application of human, financial and technical resources

As management involves decision-making, it is important that all those who have a degree of influence over wetland management, and are in direct or indirect ways impacted by wetlands or impact the wetland condition (either positively or negatively) are involved in the process. Management planning is a process of arriving at an agreement between various stakeholders on what will be achieved out of management, and what needs to be done to enable this. By helping reach such an agreement, management planning becomes a tool of communication on priorities, and a means of resolving conflicts when the aspiration or priorities are not convergent. By delivering the functions above, the management planning process can:

- Resolve conflicts and trade-offs, internal as well external
- Ensure continuity of effective management
- Helps generate resources for implementation of various activities
- Enables communication between managers and stakeholders

A sequential process for wetland management planning, which is also applicable for HAW, is described in the NPCA Guidelines, and is presented in Fig 6.

FIGURE 6. STEP-WISE WETLAND MANAGEMENT PLANNING PROCESS

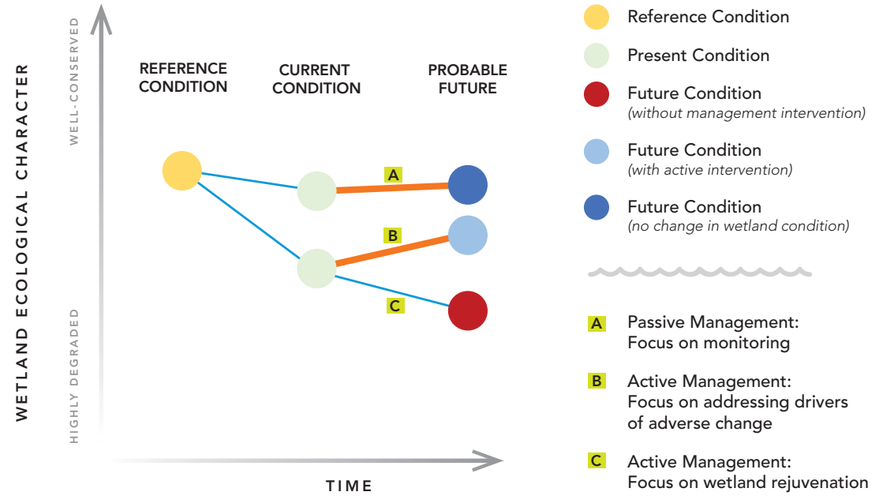


FIGURE 7. MANAGING WETLANDS FOR DIFFERENT TRAJECTORIES OF CHANGE

The NPCA guidelines have been framed on a diagnostic approach – wherein the selection of management interventions is guided by knowledge of wetlands features and factors governing these features, and their relationship with wider societal, conservation and development goals that wetland wise use is contributing to. Wetland features are the ecological, social and institutional attributes, which collectively characterize a wetland. Wetlands are dynamic systems, and thus their features undergo cyclical and temporal changes. Factors (natural as well as anthropogenic) cause the wetland to move along a certain trajectory.

Wetlands change due to several natural factors (such as ecological succession, sediment and nutrient accumulation, or even extreme events - such as landslides or earthquakes). When these natural factors intertwine with anthropogenic factors (such as pollution, change in hydrological flows), wetlands features may change to a state wherein the societal benefits from the wetlands are compromised (such as their ability to moderate extreme events) as well as their capability to sustain biological diversity. Wetland ecological character reflects its relative ability to support and maintain complexity and reorganization capacity in the face of change induced by factors.

The ecological character of a wetland with respect to its reference condition determine the nature of management intervention required (Fig 7). If the ecological character is maintained close to the reference, management may be passive, and may largely comprise monitoring activities in order to identify any potential adverse changes. When ecological character reflects a degraded state (as observed by deviation from the reference conditions), active management interventions to address the drivers of degradation can be required. With natural drivers of change, the scope of intervention may be very limited, but for anthropogenic drivers of adverse change, a range of interventions may be warranted in order to achieve wise use. Developing a reference condition (or setting a limit of acceptable change) is discussed further in Section 3.1 – step 3 of this guidebook.

HAW WHICH HAVE NOT BEEN SUBJECTED TO HUMAN-INDUCED ADVERSE CHANGE, MANAGEMENT MAY NEED TO BE PASSIVE, WITH A MAJOR FOCUS ON MONITORING ACTIVITIES.

Fig.7 illustrates that for HAW which have not been subjected to human-induced adverse change, management may need to be passive, with a major focus on monitoring activities. However, wetlands which are undergoing or likely to undergo adverse changes due to anthropogenic factors, such as pollution from tourism, overgrazing, or water regime change, more active management interventions aimed at rejuvenation may be required.

A wetland management plan is written as a technical document. The plan needs to be as exhaustive as the site demands, and available information permits. Not all management plans

therefore need to be complex technical documents.

Wetlands are open systems and thus their condition is greatly influenced by their surroundings. The condition of a HAW will be subject to the physical processes (such as climatic setting and hydrological regimes), as well as developmental settings (such as tourism and cultural activities). It is important that the management plan takes into account the wider conservation or developmental planning including:

- State Action Plan on Climate Change
- State Biodiversity Action Plan
- Protected Area Plans (in case the wetland is, or forms a part of, a protected area)
- Water Resources Development Plan / River Basin management plan
- Tourism Development Plan
- State Disaster Management Plan
- Development plans for the respective districts
- Rural development plans
- State Pollution Control Plan

THE MANAGEMENT PLAN NEEDS TO BE AS EXHAUSTIVE AS THE SITE DEMANDS, AND AVAILABLE INFORMATION PERMITS. IT IS IMPORTANT THAT THE MANAGEMENT PLAN TAKES INTO ACCOUNT THE WIDER CONSERVATION OR DEVELOPMENTAL PLANNING.

The prevailing laws and regulations define the regulatory envelope within which management planning takes place. The provisions under these laws set the boundaries within which management objectives, actions and implementation have to be framed. Some of the relevant Central Government acts and rules applicable to HAW are:

- The Environment (Protection) Act, 1972
- The Wetlands (Conservation and Management) Rules, 2017
- The Biological Diversity Act, 2002
- The Water (Prevention and Control of Pollution) Act, 1974
- The Indian Fisheries Act, 1897
- The Wildlife Protection Act, 1972 and amendments thereof

Besides these, several states have their own acts and rules which define their mandates for wetland management, and the activities permitted, prohibited or regulated.

2.2 SETTING MANAGEMENT PLANNING SCOPE AND SCALE

An important aspect of management planning for wetlands is to recognize the multi-scalar nature of ecosystem processes that influence the ecological character of HAW (Fig. 8).

At the basin level, the role of wetlands in maintaining hydrological regimes and moderating

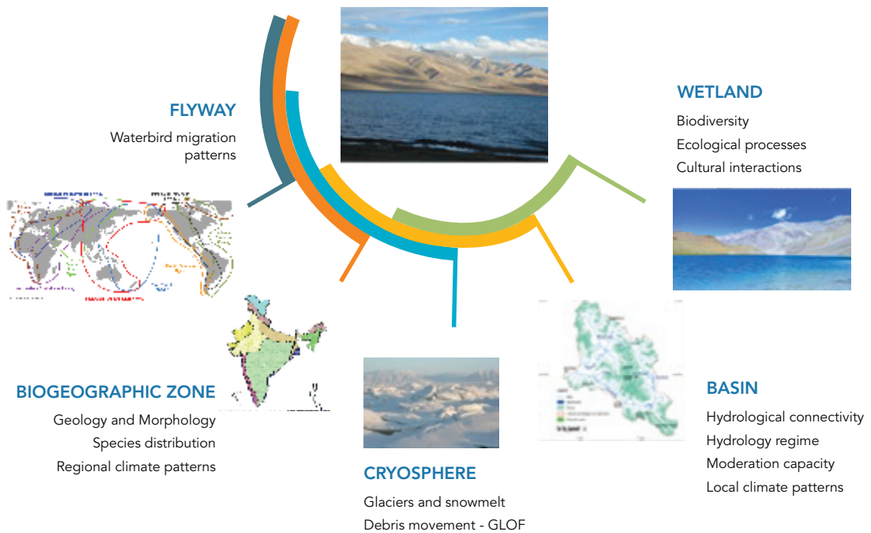


FIGURE 8. FACTORS AND THEIR INTERACTIONS AT DIFFERENT SCALES WHICH CAN INFLUENCE HIGH-ALTITUDE WETLANDS

climate are influenced by inter alia hydrological connectivity within the landscape and surrounding land use. The cryosphere has a major influence on snow and ice melt flowing into HAW, which may lead to a wetland being a potential threat to downstream areas through GLOFs.

Biogeographic zones provide the basic regionalization, geographic scale and geological timeframe within which species and ecosystems evolve and function. At these scales, several relatively slower processes such as tectonic movements, rock weathering and regional climatic patterns have a bearing on the structure and functions of HAW.

Migratory species such as waterbirds which use these wetlands to complete their migration movements are influenced by the condition of migration corridors (reflected in the status of wetlands within the flyway and pressures such as hunting, intensive agriculture and aquaculture) often termed as flyways.

Given the fact that hydrology is the main controlling variable for wetland ecosystems, which in turn influences their soil and biota, it is recommended that planning takes into account all interconnected wetland hydrological regimes, changes in which can alter the condition of the wetland. Planning must not focus only within the boundaries of a wetland site, but also take into account hydrologically and ecologically linked wetland complexes both upstream as well as downstream.

Figure 8. Factors and their interactions at different scales which can influence High-Altitude Wetlands

While changes in the factors at various levels affect the wetland, the management plan may be insufficient to influence all of these. This is where the role of institutional arrangements becomes critical. The management plan can include mechanisms for ensuring representation and consideration of the full range of HAW ecosystem services and biodiversity values within planning processes of various sectors and across different scales. For example, State Action Plans for Climate Change may be a relevant instrument to integrate the climate change adaptation and mitigation aspects of wetlands. Overlaps with Protected Area Plans may be used as an opportunity to complement species and habitat conservation measures of a range of aquatic and terrestrial species. Similarly, the role of wetlands in buffering hydrological regimes may be integrated into district planning processes for development or disaster management.

2.3 MAPPING KEY STAKEHOLDERS AND SECTORS

Wetland management planning needs to take into account the perspectives of different individuals and groups who have an interest in wetlands (and the resulting ecological character implications). Individuals and groups are often classed within sectors. It is therefore important to identify these sectors and stakeholders, and ensure their involvement in the management planning process. This is in difference to the conventional protected area planning approaches, wherein the objectives of species protection and habitat conservation takes precedence over others, and thereby management planning involves a few agencies, in most cases those dealing with forests, wildlife or environment.

MANAGEMENT PLANNING IS A PROCESS OF BUILDING CONSENSUS AMONG STAKEHOLDERS ON MANAGEMENT GOALS AND OBJECTIVES.

Stakeholder analysis is a means to identify stakeholders and assess their needs in the context of management of HAW. Typically, the analysis segregates stakeholders in terms of their degree of impact and degree of influence, and suggest appropriate engagement strategy (Fig. 9).

		DEGREE OF IMPACT ON HAW CONDITION	
		LOW	HIGH
DEGREE OF INFLUENCE ON HAW	LOW	**Keep informed** through formal and informal communication channels	**Consult** to identify their needs and ways these could be factored in management
	HIGH	**Make use of their interest** through involvement in low-risk areas of management implementation	**Ensure that the needs and aspirations are carefully evaluated** and integrated in management process Involve in decision-making processes

FIGURE 9. STAKEHOLDER ENGAGEMENT STRATEGIES

In table 3, sectors and stakeholders that may have relevance for managing HAW are listed and a generic mapping in terms of impact and influence is provided in Fig .10.

It is important to develop mechanisms to engage with the stakeholders during the management planning processes, as per the plan, during implementation stages. Stakeholders may be engaged in diverse ways in management planning, including:

- Setting management goal and purpose (Refer Section 3.1 – step 1 of this guidebook)
- Description and evaluation of wetland features (Refer Section 3.1 – step 2 and 3 of this guidebook)
- Setting management objectives (Refer Section 3.1 – step 4 of this guidebook)
- Developing implementation arrangements (Refer Section 3.1 – step 6 of this guidebook)
- Developing action plan (Refer Section 3.1 – step 7 of this guidebook)

TABLE 3. LIST OF SECTORS AND STAKEHOLDERS RELEVANT FOR HIGH-ALTITUDE WETLAND MANAGEMENT PLANNING

SECTOR	CONCERNED GOVERNMENT DEPARTMENT / AGENCY / STAKEHOLDER GROUPS
Wetlands management	State Wetlands Authority, nodal departments entrusted for management of specific HAW
Biodiversity conservation	State Biodiversity Board Forest Department Biodiversity Management Committees
Disaster Management	State Disaster Management Authority, District administration of the region in the wetland downstream
Culture	Culture Department, Ecclesiastical Department, Religious bodies present around wetland
Tourism	Tourism Department, Tour Operators (public and private), Hoteliers and Hotel Associations
Agriculture	State Agriculture Department
Fisheries & Animal Husbandry	State Fisheries and Animal Husbandry Department
Defence	Military, Army commands, Indo-Tibetan Border Police Force
Water resources	Water resources department, State Pollution Control Board, Hydropower companies
Development	Elected political representatives, District Administration
Planning	Department of Planning
Climate Change	Science and Technology Council
Research and Academia	College, Universities and research institutes conducting research on HAW
Civil society	NGOs and CBOs engaged in developmental and conservation activities around HAW
Resource users	Pastoralists and other communities which depend directly on HAW

		DEGREE OF IMPACT ON HAW	
		LOW	HIGH
DEGREE OF INFLUENCE ON HAW	LOW	Culture Department Biodiversity Management Committees	Armed forces Tour Operators (public and private) Tourists Pastoralists Religious bodies present around wetland Agriculture Department Fisheries and Animal Husbandry Department
	HIGH	State Biodiversity Board State Disaster Management Authority Water Resources Department State Pollution Control Board Department of Planning Civil society Research and Academia	State Wetlands Authority Forest Department District Administration and local PRIs Tourism Department Rural Development Department

FIGURE 10. STAKEHOLDER MAPPING FOR MANAGING HIGH-ALTITUDE WETLANDS

The stakeholder engagement strategies should be considered within all components of the management plan, particularly while framing Communication, Education, Participation and Awareness actions (CEPA) (refer Box 14).

2.4 DEFINING ROLES AND RESPONSIBILITIES

The management planning process indicated in Fig. 6 is much more than writing a technical document. It is a process of building consensus amongst stakeholders on management goals and objectives, and in doing so, establishing strategies to resolve trade-offs that may occur due to conflicting values and perceptions. It is therefore important to define institutional arrangements to perform the following tasks:

- Overall coordination of the management planning process - from inception to formal approval of the plan and agreement for implementation
- Seeking inputs of stakeholders into the management planning process
- Writing the technical document
- Reviewing the document and ensuring that the comments at various stages are acknowledged and resolved appropriately
- Keeping the stakeholders informed of the progress in management planning

2.5 SETTING UP A COMMUNICATION STRATEGY

Wetland management planning also performs an important function of engaging with stakeholders on decisions regarding maintenance or use of wetland features (Box 3). It is therefore important that a clear communication strategy is established to keep all stake holders informed on the progress and outcomes of management planning. The strategy must evolve as stakeholder mapping is done and specific engagement opportunities are identified.

A communication strategy should consider the following:

- Different stakeholders have distinct information needs and react differently to information
- Both formal and informal communication channels are required to communicate management plan findings

The CEPA Plan *(Refer box 14 in section 3.1)* should build on a detailed understanding of communication needs of different stakeholders, and the ways in which messages can be delivered to trigger participation and a positive behaviour change for wetland wise use.

A CLEAR COMMUNICATION STRATEGY MUST BE ESTABLISHED TO KEEP ALL STAKE HOLDERS INFORMED ON THE PROGRESS AND OUTCOMES OF MANAGEMENT PLANNING.

BOX 3. ENGAGING COMMUNITIES IN MANAGEMENT OF HIGH-ALTITUDE WETLANDS

High-Altitude Wetlands are located in remote terrains difficult to access. Communities living around these wetlands (including the nomadic herders such as Gaddi in Himachal Pradesh and Dokpa in Sikkim) are the primary stakeholders and custodians of these ecosystems. Their involvement can greatly strengthen management efforts in diverse ways, such as generating information on wetlands condition, regulating tourism, grazing and feral dog threats, keeping watch and ward, and promoting awareness on diverse wetlands values. The cultural and relational values that these communities have with these HAW can be a significant driver for wetlands conservation especially at grassroot level.

Community engagement in wetlands conservation can be institutionalised through the constitution of an informal, voluntary and non-statutory network of concerned citizens, termed as Wetland Mitra. The network of Wetland Mitra would support wetland managers in gaining access to local views, capacities and traditional knowledge for managing the wetland sustainably and collectively. In addition to promoting awareness on wetland values, the network would be responsible for implementation of wetland management actions while supporting wetland managers in local communication, liaison and outreach. Constitution of wetland mitra is actively promoted by the MoEFCC under the NPCA programme.

By involving themselves within the Wetland Mitra network, citizens gain an opportunity of shaping wetlands management by bringing onboard indigenous and local knowledge, and views of diverse stakeholder groups. As Wetland Mitra network member, the communities also build their capacity on various dimensions of wetlands management.

Key role and responsibilities of Wetland Mitra can be as follows:

- Promote awareness on values and functions of wetlands with local communities, students, resident welfare groups and other stakeholders.
- Participate in wetlands management planning and implementation processes and bring on board stakeholder views.
- Promote consideration of wetlands in local development plans of Gram Panchayats and Municipal Areas as may be the case.
- Alert authorities on any detrimental activities on wetlands such as encroachment, conversion, dumping of solid waste, discharge of untreated waste, release of non-native species and others.

In order to deliver the aforementioned roles and responsibilities, all members of the Wetlands

Mitra network:

- Make themselves aware of the values and functions of wetlands by participating in training workshops, outreach events, connecting with experts, self-reading and other mechanisms as feasible.
- Make themselves aware of the government official responsible for wetlands management.
- Understand the wetlands management approach and key activities being undertaken or planned.
- Dedicate a part of their time towards promoting awareness on wetlands values and functions, keeping watch and ward, and participating in wetlands management planning, implementation and monitoring activities.
- Understand that their role as a Wetlands Mitra network member is completely on a voluntary basis, and does not confer any special rights or privileges.

An example of community engagement in HAW management is that of **Pukhri Sansrakshan Samiti** (PSS) in Tsongo, a HAW of East Sikkim District. The Government of Sikkim framed guidelines for Lake Conservation in Partnership with Gram Panchayats and Pokhri Sanrakshan Samiti's in Sikkim in 2006. Constituted under Gram Sabha with ward members and representatives of Forest Department and NGOs, the PSS appoints Pokhri Rakshak (Lake Guardians) to undertake development of lake conservation plan and implement actions on ground with support of the government and panchayats.

Specific duties of the PSS include:

- Protection of the forests, environment, wildlife and biodiversity in the Pokhri Sanrakshan Shetra (jurisdictional area under PSS) through members of the PSS jointly with the Forest Department staff.
- Ensuring that the migratory and residential birds and other flora and fauna or their habitat is not disturbed.
- Protection of the soil and moisture conservation works, Afforestation works, signages and other infrastructure within the Pokhri Sanrakshan Shetra.
- Bringing to the notice of the Forest Department of any kind of developmental activity being initiated within or adjoining to the Pokhri Sanrakshan Shetra at the earliest.
- Carrying out awareness and education drives, for sensitizing and capacity building of the local community for nature conservation.
- Providing assistance and statistics as and when required by the Forest Department.
- Ensuring that the tourism within the Pokhri Sanrakshan Shetra does not cause problems related to garbage, firewood use, sanitation or disturbance to birds, wildlife or their habitat and results in equitable economic benefits to the local community.
- Providing prompt and quality service to the visitors.
- Ensuring that the shop keepers, hotels, guides, pack animal operators (hereinafter referred to as ecotourism service providers) and the visitors follow the Code of Conduct.
- Explaining to all the visitors about the code of conduct to be followed within the lake and ensure responsible behaviour of the visitors and the ecotourism service providers

FURTHER READINGS

Ramsar Handbook 6 (4th Edition): Wetland CEPA
https://www.ramsar.org/sites/default/files/documents/library/hbk4-06.pdf

International Waters Learning Exchange and Resource Network - Stakeholder Participation in Environmental Policy Toolkit
https://iwlearn.net/manuals/stakeholder-participation-in-environmental-policy-toolkit

SECTION 3

Developing an Integrated Management Plan

3.1 DEVELOPING A MANAGEMENT PLAN: AN OVERVIEW OF STEPS

HOW CAN WETLANDS BE? REGIME, CATCHMENTS, SPECIES AND HABITATS, LIVELIHOODS, INSTITUTIONS AND GOVERNANCE.

An Integrated Management Plan can be developed in eight steps which can be broadly clustered in four parts *(fig 11)*:

- Part 1 outlines the goal and purpose, and sets the rationale for wetland management.
- Part 2 involves description and evaluation of the wetland and leads to identification of priority wetland features and risk of adverse change. The capability of current institutional arrangement to address the risk of adverse change is also assessed in this section.
- Part 3 includes detailing the management framework including setting management objectives, monitoring systems, performance indicators and institutional arrangements for implementing management
- Part 4 involves action planning and includes detailing activity plan, budget requirements and financing arrangements

Communication, education, participation and awareness, and adaptive management are key processes which inform management planning at all stages.

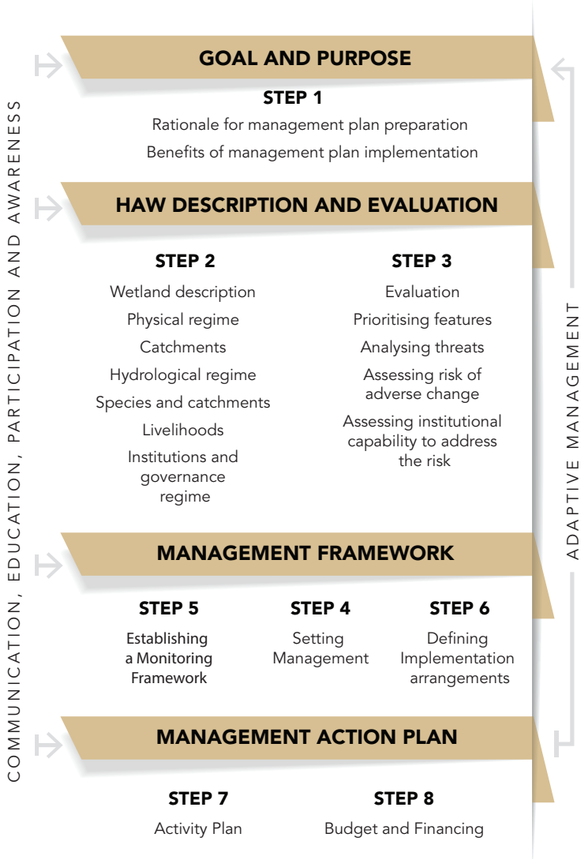


FIGURE 11: MANAGEMENT PLANNING STEPS

STEP 1

SETTING MANAGEMENT PLAN GOAL AND PURPOSE

Management plans are an articulation of the commitment of government and stakeholders for ensuring wise-use of wetlands. The first question that management plans need to answer is 'what has triggered management plan preparation?' To answer this, the overarching developmental and conservation benefit management of HAW aims to deliver or contribute to needs to be stated.

The following are examples of conservation benefits that may result from management of HAW:

- Maintenance of population and habitats of species of high conservation significance nationally or globally (such as Black-necked Crane or White-bellied Heron)
- Maintenance of regional biological diversity (such as biological diversity of Eastern Himalayan biodiversity hotspot)
- Maintenance of viable populations of migratory species (such as waterbirds or fishes)

On similar lines, developmental benefits that may result from management of HAW are:

- Water security - forming headwaters of rivers and springs
- Reduced risk of flash floods
- Economic opportunities, such as ecotourism

At the outset of the management planning process it is essential to establish a goal statement. The goal statement is an indication of the ultimate result the wetland management seeks to achieve. It is a description of the future that those entrusted with management of wetlands envision, plan and commit to achieve. For reasons discussed in section 1.6 and 2.1 of this guidebook, the goal statement should align closely with wetland wise use.

The goal statement should be underpinned by a purpose statement which sets out the reason for achieving the goal. While the goal statement sets out 'what' will be achieved through conservation of HAW, the purpose statement answers 'why' HAW are to be conserved.

The goal and purpose reflect the aspirations of all stakeholders who have a say in managing HAW and will benefit from a healthy ecosystem (Box 4). A good way of setting goal and purpose statements is to run a 'visioning' session at the management planning inception workshop, and convene a session for stakeholders to express what they would achieve from a well-conserved HAW, and the underlying motivation.

BOX 4. GOAL AND PURPOSE OF MANAGING GURUDONGMAR WETLAND COMPLEX, SIKKIM

Situated in North Sikkim District near the international border and perched at an elevation of 5150-5430 m amsl, the Gurudongmar Wetland Complex (GWC) spans 329 ha and forms the headwaters of Teesta River. The three wetlands of the complex cumulatively store capacity of 170 MCM of precipitation providing a flood buffer to downstream communities of Chopta, Thangu and Lachen. The alpine meadows of the region are believed to lock atmospheric carbon in the form of peat, thus reducing the emissions of Greenhouse gases in the region. The mosaic of habitats within the GWC is inhabited by diverse species, which include at least 52 bacterial isolates, 15 phytoplankton, 20 macrophytes, 2 amphibians, 9 waterbird species and 15 mammal species have been recorded from the wetland complex. Four species of ungulates including Kiang, Blue Sheep, Tibetan Gazelle, Tibetan Argali are endemic to the region. The picturesque landscape of GWC not only holds cultural relevance for local people, but also interests throngs of tourists. The wetland complex revered by many is designated as a sacred lake of the state finding special mention in several local legends and folklores. Local people hailing from the entire state of Sikkim take yearly pilgrimage to GWC, marking their socio-cultural linkages with the wetland complex. The wetland has been identified as a priority conservation site under various programmes of the State and Central Government, and receives protection under the Places of Worship (Special Provision) Act, 1991.

The pristine HAW is undergoing change linked with warming temperatures and receding glaciers of North Sikkim region. Major anthropogenic interferences in the wetland ecosystem are rapidly growing tourism and seasonal trans-humance pastoralism, which are creating pressures in the form of water pollution, solid waste disposal and disturbance to species habitats. Alpine meadows along Gurudongmar and the Tibetan plateau beyond it are heavily grazed by yak, sheep and pashmina-type goats of Dokpa and Lachenpa.

The management plan of Gurudongmar Wetland Complex states the goals as 'Maintain Gurudongmar Wetland Complex in a pristine state and ensure sustenance of the high-altitude wetland systems ecosystem services and biodiversity values'

The purpose of managing Gurudongmar Wetland Complex is to:

- Ensure water security to the Teesta Basin by sustaining base flows of Chhombo Chhu and moderating hydrological regimes
- Reduce disaster risks of settlements downstream, especially Thangu-Chopta Valley and Lachen
- Sustain habitats of migratory waterbird species such as Ruddy Shelduck, Brahminy Duck, Black Necked Crane
- Provide livelihood opportunities to local communities through wetlands-based tourism.

STEP 2

WETLAND DESCRIPTION

Wetlands are complex social-ecological systems. Ecosystem components and processes enable wetlands to sustain diverse life forms, as well as provide a range of benefits to humans (also called

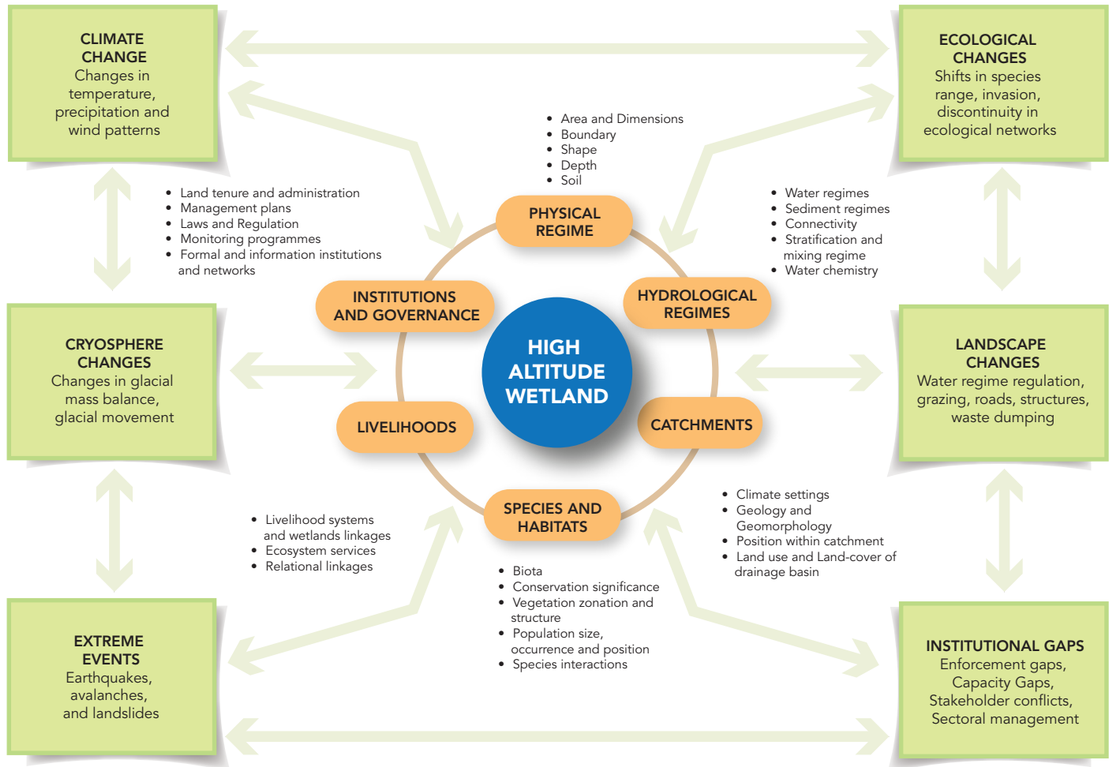


FIGURE 12. HAW FEATURES (SHOWN IN ORANGE) AND GOVERNING FACTORS (SHOWN IN GREEN)

ecosystem services). However, the benefits humans derive from these systems are not attributable to ecosystem components and processes alone, but also to the way these integrate with livelihood systems and the ways in which informal and formal institutions govern access to these benefits. This in-turn also shapes the ecosystem functions and processes. The mutual feedback between ecological subsystem and the social subsystem determines the condition and trajectory of change within the wetlands as a coupled social-ecological system. Various components of the wetland social-ecological system are also indicated in Figure 5 of this guidebook.

The HAW social-ecological system can be unpacked in terms of 'wetland features' – the distinctive attributes which characterize these ecosystems. These features may be related to one of the following six system aspects (related to the social or ecological sub-system components or the linking governance systems):

A) Physical regime – related to the spread of the wetland and the types of habitats located within.
B) Hydrological regimes – related to way water, sediment and nutrients move within the HAW.
C) Catchments – related to the topographical, and land-use and land-cover in area draining into and influencing the HAW.
D) Species and habitats – related to wetland-dependent species, their habitat use patterns and species interactions.
E) Livelihoods – related to ways communities are linked with HAW to meet their livelihood needs as well as well-being.
F) Institutions and governance – related to the diversity of stakeholders and their ways of decision-making for HAW.

The description of wetland features has two parts – current condition and change over a period of time (it is usually appropriate to consider a longer period – possibly extending over two decades). The current condition should include natural variability of the feature (for example, the interannual variability in water levels, seasonality in vegetation zonation, freezing and thawing cycles, migratory animals). A summary of wetland features status and trends forms the basis of ecological character description.

Features change in response to natural as well as human-mediated factors. These have the potential to influence or change a feature or to affect the way in which a feature is managed. These influences may exist, or have existed, at any time in the past, present, or future. Such stressors are termed as governing factors. An understanding of wetland features and governing factors helps describe wetland ecological character, the overall trajectory of change, and the underlying reasons. A schematic representation of wetland features and factors is presented in Figure 12. In the figure, features have been shown in orange and factors in green.

Due to their remote location and difficult terrains, it is often not possible to conduct detailed surveys of HAW to describe the features. A good strategy therefore is to begin with whatever is available through open sources, in the form of satellite data, published literature, reports from long-term studies and other sources. Data gaps identified during the desk analysis may be addressed during field data collection. Rapid assessments carried for at least two seasons (summer and winter, corresponding with freezing and thawing cycle of most HAW) is recommended, a format for which is at Annex I. Rapid assessments do not replace the need for systematic long-term monitoring, which should be addressed as a part of management plan implementation.

The description of features is fundamentally a process of systematically synthesizing available information. This includes evaluation of existing information in terms of its relevance to describe a particular wetland feature and its governing factors, and in doing so, also identifying gaps in information. Care must however be taken that only information relevant for management planning is subject to further data collection.

It is a good practice to catalogue information in terms of their sources (where is the information from?), time-period (what period does the data pertain to?), method (how was the data generated?) and overall quality (how robust is the data in terms of describing the wetland feature or factor?). All forms of data (published, grey, anecdotal, traditional) should be considered for management planning.

RAPID ASSESSMENTS DO NOT REPLACE THE NEED FOR SYSTEMATIC LONG-TERM MONITORING, WHICH SHOULD BE ADDRESSED AS A PART OF MANAGEMENT PLAN IMPLEMENTATION.

INFORMATION USED IN MANAGEMENT PLAN MUST BE CATALOGUED IN TERMS OF SOURCES, TIME PERIOD AND METHOD AND OVERALL QUALITY. ALL FORMS OF DATA SHOULD BE CONSIDERED FOR THE MANAGEMENT PLAN.

2.1 PHYSICAL REGIME

Water is the master variable that creates and sustain wetlands. The inundation or waterlogging by water (permanent or seasonal) creates soil conditions dominated by anaerobic processes, which in turn forces the biota, particularly rooted plants to adapt

IMAGE 8: WISA TEAM ASSESSING WETLAND BOUNDARY OF CHANDERTAL *(Wetlands International South Asia Library)*

TABLE 4. ASSESSMENT NEEDS AND DATA SOURCES FOR DESCRIBING PHYSICAL REGIMES

WHAT TO ASSESS?	HOW TO ASSESS?	POSSIBLE DATA SOURCES
Wetland extent	Maximum spread based on inundation, waterlogged soils and hydrophytic vegetation (Refer Annex II for further guidance)	Satellite data and field surveys
Wetland type	Differentiate on the basis of: • location with respect to glacier • area • water sources (see Table 1) • water movement • vegetation cover • carbon accumulation • (Refer flow chart in Figure 13)	• Satellite images • Field data on inundation, size, surface connectivity with glacier, presence of discrete inlet, presence of vegetation • Survey of India topographical maps • Published literature
Wetland soil	Physical properties – texture and colour Chemical properties - pH, Soil Organic Carbon, Nutrients	Soil samples taken from different locations within the wetland
Connectivity with other wetlands	Determine the wetland connectivity upstream or downstream by surface drainage or groundwater	Satellite imagery of the wetland catchment (refer step 2.2 of this guidebook)
Factors sustaining wetland regime	• Position of the wetland in the landscape (whether wetland is located in a valley depression, slopes etc.) • Major surface water inflows and outflows points • Presence of topographic features (such as moraine-dams for glacial lakes)	• Digital Elevation Model (DEM) from open sources such as Cartosat, SRTM, and ASTER • Survey of India topographical maps • Satellite imagery of the wetland
Trend in wetland extent (last 30 year)	Assess changes in wetland area and habitat types	Satellite imagery of the wetland with comparable resolutions
Administrative boundaries	Location within the district	Govt records Open datasets on administrative boundaries such as https://freegisdata.rtwilson.com/ https://idp.mit.edu/idp/Authn/MIT?conversation=e1s1
Location with reference to notified areas	Location with respect to: • designated protected areas • notified wetlands • areas notified under central government or state acts and rules • areas designated under international conventions (Ramsar Sites, UNESCO World Heritage Sites, Flyway network site etc.)	Respective notifications

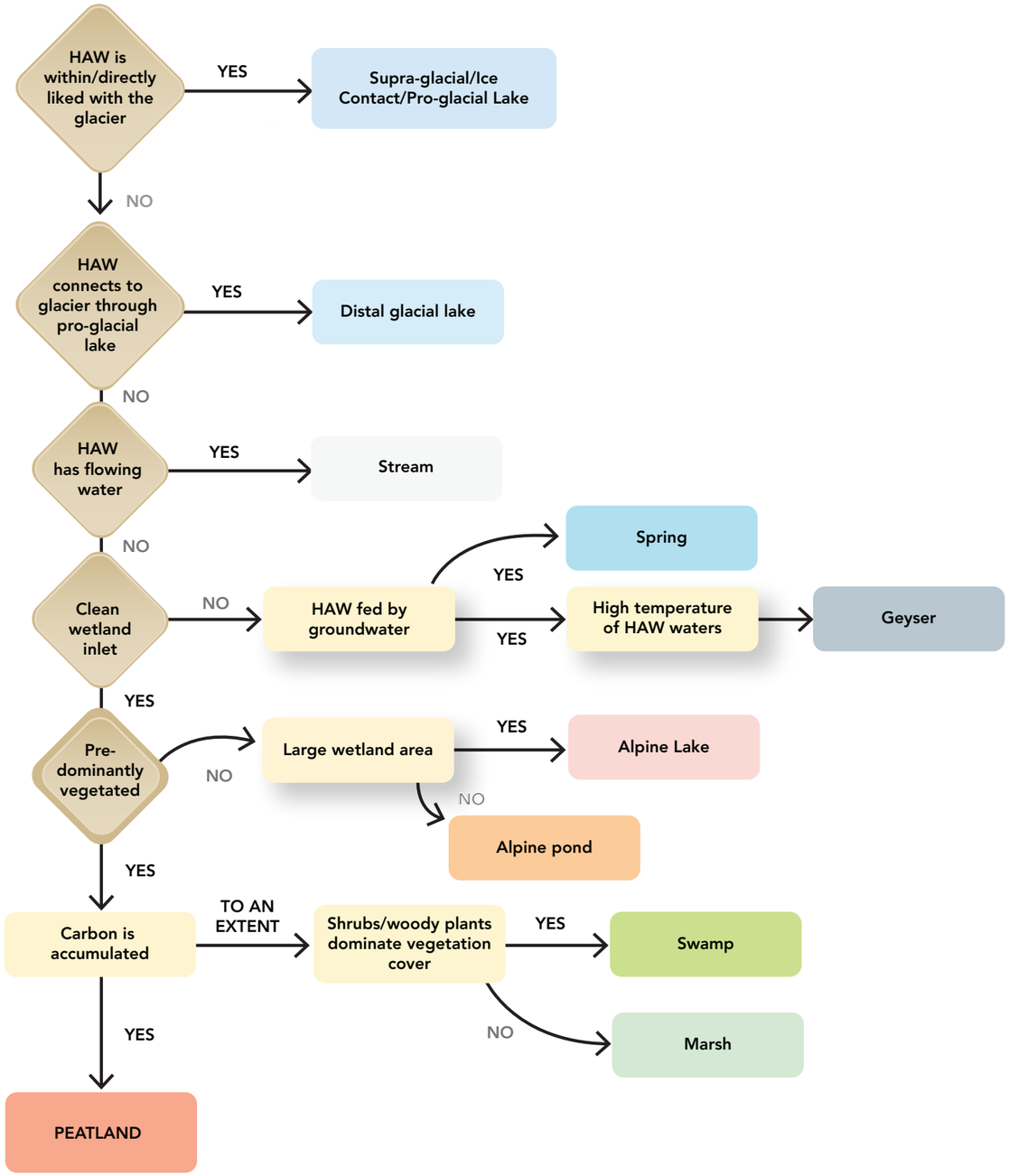


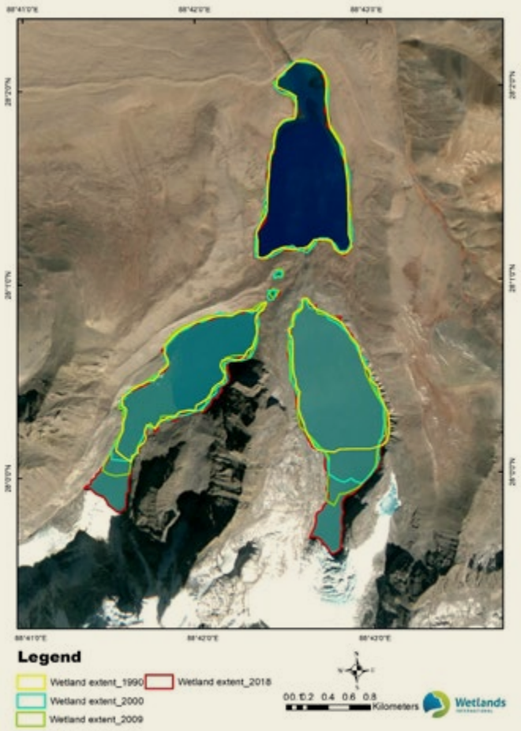
FIGURE 13. A GENERIC SCHEME FOR DETERMINING HIGH-ALTITUDE WETLAND TYPE

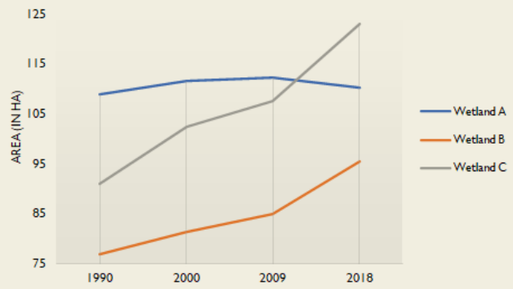
BOX 5. DELINEATING HIGH-ALTITUDE WETLANDS OF NORTH SIKKIM DISTRICT

Gurudongmar wetland complex (GWC) situated at an altitude of 5180 m amsl within Upper Teesta basin is bound by moraines, plateaus and meadows in the north while the glaciers, snow clad mountains scree rising to ca. 6000m occupy the southern upper reaches. GWC comprises three wetlands: a) Gurudongmar chho at an elevation 5174 m amsl, denoted as A) and other two wetlands located at the terminus of Gurudongmar glacier at elevations of 5253 m and 5218 m amsl (denoted as Wetland B and C) respectively. The two southern lakes are proglacial whereas the northern lake is a moraine dammed lake.

Based on open-source seasonal imagery derived from Sentinel 2B pertaining to pre-monsoon and post monsoon seasons of the year 2018. The seasonal extent or boundaries of the constituent glacial lakes were marked using a three-band composite of Sentinel image in a GIS environment (ArcMap). The extent of GWC varied from 328.36 ha in pre-monsoon to 332.76 ha in post monsoon. Variation in spatial extent is largely attributable to the glacial melt received by the complex from its source,

Wetland A, a moraine dammed lake with a well-defined inflow and outflow, did not undergo any drastic changes whereas wetlands B and C being proglacial in nature exhibited seasonal change with exposed shoreline in the pre monsoon. Trends in wetland area derived from satellite data analysis are presented in the map and graph below.





to inundation and waterlogging. Thus, wetland delineation is done on the basis of three indicators, which relate to hydrological regimes (presence of seasonal or permanent inundation or waterlogging), soils (saturated soils developed under anaerobic conditions) and plants adapted to life in inundated or waterlogged conditions (hydrophytes).

Not all of these indicators can be applied uniformly to HAW as soils are poorly developed for many HAW systems and tend to be only well developed in valley

IMAGE 9: GLACIAL CATCHMENT OF GURUDONGMAR IN SIKKIM *(Dhruv Verma / Wetlands International South Asia)*

locations, and similarly growth of vegetation is very restricted. Several of HAW are also frozen for a large part of the year. In several cases, HAW occur as wetland complexes connected with source glacier.

Detailed physical regime surveys for HAW may not be feasible due to limitations imposed by terrain, access and other factors. It is therefore recommended that the first level of wetland delineation is done on the basis of satellite images (using images from at least two seasons, peak summer and winter), and the maximum inundation area where there is surface water (encompassing fringe vegetation) for a normal hydrological year. A number of points can be validated through ground truthing and the accuracy of map improved. A guidance on wetland delineation is presented in Annex II.

Variability in water sources (precipitation, surface or groundwater), hydrodynamics and hydroperiod (static or flowing, vertical or horizontal flow), vegetation cover (sparse or dominant), and carbon content of soils (whether present or absent, or accumulating or not) are some of the major factors which explain diversity in wetland types. A simple decision-making tree for identifying wetland type can is presented in Fig 13.

An understanding of the landscape also provides insights into factors sustaining the wetland regimes (for example, location within the landscape, presence of drainage impeding topographic structures, inflows and outflows).

The analysis of wetland physical regime should also map out trends in wetland extent over a longer period of time. Some of the factors to consider are:

- variation in inundation regime and water levels
- changes in connectivity within the wetland complex
- changes in wetlands upstream and downstream
- changes in vegetation cover

THE FIRST LEVEL OF WETLAND DELINEATION CAN BE DONE USING SATELLITE IMAGES FROM AT LEAST TWO SEASONS.

2.2 CATCHMENTS

Wetland catchment refers to the surface area which drains into the wetland (although some wetlands can also be fed by groundwater). The geomorphology, land use and land cover of the catchment have a significant influence on the flux of water, sediments, nutrients and species in the wetland, and thus catchment scale management of wetlands is a recommended principle. Since, sustenance of HAW is largely governed by surface flows such as glacial and snow melt and precipitation, this section focuses on surface water catchments delineation and characterisation.

For the HAW sustained by groundwater flows, such as Springs and Geysers, it is imperative to

TABLE 5. ASSESSMENT NEEDS AND DATA SOURCES FOR DESCRIBING WETLAND CATCHMENT

WHAT TO ASSESS?	HOW TO ASSESS?	POSSIBLE DATA SOURCES
Extent of direct catchment	Delineate the area that directly drains into the wetland on the basis of surface and groundwater drainage patterns	• Drainage pattern derived from DEM data
Extent of indirect catchment	• Delineate the area which includes: • source glacier • connected wetlands • area downstream to wetland which receives flow directly	• Satellite data products Landsat 8, Sentinel • Himalayan Glacier Inventory Atlas https://vedas.sac.gov.in/vcms/en/Himalayan_Glacier_Inventory_Atlas.html • High Altitude Wetlands Inventory • Drainage pattern derived from DEM data
Climate settings (current status and long-term trend) in the catchment (direct and indirect)	Trends in: • Temperature – Maximum, Minimum and Averages (for winter and summer) • Precipitation - Maximum, Minimum and Averages (for winter and summer) • solar radiation - Maximum, Minimum and Averages (for winter and summer) • Wind patterns (velocity and direction for various seasons) • A current climate profile can be generated using the data for last three years, which can be compared with long term data for over 50 years and beyond.	• Most of the high-altitude areas are not covered by monitoring stations. So, the nearest and representative station data can be procured from Indian Meteorological Data (IMD). • Global climate data portals (such as WORLDCLIM (www.worldclim.org) and Global Precipitation Climatology Project (https://psl.noaa.gov)
Geomorphology of the catchment	• Identify major landforms such as valleys, depressions, plateau, mountain ranges etc. • Identify major rock types and structures in the catchment	• Maps and Reports of Geological Survey of India (https://www.gsi.gov.in/webcenter/portal/OCBIS/pageMAPS/pageMapsSeries?_adf.ctrl-state=49myouhva_5&_afrLoop=29376107481387432#! • Geological and topographic maps • Published papers
Topography of the direct catchment	• Delineating • Elevation profile • slope and aspect patterns	• Satellite data and digital elevation models
Land use and Land cover of the direct catchment	• Current status of land cover (such as glacier, snow, stream, shrubland, forest, grassland, wetland) and land use (such as agriculture, builtup) • Trends in land use and land cover in the last 20 years – delineating areas which have undergone transformation	• Satellite data for wetland direct catchment • Historical land use and land cover maps are available at: (Bhuvan - https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php)
Land use and Land cover of the indirect catchment	• Current status of land cover and land use features (dominant LULC features) • Trends in land use and land cover in the last 20 years – delineating areas which have undergone transformation	• Satellite data for wetland indirect catchment • Historical land use and land cover maps are available at: Bhuvan - https://bhuvan-app1.nrsc.gov.in/thematic/thematic/index.php)

BOX 6. DELINEATING CATCHMENT OF CHANDERTAL, A HIGH-ALTITUDE WETLAND OF HIMACHAL PRADESH

Chandertal is a crescent-moon shaped distal high-altitude wetland of the Chandra-Bhaga glacier system. Perched at 4,300 m amsl elevation in the upper catchment of River Chandra and spanning 46 ha, the wetland is frozen for nearly 4 months, from December to March. Due to limited anthropogenic nutrient influx, the wetland has a near-pristine water quality with only traces of geogenic elements. Apart from providing habitation to diverse animals and plants species including the endangered Snow Leopard, the wetland forms an integral part of the Central Asian Flyway network, hosting several migratory birds such as Ruddy Shelduck, Garganey, and Gadwall. The peatland on the margins of the wetland is an important carbon store. The wetland catchment and periphery are dotted with burrows of Himalayan Marmots and other faunal species. Although sightings of large mammals such as Snow Leopard, Tibetan Wolf, Blue Sheep and others have become infrequent due to anthropogenic disturbances, the wetland is a well-knit part of their range distribution. The picturesque landscape of Chandertal not only holds cultural relevance for local people but also interests many travel enthusiasts. The wetland is revered by many as a sacred and has been placed in several local legends and folklore. Local people hailing from remote villages of Lahaul and Spiti celebrate festivals such as Bees Bahado at the wetland, marking their socio-cultural linkages with Chandertal.

Chandertal is situated within the sub-basin of the River Chandra which is a tributary of River Chenab. Samudra Tapu is the largest wetland of the sub-basin and lies left to the Chandra river and at the snout of glacier by the same name. Samudra Tapu is a proglacial lake and maintains an active interface with the glacier. Chandertal, on the other hand is a distal glacial lake, and would have been connected with glacial system in the geological past. On the left bank of River Chandra is a peat bog developed in a trench about 600 m wide and 500 m long. This depression is also a point of snow accumulation which thaws during summer season creating favourable conditions for accumulation of carbon in the shallow peat system.

The catchment of Chandertal is defined by the cryosphere to which it is linked and associated drainages. The Chandra Bhaga glacier complex which feeds Chandertal, Samudra Tapu and other glacial lakes of the basin is constituted by over 200 glaciers of which Bara Lacha La and Samudra Tapu are the major ones. The overall catchment area drained by these glaciers is 74,492 ha. Direct flows into Chandertal are received from 11 streams which originate from snow clad mountains in the east and define its direct catchment.

The total catchment of Chandertal which includes the glacier system and associated wetlands is shown in yellow boundary. The red boundary shows the direct catchment of the wetland.

understand the groundwater catchments and flows. For the ease of understanding, this guidebook focuses on the surface catchment and flows.

For managing HAW, catchment delineation should be done at two levels. The direct catchment can be delineated on the basis of topography, drainage patterns, and includes the surface area that directly drains into the wetland. The indirect catchment is a larger area which includes all topographic and geomorphic features that influence the condition of the wetland. The indirect catchment encompasses: a) water sources, which are usually the glaciers or snow packs; b) the overall drainage system of which the wetland forms a part; and c) the downstream stretch the hydrology of which is influenced by the HAW.

As an embedded part of the catchment, any disturbance in natural catchment structure and processes, by human activities or natural process can adversely impact HAW condition. Some of the common disturbances in HAW catchments are extensive grazing, establishment of tourism infrastructure, construction of large-scale hydro-electric dams in downstream stretches and others.

THE HYDROLOGICAL REGIMES OF HAW ARE PRIMARILY GOVERENED BY GLACIAL MELT AND PRECIPITATION.

2.3 HYDROLOGICAL REGIMES

The term hydrological regime refers to movement of water in to and out of a wetland over space and time. It reflects the spatio-temporal patterns of water inflow, storage and outflow. The flux of water in a wetland is closely linked with movement of sediments and nutrients, thus becoming critical factors in determining variability in quality and quantity of water in a wetland.

The hydrological regimes of HAW are defined primarily by the water received from glacier streams, snow melt or precipitation, even though there may be important groundwater sources in some HAW. The melt from glaciers takes place from a long-term reservoir that has been built over a long time period, from decades to centuries. In contrast, seasonal snowpacks renew in winter and melt by early summer, providing bulk of the runoff in the early high flow season. The glacial melt contributes to streamflow mostly after the snowpack has been exhausted, and will have a critical role as a streamflow buffer during years of low snow or droughts. The albedo of ice-contact glacial lakes may also influence glacial melt rates. Rapid build-up of water levels, especially in moraine or debris dammed wetlands, increases the risk of GLOFs in the downstream.

IMAGE 10: SURFACE OUTLET OF CHANDERTAL IN HIMACHAL PRADESH
(Harsh Ganapathi/Wetlands International South Asia)

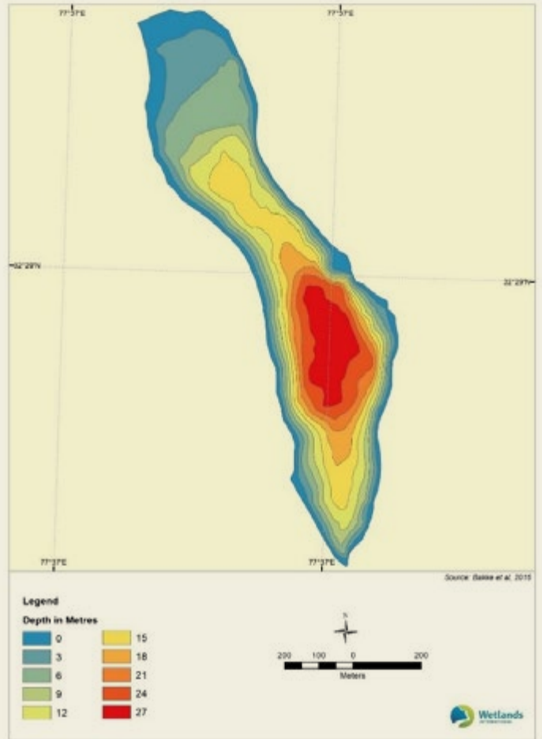
TABLE 6. ASSESSMENT NEEDS AND DATA SOURCES FOR DESCRIBING HYDROLOGICAL REGIMES

WHAT TO ASSESS?	HOW TO ASSESS?	POSSIBLE DATA SOURCES
Hydrological regime	Analysis of interannual variability in terms of: ▪ Water spread (seasonal and long term) ▪ Months of freezing – thawing ▪ Water inflow patterns • Number and seasonality of Inlets, • Volume received - %age contribution of inflows (snowmelt, precipitation) ▪ Water outflow • Number and seasonality of outlet • Volume discharged - %age discharge by surface outflow and evaporation • Water abstraction	• IMD hydro-meteorological data • Geo-information portals such as WRIS and Google Earth • Modelling using SWAT or other appropriate tools • Field survey for assessment of inlets and outlets using GPS and other equipment
Water holding capacity	• Determining bathymetric profile of the wetland. • This could be done by dividing the wetland into grids of equal sizes, and assessing depth manual methods (such as using rope with weights) or sonar-based instruments (Echo-sounder). • The area-stage plots can be converted to volumetric assessments using appropriate mathematical relationships.	• Data from primary surveys, or interpolation from similar wetlands • Satellite data analysis using altimetry techniques • Field estimation using Echo-sounder and other tools
Sediment load	• Identify aggraded area around the wetland • Determine sediment yield of the direct catchment using Universal Soil Loss Equation or other appropriate method • Determine physico-chemical properties of the sediment (texture, porosity, pH, Organic Carbon, Nutrients, Electrical Conductivity)	• Field surveys • Physico-chemical analysis of sediment samples • Sediment models • Published literature
Water quality	Determine seasonal variation (summer and winter) of: • Physical parameters: Temperature, Transparency, Color, Odor • Chemical parameters: pH, EC, DO, Phosphate and Nitrate, Alkalinity, Hardness	• Field surveys • Physico-chemical analysis of water samples • Published literature
Changes in hydrological regimes	Determine changes over a period of time (20 years) in: ▪ Water spread ▪ Water levels ▪ Months of freezing – thawing ▪ Water inflow patterns • Number and seasonality of Inlets, • Volume received - %age contribution of inflows (snowmelt, precipitation) ▪ Water outflow • Number and seasonality of outlet • Volume discharged - %age discharge by surface outflow and evaporation • Water abstraction	• Monitoring records • Interpretation of temporal satellite data • Technical reports of government department and research institutions • Published literature
Changes in water quality	Determine changes over a period of time (20 years) in: ▪ Nutrient concentrations ▪ Oxygen levels (Dissolved oxygen, Biological Oxygen Demand)	• Monitoring records • Technical reports of government department and research institutions • Published literature

BOX 7. DETERMINING WATER-HOLDING CAPACITY OF CHANDERTAL

Three solid geometry based methods are generally used to compute water holding capacity of a wetland (calculating the volume of a frustum of a circular cone, end-area formula for calculating the volume of prismoidal forms, and using depth interval data for different parts of the wetland).

In Chandertal, information on bathymetry derived from Echo-sounding was used to produce geographically referenced image of wetland bottom with different depth measurements. The individual points were spatially interpolated to generate the depth contours and bathymetric profile of the wetland in a software called Reefmaster. The assessment showed that the maximum depth of the lake (29 m) was in the southern part, whereas the northern part was shallow with a depth of 15-17 m (image below). Considering the lake as a frustum of a circular cone, the volumes of successive contours of water was calculated and summed up to obtain the total volume. The volume of Chandertal wetland was estimated to be ~5.72 MCM which when compared with flow volumes and water level changes gives an indication of water regime buffering capacity of the wetland.



CASE STUDY BASED ON:

Bakke J., Vasskog, K., Ramanathan, A., Mandal, A., Kumar, O., & Nesje, A. (2016). The Water Tower of India in a Long-term Perspective – A Way to Reconstruct Glaciers and Climate in Himachal Pradesh during the last 13,000 Years. Journal of Climate Change, 2(1), 103–112. https://doi.org/10.3233/jcc-160011

The HAW are majorly oligotrophic (nutrient poor), and highly sensitive to anthropogenic nutrient enrichment resulting from activities such as grazing or tourism, or even army establishments. Water chemistry generally reflects the chemical properties of rocks and related weathering processes, and may lead to striking dissimilarities even within adjacent wetlands. Deeper lakes develop seasonal stratification allowing nutrient mixing and enabling aquatic organisms to survive.

Hydrological regimes underpin ecosystem functioning, biodiversity and ecosystem services of HAW. These wetlands influence regional hydrology owing to their water retention capacity, water release, and in some circumstances, alterations to stream flows through moderation by the prevailing vegetation cover (such as in wet grasslands or peatlands).

Deriving high quality hydrological information for most HAW is rendered difficult due to extreme climatic conditions and general lack of hydrometric stations. Information on long-term changes in glaciers, hydrological regime, rock chemistry can provide a meaningful basis for characterizing hydrological regimes for management planning. Generic water holding capacity models are available which can provide an approximation of water flux, in cases where primary surveys are not possible due to paucity of time and resources.

2.4 SPECIES AND HABITATS

The species whose life cycle stages are directly and functionally linked to wetlands are termed as 'Obligate' or 'wetland dependent' species. They solely depend on the wetland habitat and its resources at a requisite time(s) of year or stage(s) to complete their breeding and migration requirements. Unavailability of such resources at the HAW hinders their survival. Examples of wetland dependent species includes Black-necked Crane and Bar headed Goose. While species which are indirectly or partially dependent on the wetland are termed as 'Facultative' species. Such species can be found in upland regions and examples include mammals like Tibetan Ass and Tibetan Gazelle.

Vegetation within HAW is usually sparse and emergents can be seen within the fringes of lakes and ponds. Peatlands are usually covered by mosses (like Sphagnum). Vegetation colonizes the HAW margins upon thawing. The shallow parts of several lakes have mats of ***Hippuris vulgaris, Potamogeton spp*** and other submerged vegetation. The moisture regime created by HAW may also enable sustenance of grasslands along the margin.

The remoteness and inaccessibility of the high-altitude areas makes assessment of species and habitats difficult, and hence, published reports, maps and species range datasets may be used to

IMAGE 11: BLACK-NECKED CRANE (ADULT AND JUVENILES) AT CHUMUR IN LADAKH *(Dr Pankaj Chandan)*

create a profile prior to field visits. Varied sampling techniques (recording of opportunistic sightings, point sampling, random sampling, transect sampling) may be adopted for mapping species occurrence and assessing faunal population and floral density. Existing human and livestock trails, roads are used to access the sample sites including mountain slopes, wetland fringes and alpine meadows and grazing grounds. Often it is difficult to sight animal species therefore indirect signs of occurrence such as hoof marks, tracks and pellets are recorded. Semi-structured interviews with local people may also be conducted to record the presence of an animal species and understand its population trend. Topographical maps are used to determine and mark permanent transects along the HAW and its adjoining areas to record species occurrence. These can be mapped using a hand-held global positioning system. For recording information in the field and minimising potential disturbance, a pair of good binoculars should be used for observing and counting birds and cryptic animals from distance.

THE SIGNIFICANCE OF HAW IN LIVELIHOOD SYSTEMS IS UNDERPINNED BY ITS UNIQUE SOCIO-ECOLOGICAL VALUES FOLLOWED BY DIRECT DEPENDENCE.

The migratory and resident waterbirds are dependent on the high altitude marshes for feeding, breeding and roosting. Site fidelity is also an important factor of species interactions as some of the species visit the same area for breeding and nesting every year. For example, Black necked Crane forage and nest in shallow wetlands or nearby grasslands.

Some of the wetland floral and faunal species are indicators of wetland condition and can be the basis of conservation attention. Regular field assessments of the species and habitats should be carried out at landscape level. This helps to document the population and diversity trends, in order to design the conservation activities. Considerations to criticality of wetlands in supporting resources and conditions to maintain regional biodiversity profile need to be assessed and mainstreamed in protected areas management and developmental planning. The table below provides an overview of assessment procedure for key features defining wetlands biodiversity.

IMAGE 12: KAILASH MANSAROVAR, A HIGH ALTITUDE WETLAND OF OUTSTANDING UNIVERSAL VALUE *(Jean-Marie Hullot / Wikimedia Commons)*

TABLE 7. ASSESSMENT NEEDS AND DATA SOURCES FOR ASSESSING WETLAND SPECIES AND HABITAT

WHAT TO ASSESS?	HOW TO ASSESS?	DATA SOURCES
Key habitats in HAW	• Delineate major habitat types (Open water, Deep, Shallow, Marshy, Peat, Rocky substrate) and associated environmental settings • Mapping habitat types on the basis of vegetation zonation and use by key species	• Satellite Imagery • Field surveys • Secondary literature such as wetland management plans and study reports.
Inventory of wetland dependent species (flora)	• List different life-forms (Micro and Macroflora) • Assess conservation status based on IUCN Red List, CITES, Wildlife Protection Act and other national lists • List presence of species of ethnobotanical importance	• Literature review, checklist provided in wetland management plans, Study reports, BSI, Interviews with locals • Field assessments (April-October) by laying transects
Inventory of wetland dependent species (fauna)	• List Vertebrates and Invertebrates • Assess conservation status based on IUCN Red List, CITES, Wildlife Protection Act and other national lists • List migratory species and their use of wetland habitat	• Literature review, checklist provided in wetland management plans, Study reports, ZSI, Interviews with locals • Field assessments (all seasons) based on ocular observations and indirect evidences by laying transects
Trends in habitat availability for key species **Impacts of habitat fragmentation / anthropogenic stressors on biodiversity**	• Map species distribution (both past and present) • Record changes in habitat area and quality	• Past distribution records - Literature review & anecdotal accounts, Bird migration maps. • Satellite Imagery to map the habitat settings and assess changes having occurred over the time, such as; habitat fragmentation
Trends in sightings of key species	• Transect sampling to maintain a list of species and how many times a respective species is sighted/recorded. • Frequency of sightings expressed as 'abundance' status of species: **Common** (recorded 9–10 times out of 10 visits), **Fairly common** (recorded 6–8 times out of 10 visits), **Uncommon** (recorded 3–5 times out of 10 visits) and, **Rare** (recorded 0–2 times out of 10 visits)	• Past distribution records - Literature review & anecdotal accounts, Bird migration maps. • Current abundance estimates from field assessments
Wildlife diseases	• Listing of potential wildlife diseases (foot and mouth disease in ungulates, influenza in birds and canine distemper in carnivores) • Possible cause and vectors • Mortality is incidental or mass	• Records from the Forest Veterinary department; Animal husbandry records. • Biodiversity management committee records

BOX 8. CONSERVING BLACK-NECKED CRANE HABITATS IN LADAKH

WWF-India in collaboration with the Department of Wildlife Protection, Government of Jammu & Kashmir, Ladakh, Sikkim and Arunachal Pradesh carried out an ecological study on the Black-necked Crane in the Western and Eastern Himalayas, India. The study was conducted from May 2000 to November 2014 at four locations (Changthang Ladakh, Pangchen valley and Sangti valley in Arunachal Pradesh and Lhonak valley in Sikkim), the major part being in Ladakh. Following were the objectives of the study; (i.) Establish the breeding population and, identify the nesting and feeding sites (ii.) Identify potential threats to the breeding and wintering habitats.

During the study period data were collected from 22 wetlands sites in Changthang Ladakh, one wetlands site in Sikkim and two wetlands sites in Arunachal Pradesh. 17 breeding pairs of the Black-necked Crane were recorded in Ladakh, followed by 5 in Arunachal Pradesh and one in Sikkim. Although new breeding sites were recorded, the overall breeding productivity was found to be declining. The decline in breeding success is related to increased anthropogenic pressures, and resultant secondary impacts, like direct killing by free ranging dogs and pressure on habitat due to unplanned infrastructural development, excessive livestock grazing and unregulated tourism.

To ensure a healthy population of Black-necked Cranes and the protection of its habitat, the study recommended conservation measures, such as (i.) Instituting an advisory committee comprising government departments, scientific experts and local community representatives as major stakeholders to take decisions and guide conservation planning (ii.) Ensure protection of the bird's habitat during the breeding season, especially during incubation period which is critical part of the breeding cycle of the species (iii.) Encourage traditional ecological practices for pasture management as practised by the nomads in Tsokar (iv.) Fixing of physical structures (such as electric poles) which could obstruct the bird in flight should be avoided in the wetland vicinity (v.) and regular and sustained monitoring of the species should be ensured by building capacity and involvement of the locals in the conservation processes.

BASED ON:

Status and distribution of Black-necked Crane (Grus nigricollis) in India. Chandan, P. et. al. (2014). Zoological Research. 35 (S1). Pp. 39–50.

TABLE 8. ASSESSMENT NEEDS AND DATA SOURCES FOR WETLAND LIVELIHOOD SYSTEMS

WHAT TO ASSESS?	HOW TO ASSESS?	DATA SOURCES
Demographic profile of communities living within the indirect catchment	Mapping of the settlements in the downstream stretches Collating and analysing data on population, literacy, occupation, age and other demographic parameters of the communities	Census
Key resource user groups	Conduct primary surveys to identify key resource users – communities depending on wetlands directly (through use of wetlands resources) or indirectly (dependant on wetland functions, or recreational and cultural values)	Primary surveys Published literature
Resource use patterns and trends	Identify intensity (in terms of number of people and criticality of resource in livelihoods) and seasonality (which months of the year) of resource use Assess major trends in resource use in the last two to three decades	Primary surveys Government records such as Census data, Grazing records at Forest Dept
Community management arrangements with respect to wetlands	Identify ways in which communities engage in wetland management, in the form of: ▪ Setting access norms ▪ Beliefs, taboos, totems ▪ Cultural and religious practices ▪ Wetland issues in the agenda of Panchayat meetings ▪ Local action related to wetlands ▪ local bodies entrusted with wetland management	Stakeholders consultation through key informant interviews and focused group discussion Published literature
Resource use conflicts	Record whether there has been any conflict between stakeholders (including different resource user groups) on wetlands	Primary surveys Records in Panchayat meetings, Forest Dept etc
Views, Rights and capacities of resource user groups	Record the perceptions of communities towards status of HAW key issues impacting the HAW possible solutions Community participation in wetland management	Primary surveys Newspaper articles

IMAGE 13: FOREST DEPARTMENT SIGNAGE IN CHANDERTAL SHOWING INSTRUCTIONS FOR VISITORS *(Dhruv Verma/Wetlands International South Asia Library)*

2.5 LIVELIHOODS SYSTEMS

Most of the HAW do not have community settlements in their immediate vicinity, and thereby livelihood interactions are mostly indirect. The significance of HAW in livelihood systems is primarily in terms of cultural and recreational values, followed by direct livelihood dependence through engaging in tourism, or animal husbandry with wetlands providing seasonal grazing areas (box 9). Several communities attach significant cultural and religious values to these wetlands and the surrounding areas, and set norms governing their use and access.

At the landscape scale, HAW serve as the primary sources of freshwater. Understanding the ways in which HAW link with livelihood systems of communities (including all forms of capital – natural, physical, financial, social and human) is crucial in defining strategies for their engagement in wetland management. In recent times, the rapid growth in tourism and infrastructure development has created adverse impacts on these ecosystems, and the communities are (or are likely to be) at the frontline of such impacts. Effective management planning needs to be based on careful analysis of views, rights and capacities of these communities in the context of wetlands management (refer box 10 for Rapid Assessment of Wetland Ecosystem Services).

THE FORMAL AND INFORMAL INSTITUTIONAL AND GOVERNANCE REGIME RELATED TO WETLANDS MUST BE MAPPED IN TERMS OF THEIR COLLECTIVE ABILITY TO ENSURE WISE USE.

2.6 INSTITUTIONS AND GOVERNANCE REGIMES

Institutions and governance regimes define the way decision-making is undertaken to steer collective behaviour towards desired outcomes. In the context of wetland management, institutions and governance regimes encompass a set of formal and informal regulatory processes, mechanisms and organizations through which stakeholders influence wetland condition, and in particular resolve conflicts

BOX 9. PASTORALISM IN HIGH-ALTITUDE WETLANDS

Pastoralism is one of the oldest forms of subsistence livelihoods for nomadic and indigenous communities in the Himalayas. Changpa nomads of Changthang plateau, Gaddi of Himachal Pradesh, and Bhutia of North Sikkim are agro-pastoralists who raise large flocks of sheep, goats, yaks, and ponies to graze on alpine vegetation in high altitude rangelands. These livestock provide a range of products and services to support economic well-being of the communities.

The Changthang region of Ladakh is a highland grazing ecosystem for the local Changpa community. The landscape is characterised by a mosaic of habitats comprising alpine meadows along the shores of the high-altitude wetlands and the banks of the Indus and Hanle Rivers. The landscape serves as a habitat for a diversity of migratory birds and high-altitude mammals, including domestic livestock. The livestock herds graze upon the highly nutritious alpine herbs and grasses of the Changthang landscape, that are usually abundant around high altitude wetlands. The Changpa value these wetlands not only for water and fodder for the livestock, but also collect salt and soda from the shores of brackish lakes such as Tsokar. These livestock animals are then reared for production of economy generating products such as wool, dairy items, meat and services like transportation.

However, the dynamics of pastoralism has changed over years and has a bearing on wetlands health. In recent times, the migration routes and pasture use patterns have changed due to changes in socio-economic settings of the communities and immigration of refugees. With increase in livestock population and changes in resource management strategies, pressures on alpine pastures and wetlands in Changthang have intensified. In addition, tourism at wetlands, in its current form is considered to have negative impacts on the functioning of wetlands and alpine pastures. Thus, wetlands being a barometer of changes induced by anthropogenic activities, it is essential to manage wetlands and associated ecosystems in a participatory manner. In this endeavour, the GoI declared Changthang as a Protected Area under Indian Wildlife Protection Act 1972, imposing restrictions on resource extraction and allowing limited tourism activities. However, the management planning for the protected area inadequately addressed the community linkages with the wetland complex, and thus had an ineffective management regime. Taking into cognizance the socio-ecological values of the Changthang, the management authority initiated a proposal to declare it as a Biosphere Reserve where conservation and development agendas complement each other. Integration of opinions of different user groups and management stakeholders in wetlands management planning and implementation can secure the goal of wetland conservation and resource wise-use.

CHANGTHANGI GOATS IN LEH LADAKH REGION. *(Credit – Eatcha/ikimedia commons)*

TABLE 9. ASSESSMENT NEEDS AND DATA SOURCES FOR INSTITUTIONS AND GOVERNANCE REGIMES

WHAT TO ASSESS?	HOW TO ASSESS?	POSSIBLE DATA SOURCES
Formal governance arrangements related to HAW: ▪ Nodal State Government Department for management of HAW - programmes, budget and human resource allocations ▪ State Government Departments with programmes related to HAW - programmes, budget, human resource allocations ▪ Formal purpose-linked spatial planning (PA management, tourism management etc.) ▪ District planning (inclusion of activities related to HAW) ▪ Rules and regulations (central and state) and specific implications for activities prohibited, regulated and permitted in and around HAW ▪ Involvement of civil society organizations in HAW management	Undertake a network analysis to develop an institutional network diagram Conduct face to face interviews with different stakeholder groups Review of rules and regulations to identify complementaries and gap areas	Government policy and programme documents Stakeholder surveys (For survey elements, refer to step 2.6 of the guidebook)
Informal governance arrangements ▪ Resource use arrangements (such as tourism permit systems) ▪ Community norms and beliefs ▪ Cultural practices related to wetlands ▪ Traditional resource management practices linked to wetlands	Interviews and focal group discussions with stakeholders	Stakeholder surveys
Degree of convergence within various formal and informal governance arrangement	An analysis of management objectives and degree of influence on wetland condition	To be drawn from above
Major changes in formal and informal governance arrangements	Interviews and focal group discussions with stakeholders	Stakeholder surveys and focal group discussions

and trade-offs related to wetlands ecosystem services and values. The concept of governance encompasses actions delivered by a range of actors beyond the apparatus of state, and thus includes, but is not limited to the government.

Decision-making for the management of HAW is taken at several levels, each having a bearing on implementation of activities in and around the wetland, and funds available for the same. Within states, the State Wetland Authorities have been mandated to be the nodal policy-making and regulatory organs of the state government for all matters related to all wetlands including HAW. At central government level, the MoEFCC provides the overarching policy and programming framework for wetland conservation, and integration in sectoral policies such as climate change, biodiversity conservation and others. At local level, Gram Panchayats and religious and cultural associations regulate access to wetlands based on local considerations. Nomadic communities, such as animal herders and pastoralists which are known to frequent several HAW, are guided by traditional resource management systems.

For management of HAW, it is pertinent to map the formal and informal institutional and governance regime related to wetlands, identify the ways and efficiency of interactions with site management, and their collective ability to ensure wise use.

BOX 10. RAPID ASSESSMENT OF WETLAND ECOSYSTEM SERVICES (RAWES)

HAW management aims at maintenance of wetland ecological character which includes full range of ecosystem services provided by the wetland. A comprehensive assessment of ecosystem services requires a detailed mapping of ecosystem structure and functions which underpin these services, as well as values and perceptions stakeholders attribute to these services. Physical inaccessibility and remoteness of HAW, and paucity of time & resources calls for using rapid tools for ecosystem services assessment which can sufficiently inform wetland management on their conditions, values and their trade-offs.

A rapid assessment protocol, Rapid Assessment of Wetland Ecosystem Services (RAWES) has been devised under the Ramsar Convention which addresses the time and resource limitations. The tool is designed to:

- Provide a qualitative assessment of a comprehensive range of wetland ecosystem services
- Provide information across different categories of wetland ecosystem services
- Be systemic in nature and averts prejudgements about which services are important.
- Allow the assessors to evaluate the ecosystem services within the local context and at relevant scales

The assessment begins with defining the relevant scale (wetland system) and assessors (who will do the assessment). The assessment is done in following steps:

- Developing a scoring system for scale of benefits (which includes disbenefits)
- Identifying ecosystem services based on a checklist of 37 services grouped into functional categories as defined in the Millennium Ecosystem Assessment (2005)
- For each ecosystem service, defining the benefit score and relevant geographical scale (local, regional and global),
- Checking and analysing the data
- Communicating the results with stakeholders

FOR FURTHER READING:

RRC-EA (2020) Rapid Assessment of Wetland Ecosystem Services: A Practitioners' Guide. Ramsar Regional Center - East Asia, Suncheon, Republic of Korea.

BOX 11. ENGAGING INDIAN ARMY IN MANAGEMENT OF HIGH-ALTITUDE WETLANDS

After the Indo-China war of 1962, Ladakh became an important base for the Indian Army. The area around HAWs were used for camping and conducting military exercises. In July 2000, a National Consultation was convened by Department of Wildlife Protection, Government of Jammu & Kashmir and World-Wide Fund for Nature – India to identify priority wetlands of Ladakh and devise strategies for their long-term conservation. Six priority wetlands i.e., Tsomoriri, Tsokar, Pangong Tso, Hanle, Chushul and Rungdum were identified in Leh and Kargil districts respectively. These wetlands form fragile ecosystems and are important as breeding grounds of Black-necked Crane. In recent times, increased tourism and development activities around wetlands and in surrounding pasturelands are the major conservation challenges.

Over the years, having recognised the need for achieving the wetland conservation goals, the Indian army has worked closely with local communities, non-government organisations and the civil authorities. The India Army's ecology cell at Leh plays a crucial role in the management of these wetlands. This includes protecting eggs and chicks of the Black-necked Crane from the feral dogs, recording climate witness accounts, reducing the impacts of tourism and other anthropogenic activities. Special orientation programmes including environment educational courses are organised for the army personnel.

SOURCE:

Management Planning for Tsomoriri-Tsokar – A Framework. (2007). 60pp. Published by World Wide Fund for Nature – India and, Department of Wildlife Protection, Government of Jammu & Kashmir.

BOX 12. WETLAND HEALTH CARD

Wetland health is a metaphor to describe the condition of the ecosystem. The concept integrates information on environmental conditions with the impacts of anthropogenic activities in order to provide the information for sustainable use and management of natural resources such as wetlands.

Wetland health card is a scoring tool for assessing ecosystem health in terms of a set of indicators and their desired thresholds. The tool enables communicating complex and large amount of information to a broad audience in a simple manner. A health card also provides the framework for wetland inventory, assessment and monitoring, and helps evaluation of management effectiveness. A transition towards a higher score in the health card is an indicator of improving wetland health, and a positive outcome for wetlands management.

The MoEFCC under National Wetlands Programme has identified a suite of indicators for rapid assessment of wetland health. These indicators pertain to the following five categories:

- Extent
- Hydrology and catchments
- Biodiversity
- Ecosystem Services
- Governance

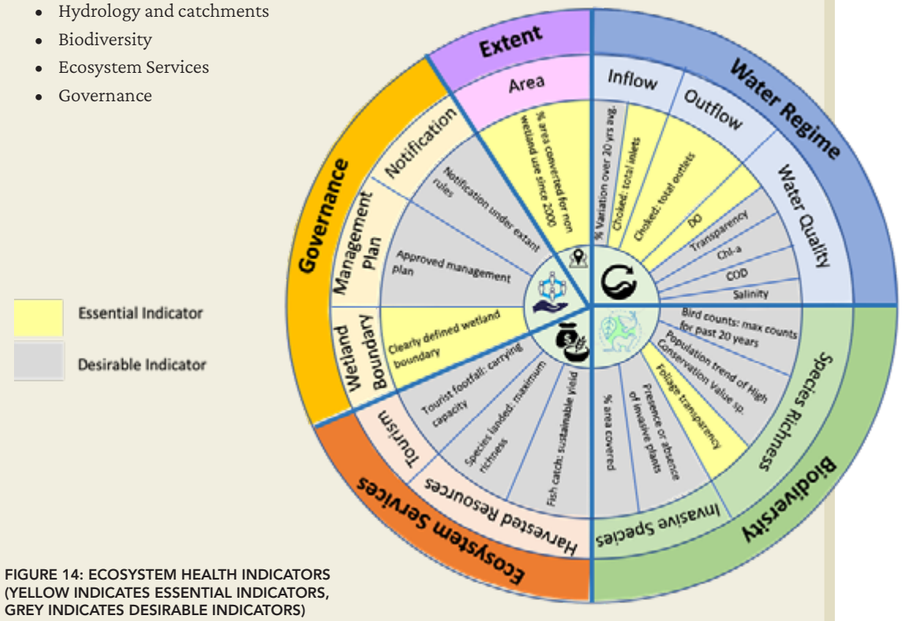


FIGURE 14: ECOSYSTEM HEALTH INDICATORS (YELLOW INDICATES ESSENTIAL INDICATORS, GREY INDICATES DESIRABLE INDICATORS)

For each indicator, a desired level is identified. Maintaining the indicator at the desired level is likely to sustain the wetland ecosystem in a healthy state and ensure biodiversity conservation and ecosystem service values. The current indicator value with respect to the deviation from the desired level is used to assign a rank from A to E, A being close to the desired level and E being the highest deviation from desired level. An overall wetland health score is derived by weighing each of the indicator scores. A high score reflects that the wetland is in a good health and thereby management maybe passive focused on monitoring of wetland features and actions to ensure that anthropogenic stresses are minimized.

TABLE 10: ECOLOGICAL CHARACTER DESCRIPTION

ECOSYSTEM CHARACTER ELEMENTS	STATUS DESCRIPTOR	TREND DESCRIPTOR
ECOSYSTEM COMPONENTS		
Physical regime	Wetland area Current wetland form (depth, shape and bathymetry)	Change in wetland area over a period Change in wetland depth, shape or bathymetric profile over a period
Glacier system	No. of glaciers in the basin, glacial mass, associated glacial lakes, connectivity with the glaciers	Trends in glacial retreat, risks of GLOF
Catchment	Current land cover and land use No of HAW within the catchment and their connectivity	Trends in land use land cover, landscape fragmentation Increase or decrease in the no. of HAW within the catchment and its impact on connectivity over past 10-20 years
Wetland soils	Soil texture (percent sand, silt and clay) Physical properties (texture, profile etc.) Chemical properties (organic carbon, nutrients, pH etc.) Peat accumulation	Variation in soil texture Change in physical properties over past 20 years Change in chemical properties over past year Trends in peat or carbon storage by the wetland
Hydrology	Water spread, Water balance (water flowing in, water flowing out), freeze and thaw cycle	Variations in water spread flows over a period of time (5-20 years)
Water quality	Nutrients (Nitrogen and Phosphorus), conductivity, temperature, DO, Turbidity, pH	Change in wetlands water quality over a short (5 years) or a long term (20 years)
Biodiversity	Key habitats in HAW Key wetland dependent species (Phytoplanktons, macroinvertebrates, wetland plants, fish, amphibians, avifauna, mammals) Migratory waterbirds Species of conservation significance	Variation in habitat availability for key species, habitat loss Variation in species diversity, distribution and density Variation in number of species and counts over a period of 10-20 years Variation in the number of species of conservation significance visiting the HAW

ECOSYSTEM CHARACTER ELEMENTS	STATUS DESCRIPTOR	TREND DESCRIPTOR
ECOSYSTEM PROCESSES		
Climate	Annual variation in precipitation	Trends in precipitation over a period of time (20 years)
	Annual variation in Temperature	Trends in temperature over a period of time (20 years)
Geomorphology and Catchment	Topography (slope, aspect, elevation etc) Connectivity of surface waters Sedimentation rate and sources Erosion rates	Trends in connectivity with other wetlands and surface waters over a period of 20 years Trends in sedimentation received by the wetlands Variation in Erosion within the catchment over a period
Hydrology	Water source (inlets and outlets) Inundation regime (volume, frequency, duration, seasonality) Stratification and mixing	Change in the number of inlets feeding the wetlands over a period of 5-20 years Temporal variations in inundation regime over a period of 5-20 years
Nutrient dynamics*	Nutrient cycling (Nitrogen and Phosphorus) Carbon cycling	
Process maintaining population	Migration patterns No. of migratory species	Alterations in migratory patterns and their timings or seasonality within the region over past decades Trends in number of migratory species sited at the wetlands over past decade or so

ECOSYSTEM CHARACTER ELEMENTS	STATUS DESCRIPTOR	TREND DESCRIPTOR
ECOSYSTEM SERVICES		
Provisioning services (products obtained from HAW, if any)	Freshwater Wetland products (Medicinal plants)	Variations in resource production and use over a time scale (5-20 years)
Regulating services (benefits from regulation of processes)	Maintenance of hydrological regimes Climate regulation (Local or regional)	Variation in the capacity of HAW to regulate regimes Impact of changing climate on regulating services
Cultural services (benefits obtained through enrichment, recreation, tourism and aesthetics)	Recreation and tourism Spiritual and inspirational Scientific and educational	Variation in number of tourists visiting the wetland over a period of time Community linkages and trends over a period of time (5-20 years) Trends in wetlands utilization for scientific and educational purposes
Supporting services (necessary for production of other services)	Habitat availability for HAW biodiversity Peat accumulation Nutrient cycling (carbon sequestration, storage and recycling of nutrients)	Variation in habitat or its loss over a period of time Potential to store carbon in the form of peat over a period of time
Livelihood linkage	Community dependent on the wetland directly or indirectly; intensity and seasonality of dependence	Major trends in livelihood dependence and resource use by community

2.7 DESCRIBING WETLAND ECOLOGICAL CHARACTER

The information on wetland features and their governing factors derived in step 2 of the management plan (steps 2.1 to 2.6) can be summarised to represent the status and trends in wetland ecological character. A suggested framework is in table 10. Information gaps in ecological character provide the initial information for developing a monitoring and research programme for the wetland (step 5 of the management plan).

Information on ecological character can also be summarised in the form of health cards (generated on the basis of indicators) which allows stakeholders to get a comprehensive view of the wetland condition (refer box 12).

STEP 3

EVALUATING WETLAND FEATURES AND RISKS OF ADVERSE CHANGE

The preceding management planning step leads to identification of wetland features, synthesis of information on status and trends in these features, and the factors which govern changes in these features. This process provides a description of the HAW. The evaluation of features involves identifying the priority features, as presented in the description, resolving conflicts between features (if any), and ultimately assessing the risk of adverse change in these features. This step-in management planning thus allows narrowing down the focus to a select set of HAW features which should become the focus of the remainder of the planning process. It is crucial that prioritization is done systematically, with consideration to ecological functioning, as well as social and institutional realities that define decision-making context.

TABLE 11. SUGGESTED CRITERIA FOR PRIORITIZING WETLAND FEATURES

CRITERIA TYPE & WETLAND FEATURES	CRITERIA	EXAMPLE OF PRIORITY FEATURE
Ecological Physical regime, Catchments, Hydrological regime Species & Habitats	Size - Feature is of appropriate size to maintain an ecological function or underpin an ecosystem service (can be population, habitat or the wetland extent)	Breeding population of migratory birds which can sustain population within the flyway
	Rarity - Feature is included in Red Data Books for species and habitats (national or global); Feature is included within the national priorities in the biodiversity or wildlife policies	Presence of species Listed under Schedule I of Wildlife Protection Act; Presence of a rare, endangered or threatened species
	Fragility - Feature is vulnerable to disturbance and loss because of small area, low population or reliance on a single key resource	Presence of breeding grounds of high conservation value migratory waterbird species
	Criticality - Feature has a disproportionate influence on ecosystem functions, biodiversity and ecosystem services	Water level variation which regulates water flow downstream and moisture in the areas in vicinity of HAW
Social Livelihoods	Instrumental dependence - Feature directly contributes to livelihoods of dependent communities	Tourism values associated with HAW which provides livelihoods to tour operators
	Relational dependency - Feature is ascribed high importance on account of relational values held by communities	Cultural significance associated with HAW (presence of sacred sites, or wetland itself treated as scared site)
Institutional Institutions and governance	Regulatory - Maintenance of feature is required to ensure compliance with existing rules and regulations	Maintenance of near natural shoreline as per provisions of Wetlands (Conservation and Management) Rules, 2017 Prohibited removal of biomass from area designated as Protected as per provisions of Wildlife Protection Act

3.1 PRIORITIZING FEATURES

From a long list of wetland features, a prioritized list needs to be prepared on the basis of a set of criteria, which adequately reflect the management goals. Following criteria are relevant for HAW, which can be suitably modified for specific wetlands contexts:

3.2 THREATS ANALYSIS

Wetland features change in response to factors. Management must incorporate actions to regulate factors so that features do not change adversely, or are maintained within the limits of acceptable change. Limits of acceptable change (LAC) is defined as a variation in a particular component or process of the HAW that is considered acceptable, without indicating changes in the wetland functioning or provision of services. LAC can be established for those components and/or processes:

- For which adequate information is available to form a reference wetland condition
- For which it is possible to characterise variability
- Critical to determining ecological character
- Can be monitored

Some examples for different wetland features are presented in Table 11.

The factors can be classed in various ways, but it is useful to distinguish between factors which

FROM A LONG LIST OF WETLAND FEATURES, A PRIORITIZED LIST NEEDS TO BE PREPARED ON THE BASIS OF A SET OF CRITERIA, WHICH ADEQUATELY REFLECT THE MANAGEMENT GOALS.

TABLE 12. EXAMPLES OF LIMITS OF ACCEPTABLE CHANGE

WETLAND FEATURE	LIMIT OF ACCEPTABLE CHANGE	REASONS
Wetland area	Not more than 10% increase for three consecutive years	A continuous increase in area may indicate GLOF risk
Water levels	Not more than 10% increase over annual average for three consecutive years	A continuous increase in area may indicate GLOF risk
Waterbird species	Not more than 20% deviation in numbers for key species over long-term average (say 10 years)	Over 20% decline may suggest disturbances in waterbird habitat
Nutrient level	Levels within oligotrophic range	Concentrations beyond oligotrophic range may indicate nutrient enrichment
Tourism	No solid waste deposition on account of tourism No permanent infrastructure within 500m of the wetland Visitation rate below those permitted by the regulating authority	Increase in solid waste or permanent infrastructure may indicate adverse impact of tourism on the wetland

TABLE 13. CLASSIFICATION OF THREATS TO WETLANDS

	NATURAL	ANTHROPOGENIC
Internal	Internal Natural Factors Example: Water level changes beyond natural variability	Internal Anthropogenic Factors Example: Pollution
External	External Natural Factors Example: Changes in hydrological regimes in response to glacial melt	External Anthropogenic Factors Example: Tourism planning which does not take into account fragility of HAW

AN UNDERSTANDING OF FACTORS LEADS US TO THREATS - FACTORS WHICH CAUSE OR HAVE PROPENSITY TO CAUSE AN ADVERSE CHANGE IN A WETLAND FEATURE. DIRECT THREATS ARE FACTORS THAT AFFECT THE HAW DIRECTLY, WHEREAS INDIRECT THREATS ARE FACTORS THAT ACT THROUGH THE DIRECT THREATS.

are anthropogenic (such as pollution), or natural (such as nutrient deposition in HAW due to weathering of rocks). Similarly, factors can be internal (affecting the wetland feature directly), or external (acting through an internal factor). Actions for addressing external factors mostly lie in the domain of institutions and governance (for example through mainstreaming wetlands in developmental planning).

An understanding of factors leads us to threats - factors which cause or have propensity to cause an adverse change in a wetland feature. Direct threats are factors that affect the HAW directly, whereas indirect threats are factors that act through the direct threats.

In this step of management planning, for each prioritized wetland feature, factors leading to adverse change are identified. These factors can be grouped into: a) natural, b) anthropogenic, and c) institutional. Most of the indirect factors are likely fit within the category of institutional factors. The threats can be analysed based on likelihood of its occurrence and severity with respect to various ecosystem components, processes and services. The likelihood of occurrence of a threat and its severity (magnitude of the impact) can be identified during the process of description of wetland features (discussed in section 3.1 - step 2 of this guidebook). An understanding of the threats also helps to assess where interventions are required (whether

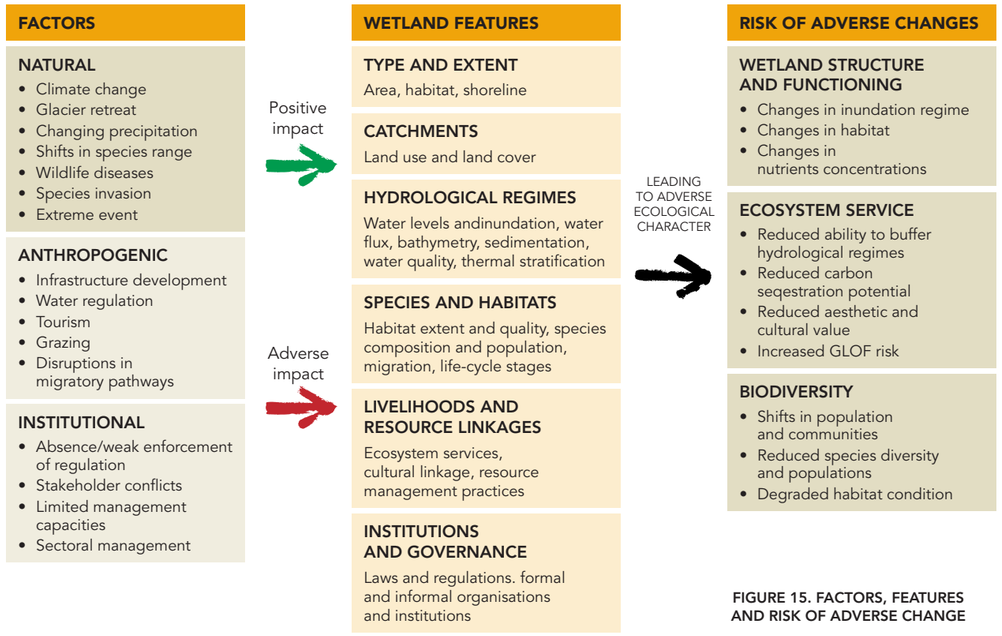


FIGURE 15. FACTORS, FEATURES AND RISK OF ADVERSE CHANGE

BOX 13. HIGH-ALTITUDE WETLANDS AND CLIMATE CHANGE

The High-Altitude Wetlands are extremely sensitive to climate change, and even a small change in climatic parameters (such as temperature and precipitation) can have significant impact on these ecosystems. Evaluating the vulnerability of HAW to climate change and including vulnerability reduction actions is imperative to management of these wetlands.

The Ramsar Convention has developed guidelines on vulnerability assessment of wetlands to climate change, within the Integrated Framework for Wetlands Inventory, Assessment and Monitoring. The vulnerability of wetlands is defined in the framework as 'the degree to which a wetland is sensitive to and unable to adapt to or moderate the consequences of climate change and other anthropocentric pressures on its ecological character'. Sensitivity is defined as 'the degree to which a wetland is affected, either adversely or beneficially, by climate-related stimuli' and adaptive capacity as 'the ability of a wetland to adjust to climate change, to take advantage of opportunities, or to cope with or moderate the consequences. Assessment of sensitivity and adaptative capacity of the HAW are suitable entry-points for climate change considerations within management planning process. The following steps are recommended:

STEP 1. REVIEWING AVAILABLE CLIMATE PROJECTIONS

Within the evaluation of wetland features, available climate projects for specific HAW, its basin or broader biogeographic regions must be compiled. Following specific information may be synthesized:

- Trends in temperature (evidences of increasing maximum and minimum temperatures)
- Trends in precipitation (evidences of total precipitation, seasonality and relative contribution of rainfall and snowfall in the total precipitation)
- Trends in glacial extent (evidences of deglaciation and changes in mass balance)
- Trends in extreme events (such as evidences of GLOFs and mudslides)

STEP 2. SENSITIVITY ASSESSMENT TO CLIMATE CHANGE

The available information on climate change needs to be translated in terms of sensitivity of wetland features or factors governing those features. These could be in the form of:

- Changes in wetland extent (such as proglacial wetlands may increase in area as glaciers recede)
- Changes in hydrological regime (such as an increased proportion of rainfall in total precipitation may induce peaks in hydrographs and increased inundation regime variability. A continuous increase in water levels in moraine dammed wetland increases susceptibility to GLOFs)
- Changes in land cover (such as increase in vegetation cover, and reduction in permafrost)
- Changes in GHG emissions (drying up of carbon rich wetlands such as peatlands and marshes may increase GHG emission from the HAW)
- Changes in habitats (water level and vegetation changes have been observed to influence distribution of waterbird habitats in and around HAW)
- Changes in wetland dependent livelihoods (such as grazing patterns around the wetland may change on account of land cover changes. GLOF susceptibility may also expose communities to disaster risks.)

STEP 3. ASSESSING ADAPTIVE CAPACITY OF HAW TO CLIMATE INDUCED CHANGES

The next step in assessment is to determine the ability of the wetland to cope with the changes without fundamentally getting altered into a modified state. Some example of changes which can fundamentally transform the wetland are:

- Continuous buildup of water levels in a proglacial moraine dammed lake which when bursts can lead to substantive reduction in wetland regime.
- Continuous draining and drying of peat may enhance territorialization of the HAW
  Some examples of changes which a HAW can cope without fundamental transformations in its ecosystem structure are:
- Change in water chemistry may lead to gradual changes in vegetation cover around the wetland
- A small increase in proportion of rainfall in total precipitation may expose the wetland shoreline and enable development of wet meadows around the HAW
- Changes in water levels may shift waterbird habitats around the HAW

A wetland which has several of its features with high sensitivity and low adaptive capacity has higher vulnerability to climate change as compared to the ones which have low sensitivity and high adaptive capacity.

STEP 4. IDENTIFYING IMPLICATION OF PLANNED INVESTMENTS IN THE CATCHMENT OF HAW

Climate risks are superimposed on existing risks which are related with current developmental planning and planned sectoral investments. In most circumstances, wetlands form a part of regional tourism developmental plans, climate change action plans, disaster risk reduction plans, biodiversity conservation actions, and others. In not all circumstances, are the implications for wetlands considered in these investment plans, and thereby, risks screening of these investments is essential to determine the true vulnerability of HAW. This can be done by:

- Reviewing sectoral plans and identifying interventions proposed in the HAW or its catchment
- Identifying interventions which have the potential to alter any of the wetland features adversely
- Revising the vulnerability assessment in Step 3 to incorporate the implications of planned investments.

STEP 5. IDENTIFYING MANAGEMENT ACTIONS

Having determined vulnerability of the HAW, the next step is to categorize the changes in HAW into degree of impact on wetland biodiversity and ecosystem services, and prioritise those changes which are of adverse nature. For each of these changes, the influencing ability of wetland management must be taken into account. The following table illustrates the nature of direct or indirect response options:

ABILITY OF WETLAND MANAGEMENT TO INFLUENCE ADVERSE CHANGE	RESPONSE OPTION	EXAMPLES
Wetland management is able to influence adverse change through direct interventions	Specific interventions which are aligned with ecosystem functioning Monitoring and review	Vegetated flow retention structures Channeling of water to avert rapid increase in water levels Limiting excessive grazing
Wetland management is able to influence adverse change indirectly by influencing other sector activities operating beyond the HAW and its catchment	Engagement with concerned sector planning process to ensure: ▪ wetland features are not adversely impacted ▪ wetland conservation contributes to sectoral developmental objectives ▪ Monitoring and review	Ensuring carbon storage potential of peatlands is taken into account in climate change mitigation plans Ensuring natural hydrological regimes of HAW are not altered for Water Resource Development
Not possible to influence the change	Monitoring and review	Basin wide wetland monitoring system

STEP 6. IDENTIFYING KNOWLEDGE GAPS AND INTEGRATION IN RESEARCH PLAN

HAW management plan should include research activities aimed at unpacking the impacts of climate change on various wetland features and its governing factors. The outcomes of these studies will inform review and adaptation of management plan in due course of time and better integrate climate change dimensions. Some examples of research areas include:

- Climate modelling to understand impacts of changes in climatic parameters on wetland hydrology and catchment land cover;
- Carbon storage and flux estimates from wetlands and its catchment
- Climate scenarios and implications for species habitats, and interactions
- Vulnerability assessment of HAW linked with climate scenarios.
- Community coping and adaptive strategies for different climate scenarios

The climate risk assessment may be built within different sections of the management plan or written as a separate sub-section of the management plan. The outcomes of steps 1 – 4 maybe included within Section 2 of the management plan (description and evaluation of the wetland). Step 5 and 6 must be integrated in Section 4 of the management plan (detailed activity plan and budgeting).

within the wetland habitat, or within actions taking place in the wetland catchments related to various sectors), and thus helps build the action plan (discussed in section 3.1 - step 7 of this guidebook).

3.3 RISK OF ADVERSE CHANGE

The final stage of evaluation is assessment of risk of adverse change. The risk is assessed with reference to Limits of Acceptable Change (refer Section 3.1 – step 3 of this guidebook).

A wetland with a very low risk of adverse change, which is the likely case for most of HAW, would not need much management interventions, but rather close monitoring to ensure that the features are maintained within their natural range of variation (or their limits of acceptable change). On the other hand, a wetland with high risk of adverse change may need a range of direct and indirect management interventions.

The analysis of factors and features can be finally mapped into the risk of adverse change in terms of wetland structure and functioning, leading to changes in ecosystem services, and biodiversity sustained by the HAW (also refer to Box 13 for ways in which climate related risks can be integrated in wetland management plan).

AN OBJECTIVE SHOULD NOT INCLUDE A PATHWAY FOR ACHIEVING AN OUTCOME.

OBJECTIVES ARE NOT PRESCRIPTIVE. OBJECTIVES ARE MEASURED USING PERFORMANCE INDICATORS WHICH INDICATE THE ECOLOGICAL CHARACTER.

STEP 4

SETTING MANAGEMENT OBJECTIVES

Objective setting is the single most important function of HAW management planning. In several instances, failure to clearly describe management objectives, and the rationale thereof, leads to investment in activities which do not lead to any favourable change in wetland condition, or reduction in anthropogenically induced threats.

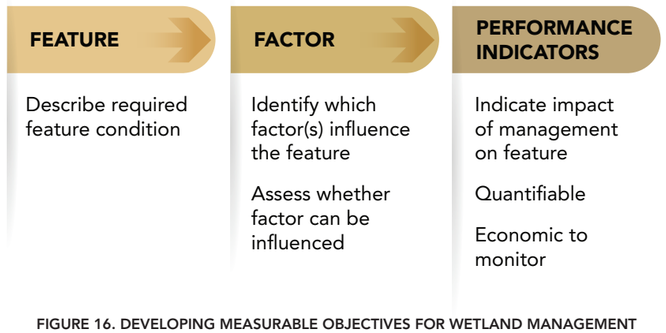


FIGURE 16. DEVELOPING MEASURABLE OBJECTIVES FOR WETLAND MANAGEMENT

An objective describes the outcome of management. It is a statement of the desired condition of a wetland feature or of a factor, and in a way, also, directly or indirectly establishes the limit of change in a particular feature that is acceptable. The following model describe some:

- Specific: An objective statement must clearly relate to one or more wetland features. It should be specific enough to prevent multiple interpretations.
- Measurable: An objective must be measurable using (a or a set of) performance indicators. This will enable judgement of management effectiveness.
- Achievable: An objective should be achievable within the limits of available financial and technical resources.
- Relevant: An objective should be relevant in the context of the ecosystem that it is applying to, the linked communities and decision-making systems. The objective should also be tenable in the existing institutional and regulatory set up.
- Time-bound: Achievement of an objective should be linked within a time-frame.

In addition to the above, following aspects also have a bearing on the level of definition of management objective:

- Degree of naturalness: Highly modified habitats depending on continual management intervention require a much specific definition of wetland feature.
- Size, complexity and dynamics of a wetland feature.
- Resources available to monitor and manage a wetland feature.
- Availability of reliable information on wetland features.

While setting an objective based on wetland feature, the capability of management to influence the feature should be kept in mind. In the situation where wetland management is not able to influence the feature, it may become a part of monitoring, but no active intervention to address adverse change may be possible at present. Monitoring however is crucial to assess current management and inform future management objectives for course correction (Refer Section 5 of this Guidebook).

Finally, an objective should not include a pathway for achieving an outcome. In that sense, objectives are not prescriptive. The steps that are required to be taken to achieve an objective are best stated in the action plan, after a careful evaluation of intervention options. Thus, an objective of 'enhancing tourism experience in HAW by limiting the number of tourists' pre-empts other interventions through which tourism experience can be enhanced, such as improving communication and interpretation facilities, or providing facilities for enjoying nature.

Objectives are measured using performance indicators which indicate the condition of a wetland feature (Figure 16). These are attributes of a wetland feature- specific characteristics, qualities, properties of a wetland feature which provide evidence of its

AN OBJECTIVE DESCRIBES THE OUTCOME OF MANAGEMENT. IT IS A STATEMENT OF THE DESIRED CONDITION OF A WETLAND FEATURE OR OF A FACTOR.

TABLE 14: POSSIBLE MANAGEMENT OBJECTIVES FOR HIGH ALTITUDE WETLANDS AND THEIR PERFORMANCE INDICATORS AND ATTRIBUTES

WETLAND FEATURE	MANAGEMENT OBJECTIVE	PERFORMANCE INDICATOR	MEASURABLE ATTRIBUTE
Wetland habitat and dependent-species	• Maintain naturalness of the wetland shoreline	Nature of shoreline	% of wetland shoreline which is devoid of construction or human-made infrastructure
		Creation and maintenance of a buffer around the wetland	Presence of a buffer around key habitats bordering the wetland shoreline
	• Maintain hydrological connectivity with glaciers and other HAW	Surface flow connectivity	Number of days for which the wetland receives glacial-melt / flows from other wetlands of the complex
	• Maintain water quality to support ecosystem processes and services	Water quality (physical and chemical parameters)	Dissolved Oxygen / Biological Oxygen Demand Electrical conductivity Nutrient concentrations
	• Maintain peat carbon stocks	Wetland Soil Quality	Soil Organic Carbon
	• Limit anthropogenically-induced sedimentation	Sedimentation	Trend in sediment accumulation areas
			Sedimentation rates
	• Reduce risks of GLOFs	Water levels	Rate of increase in water level
	• Maintain and improve habitat quality to support diverse wetland-dependant species	Habitat type diversity Species occupancy patterns	% habitat area Species count and composition
	Maintain and enhance populations of high conservation significance	Population and population composition	Species count Number of breeding adults Presence of breeding sites

WETLAND FEATURE	MANAGEMENT OBJECTIVE	PERFORMANCE INDICATOR	MEASURABLE ATTRIBUTE
Wetland communities and livelihoods	• Align grazing regime within the regenerative capacity of the alpine vegetation within wetland catchment	Regenerative potential of grasslands	Change in vegetation cover within direct catchment Change in soil organic matter
	• Maintain non-declining harvest of medicinal plants and other species of economic use derived from wetland and its surroundings	Species diversity and abundance of economically important species	Rate of harvest % species cover
	• Preserve cultural and spiritual values and traditional and customary practices aligned with wise use of wetlands	Cultural values	Prevalence of practices
	• Preserve scenic and aesthetic beauty of the wetlands	Wetland aesthetic quality	Naturalness
	• Preserve recreational and touristic value of the wetland	Touristic and Recreation Value	Tourism quality scores Visitation rate Tourist satisfaction score Visitor's environmental sensitive behaviour
	• Provide livelihood opportunities to stakeholders through engagement in wetland based-tourism activities	Local community engagement in wetland based -tourism activities	% local employment generated % local revenue generation
Institutions and Governance regimes	• Maintain compliance with existing rules and regulation	Compliance with conditions laid under the Rules and Regulation	Number of violations
	• Enhance awareness of wetlands biodiversity and ecosystem services amongst stakeholders	Pro-environment behaviour of stakeholders	Behavioural indicators
	• Ensure consideration of HAW values and functions in sectoral plans	Integration of HAW in sectoral plans	Number of plans that take into account HAW values and functions Avoided sectoral development risk to wetlands
	• Promote stakeholder participation in wetlands management	Stakeholder participation in management	Diversity of stakeholder groups engaging in management Consideration of stakeholder issues and feedback in management implementation
	• Maintain and enhance capabilities for integrated management	Management effectiveness	Management effectiveness assessment Use of integrated wetland inventory, assessment and monitoring system to inform management

condition. The choice of performance indicators should take into account the factors wetlands management is attempting to address, and be:

- Inherent and inseparable from a feature
- Informative of feature
- Quantifiable
- Economical to monitor
- Bound by specified limits

The boundaries of performance indicators define thresholds of action. When the feature is within the limit of acceptable change, no action may be required. But, when the features cross or approach the limits, management intervention is required.

Some of these indicators might be categorised as 'early-warning indicators' i.e., information on these indicators is acted upon before ecological character change actually occur and thus, are developed to predict and forewarning of important changes. The Ramsar Convention defines this set of indicators as measurable biological, physical or chemical responses to a particular stress, preceding the occurrence of potentially significant adverse changes in key wetland features.

STEP 5

ESTABLISHING A MONITORING SYSTEM

Systematic information on the condition of wetland features and governing factors provides the basis of a diagnostic approach to wetlands management. The decision 'to intervene' or 'not to intervene' should be based on a careful understanding of the change in feature, and whether or not this change needs to trigger a management intervention.

A variety of terms are used to describe information generation processes – survey, surveillance, assessment and monitoring being the most prevalent ones. These terms are used interchangeably, whereas each of these have a different meaning and purpose.

Survey – is one-time information generation on a wetland feature.

Inventory – is building information on wetland features. Surveys can be designed to develop baseline inventory of wetland features and governing factors.

Surveillance – is repeated surveys to detect changes in a wetland feature.

Assessment – is building information to determine status, trends and threats to wetlands. Thus, data and information generated from surveillance can be used to conduct wetlands assessment.

Monitoring – is a systematic surveillance done in order to test a hypothesis about the wetland feature and its factors.

For example, a HAW manager may build a hypothesis around the adverse impact of tourism on waterbird nesting. A one-time survey of nests and number of tourists can create the necessary baseline information, but cannot lead to conclusion on acceptance or rejection of the hypothesis. The manager can develop a surveillance system for detecting changes in waterbird nesting patterns. A monitoring system however will be built around testing the hypothesis, developing information on a systematic sampling frame (enabling comparison of nesting patterns in sites which are disturbed by tourist activities with a control set which is undisturbed and recording metrics for tourism activities).

Monitoring may be time-consuming and resource intensive activity. For some critical changes, the wetland manager may need to act within a reasonable time-frame, even in situations wherein the outcomes of monitoring are not known. For this reason, a suite of 'early-warning indicators' need to be an essential part of the monitoring programme. Secondly, managers should also avoid the 'it-depends' syndrome – wherein for every information generated on wetland feature, decision-making is confounded by referring to complexity, and that every change has a number of underlying factors. More monitoring and more data do not essentially result better management decisions, in most circumstances, additional monitoring may only confirm a known ecosystem behaviour. This calls for adopting a more pragmatic approach to design of monitoring systems.

The distinction between these data and information generation processes is not watertight, in fact these

THE DECISION TO INTERVENE OR NOT TO INTERVENE SHOULD BE BASED ON A CAREFUL UNDERSTANDING OF THE CHANGE IN WETLAND FEATURE, AND WHETHER OR NOT THIS CHANGE NEEDS TO TRIGGER A MANAGEMENT INTERVENTION.

form an integral part of an information collection process to inform decision-making on wetland features. Without monitoring in place, however rudimentary in form, no management can be thought of.

While developing a monitoring plan, it may be useful to consider the following aspects:

- Inclusion of prioritized wetland features and factors
- Ensure inclusion of measurable attributes identified for monitoring key performance indicator
- Spatial (the area from which data will be collected) and temporal (time-frame for which data will be collected) scale of data
- Hypothesis that needs to be tested (related to condition of a wetland feature, factor or specific threat)
- Monitoring cost
- Availability of human and financial resources to implement monitoring
- Way in which collected data will be analysed.

Table 15 presents a generic listing for parameters that need to be monitored for HAW. These have been classed into core (minimum set of variables required) and additional (to be considered based on wetland-specific conditions). Details on monitoring parameters, frequency and methods are provided in Annex IV of this guidebook.

TABLE 15: MONITORING PARAMETERS FOR HIGH ALTITUDE WETLANDS

WETLAND FEATURES	CORE DATA	ADDITIONAL DATA
Physical regime	• Wetland area • % cover of emergent macrophytes • Soil Organic Carbon (for peatlands)	• % wetland area under different habitat types
Hydrological regimes	• Water level • Freezing – thawing cycle • Location of sediment accumulation • Number of inflows and duration of water flows • Number of outflows and duration of water flows • Surface flows connectivity with other wetlands of the network • Water-balance • Dissolved Oxygen • pH • Alkalinity	• Bathymetry • Water inflow proportion received in form of snowmelt, precipitation and rainfall • Sediment flux • Nutrient concentrations
Catchments	• Location of glacier • % catchment area under glacial cover • Land-use and landcover of direct catchment • Temperature • Precipitation • Status of vegetation in the meadows (if any) • Solid waste dumping in the direct catchment	• Glacier mass-balance • Solar radiation • Land-use and landcover of indirect catchment
Species and habitats	• Occurrence of high conservation value species • Species and population count of waterbirds • Counts of waterbird nests • Habitats for species of high conservation significance	• Species richness for all wetland-dependent biota
Livelihoods and Resource Linkages	• Number of graziers visiting wetland direct catchments • Number of tourists (local, national and international) visiting wetlands • Quantity of wetland plants harvested • Norms and belief systems	• Tourist behaviour indicators • Demographic profile of wetland-dependent communities • Perceptions of wetland values and benefits • Cultural inventory • Resource use conflicts • Traditional knowledge of communities on wetlands
Institutions and governance	• Compliance with the provisions of various rules and regulation • Availability of finances, staff and other infrastructure for implementing management actions • Participation of wetland communities and other stakeholders in meetings and workshops • Participation of wetlands managers in planning meetings for various sectors • Reflection of wetland values and benefits in sectoral plans	• Diversity of stakeholder groups engaging in HAW management • Consideration of stakeholder issues and feedback in management implementation • Risk screening of developmental projects in wetlands catchments • Management effectiveness (Refer section 5.1 of this guidebook)

STEP 6

DEFINING MANAGEMENT PLAN IMPLEMENTATION ARRANGEMENTS

Implementation of management plans requires diverse skill-sets to deliver multiple functions and connect with a range of stakeholders. An important part of management planning is to clarify roles and responsibilities of different organizations involved in implementation, and define coordination arrangements. The arrangement should also spell out the way in which compliance with extant regulatory regimes will be ensured.

As per the provisions under The Wetlands (Conservation and Management) Rules, 2017, State Wetland Authorities are the nodal agencies for all matters related to policy, programme implementation and regulation of all wetlands in the state. The State Wetland Authorities function under the aegis of Department of Forest / Environment, which on the basis of the rules, becomes the overall custodians of management plan implementation. While approving the management plan, the State Wetland Authority also specifies the agency which will be responsible for coordinating implementation of management plan at the site level.

ROLES AND RESPONSIBILITIES OF DIFFERENT ORGANIZATIONS INVOLVED IN IMPLEMENTATION SHOULD BE CLARIFIED.

The implementation arrangements can be developed by keeping in mind the suitability of agencies with respect to delivering outcomes related to:

- Sector specific interventions – such as habitat conservation, water management, tourism
- Wetlands monitoring
- Knowledgebase and research development
- Communication, Education, Participation and Awareness

A generic representation of sectoral and possible mainstreaming considerations is presented in Fig. 17.

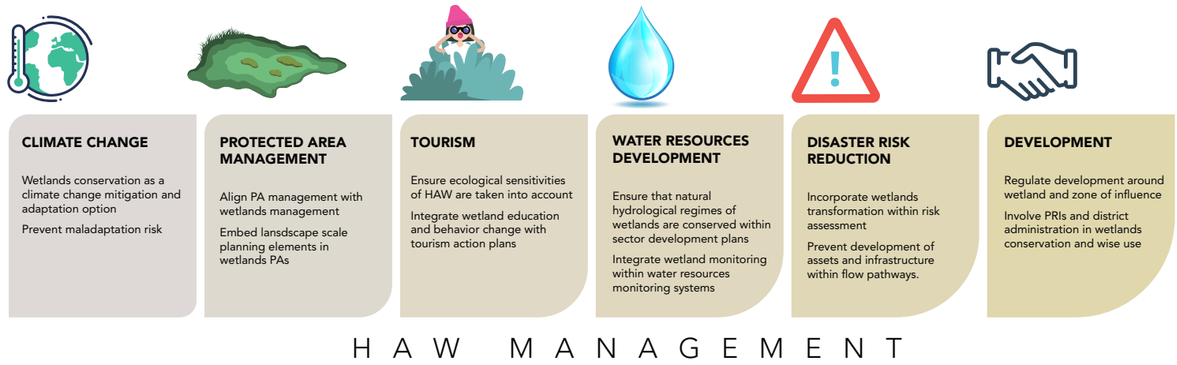


FIGURE 17. COORDINATING HAW MANAGEMENT PLANNING WITH DIFFERENT SECTORS

TABLE 17. MAPPING ORGANIZATIONS AND MANAGEMENT COMPONENTS

	MANAGEMENT ACTIONS				
ORGANIZATIONS / AGENCIES	INTER-AGENCY COORDINATION	SECTOR SPECIFIC INTERVENTIONS	WETLANDS MONITORING	KNOWLEDGE AND RESEARCH DEVELOPMENT (REFER BOX 16)	COMMUNICATION, EDUCATION, PARTICIPATION AND AWARENESS (REFER BOX 14)
State government departments	State Wetlands Authority	• Forest and Wildlife department (for PA management) • Tourism • Culture • Water resources • Rural Development	• Wildlife Department (For species and Habitat) • Tourism • Water resources (monitoring hydrological regimes)	• Science and Technology (research on Cryosphere, water quality)	
Research organizations			Specialized research agencies may be involved in undertaking assessments on status and trends of various wetland features	Local universities and specialized research agencies can help in addressing the data and information needs for management planning	
Civil society organizations	Can assist stakeholder engagement	Can complement ground implementation of various interventions	Can conduct research using citizen-science framework	Can assist in conducting participatory research on different wetland features	Can play a strong role in designing and implementing CEPA
Panchayati Raj Institutions	Can assist in implementation		Can assist in monitoring and surveillance		Can play a strong role in designing and implementing CEPA interventions
Resource user groups	Can assist in implementation				Can play a strong role in designing and implementing CEPA interventions
Armed Forces	Can assist in implementation		Can assist in monitoring and surveillance		Can be a partner in implementing CEPA

The organizations that can be involved in management plan implementation can include:

- State government departments
- Research organizations, including universities and college departments
- Civil society organizations, especially those having presence in the landscape
- Panchayati Raj Institutions
- Resource user groups
- Military, wherever present in the landscape

A mapping of different functions with management components is presented in the table 17.

The implementation arrangements should also describe the mechanisms for building convergence with sectoral development plans which have a bearing on wetland functioning. Possible mechanisms are:

- Taking into cognizance wetland ecosystem functioning within sectoral development planning
- Risk screening of sectoral programmes to prevent creation of adverse risks on wetlands
- Work on opportunities for creating co-benefits of wetlands conservation with sectoral development plans

THE ACTION PLAN DESCRIBES THE SPECIFIC INTERVENTIONS TO BE UNDERTAKEN FOR ACHIEVING MANAGEMENT OBJECTIVES

TABLE 18: GENERIC LISTING OF POSSIBLE ACTIONS FOR MANAGING HIGH ALTITUDE WETLANDS

	MANAGEMENT INTERVENTION TYPE		
MANAGEMENT OBJECTIVE	REACTIVE (ATTEMPTS TO MAINTAIN A CURRENT ECOSYSTEM STATE OR AN ACTIVITY DEGRADING WETLAND FEATURE)	ACTIVE (POSITIVE STEPS TO CHANGE WETLAND FEATURE TOWARDS A CERTAIN DIRECTION)	PROACTIVE (ACTIONS TO LIMIT ANTHROPOGENIC INDIRECT DRIVERS OF DEGRADATION)
Maintain naturalness of the wetland shoreline	Restrict construction around the shoreline Restrict access to ecologically sensitive habitat areas along the shorelines (such as breeding and nesting grounds of waterbirds, and rodents)		Recognising wetland area ecologically sensitive within infrastructure development plans
Maintain hydrological connectivity with glaciers or other HAW	Remove flow impediments in the connecting channels		Engage with sectoral development planning processes to ensure that hydrological connectivity of the entire wetland system is recognised and kept in intact
Maintain water quality to support ecosystem processes and services	Restrict activities such as solid waste disposal which can alter wetlands water quality		Promote community engagement in spreading awareness (refer Box 3) Community sensitization and participation in management of wetland (refer Box 14) Issue do's and don'ts and display at wetland sites

MANAGEMENT OBJECTIVE	MANAGEMENT INTERVENTION TYPE		
	REACTIVE (ATTEMPTS TO MAINTAIN A CURRENT ECOSYSTEM STATE OR AN ACTIVITY DEGRADING WETLAND FEATURE)	ACTIVE (POSITIVE STEPS TO CHANGE WETLAND FEATURE TOWARDS A CERTAIN DIRECTION)	PROACTIVE (ACTIONS TO LIMIT ANTHROPOGENIC INDIRECT DRIVERS OF DEGRADATION)
Maintain peat carbon stock	Prevent grazing over and drainage of peatlands Maintain water levels through actions like rewetting	Restrict number of permits issued for grazing within a time period Paludiculture	Promoting rotational grazing patterns to allow regeneration and sustain maximum vegetation cover Include peatland conservation within SAPCC
Limit anthropogenically-induced sedimentation	Dredging of inflows Desilting of inflows and outflows		Identify additional sediment sources Assessment of sediment flows
Reduce risk of GLOF	Drain the wetland in case of rapid build-up of water levels	Prevent rapid build-up in water levels particularly in moraine dammed wetlands	Put in place an early warning system and risk modelling to assess risk of GLOF
Maintain & improve habitat quality to support diversity of wetland dependent species **Maintain and enhance populations of species of high conservation significance**	Restrict anthropogenic disturbances in breeding, feeding and nesting habitats of wetland dependent species	Faunal census	Identification, demarcation and monitoring of habitats utilisation pattern by wetland dependent species Community awareness to arrest anthropogenically induced changes such as pollution Commission research projects on biodiversity aspects of the HAW (refer Box 16 on research studies to support management of HAW) Satellite telemetry (ringing and collaring) to study life-cycle stages and migration patterns
Align grazing regime within the regenerative capacity of the alpine vegetation within wetland catchment	Restricting grazing over peatlands and meadows (waterbirds and mammals habitats) Building up of check dams on inflows to arrest sediment inflow	Maintain rotational grazing to allow regeneration and sustain maximum vegetation cover	Including graziers in protection of alpine meadows through capacity building and incentivisation
Maintain non-declining harvest of medicinal plants and other species of economic use derived from wetland and its surroundings	Regulate over extraction of resources	Based on feasibility studies, design and implement a permit / quota system	Monitor habitat conditions and harvest rates to determine overall impact of harvesting Align resource extraction activities with Tribal development activities
Preserve cultural and spiritual values and traditional and customary practices aligned with wise use of wetlands	Prepare do's and don'ts for activities permitted and prohibited in these landscapes	Conduct awareness programmes as a part of traditional and customary practices Put in place informative signages at strategic locations Prepare and disseminate target communication and outreach material in local language	Build a cultural inventory of the wetland Identify and protect cultural heritage values of the wetland and its landscape Incentivise local communities to promote customary and traditional practices aligned with wetland ecosystem functioning as a part of management measures Involve local communities in implementation of management plan

MANAGEMENT OBJECTIVE	MANAGEMENT INTERVENTION TYPE		
	REACTIVE (ATTEMPTS TO MAINTAIN A CURRENT ECOSYSTEM STATE OR AN ACTIVITY DEGRADING WETLAND FEATURE)	ACTIVE (POSITIVE STEPS TO CHANGE WETLAND FEATURE TOWARDS A CERTAIN DIRECTION)	PROACTIVE (ACTIONS TO LIMIT ANTHROPOGENIC INDIRECT DRIVERS OF DEGRADATION)
Preserve scenic and aesthetic beauty of the wetlands **Preserve recreational and touristic value of the wetland** **Provide livelihood opportunities to stakeholders through engagement in wetland based-tourism activities**	Restrict tourist movement in ecologically sensitive areas Put in place restrictions and systems for waste management Develop of Do's and Don'ts for tourists Promotion of local economy through registration of local taxis and issue of permits for tourism Strict permits for private cars and taxis in order to reduce congestion and pollution around HAW	Train eco-guides on HAW values and benefits Create medical facilities to attend to emergency situations Regulate activities in line with management strategy	Create institutional arrangements to provide incentives to local communities to act as Eco-guides Develop awareness and outreach material for tourists (informative signages and boards) Conduct a capacity assessment to determine the level of tourism that can be supported at the site Prepare a tourist zoning plan to regulate tourism Conduct feasibility studies for implementing home-stay programmes for tourists Leverage compensatory schemes or provide alternative livelihoods
Maintain compliance with existing rules and regulation	Banning illegal/ unauthorised activity in and around wetlands	Monitor and penalize to ensure appropriate implementation of actions and responses	Manage conflicts by establishing operating rules/strategies to meet emergency situations Participatory management planning to ensure compliance with applicable laws and regulations.

MANAGEMENT OBJECTIVE	MANAGEMENT INTERVENTION TYPE		
	REACTIVE (ATTEMPTS TO MAINTAIN A CURRENT ECOSYSTEM STATE OR AN ACTIVITY DEGRADING WETLAND FEATURE)	ACTIVE (POSITIVE STEPS TO CHANGE WETLAND FEATURE TOWARDS A CERTAIN DIRECTION)	PROACTIVE (ACTIONS TO LIMIT ANTHROPOGENIC INDIRECT DRIVERS OF DEGRADATION)
Enhance awareness of wetlands biodiversity and ecosystem services amongst stakeholders			Develop landscape level approaches to ensure wetlands functioning and delivery of wetlands ES. Identify stakeholders and conduct capacity needs assessments and identify priority training areas Organise awareness and orientation programmes on wetland ecosystem services (Refer Box 14 on CEPA)
Ensure consideration of HAW values and functions in sectoral plans		Review and alignment of cross sectoral plans	Setting up Intersectoral management committee with defined roles and responsibilities Integrating wetlands functioning in sectoral development plans such as SAPCCs, DDMPs
Promote stakeholder participation in wetlands management **Maintain and enhance capabilities for integrated management**		Review and Orientation of SWA, DWC and wetland managers towards importance of HAWs and their management Identify sectoral priorities and align with management of HAWs	Conduct trainings on priority areas/features with identified stakeholders Devise long-term capacity development program (refer Box 15 on Capacity development for management of HAW) Establish mechanism to integrate stakeholders into management implementation Consideration of stakeholder issues and feedback in management implementation Devise and conduct MEE in a timely manner to improve management effectiveness

STEP 7

ACTION PLAN

The action plan describes the specific interventions to be undertaken for achieving management objectives. It should be a clear articulation of what needs to be done to manage the HAW. It is useful to consider, wherever feasible, at least three types of interventions:

- Reactive interventions: interventions aimed to contain an activity which directly degrades a wetland feature
- Active interventions: interventions aimed at improving a wetland feature towards a desired condition
- Proactive interventions: interventions aimed at limiting the indirect drivers of wetland degradation (the underlying causes within the direct drivers of change)

A generic listing of actions that may be taken to achieve different management objectives is presented below in table 18.

While developing the action plan, following details need to be provided:

- **What** is the activity?
- **When** will the activity be done?
- **Where** will this activity be done?
- **How** will the activity be done? (breaking down activity into sub-activities)
- **Who** will do this activity?
- **How** much resource (human, financial, equipment, etc.) is required?

EACH ACTIVITY NEEDS TO BE COSTED TO ASSESS THE FINANCE REQUIRED TO IMPLEMENT THE MANAGEMENT PLAN.

STEP 8

MANAGEMENT PLAN BUDGETING AND FINANCING

Each activity needs to be costed to assess the finance required to implement the management plan. Costs for each activity may be assessed by using accounting heads, such as the following:

- Personnel - Cost of time
- Consultants - Cost for hiring consultants
- Subcontractors - Costs for sub-contracting work
- Travel - Costs of travel related to implementation of management plan. The costs may be further broken down into local, national and international
- Infrastructure - Cost for building infrastructure (such as purchasing equipment, vehicles, or structures)
- Meetings and Workshops - Cost for organizing meetings and workshops
- Consumables - Costs of items that will be

GOVERNMENT OFFICIALS' VISIT TO CHANDERTAL WETLAND *(Dhruv Verma/Wetlands International South Asia Library)*

BOX 14. ESTABLISHING A COMMUNICATION, EDUCATION, PARTICIPATION AND AWARENESS PLAN

Wetlands management is as much a social enterprise as an ecological one. Having stakeholders onboard management not only enhances implementation effectiveness, but enables informed stakeholders to take into account wetland values and functions in various spheres of developmental planning and action.

The Ramsar CEPA Handbook defines various concepts as under:

Communication is a two-way exchange of information leading to mutual and enhanced understanding. It can be used to gain the involvement of 'actors' and stakeholders and is a means to encourage cooperation of groups in society by listening to them first and clarifying why and how decisions are made.

Awareness brings the issues relating to wetlands to the attention of individuals and key groups who have the power to influence outcomes. Awareness is an agenda-setting and advocacy exercise that helps people to know what and why this is an important issue, the aspirations for the targets, and what is being and can be done to achieve these.

Education is a process that can inform, motivate, and empower people to support wetland conservation, not only by fostering changes in the way that individuals, institutions, business and governments operate, but also by inducing lifestyle changes. It may take place in both formal and informal settings. Education in the broadest sense is a life-long process. Training, which is the process of increasing or strengthening specific knowledge, skills, attitudes and behaviours that can be taken back to the workplace, forms an integral part of education, and can take place in both formal and informal settings.

Participation is the active involvement of 'stakeholders' in the common development, implementation and evaluation of strategies and actions for the wise use of wetlands. Levels and kinds of participation can be highly variable, depending upon both the specific context and the decisions of the individuals and institutions leading the process.

The overarching goal that CEPA seeks to achieve is to motivate and enable people to act for wise use of wetlands. The management plan can serve as an instrument to achieve this goal by:

- Improving the individual and collective capacity and opportunities for people to participate in and contribute to using wetlands wisely.
- Supporting and developing mechanisms to ensure multi-stakeholder participation in wetland management.

An understanding of stakeholders is crucial for designing and implementing an effective CEPA plan. The analysis done in Section 2.3 can be a further developed for this purpose. For HAW, following specific stakeholder groups may be relevant:

- Communities
- Nomadic communities grazing livestock within the wetland catchments
- Indigenous people and local communities in the settlements from which HAW is accessed
- Children
- Religious and spiritual leaders
- Community leaders, including Panchayati Raj Institutions representatives
- Representatives of community-based organizations
- Non-government organizations working in the settlements nearing the wetlands
- Home-stay operators

State Government Department and Agencies
Businesses

- Tour operators
- Transport agencies

- Hoteliers
- Camping and trekking businesses

Media (print and electronic)
Elected representatives

Effective use of CEPA requires a planned systematic approach to understand the interests of stakeholders, so that approaches are tailor-made to the local context, culture and traditions.

The following table summarizes CEPA tools that can be used for various stakeholders.

TABLE 16. CEPA TOOLS TO SUPPORT MANAGEMENT OF HIGH-ALTITUDE WETLANDS

	TRAINING WORKSHOPS	PUBLIC WORKSHOPS AND SEMINARS	CAMPAIGNS AND PUBLIC EVENTS	DEVELOPING DOS AND DON'TS	TARGETED AUDIO-VISUAL MATERIAL	POLICY BRIEFS	SIGN-AGE	PUBLICATIONS – NEWSLETTERS	ENGAGE IN MANAGEMENT PLAN IMPLEMENTATION	ENGAGE IN WETLANDS MONITORING
COMMUNITIES										
Pastoralists	++	+	+++	++	+		+++			
Indigenous and local communities	++	+	+++	++	+		+++		+	
Children			+++		+++		+++			
Religious leaders			+++	++	+++		+++			
Community leaders			+++	++	+++		++	+	++	++
NGOs and CBOs	+++	++	+++		+++					
State Government Department and Agencies						+++		+++	+++	+++
BUSINESSES										
Tour-operators			++	+++	++		+++			
Transport agencies			+	+++	++		+++			
Camping and trekking businesses			++	+++	++		+++			
Homestay operators			++	+++	++		+++			
Media			+++			+++		+++		
Elected representatives			+++			+++		+++		

(+++ highly relevant, ++ of moderate relevance, + of low relevance)

BOX 15. CAPACITY DEVELOPMENT FOR MANAGEMENT OF HIGH-ALTITUDE WETLANDS

To improve conservation of HAW, developing capacities of government, non-government organisations and communities to effectively formulate and implement wetland policies and management plans is crucial.

Capacity development is a process through which individuals, organizations and societies obtain, strengthen and maintain their capabilities to set and achieve their development objectives over time which in the context of HAW is conservation of natural wetland regime. Capacity development is usually at the following three levels:

- At the level of individuals, capacity development focuses on their competencies to perform specific tasks and often involves training and education activities.
- At the level of organisations, such as Forest Department, State Wetlands Authority, research organisation and NGOs, capacity development can focus on the hardware needed for performing certain tasks (such as equipment and infrastructure) but also on the software which is built around competency of people within the organisation and collective ability to initiate and engage in wetlands conservation.
- At the level of institutions, capacity development refers to the enabling environment for wetlands conservation as determined by the policies, strategies, regulations and customary norms and beliefs which define and shape interactions with wetlands. At this level, capacity development includes accountability, transparency, coordination and cooperation amongst stakeholders involved in wetlands conservation.

Wetland management planning process can be designed to effectively address interventions at the first two levels. Capacity development at institutional level maybe taken up by engaging with relevant policy and decision-making processes.

Specific competencies relevant for capacity development at individual and organisational levels include:

- Systems thinking – ability to recognise and understand interactions of HAW with the basin, cryosphere, biogeographic zone and flyway level processes. This also includes an understanding of the relationship of wetlands with sectoral development plans.
- Anticipatory competence – ability to understand and evaluate wetland features in light of climate uncertainties. It implies decision making to set management goals, devise wetland management actions to reduce adverse changes in wetland character with respect to anticipated changes and risk.
- Strategic competence - ability to link HAW ecosystem services and biodiversity with sector strategy plans for rural development, tourism, disaster risk reduction, climate change, and others.
- Interpersonal competence – ability to work in a multi-stakeholder environment considering their views, rights, and capacities to engage with and contribute to wetland management.

Capacities can be developed by a range of interventions including:

- Mentoring
- Training
- Knowledge management
- Communication and education
- Peer exchange and learning
- Expert networks
- Infrastructure development
- Participation in decision making body meetings

A mapping of competencies and capacity development tools for various actors that HAW management will engage with is in table below:

	KEY ACTORS THAT HAW MANAGEMENT WILL ENGAGE WITH				
	WETLAND MANAGER	COMMUNITIES & USER GROUPS	CSOS & CBOS	STATE WETLANDS AUTHORITY	OTHER LINE DEPARTMENTS
COMPETENCIES TO BE DEVELOPED					
Systems thinking	+++	+	++	+++	++
Anticipatory competence	+++	+	++	+++	+
Strategic competence	+++	+	++	+++	++
Interpersonal competence	+++	+++	+++	+++	+++
CAPACITY DEVELOPMENT TOOLS					
Mentoring	++	+++	+++	+	+
Training	+++	++	+++	+++	++
Knowledge Management	+++	+	+++	+++	+
Communication and education	+++	+++	+++	++	+
Peer exchange and learning	+++	+	++	+++	+
Expert networks	+++	+	++	+++	+++
Infrastructure development	+++	++	+	++	++
Participation in decision making body meetings	++	+++	+++	+	+

Note: +++ high significance; ++ moderate significance; + low significance

The evaluation of management plan effectiveness should also include evaluation of capacity development efforts. Key elements to be considered are:

- Impact: Were the competencies improved as intended? Did the interventions lead to improved HAW management practices?
- Sustainability: How likely is the persistence of competency development impacts after completion of management plan implementation cycle?
- Relevance: Are the results of capacity development consistent with priorities of management plan?
- Effectiveness: Did the capacity development interventions achieve desired outcomes as envisaged in the management plan?
- Efficiency: Are the competency enhancement outcomes commensurate with use of resources (funds, time, expertise, etc.)?

BOX 16. RESEARCH STUDIES TO SUPPORT MANAGEMENT OF HIGH-ALTITUDE WETLANDS

High-Altitude Wetlands are relatively under-researched and thereby not all information required for management planning is available. Management planning, thus should strive to include a component on research studies to address knowledge gaps and proactively use the outcomes to refine management. Implementation of research studies involves specialised agencies which should be budgeted for within the plan. Prior to zeroing down on specific research areas, a review of ongoing research (such as research on glacial dynamics, geology and hydrology, climate change trends and impacts, species migration patterns and flyways) must be conducted to assess the extent to which knowledge needs for wetland management are fulfilled.

Some of the research topics that may benefit HAW management process are listed below:

WETLAND FEATURE	THEMATIC RESEARCH TOPICS
Physical regime	• Estimation of HAW extent using remote sensing and field assessments • Estimation of peatland extent and carbon stock
Catchments	• Land use and Land cover change and implication for HAW • Predictive estimation of spatio-temporal changes in glacial mass and extent in HAW catchment • Predictive climate modelling to estimate changes in precipitation and temperature patters over cryosphere defining HAW character

Hydrology	• Characterization of HAW hydrological regimes
	  • Quantification of water inflows and outflows for water balance estimation
	  • Quantification of sediment influx and its impact on HAW hydrological functioning
	  • Hydrological linkages between springshed and HAW using isotope probes
	  • Assessment of water quality
	• Functional analysis of HAW in regulating river base flows
	• Functional analysis of HAW in regulating GLOF risk

Species and habitats	• Inventorying plant and animal species, including migratory species dependent on the HAW • Evaluating HAW features governing presence and use of resources by species • Predictive climate modelling to detect range shift in alpine vegetation and species habitat use patterns
Livelihoods	• Estimation of carrying capacity with respect to seasonal tourism and grazing • Assessment of community attitudes and perceptions on wetland values, threats and management regime
Institutions and governance	• Adaptive governance • Assessment of opportunities and challenges in cross-sectoral wetland management

ARMED FORCES PERSONNEL ARE AN IMPORTANT STAKEHOLDER IN THE MANAGEMENT OF HAW *(Dhruv Verma/Wetlands International South Asia Library)*

used up in the process of management plan implementation, mostly within a single accounting year (these may include office supplies, printing etc.)

- Publication - Cost of printing and publishing
- Audits - Costs of auditing project accounts

The NPCA guidelines for wetlands management planning recommend that the budget is prepared for a period of five years. It is recommended to factor in inflation while preparing cost estimates.

The management plan should also outline the strategy for financing. This is also an opportunity to build convergence with various government departments as well as non-government entities, and mainstreaming within the development planning.

Some possible source of finance are as follows:

- State budgets (under specific budget allocations for HAW or Compensatory Afforestation Funds)
- Ministry of Environment, Forest and Climate Change (under the National Plan for Conservation of Aquatic Ecosystems (NPCA), the National Mission on Himalayan Studies, the scheme on Integrated Development of Wildlife Habitats)
- Department of Science and Technology (under Water Technology Initiative)
- Ministry of Earth Sciences (under Polar Science and Cryosphere Scheme)
- Ministry of Rural Development (Mahatma Gandhi National Rural Employment Guarantee can be used to support implementation of activities linked with generation of rural employment)
- Ministry of Tourism
- Ministry of Culture and Heritage
- Ministry of Jal Shakti (the Jal Jeevan Mission includes provisions for investments in water source protection wherein HAW can be included)

Besides public finance sources, there are also opportunities to attract private sector finance under Corporate Social Responsibility or Corporate Environmental Responsibility programmes.

While developing the budget and financing plan, it may be borne in mind that management is not a one-off activity that will end with the management plan implementation. Even if wetland is in good ecosystem health, activities such as monitoring, communication and outreach, maintenance of built infrastructure and capacity development will need to continue. Hence, the management plan budgeting must provide for a financing plan for recurrent activities. As far as possible, such activities need to be tied to a permanent allocation, such as an endowment, or an allocation within the state budgets.

3.2 COMPILING THE MANAGEMENT PLAN

The NPCA guidelines recommend a structure for compiling a management plan. The management planning steps described above and information generated therein can be used to fill in the required format and compile the management plan. As mentioned earlier, the plan should be as complex as the site management demands, and the available information permits. NPCA suggests the following table format to be used as a template for compiling a HAW management plan. A list of maps recommended to be included in a management plan is at Annex III and an overall checklist at Annex V.

TABLE 19. SUGGESTED FORMAT FOR COMPILING HIGH ALTITUDE WETLANDS MANAGEMENT PLAN

CHAPTER HEADING	SUB-HEADINGS	EXPLANATION	RELEVANT STEP FROM THE GUIDEBOOK
1. Introduction	1.1 Rationale for management planning	Describe why management planning is being done and where does the mandate come from	Section 3.1 – Step 1
	1.2 Terms of reference	Enlist the overall terms of reference for the management plan	
	1.3 Approach and Method	Provide an overview of approach (ways in which the recommended steps have been used) Describe the data sources and research carried out for management planning if any	
2. Description of wetlands features	2.1 Description of wetland features • Physical regime • Wetland catchments • Hydrological regimes • Species and habitat • Communities and livelihoods • Institutions and goverenace	Describe wetland features. As far as possible, present the data in maps.	Section 3.1 – Step 2
3. Evaluation of wetlands features	3.1 Evaluation • Priority wetland features that need to be maintained and thresholds thereof • Threats	From the wetland features described in the previous section, enlist the priority wetlands features. Describe the threats that adversely affect the priory wetland features.	Section 3.1 – Step 3

CHAPTER HEADING	SUB-HEADINGS	EXPLANATION	RELEVANT STEP FROM THE GUIDEBOOK
4. Institutional arrangements	4.1 Review of existing arrangements • Key organizations and programmes • Rules and regulations • Role of civil society and community-based organizations	Provide an overview of the current institutional arrangements in the context of wetlands management	Section 3.1 – Step 2.6
	4.2 Gaps	Discuss why the current institutional arrangements are insufficient in ensuring wetlands conservation and wise use.	
	4.3 Proposed arrangements for wetland management	Propose institutional arrangement for wetland management, which specific focus on a) nodal agency, b) role of various departments and agencies and coordination mechanism, and c) the role of civil society and communities. Develop an organogram for management plan implementation.	Section 3.1 – Step 6
5. Setting Management Objectives	5.1 Goal and purpose	Provide a statement of the overall goal that the management plan seeks to achieve	Section 3.1 – Step 1
	5.2 Benefits (ecological as well as societal)	Summarize the ecological and economic benefits that are expected from management plan implementation	
	5.3 Management objectives	Enlist the specific objectives	Section 3.1 – Step 4
	5.4 Strategies	Describe strategy(ies) for achieving each of the management objectives	

CHAPTER HEADING	SUB-HEADINGS	EXPLANATION	RELEVANT STEP FROM THE GUIDEBOOK
6. Monitoring and evaluation plan	6.1 Monitoring strategy	Present an overview of monitoring the wetland, and management plan implementation	Section 3.1 – Step 5
	6.2 Monitoring parameters, frequency and responsibility	Describe the monitoring parameters, the frequency of monitoring and the agency that will be responsible for monitoring	
	6.3 Institutional design	Describe how coordination between different monitoring agencies will be achieved.	
	6.4 Infrastructure and human resources design	Discuss the infrastructure and human resource requirement for implementing the management plan. As far as possible, including local universities, research organizations and NGOs in wetlands monitoring	
	6.5 Reporting	Discuss the frequency in which reporting shall be done and the responsible agency.	
	6.6 Review and adaptation	Discuss how the monitoring outcomes will be used to adapt management	
7. Developing an Action Plan	7.1 Component wise activities linked with management objectives	Generic listing of activities indicating: • What will be done? • Where will the activity be done? • What is the priority for the activity? • How will the activity be implemented? (include intermediate steps, technical specifications and relevant drawings, as may be the case) • Where will the activity be implemented? • Who will implement the activity? • What are the quantitative targets to be met?	Section 3.1 – Step 7
8. Budget and activity phasing	8.1 Activity linked budget	Present a summary budget Provide details of funding available from convergence sources	Section 3.1 – Step 8
	8 2 Time planning	Present a monthly Gantt Chart for management plan implementation	

SECTION 4

Implementing Management

4.1 SETTING UP AN INCEPTION PROCESS

Implementation of management plan should begin with a systematic inception. How detailed a management planning process is, some operational detailing always is left to implementing agencies. An inception phase helps bridge these gaps so that management plan implementation runs smoothly. Some activities that may form part of inception include:

- Issuing necessary government orders assigning management plan implementation coordination functions to specific department and officer.
- Detailing implementation coordination mechanisms and constitution of committees.
- Setting up banking systems to enable transfer and utilization of funds.
- Seeking confirmation of funds and actions plans to be implemented in convergence with other line departments.
- Constituting stakeholder committees with clear terms of reference.
- Constituting scientific advisory committees as per the needs of management plan.
- Detailing time-plan for specific activities.
- Putting monitoring systems in place – including building network of organizations, setting up monitoring stations, database systems and reporting formats.
- Public announcements of initiation of management plan implementation.
- Engaging with communities on management plan implementation.

WHILE PHASING THE ACTION PLANS, IT IS NECESSARY TO PAY ATTENTION TO THE SEQUENCE OF ACTIONS AND GROUND CONDITIONS FOR IMPLEMENTING FIELD BASED ACTIVITIES AS HAW ARE NOT ACCESSIBLE THROUGHOUT THE YEAR.

WETLANDS MANAGERS SHOULD KEEP STAKEHOLDERS INFORMED OF THE PROGRESS OF MANAGEMENT PLAN IMPLEMENTATION.

4.2 ANNUAL PLANS AND PHASING

Management plans are usually set for a period of five years. It is important to break the five yearly action plans into annual and half-yearly plans, with as much details as possible. While phasing the action plans, it is necessary to pay attention to the sequence of actions and ground conditions for implementing field-based activities as HAW are not accessible throughout the year.

While phasing, priority may be given to actions that build stakeholder participation and establish learning processes from annual monitoring. It is much more important to build community trust so that their engagement in management plan implementation is ensured. Learning mechanisms ensure that a process is set for continuous evaluation of information generated through assessment and monitoring processes.

4.3 KEEPING STAKEHOLDERS INFORMED

Wetlands managers should keep stakeholders informed of the progress of management plan implementation. This will ensure broader ownership of the plan implementation and continuous feedback for improvement. As different stakeholders have varying propensity to consume information, the following may be built in within CEPA component of management plan:

- A popular and non-scientific version of management plan (with a version in local language)
- A periodic newsletter
- Summaries of major assessments

Information may be shared through various means, such as having a dedicated web-page, and social-media presence.

WISA TEAM INTERACTING WITH PRI REPRESENTATIVES OF VILLAGES NEAR CHANDERTAL
(Wetlands International South Asia Library)

SECTION 5

Reviewing and Adapting Management

5.1 ASSESSING MANAGEMENT EFFECTIVENESS

Wetlands are dynamic and so are their management needs. Wetland management planning is an on-going process that should never end and always strive to adapt and improve. Management plans, which are developed based on assumptions known to managers, need to be periodically assessed to make sure that the set goals and objectives are being achieved. Wetlands managers must also anticipate adverse changes in HAW to be able to respond to them effectively and in-time. To facilitate this, managers need to conduct regular assessments of the effectiveness of site management and take lessons from both successes and failures. The nodal officer assigned with the specific function of coordinating management plan implementation is referred to as the wetland manager.

MANAGERS NEED TO CONDUCT REGULAR ASSESSMENTS OF THE EFFECTIVENESS OF SITE MANAGEMENT AND TAKE LESSONS FROM BOTH SUCCESSES AND FAILURES.

Within protected areas, management effectiveness evaluation is periodically done to assess 'how well the protected areas are being managed – primarily the extent to which management is protecting values and achieving goals and objectives. Such assessments help refine management periodically by taking a systematic look at management performance (achievements against set objectives), and reasons of deviation and / or underperformance.

The effectiveness of HAW management towards achieving the overarching objective of maintenance of ecological character can be greatly enhanced if following questions are periodically reflected upon:

- What is the current status of the HAW?
- Is the management achieving the goal of maintenance of ecological character?
- What are the current and future threats?
- Are adequate resources available for implementing management, and if not, how can they be improved?
- Are management processes adequate, effective and efficient?
- What other steps can be taken to improve management?

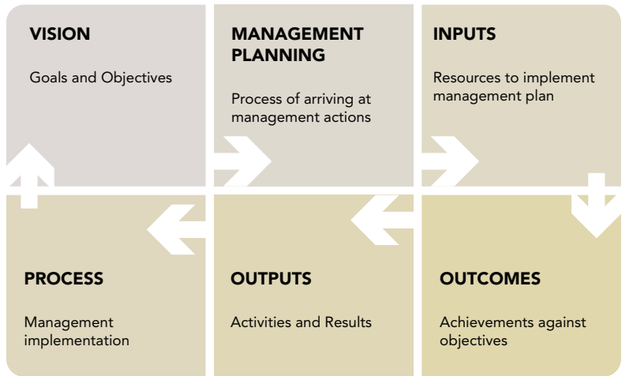


FIGURE 18. MANAGEMENT EFFECTIVENESS ASSESSMENT FRAMEWORK

The Contracting Parties to the Ramsar Convention adopted the R-METT (Ramsar Site Management Effectiveness Tracking Tool) to assist Ramsar site managers in assessing effectiveness of management in achieving wetland wise use outcomes. The assessment looks into the following aspects:

- **Context** of management (wetland ecological character, threats and risks of adverse change).
- **Management planning** that defines how the management goals and objectives have been defined.
- **Inputs** including human, technical and financial resources applied to implement management actions.
- **Process** of management plan implementation.
- **Outputs** (tangible and intangible) that result from implementation of management actions.
- **Outcomes** with respect to the objectives defined by the management plan.

The R-METT steps are summarized in Figure 18, and are relevant for HAW as well. The specific parameters are listed at Annex V. It is recommended that management effectiveness assessments are done at least once in five years, so that management action plans are revised and updated to reflect the condition of wetlands as well as ability of management to prevent adverse change in ecological character.

5.2 PERIODIC REVIEW AND EVALUATION

HAW, as with several other ecosystems, have an inherent uncertainty and unpredictability in their behaviour owing to complex and multi-scalar ecological, social and institutional interactions that shape their features and governing factors. There are a number of reasons, including

- Environmental variation that is uncontrollable (such as melting rates of glaciers)
- Partial observability (as not all wetland features and factors can be monitored on the basis of a comprehensive design)
- Partial controllability of actions (as management interventions are implemented through a number of agencies)
- Structural uncertainty arising out of lack of complete understanding of how the ecosystem functions

Thus, despite the best monitoring systems and systematic analysis of data of wetland features, the knowledge about these ecosystems will remain incomplete. Yet, management cannot wait for all data and information needs being met, and more data and information may not always lead to improved decisions. Thus, management needs to be adaptive – based on iterative learning, and using that learning to improve management using a goal-oriented and structured process (Fig 19). This is core of adaptive management – a formal iterative process of resource management that acknowledges uncertainty yet strives to achieve management objectives by increased system knowledge using a structured feedback process.

Adaptive management for HAW can be enabled by a combination of processes, such as:

- Structured decision making to clarify management goals, objectives and actions, involving stakeholders (this is the essence of steps described in Section 3 of this guidebook)
- Investing into monitoring and learning for management. Each management intervention in reality is an experiment based on a working hypothesis of ecosystem functioning. Monitoring enables assessment whether the hypothesis works in reality (for example, tourism may be controlled to check nutrient enrichment of the HAW based on an assumption that nutrients are generated from anthropogenic sources. Monitoring may lead to a conclusion that nutrients are geogenic – related to geological processes instead, thus allowing for an alternate view on nutrient management options)
- Investing into cross-scale communication. Understanding change at multiple scales (such as cryosphere, flyways, catchments) may help getter a better understanding of ecosystem functioning and variability.

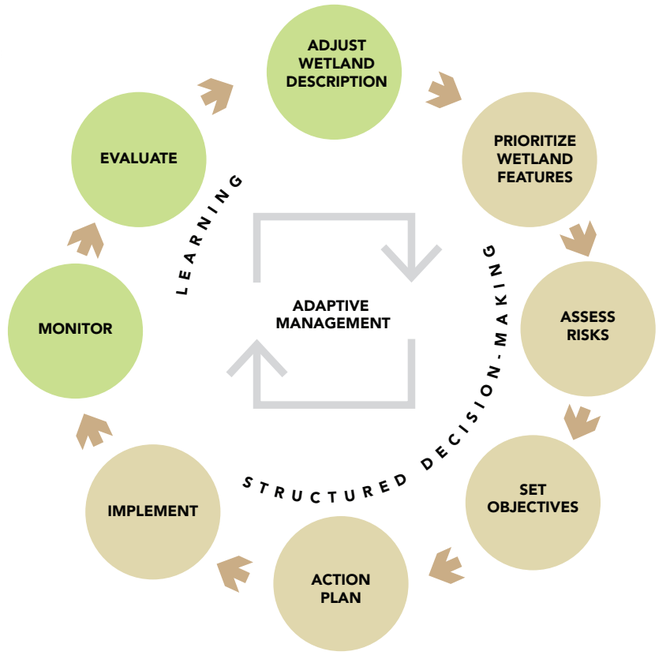


FIGURE 19. THE ADAPTIVE MANAGEMENT CYCLE

- Adaptive governance, based on collaborative and participatory management which has the flexibility of sharing management responsibilities. Successful adaptive governance has required leadership with a vision, systematic monitoring, complementary legislation framework which allows for adaptive management, information flow amongst stakeholders, and clear opportunities for stakeholders to collaborate.

Adaptive management is the philosophy which all wetland managers should adhere and subscribe to. This will open up a culture of learning and participation, and build a flexible management by responding to new information. This includes information generated from management effectiveness assessment (discussed in Section 5.1 of this guidebook) as well as monitoring (discussed in Section 3.5 of this guidebook). Adaptive management leads not just to adjustments of the management objectives and actions, but also in monitoring systems. Thus, management plans should not be treated as fixed documents and set-in-stone, but written for a shorter time-frame (say five years), and revised with new information as and when these become available.

SECTION 6

Designating High-Altitude Wetlands as Ramsar Sites

6.1 WETLANDS OF INTERNATIONAL IMPORTANCE (RAMSAR SITES)

The Ramsar Convention on Wetlands is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. India ratified the Convention on the 1st of February, 1982.

A key commitment under the Ramsar Convention is to identify and place suitable wetlands onto the List of Wetlands of International Importance, also known as the Ramsar List. The Wetlands of International Importance, also known as Ramsar Sites, form a part of an international network of wetlands which are important for the conservation of global biological diversity and for sustaining human life through the maintenance of their ecosystem components, processes and services.

6.2 BENEFITS OF DESIGNATING HIGH-ALTITUDE WETLANDS AS RAMSAR SITES

Designating HAW to the Ramsar list and meeting Ramsar Convention commitments is India's contribution to global efforts for biodiversity conservation. Ramsar Sites are recognized as being of significant value not only for our country but for humanity as a whole. Designating Ramsar Sites and ensuring their conservation and wise use:

- presents an opportunity to make its voice heard in the principal intergovernmental forum on the conservation and wise use of wetlands
- brings increased publicity and prestige for the Ramsar Sites and hence increased possibilities of support for conservation and wise use measures
- brings access to the latest information and advice on adoption of the Convention's internationally-accepted standards, such as criteria for identifying wetlands of international importance, advice on application of the wise use concept, and guidelines on management planning in wetlands
- brings access to expert advice on national and site-related problems of wetland conservation and management through contacts with Ramsar Secretariat personnel and collaborators and through application of the Ramsar Advisory Mission when appropriate
- encourages international cooperation on wetland issues and brings the possibility of support for wetland projects, either through the Convention's own small grants assistance programmes or through the Convention's contacts with multilateral and bilateral external support agencies.

THE WETLANDS OF INTERNATIONAL IMPORTANCE, ALSO KNOWN AS RAMSAR SITES, FORM A PART OF AN INTERNATIONAL NETWORK OF WETLANDS WHICH ARE IMPORTANT FOR THE CONSERVATION OF GLOBAL BIOLOGICAL DIVERSITY AND FOR SUSTAINING HUMAN LIFE THROUGH THE MAINTENANCE OF THEIR ECOSYSTEM COMPONENTS, PROCESSES AND SERVICES.

6.3 RAMSAR SITE DESIGNATION CRITERIA

The Convention establishes that "wetlands should be selected for the List on account of their international significance in terms of uniqueness & representativeness of wetland types and biological diversity". This reflects in the nine designation criteria, of which at least one should be met at the time of designation.

GROUP A OF THE CRITERIA. SITES CONTAINING REPRESENTATIVE, RARE OR UNIQUE WETLAND TYPES

- Criterion 1: A wetland should be considered internationally important if it contains a representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region.

GROUP B OF THE CRITERIA. SITES OF INTERNATIONAL IMPORTANCE FOR CONSERVING BIOLOGICAL DIVERSITY

Criteria based on species and ecological communities

- Criterion 2: A wetland should be considered internationally important if it supports vulnerable, endangered, or critically endangered species or threatened ecological communities.
- Criterion 3: A wetland should be considered internationally important if it supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.
- Criterion 4: A wetland should be considered internationally important if it supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions.

Specific criteria based on waterbirds

- Criterion 5: A wetland should be considered internationally important if it regularly supports 20,000 or more waterbirds.
- Criterion 6: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of waterbird.

Specific criteria based on fish

- Criterion 7: A wetland should be considered internationally important if it supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity.
- Criterion 8: A wetland should be considered internationally important if it is an important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend.

Specific criteria based on other taxa

- Criterion 9: A wetland should be considered internationally important if it regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species.

The information required to justify inclusion of HAW under any of the nine criteria can be generated during the wetland ecological character description and evaluation process (Section 3 – Step 2 and 3 of this manual). Some of the databases that can be consulted for information are:

Waterbird Population Estimates database of Wetlands International (http://wpe.wetlands.org/) – For Criteria 5, 6 and 9

Red list database of threatened species IUCN (https://www.iucnredlist.org/) – For Criteria 2,3,4,7,8 and 9

RAMSAR SITES ARE RECOGNIZED AS BEING OF SIGNIFICANT VALUE NOT ONLY FOR OUR COUNTRY BUT FOR HUMANITY AS A WHOLE.

A VIEW OF TSO KAR, A NEWLY DESIGNATED RAMSAR SITE IN LADAKH *(Pazhyna/istockphoto)*

DESIGNATION OF WETLANDS AS RAMSAR SITE EMBODIES COMMITMENT OF THE GOVERNMENT OF INDIA AND THE STATE GOVERNMENT SFOR WISE USE OF THESE WETLANDS. RAMSAR SITES ARE ALSO REGULATED UNDER WETLANDS (CONSERVATION & MANAGEMENT) RULES, 2017.

Datazone of Birdlife International (http://datazone.birdlife.org/home) – For Criteria 5 and 6

Fishbase (https://www.fishbase.in/) – For criteria 7, 8 and 9

Zoological Survey of India (https://zsi.gov.in/) – For criteria 2,3,4,7,8 and 9

Botanical Survey of India (https://bsi.gov.in/) – For criteria 1, 2,3,4 and 9

6.4 PROCESS OF RAMSAR SITE DESIGNATION

A five stage process, which involves actions at the end of State Government / UT administration and the Ministry of Environment, Forest and Climate Change is followed for designation of Ramsar Site.

6.5 DESIGNATION COMMITMENTS

Designation of wetlands as Ramsar Site embodies commitment of the Government of India and State Government for wise use of these wetlands. Ramsar Sites are also regulated under Wetlands (Conservation & Management) Rules, 2017.

Commitments of State Government

- Designating nodal agency within State Government/UT administration for site management
- Delineating wetland boundary and its zone of influence.
- Notification under Wetlands (Conservation and Management) Rules, 2017, which includes:
  - A) Preparing a brief document in the format recommended under the guidelines for implementation of rules
  - B) Enlisting activities prohibited, regulated and permitted.
  - C) Enforcement of extant regulations as per the mandate
- Preparing an integrated management plan outlining specific actions for wetland wise use. The management plan should be prepared on the basis of diagnostic evaluation of wetland ecological character, and be sufficient to address any risks of adverse change.
- Updating Ramsar Information Sheet every 6 years
- Monitoring to assess the risk of adverse change in ecological character
- Providing status updates on the condition of Ramsar Site to the MoEFCC

To facilitate implementation of these commitments, the Ministry of Environment, Forest and Climate Change shall:

- Support the implementation of management plans based on specific request from state government under the National Plan for Conservation of Aquatic Ecosystems
- Conduct capacity development of wetlands managers in different aspects of wetlands management
- Maintain oversight on the condition of Ramsar site through the State Wetlands Authority

FURTHER READINGS:

5th Edition Ramsar Handbook 1: An introduction to the Convention on Wetlands https://www.ramsar.org/sites/default/files/documents/library/handbook1_5ed_introductiontoconvention_e.pdf

Ramsar Handbook 17 (4th Edition): Designating Ramsar Sites https://www.ramsar.org/sites/default/files/documents/pdf/lib/hbk4-17.pdf

Ramsar Handbook 18 (4th Edition): Managing Wetlands https://www.ramsar.org/sites/default/files/documents/pdf/lib/hbk4-18.pdf

FEASIBILITY ASSESSMENT	RAMSAR SITE DESIGNATION INTENT	APPROVAL TO DESIGNATE SITE	PROPOSAL PREPARATION	PROPOSAL REVIEW AND FINALIZATION
• Wetland identification • Brief document preparation • Assessment against 9 Ramsar criteria	• State Government to communicate Ramsar Site designation intent to National Focal Point, Ramsar Convention (AS, MoEFCC) • State Government to share details of Ramsar Site to proposal compiler	• MoEFCC seeks approval of MEA and • MoD Upon approval, MoEFCC communicates site designation intent to Ramsar Secretariat • Ramsar Secretariat allocates a Site ID and password to access Ramsar Site Information System	• Ramsar Site compiler to prepare designation proposal in RSIS • Ramsar Site compiler to upload map as per prescribed format	• State Government to electronically forward finalized proposal along with cover letter to MoEFCC • MoEFCC after review, to forward proposal to Ramsar Secretariat • Ramsar Secretariat shares comments on proposal with MoEFCC • Comments to be addressed by compiler • Final proposal processed by Ramsar Secretariat • Site is designated and Designation Certificate sent to MoEFCC
KEY AUTHORITY: STATE GOVERNMENT	KEY AUTHORITY: STATE GOVERNMENT	KEY AUTHORITY: MOEFCC	KEY AUTHORITY: STATE GOVERNMENT	KEY AUTHORITY: MOEFCC

FIGURE 20: PROCESS OF RAMSAR SITE DESIGNATION

SECTION 7

Notifying High-Altitude Wetlands under Wetlands Rules, 2017

7.1 WETLANDS (CONSERVATION & MANAGEMENT) RULES, 2017

The MoEFCC has notified the Wetlands (Conservation and Management) Rules, 2017 (hereinafter Wetlands Rules) under the provisions of the Environment (Protection) Act, 1986 as the regulatory framework for conservation and management of wetlands in India. The Guidelines for implementation of Wetlands Rules were issued by the Ministry in 2019.

Following are the major provisions of the Wetlands Rules:

- Wetlands Authorities within States and UTs have been constituted to serve as the nodal organizations for all policy, regulation and management aspects of the wetlands within their jurisdiction. Regulation, management and policy aspects of transboundary wetlands are the responsibility of the MoEFCC. The National Wetlands Committee constituted at the central level shall maintain the overall oversight of the implementation of Wetlands Rules.
- Wetlands notified under the Rules shall be regulated as per a list of activities prohibited, regulated and permitted for the site and its zone of influence. The Wetlands Authority will designate a specific department responsible for enforcement of the regulation. The Wetlands Authority will provide periodic overview of implementation of Wetlands Rules to the MoEFCC.
- Management of all notified wetlands will be on the basis of an integrated plan prepared on wise use approach. Such plan will be approved by the Wetlands Authority.

The provisions of Wetlands Rules apply to:

- Wetlands designated by the Government of India to the List of Wetlands of International Importance under the provisions of the Ramsar Convention.
- Wetlands notified under the rules by the Central Government, State Government and UT Administration.

All wetlands, irrespective of their location, size, ownership, biodiversity, or ecosystem services values can be notified under the Wetlands Rules, except:

- River channels;
- Paddy fields;
- Human-made waterbodies specifically constructed for drinking water purposes;
- Human-made waterbodies specifically constructed for aquaculture purposes;
- Human-made waterbodies specifically constructed for salt production purposes;
- Human-made waterbodies specifically constructed for recreation purposes;
- Human-made waterbodies specifically constructed for irrigation purposes;
- Wetlands falling within areas covered under the Indian Forest Act, 1927; Forest (Conservation) Act, 1980; State Forest Acts and amendments thereof;
- Wetlands falling within areas covered under the Wildlife (Protection) Act, 1972 and amendments thereof;
- Wetlands falling within areas covered under the Coastal Regulation Zone Notification, 2011 and amendments thereof.

For the purpose of implementation of the Rules, human-made wetlands are defined as wetlands which are planned, designed and operated to meet a specific purpose (such as providing water for irrigation, producing fish through culture operations, producing salt, recreation, preventing salinity intrusion, flood control etc.). Only those human-made wetlands which have been built for purposes mentioned above at c) – g) above are excluded from notification under these Rules. Natural wetlands, partly or wholly used for purposes as mentioned at c) – g), attract the provisions of the Wetlands Rules. Thus, all natural HAW, except river channels, irrespective of their size and location are to be notified under the Wetlands Rules.

It has been clarified in the Guidelines for implementation of Wetlands Rules that Ramsar Sites may be notified under the Rules as per the process mentioned in the guidelines, even when partly or wholly overlapping with areas covered under the Indian Forest Act, 1927; Forest (Conservation) Act, 1980; State Forest Acts and amendments thereof; Wildlife (Protection) Act, 1972 and amendments thereof; and Coastal Regulation Zone Notification, 2011 and amendments thereof. Regulations for parts of wetlands overlapping with

ALL NATURAL HAW, EXCEPT RIVER CHANNELS, IRRESPECTIVE OF THEIR SIZE AND LOCATION ARE TO BE NOTIFIED UNDER THE WETLANDS RULES.

h)-j) will, however, be as per the corresponding regulatory framework. Ramsar site areas not covered under any of the overlapping laws and rules will attract the provisions of Wetlands Rules.

7.2 PROHIBITED, REGULATED AND PERMITTED ACTIVITIES

The following activities are prohibited within notified wetlands:

- Conversion for non-wetland uses including encroachment of any kind;
- Setting up of any industry and expansion of existing industries;
- Manufacture or handling or storage or disposal of construction and demolition waste covered under the Construction and Demolition Waste Management Rules, 2016; hazardous substances covered under the Manufacture, Storage and Import of Hazardous Chemical Rules, 1989 or the Rules for Manufacture, Use, Import, Export and Storage of Hazardous Micro-organisms Genetically engineered organisms or cells, 1989 or the Hazardous Wastes (Management, Handling and Transboundary Movement) Rules, 2008; electronic waste covered under the E-Waste (Management) Rules, 2016;
- Solid waste dumping;
- Discharge of untreated wastes and effluents from industries, cities, towns, villages and other human settlements;
- Any construction of a permanent nature except for boat jetties within fifty metres from the mean high flood level observed in the past ten years calculated from the date of commencement of these rules; and,
- Poaching.

Wetlands Authority, based on consideration of site-specific conditions may expand the list of prohibited activities for a notified wetland. This should be specified as such within the notification for the specific wetland (or wetlands complex). Permission for carrying out any activity included within the list of prohibited activities [as per Rule 4(2) of Wetlands Rules], within a notified wetland can only be given by the MoEF&CC.

Activities within a notified wetland and its zone of influence, which when contained within a specific threshold or area, are not likely to induce an adverse change in wetlands ecological character may be placed under the regulated category. Such activities should be notified as such within the notification for a specific wetland (wetlands complex). Given the high ecological sensitivity of HAW, only a very low level of anthropogenic activity may be permitted. Following activities may be permitted within a defined threshold:

- Tourism (within carrying capacity and restricted to select areas – excluding key habitats)
- Grazing within zone of influence (on rotational basis and within regenerative capacity)
- Constructions of temporary nature (on the downstream reaches of the wetland)

Each activity, however, would need to be considered on a case-to-case basis keeping in mind the ecological character of wetland or wetlands complex. As specified in the Guidelines to Wetlands Rules, the Wetlands Authority shall be responsible for enforcing the regulations, through the enforcement machinery of the concerned State Government / UT Administration.

Activities aligned with the wise use of wetland may be permitted within the wetland or its zone of influence. The following activities are likely to be aligned with the 'wise use' approach:

- Wetlands inventory, assessment and monitoring;
- Research;
- Communication, environmental education and participation activities;
- Management planning;
- Habitat management and conservation of wetland-dependent species;
- Community-based ecotourism (with minimum construction activities);
- Harvesting of biomass within regenerative capacity; and,
- Integrating wetlands as nature-based solutions for climate change mitigation and adaptation.

Permitted activities may need to be identified considering the ecological character of each wetland to be notified. It is likely that an activity may be benign for one wetland, yet would need regulation for others. For example, ecotourism may not be desirable for all wetlands.

WETLANDS AUTHORITY, BASED ON CONSIDERATION OF SITE-SPECIFIC CONDITIONS MAY EXPAND THE LIST OF PROHIBITED ACTIVITIES FOR A NOTIFIED WETLAND.

7.3 DELINEATING WETLANDS AND ZONE OF INFLUENCE

For notification purposes, the boundary of the wetland and its zone of influence need to be specified.

WHERE TWO OR MORE WETLANDS EXIST WITH A HIGH DEGREE ON HYDROLOGICAL CONNECTIVITY (FOR EXAMPLE, WETLANDS CONNECTED DURING MONSOON), OR ECOLOGICAL CONNECTIVITY (SHARING WATERBIRD HABITATS OR LOCATED ON MIGRATORY FISH PATHWAYS), THESE CAN BE DELINEATED AS A SINGLE COMPLEX

HAW boundary can be derived as the outer envelope of the maximum area under inundation, the area covered by hydrophytes, or saturation of soil near the surface during a normal monsoon year. The boundary should be such that during a normal monsoon year the entire area is inundated for at least 15 days, or the soil is saturated roughly within one foot from the surface. It may be pertinent to exclude areas that are only intermittently inundated in the case of high floods (such as one in 100-year floods) or extreme events (such as storm surges of extreme intensity). Guidelines for delineating wetlands are provided in Section x.x.

Where two or more wetlands exist with a high degree on hydrological connectivity (for example, wetlands connected during monsoon), or ecological connectivity (sharing waterbird habitats or located on migratory fish pathways), these can be delineated as a single complex. In such cases, non-wetland areas may be included within the boundary of the complex to ensure connectivity and continuity. The connotation of wetland throughout this document includes wetlands complex, as may be the case.

For each wetland and wetlands complex, a map should be prepared using a Geographical Information System (WGS84 datum and UTM (Universal Transverse Mercator) projection) and adopting professional cartographic standards. Essential features to be included in the map are as follows:

- Wetland boundary
- The boundary of settlements located within and around the wetland
- Connecting drainages, inflows and outflows
- Main roads and railway (if any)
- Major landmarks

Recommended scale for producing the wetlands maps is as follows:

WETLAND / WETLANDS COMPLEX AREA	RECOMMENDED SCALE
Below 100 ha	1: 4000
Between 100 – 500 ha	1: 10,000
Between 500- 4000 ha	1: 25,000
4000 ha and above	1: 50,000

For each HAW to be notified, a zone of influence is to be defined. The zone of influence of a wetland is an area, developmental activities wherein are likely to induce adverse changes in wetland ecosystem structure and (ecological) functioning.

BOUNDARY DEMARCATION OF HAW PEATLAND AROUND CHANDERTAL WETLAND BY WISA TEAM *(Dhruv Verma/Wetlands International South Asia Library)*

The boundary of the zone of influence may be defined with due consideration to local hydrology and nature of land use. For wetlands with a well-defined surface drainage system, its directly and freely draining basin should be delineated as the zone of influence. This can be done using a suitable digital elevation model data and validated using toposheets. The basin should encompass all direct inflow as well as outflow areas. The river basin atlas of India (available at http://www.india-wris.nrsc.gov.in/wrpinfo/index.php?title=WRIS_Publications) may be used to support the delineation.

For HAW with diffused drainage and where the slope is too gentle leading to large basin area, the zone of influence can be delineated on the basis of features that are likely to influence wetland functioning adversely. These could be based on the outer periphery of adjoining settlements, or peripheral area which drain directly into the wetland.

A map should be prepared to indicate the following elements in a Geographical Information System (WGS84 datum and UTM projection) and adopting professional cartographic standards:

- Zone of influence
- Wetland boundary
- Connecting drainages, inflows and outflows
- Main roads and railway (if any)
- Major landmarks

The recommended scale at which the map of the zone of influence is to be produced is as follows:

AREA OF ZONE OF INFLUENCE	RECOMMENDED MAPPING SCALE
Below 100 ha	1: 4000
Between 100 and 500 ha	1: 10,000
More than 500 ha	1: 50,000

7.4 NOTIFYING WETLANDS

For each wetland proposed to be notified, a 'Brief Document' containing the following information would need to be prepared:

- Demarcation of wetland boundary supported by accurate digital maps with coordinates and validated by ground truthing;
- Demarcation of its zone of influence along with land use and land cover thereof indicated in a digital map;
- Ecological character description;
- Account of pre-existing rights and privileges;
- List of site-specific activities, to be permitted within the wetland and its zone of influence;
- List of site-specific activities, to be regulated within the wetland and its zone of influence; and,
- Modalities for enforcement of regulation.

Data requirements for Brief Document are indicated within the HAW survey format at Annex 1. The full-format is accessible in the guidelines for implementing the Wetlands (Conservation & Management) Rules, 2017 (http://moef.gov.in/wp-content/uploads/2020/01/final-version-and-printed-wetland-guidelines-rules-2017-03.01.20.pdf).

The nodal department designated by the State Government/UT Administration for wetlands shall be responsible for preparing the Brief Documents. All Brief Documents shall be placed for approval of the Wetlands Authority. The Authority may endorse the Brief Document for notification to the concerned State Government / UT Administration.

The State Government / UT Administration shall issue a draft notification indicating the wetland (wetlands complex) to be covered under the Wetlands Rules. The notification should contain:

- Description of the wetland (wetlands complex) boundary along with its map
- Description of the zone of influence along with a map
- List of activities prohibited within the wetland (wetlands complex) and its zone of influence
- List of activities regulated within the wetland (wetlands complex) and its zone of influence
- List of activities permitted within the wetland (wetlands complex) and its zone of influence
- Name and contact details of the nodal person, who is to be contacted for seeking permission to undertake regulated activities.

Each draft notification shall be placed for public consultation for sixty days. The State Government

LIVESTOCK GRAZING IN ALPINE MEADOWS NEAR CHANDERTAL

after considering objections from the concerned and affected persons shall publish the final notification within a period not exceeding 240 days from the date of recommendation of the concerned Wetlands Authority.

MoEFCC shall issue the draft and final notification for transboundary wetlands. All Ramsar Sites, deemed covered under these Rules, shall also be notified as per the process laid out above. This is proposed to ensure that the site boundaries are properly delineated, and the knowledge about the same is available in public domain. It is advisable that the information in the 'Brief Document' may be consistent with Ramsar Site Information Sheet (RSIS) submitted to the Ramsar Convention during site designation or RSIS updated thereafter.

7.5 VIOLATIONS AND PENAL PROVISIONS

The Wetlands Authorities are entrusted with the responsibility of ensuring enforcement of Wetlands Rules and other relevant Acts, rules and regulations. Provisions of the relevant Central and State Government Acts are applicable.

All prohibited and regulated activities beyond their thresholds, if taken up within the wetlands and its zone of influence, shall be deemed violations under the Wetlands Rules. The violations of the Wetlands Rules shall attract the penal provisions as per the Environment (Protection) Act, 1986.

Complaints may need to be filed in the case of violations. The Central-Government has authorised the officers and authorities listed in the Table (p. 238) vide S.O. 394 (E) published in the Gazette No. 185 dated 16-4-87, S.O. 237(E) published in Gazette No. 171 dated 29-3-89 and S.O. 656(E) published in the Gazette No. 519 dated 21-8-89, and amendments thereafter, if any.

The Authority is entrusted with the responsibility of evolving a mechanism for continuous watch and ward of HAW within their jurisdiction. At the local level, the concerned Gram Panchayat may be entrusted with watch and ward in association with any body constituted by the State Wetlands Authority, such as a Wetlands Management Unit for a specific Wetland. At District levels, the responsibility may be entrusted to the District Wetlands Committee, DDO/CDO (District/Chief Development Officer)/CEO (Chief Executive Officer)/ Chief Programme Officer of the Wetland level body, such as a Wetlands Management Unit. The Wetlands Authority are to report the status of notified wetlands on half yearly basis to the State Government/UT Administration and Central Government.

ALL PROHIBITED AND REGULATED ACTIVITIES BEYOND THEIR THRESHOLDS, IF TAKEN UP WITHIN THE WETLANDS AND ITS ZONE OF INFLUENCE, SHALL BE DEEMED VIOLATIONS UNDER THE WETLANDS RULES

FURTHER READING:

Wetlands (Conservation & Management) Rules, 2017 http://moef.gov.in/wp-content/uploads/2019/09/Wetlands2017.pdf

Guidelines for implementing Wetlands (Conservation & Management) Rules, 2017 http://moef.gov.in/wp-content/uploads/2020/01/final-version-and-printed-wetland-guidelines-rules-2017-03.01.20.pdf

Annexes

ANNEX I

SAMPLE DATA COLLECTION SHEET

State / Union Territory:

_____

Name and address of person(s) compiling this information

_____

SECTION 1: IDENTIFICATION, LOCATION AND JURISDICTION

1.1 Name of the Wetland (Alternative names, including in local language should be given in parenthesis after official name)

_____

1.2 Name of the Village(s), Tehsil(s),

_____

1.3 Name of the District(s) in which wetland complex is located

_____

1.4 Geographical coordinates (Latitude and Longitude, to degree, minutes and second)

Latitude: From _____ to _____

Longitude: From _____ to _____

1.5 Name of the Department / Agency which has jurisdiction over the wetland / wetlands complex

_____

SECTION 2: SITE CHARACTERISTICS

2.1 Area of wetland / wetlands category (ha) _____

2.2 Wetland type (Please tick appropriate categories and sub-categories)

Category	Subcategory
☐ Natural (Inland)	☐ Permanent lakes ☐ Seasonal/ intermittent lakes ☐ Permanent streams/ creeks ☐ Seasonal/ intermittent streams/ creeks ☐ River floodplain ☐ Permanent freshwater marshes ☐ Seasonal/ intermittent freshwater marshes ☐ Shrub-dominated wetlands ☐ Geothermal wetlands ☐ Karst and other subterranean hydrological systems
☐ Human-made	☐ Tank ☐ Dam / Reservoir

2.3 Depth (m) Average _____ Maximum _____

2.4 Elevation (m above mean sea level) _____ m

2.5 Water regimes

Main source of water (tick all applicable)

☐ Rainfall ☐ Groundwater ☐ Catchment runoff ☐ Direct / indirect inflow from river

☐ Others, please specify _____

a) Water permanence

☐ Mostly permanent ☐ Mostly intermittent

b) Destination of water from wetland

☐ Feeds groundwater ☐ To downstream catchment ☐ To river

c) Water pH

☐ Acid (< 5.5) ☐ Circumneutral (5.5 – 7.4) ☐ Alkaline (> 7.4) ☐ Not known

d) Water salinity

☐ Fresh (< 0.5 g/l) ☐ Brackish (0.5 – 30 g/l) ☐ Euhaline (30- 40 g/l)

☐ Hypersaline (>40g/l) ☐ Not known

e) Nutrient in water

☐ Oligotrophic ☐ Mesotrophic ☐ Not known

2.6 Climatic setting

a) Annual Rainfall /Snowfall (mm) _____

b) Temperature (°C) Minimum _____ Maximum _____

c) Humidity (%) Minimum _____ Maximum _____

d) Area of zone of influence (in ha) _____

2.7 Major land use within zone of influence (provide as approximate % of catchment area)

Glaciers _____%

Snow packs _____%

Alpine Vegetation _____%

Plantation _____%

Agriculture _____%

Settlements (Rural) _____%

2.8 Map of wetland complex and zone of influence

SECTION 3: BIODIVERSITY

3.1 Notable plant species present in wetland

3.2 Notable animal species present in wetland

3.3 Species of conservation significance (rare, endangered, threatened, endemic species)

3.4 Major plant invasive alien species

3.5 Major animal invasive alien species

SECTION 5: PRE-EXISTING RIGHTS AND PRIVILEGES

IMPORTANCE	RELEVANT FOR THE SITE (PLEASE TICK YES OR NO)	IF YES, DETAILS (UP TO 50 WORDS FOR EACH CATEGORY)
Source of drinking water for people living and around	☐ Yes ☐ No	
Source of water for agriculture	☐ Yes ☐ No	
Fisheries	☐ Yes ☐ No	
Medicinal plants	☐ Yes ☐ No	
Buffering communities from extreme events as GLOF	☐ Yes ☐ No	
Micro-climate regulation	☐ Yes ☐ No	
Acts as a sink for sediments	☐ Yes ☐ No	
Has significant cultural and religious values	☐ Yes ☐ No	
Is a site for recreation and tourism	☐ Yes ☐ No	
Supports noteworthy plants species	☐ Yes ☐ No	
Supports noteworthy animal species	☐ Yes ☐ No	
Site of high congregation of migratory waterbirds	☐ Yes ☐ No	
Supports life cycle of fish or amphibians	☐ Yes ☐ No	
Any other, please list		

- Community based wetland management arrangements: _____
- Community norms: _____
- Views, Rights and capacities of resource user groups: _____

SECTION 6: PRESENT AND POTENTIAL THREATS

THREAT	DEGREE	PRESENT OR POTENTIAL	ADDITIONAL INFORMATION, IF ANY
Changes in water inflow and outflow	☐ High ☐ Medium ☐ Low	☐ Present ☐ Potential	
Pollution	☐ High ☐ Medium ☐ Low	☐ Present ☐ Potential	
Unsustainable harvest of biological resources	☐ High ☐ Medium ☐ Low	☐ Present ☐ Potential	
Siltation	☐ High ☐ Medium ☐ Low	☐ Present ☐ Potential	
Encroachment	☐ High ☐ Medium ☐ Low	☐ Present ☐ Potential	
Spread of invasive species	☐ High ☐ Medium ☐ Low	☐ Present ☐ Potential	
Any other, please list	☐ High ☐ Medium ☐ Low	☐ Present ☐ Potential	

SECTION 8: ACTIVITIES PROPOSED TO BE PERMITTED

ACTIVITY	WHETHER PROHIBITED OR REGULATED	REGULATION WITHIN WETLANDS OR ZONE OF INFLUENCE	IF REGULATED, INDICATE THE LEVEL OF REGULATION (IN TERMS OF PEOPLE, RESTRICTED AREA OR ANY OTHER)	NAME OF DEPARTMENT / AGENCY RESPONSIBLE FOR REGULATION / PROHIBITION	ADDITIONAL INFORMATION, IF ANY
Withdrawal of water / impoundment/diversion or any other hydrological intervention		☐ Wetland / Wetlands complex boundary ☐ Zone of influence			
Harvesting of resources (living / non-living)		☐ Wetland / Wetlands complex boundary ☐ Zone of influence			
Grazing		☐ Wetland / Wetlands complex boundary ☐ Zone of influence			
Discharge of treated sewage/ effluent / wastewater		☐ Wetland / Wetlands complex boundary ☐ Zone of influence			
Construction of boat jetties, and facilities for temporary use , as pontoon bridges		☐ Wetland / Wetlands complex boundary ☐ Zone of influence			
Aquaculture, agriculture and horticulture activities within the wetland boundaries.		☐ Wetland / Wetlands complex boundary ☐ Zone of influence			
Any other, please list		☐ Wetland / Wetlands complex boundary ☐ Zone of influence			

SECTION 9: LISTING OF AVAILABLE SCIENTIFIC RESOURCES USED

GUIDANCE FOR WETLAND DELINEATION

WETLAND TYPE	INUNDATION	VEGETATION	SOIL
Glacial lakes	Outer boundary demarcated on the basis of maximum water spread during a normal hydrological year	Presence of sparse hydrophytes along the margins	None
	Generally associated with glaciers	GPS Field survey can help demarcation along with delineation using satellite image FCC and derived indices such as NDVI	
	Can be delineated using different band combinations and individual spectral bands of satellite imagery (* glacial lakes are largely white in colour during winter season)		
Lakes and Ponds	Outer boundary demarcated on the basis of maximum surface water spread during a normal hydrological year	Lake or pond ecosystem will have presence of dense bed of hydrophytes beyond the water boundary	Saturated soils and/ or soil moisture can also indicate wetland boundary
	Can be demarcated on the field or using satellite image FCCs or derived indices such as NDWI	Area with a dominance >60% is considered to be a part of the lake	
		Area under vegetation can be mapped either through field survey or can be demarcated using satellite imagery or derived indices such as NDVI	
Streams	Boundary can be drawn based on DEM derived flow accumulation data		
	Boundary can be digitized using optical remote sensing imagery FCC and satellite derived indices such as NDWI		
Springs	Surface seepage of groundwater along gently sloping areas with low relative relief and high flow accumulation	High vegetation density around the spring can also be an indicator	None
	Geological form and geological controls which supports ground water recharge potential (forms such as quartzite, slate, river terrace and controls such as joints, faults etc)		

WETLAND TYPE	INUNDATION	VEGETATION	SOIL
Hot Spring/ Geysers	Surface seepage of groundwater similar to a spring	None	None
	High temperature of water (≥100 degrees)		
Peatlands	Water saturation episodes (either seasonally wet or constantly wet)	Distinctive vegetation structure and Low species diversity are major indicators	Demarcation of organic soils based on available soil maps
	Water tables lie close to or above the surface throughout the year	Boundary can be drawn using optical satellite imagery (Landsat), RADAR data (ALOS PALSAR), LiDAR	Field surveys to verify occurrence of organic soils through augering or coring (element analysis, dry bulk density)
	Boundary can be delineated using a Digital elevation model or satellite image derived topographic wetness index		(on an average should contain >12% SOC)
	Other Remote sensing data sources such as RADAR and LIDAR data		
Marshes	Surface saturation during pre and post monsoon	Outer boundary demarcated on the basis of presence and dominance of hydrophytic vegetation (soft stemmed vegetation)	None
	(maybe without standing water for most part of the year)	Characterized by sedges and hydrophytic grasses in the emergent or marginal zone	
	Saturation can be determined on the basis of satellite data and derived indices such as NDWI	Marsh dominated regions can be delineated using satellite imagery based NDVI	
		NDVI can be further sliced based on percent dominance cover obtained from field transect surveys (cover, dominance and height) and categorise marshes into emergent or meadow marsh	
Swamps	Delineation of outer boundary on the basis of seasonal presence of standing water	Outer boundary demarcated on the basis of dominant woody species	Highly organic soils form the boundary of these wetlands largely black in colour
		Dominance >60% a criteria for boundary demarcation	
		Dominance can be determined on the basis of a field transect sampling	

RECOMMENDED LIST OF MAPS TO BE DEVELOPED

1. WETLAND PHYSICAL REGIME

A) HAW location map showing wetland boundary, zoning and protected area boundary, if applicable
B) Land use and land cover within the HAW

2. WETLAND CATCHMENT

A) Direct and indirect catchment of HAW
B) Drainage pattern and flow direction within the direct catchment/zone of influence
C) Current LULC within the wetlands zone of influence
D) Decadal change, if any, within the HAW catchment
E) Geological and geomorphological profile of the catchment (including patterns of slope, aspect, elevation, soil type and landforms)
F) Climate profile (Long term trends in average temperature, precipitation over last twenty years)

3. WETLAND HYDROLOGY

A) Map showing wetlands inflows and outflows
B) Map showing sediment inflows and outflows from the HAW
C) Surface water quality maps of HAW
D) HAWs bathymetry map

4. WETLAND SPECIES AND HABITATS

A) HAW map showing habitats of key species
B) Macrophyte/ Vegetation type and distribution map within the wetland
C) Map showing area covered by invasive (only if applicable)

5. WETLAND LIVELIHOODS AND RESOURCE LINKAGES

A) Major settlements downstream indirectly dependent on HAW
B) Demographic profile of major settlements (population, income etc)
C) Tourism infrastructure in the vicinity of the wetland
D) Map showing distribution of high value medicinal plants in and around the HAW
E) Map showing pasturelands in and around the wetland

ANNEX IV

MONITORING PARAMETERS AND GUIDELINES

WETLANDS FEATURE	WHAT TO MONITOR	MONITORING PRIORITY	WHEN TO MONITOR	HOW TO MONITOR
Wetlands Extent	Wetland Area	Essential	Annual	Remote sensing and GIS
Wetlands Catchment	Change in area under various LULC classes	Essential	Annual - Once in two years	Remote sensing and GIS
HYDROLOGY				
Water and sediment flux	Water inflow	Essential	Daily	Automatic monitoring / gauging stations within the wetland
	Water levels	Essential	Daily/Monthly	
	Water outflow	Essential	Daily	
	Sediment inflow	Essential	Daily	
	Sediment outflow	Essential	Daily	
Storage potential	Bathymetry	Essential	Once in 5 years	Bathymetric profile
Inundation regime	Seasonal Fluctuations in waterspread	Essential	Once in five years	Remote sensing and GIS
Water quality	Physical parameters (pH, TDS, Conductivity, transparency)	Desirable	Once a month	Standard protocols of CPCB
	Chemical parameters (DO, BOD, cations, anions)	Essential	Once a month	Standard protocols of CPCB
	Nutrients (Nitrate and Phosphate)	Essential	Once a month	Standard protocols of CPCB
Soil and Sediment quality	Soil texture	Desirable	Biannual	Standard protocols of CPCB
	Soil pH	Essential	Biannual	Standard protocols of CPCB
	Soil organic carbon	Essential	Biannual	Standard protocols of CPCB
SPECIES AND HABITATS				
Flora	Phytoplankton	Essential	Seasonal	Protocols of Central Inland Fisheries Research Institute
	Floral diversity and abundance	Essential	Seasonal	Taxonomic Identification and Field metrics (such as Shannon Weiner index)
	Invasive species	Desirable	Once in two-three years	Field based sampling Satellite data analysis
Fauna	Zooplankton	Desirable	Seasonal	Protocols of Central Inland Fisheries Research Institute
	Waterbird population and diversity	Essential	Yearly	Taxonomic identification and Species counts
	Waterbird migration patterns	Desirable	Once in three years	Species ranging and banding studies
	Amphibians	Desirable	Yearly	Taxonomic identification and counts
	Mammal population and diversity	Essential	Yearly	Taxonomic identification and counts
Habitat Quality	No. of nests/burrows	Essential	Yearly	Field investigation and habitat quality assessment protocols
	Type of vegetation	Essential	Yearly	Taxonomic identification and counts
	Percent vegetation cover	Essential	Yearly	Remote Sensing and GIS
LIVELIHOODS				
Community dependence	No. of graziers visiting Chandertal and its catchment	Essential	Yearly	Socio-economic surveys
	No. of tourists visiting the HAW	Essential	Yearly	
	% contribution of wetland based tourism to income and employment	Essential	Yearly	
INSTITUTIONS AND GOVERNANCE				
Compliance with extant regulations	Compliance with the provisions of the Wildlife (Protection) Act, 1972; Environment (Protection) Act, 1986; and others	Essential	Once in four years	Management Effectiveness Evaluation

MANAGEMENT PLAN CHECKLIST

- Management planning process scope and scale are identified and set in consultation with relevant stakeholders
- Key stakeholders are mapped with defined roles and responsibilities
- Responsible agency has been clearly identified and details of contact person included
- Communication strategy is established
- Wetland features (physical regime, catchments, hydrology, species & habitats, livelihoods & resources, and institutional arrangements) are assessed and mapped at required scale
- Wetland features at risk are evaluated
- Management objectives for features at risk are defined
- Monitoring system is established
- CEPA plan is established
- Action plan for the identified objectives is established
- Implementation strategy and agreements are defined
- Management plan is adequately budgeted with yearly action plans
- Management effectiveness evaluation system is developed and implemented in a timely manner
- Management stakeholders are regularly informed in implementation phase (adaptive management)
- List of activities to be regulated within wetlands and indirect catchment is included
- List of activities to be permitted is included

ABLATION - The loss of ice and snow from a glacier system. This occurs through a variety of processes including melting and runoff, sublimation, evaporation, calving, and wind transportation of snow out of a glacier basin.

ACCUMULATION - The addition of ice and snow into a glacier system. This occurs through a variety of processes including precipitation, firnification, and wind transportation of snow into a glacier basin from an adjacent area.

BIOLOGICAL DIVERSITY - Variability among living organisms from all sources including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species (genetic diversity), between species (species diversity), of ecosystems (ecosystem diversity), and of ecological processes. (This definition is largely based on the one contained in Article 2 of the Convention on Biological Diversity.)

CATCHMENT – The total area of land, including hills, mountains and woodlands, within a drainage basin where water drains and is collected before flowing into streams, rivers, lakes and tarns.

CLIMATE CHANGE - Climate in a narrow sense is usually defined as the "average weather," or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands of years. The classical period is 3 decades, as defined by the World Meteorological Organization (WMO). These quantities are most often surface variables such as temperature, precipitation, and wind. Climate in a wider sense is the state, including a statistical description, of the climate system. Climate change refers to any significant change in the measures of climate lasting for an extended period of time. In other words, climate change includes major changes in temperature, precipitation, or wind patterns, among others, that occur over several decades or longer.

ECOLOGICAL CHARACTER - Combination of the ecosystem components, processes and benefits/services that characterise the wetland at a given point in time

ECOLOGICAL COMMUNITIES - Any naturally occurring group of species inhabiting a common environment, interacting with each other especially through food relationships and relatively independent of other groups. Ecological communities may be of varying sizes, and larger ones may contain smaller ones.

ECOSYSTEM SERVICES - Benefits that people receive from ecosystems, including provisioning, regulating, and cultural services

ECOTONE - A narrow and fairly sharply defined transition zone between two or more different communities. Such edge communities are typically rich in species.

ENDEMIC SPECIES - A species that is unique to one biogeographical region, i.e., it is found nowhere else in the world.

FLAGSHIP SPECIES - Species that appeal to the public and have other features that make them suitable for communicating conservation concerns.

FLYWAY - Migration routes(s) and areas used by waterbird populations in moving between their breeding and wintering grounds. Each individual species and population migrates in a different way and uses a different suite of breeding, migration staging and wintering sites. Recent research into the migrations of many wader or shorebird species, for example, indicates that the migrations of waders can broadly be grouped into eight flyways, the Central Asia Flyway is one of them covering Indian sub-continent.

FUNCTIONS OF WETLANDS - Activities or actions which occur naturally in wetlands as a product of interactions between the ecosystem structure and processes. Functions include flood water control; nutrient, sediment and contaminant retention; food web support; shoreline stabilization and erosion controls; storm protection; and stabilization of local climatic conditions, particularly rainfall and temperature

GIS - GIS is a computer-based tool that analyses, stores, manipulates and visualizes geographic information on a map, good for finding spatial patterns, relationships and trends.

GLACIAL LAKE - An accumulation of standing liquid water on (supraglacial), in (englacial), or under (subglacial) a glacier.

GLACIAL LAKE OUTBURST FLOOD - A sudden release of a significant amount of water retained in a glacial lake, irrespective of the cause. GLOFs are characterized by extreme peak discharges, often several times in excess of the maximum discharges of hydrometeorological induced floods, with an exceptional erosion/transport potential.

GLACIAL STREAM - A channelized accumulation of liquid water on (supraglacial), in (englacial), or under (subglacial) a glacier, moving under the influence of gravity.

GLACIER - A large, perennial accumulation of ice, snow, rock, sediment and liquid water originating on land and moving down slope under the influence of its own weight and gravity; a dynamic river of ice. Glaciers are classified by their size, location, and thermal regime

GLACIER FLOW - The movement of ice in a glacier, typically in a downward and outward direction, caused by the force of gravity.

GLACIER ICE - A mono-mineralic type of rock, composed of crystals of the mineral ice, formed through metamorphism of snowflakes. Metamorphism results in recrystallization, increased density, and the growth of hexagonal crystals. This ice comprises the majority of the mass of a glacier.

HOLOCENE - The current part of geologic time. The Holocene epoch began ~12,000 years ago, at the end of the Pleistocene epoch.

HYDROLOGY - Hydrology is the science that encompasses the occurrence, distribution, movement and properties of the waters of the earth and their relationship with the environment within each phase of the hydrologic cycle.

HYDROMORPHIC SOILS - Waterlogged soils which develop under conditions of poor drainage in marshes, swamps, seepage areas, or flats.

ICE-DAMMED LAKE - A lake that exists because its water is restricted from flowing by an ice dam. Sometimes these lakes form because an advancing glacier had blocked a valley.

ICE-MARGINAL LAKE - A lake that is located adjacent to the terminus of a glacier. Typically, these lakes form in bedrock basins scoured by the glacier. They enlarge as the glacier retreats. Sometimes they are dammed by an End or Recessional Moraine.

INDICATOR SPECIES - Species whose status provides information on the overall condition of the ecosystem and of other species in that ecosystem; taxa that are sensitive to environmental conditions and which can therefore be used to assess environmental quality.

MASS BALANCE - A measure of the change in mass of a glacier at a certain point for a specific period of time. The balance between accumulation and ablation. Also called Mass Budget.

MORAINE - A general term for unstratified and unsorted deposits of sediment that form through the direct action of, or contact with, glacier ice. Many different varieties are recognized on the basis of their position with respect to a glacier.

NUTRIENT CYCLING - The movement of nutrients, notable nitrogen and phosphorus in various forms between the various stores within the wetland ecosystem. Leaf fall, decomposition, sedimentation, plant uptake, grazing, defecation, and denitrification are some of the processes involved.

OLIGOTROPHIC LAKE - Lake poorly provided with the basic nutrients required for plant and animal production.

PEAT - A dark-brown or black residuum produced by the partial decomposition and disintegration of mosses, sedges, trees, and other plants that grow in marshes and other wet places.

RAMSAR CONVENTION - The Convention on Wetlands of International Importance is commonly referred to as the Ramsar Convention from its place of adoption in Iran in 1971. The first of the modern global intergovernmental treaties on conservation and wise use of natural resources. The Ramsar Convention is the intergovernmental treaty which provides the framework for international cooperation for the conservation and wise use of wetland biomes. The Convention entered into force in 1975 and now has Contracting Parties from all over the world.

RAMSAR SITES - Wetlands designated by the Contracting Parties for inclusion in the List of Wetlands of International Importance because they meet one or more of the Ramsar Criteria

REMOTE SENSING - Remote sensing is a type of geospatial technology that samples emitted and reflected electromagnetic (EM) radiation from the Earth's terrestrial, atmospheric, and aquatic ecosystems in order to detect and monitor the physical characteristics of an area without making physical contact. This method of data collection typically involves aircraft-based and satellite-based sensor technologies, which are classified as either passive sensors or active sensors. There are two primary types of remote sensing instruments -- active and passive.

RESILIENCE - The capacity of a system to deal with change and continue to develop; withstanding shocks and disturbances (such as climate change or financial crises) and using such events to catalyse renewal and innovation.

SEDIMENT - Inorganic solid fragmented material, sometimes augmented with organic material, that comes from weathering of rock and is carried by, suspended in, or dropped by air, water, or ice; or a mass that is accumulated by any other natural agent and that forms in layers on the earth's surface such as sand, gravel, silt or mud.

SEDIMENTATION - The process of deposition of sediment.

SPECIES - Naturally occurring populations that interbreed, or are capable of interbreeding, in the wild. Under these (and other) Criteria, subspecies are also included.

SPECIES INTERACTION - exchanges of information or energy between species that are of particular interest or significance, e.g., symbiosis, commensalism, mutual resource defence, communal brooding, cuckoo behaviour, advanced parental care, social hunting, unusual predator-prey relationships, parasitism and hyperparasitism.

TARN - A lake that develops in the basin of a cirque, generally after the melting of the glacier.

TERMINUS - The lower-most margin, end, or extremity of a glacier. Also called Toe, End or Snout.

U-SHAPED VALLEY - A valley with a parabolic or "U" shaped cross-section, steep walls and generally a broad and flat floor. Formed by glacier erosion, a U-shaped valley results when a glacier widens and over-steepens a V-shaped stream valley.

VALUES OF WETLANDS - Perceived benefits to society, either direct or indirect, that result from wetland functions. These values include human welfare, environmental quality, and wildlife support

WATER BALANCE - A hydrological calculation of the water inputs, outputs and changes in storage within a natural system.

WATER YEAR - A hydrological term used to describe the 12 months starting at the end of the driest season, passing through the wet season(s), and ending with the next dry season.

WATERBIRDS - The Convention functionally defines waterfowl (a term which, for the purposes of these Criteria and Guidelines, is considered to be synonymous with waterbirds) as birds ecologically dependent on wetlands. This definition thus includes any wetland bird species.

WETLAND BENEFITS - Services that wetlands provide to people, e.g., flood control, surface water purification, supplies of potable water, fishes, plants, building materials and water for livestock, outdoor recreation and education.

WISE USE OF WETLANDS - Maintenance of their ecological character, achieved through the implementation of ecosystem approaches, within the context of sustainable development.

UNDP India, in partnership with the Ministry of Environment, Forest and Climate Change is implementing the SECURE Himalaya project, supported by the Global Environment Facility. The project aims to strengthen Government of India's efforts in sustainable management of snow leopard habitats across the Indian Himalayan Region. The project works extensively to generate awareness on biodiversity conservation, sustainable livelihoods and curbing illegal trade in wildlife.

The concept, design and production of this report follows the work of the project in conservation and sustainable management of High-Altitude Wetlands, which are unique ecosystems that play an important role in providing water, food and climate security and cultural identity to the entire Indian Himalayan region and beyond.

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