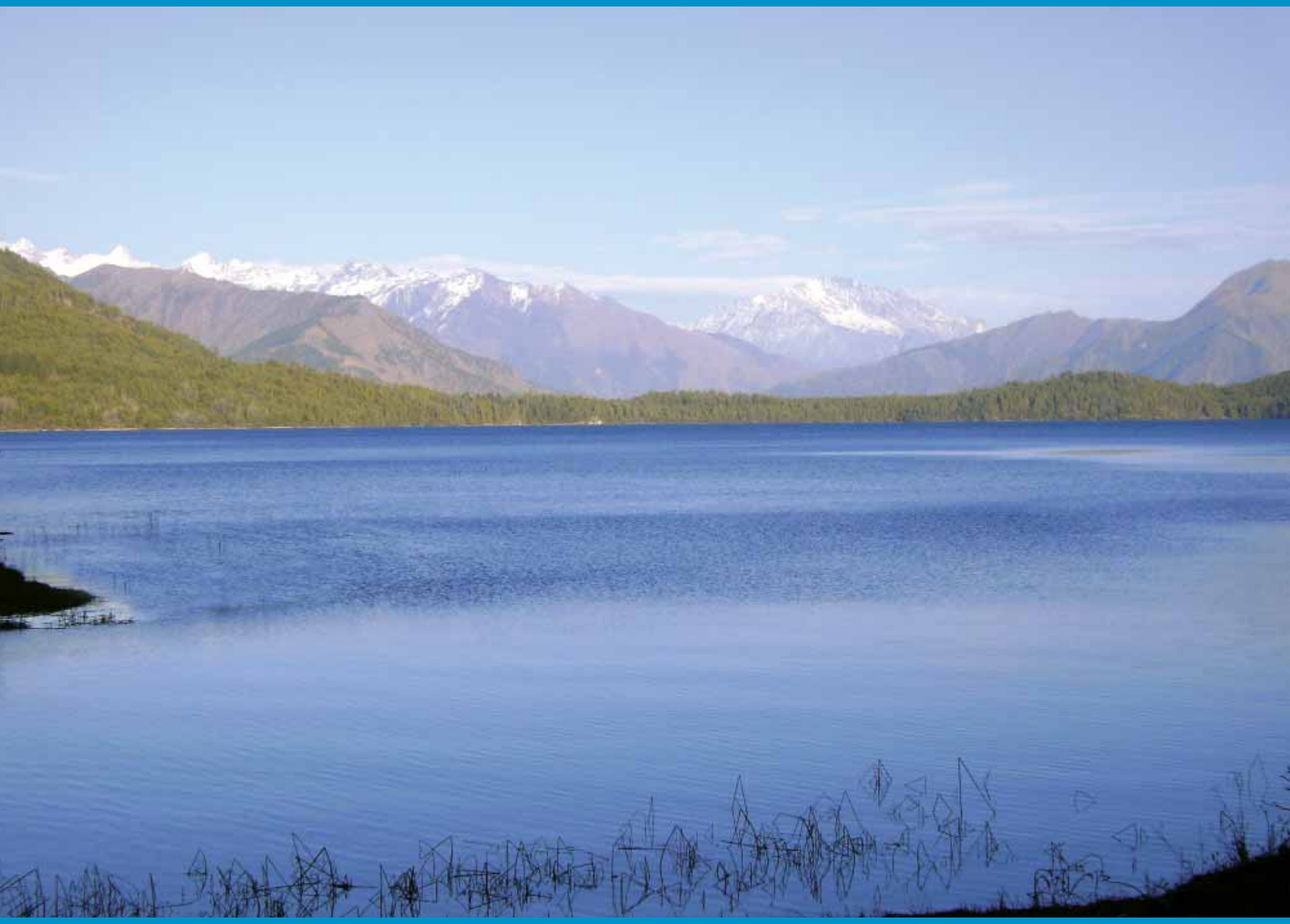
# Wetlands Inventory, Assessment and Monitoring Tool



Government of Nepal
Ministry of Forests and Soil Conservation
Conservation and Sustainable Use of Wetlands in Nepal
2011

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# Foreword

Wetlands, are a critical part of our natural environment and the most productive and dynamic ecosystems on Earth. They provide a wide range of goods and services for humanity. Despite their immense economic, ecological and socio-cultural values, they continue to be degraded and lost at an alarming rate. The obvious reason is that we have not been able to account the full range of benefits wetlands provide and subsequently educate and aware the general public. In Nepal, some attempts have been made towards the documentation and inventory of the wetlands, however, a comprehensive approach towards their documentation and inventory is still lacking. Realizing the above need, CSUWN has developed a practical Wetland Inventory, Assessment and Monitoring (WIAM) tool.

The WIAM tool prepared for Nepal has been prepared with due cognizance to Ramsar framework and national objectives. This tool is a culmination of the efforts of various key stakeholders comprising of individual experts, conservation partners, technicians and academicians, who have contributed profusely through consultations, advice, feedback and reviews. Before giving it a final shape, this tool was tested in two wetland sites.

At this juncture, I would like to express my sincere gratitude to the Ministry of Forests and Soil Conservation, Department of Forests, and Department of National Parks and Wildlife Conservation for their continued support and cooperation. I would like to take this opportunity to thank UNDP and GEF for providing the technical and financial support. I would also like to thank the entire members of the technical team who have contributed significantly in realizing the WIAM Tool. I would like to acknowledge and thank the expertise of Mr. Shailendra Pokharel, Prof. Dr. Mohan Siwakoti and Dr. Sajani Shrestha for the preparation of this WIAM Tool and its application guidelines. Finally, I would like to thank the CSUWN team including Mr. Top B. Khatri, NPM for technical backstopping and Mr. Hari K. Uprety-WBS and Ms. Shalu Adhikari-GMCO for their coordination, supervision, and inputs in bringing out the tool to this stage.

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# Acronyms

| | |
|---|---|
| amsl | above mean sea leve |
| Avg. | Avegrage |
| Approx. | Approximate |
| BOD | Biological Oxygen Demand |
| CBS | Central Bureau of Statistics |
| CF | Community Forestry |
| CITES | Convention on International Trade of Endangered Species |
| COD | Chemical Oxygen Demand |
| CSUWN | Conservation and Sustainable Use of Wetlands |
| DDCs | District Development Committees |
| DO | Dissolved Oxygen |
| DFO | District Forest Office |
| DSCO | District Soil Conservation Office |
| FRA | Forest Resource Assessment |
| GIS | Geographic Information System |
| g/m2 | gram per square meter |
| ha | Hectare |
| HH | Household |
| IAS | Invasive Alien Species |
| Ind./m2 | Individual per square meter |
| IUCN | International Union for Conservation of Nature and Natural Resources |
| KBA | Key Biodivesity Area |
| KTWR | Koshi Tappu Wildlife Reserve |
| LRMP | Land Resource Maping Project |
| m | Meter |
| mg/L | Milligram per Liter |
| µs/cm | Micro Semen per cetimeter |
| NGOs | Non-Government Organizations |
| NLCDC | National Lake Conservation Development Committee |
| NPWCA | National Parks and Wildlife Conservation Act |
| NR | Natural Resources |
| NRM | Natural Resources Management |
| NTFPs | Non Timber Forest Products |
| NWP | National Wetland Policy |
| PRA | Participatory Rural Appraisal |
| TDS | Total Dissolved Solid |
| TSS | Total Suspended Solid |
| VDC | Village Development Committee |
| WDCs | Wetland Dependent Communities |
| WIAM | Wetland Inventory, Assessment and Monitoring |
| Yr | Year |

# Table of Contents

## 1. Background

Wetlands are the most productive and dynamic ecosystems on earth. Wetlands provide a range of ecosystem services including provisioning, regulating, and cultural services. Despite their immense values, the inability to account the benefits of the full range of wetland goods and services in decision making and planning has resulted in the degradation and loss of the wetlands nationally and globally. Wetlands in Nepal have suffered largely due to two main reasons; lack of awareness amongst the general public that has led to overharvesting and degradation and effects due to various anthropogenic pressures such as encroachment for conversion into agricultural land, siltation and dredging. Although some efforts have been made with regard to the documentation and inventory of wetlands, a comprehensive approach, towards their proper documentation and inventory is still lacking.

An inventory is a systematic stock taking exercise aimed at locating wetland sites, their areal extent and types that exist within a landscape. An assessment, however, implies a more detailed evaluation of how a wetland functions and its values as perceived by a society. It may also involve an evaluation of the current status, or its ecological integrity of the wetland.

Wetland monitoring is a collection of specific information for management purposes in response to conclusion derived from assessment activities and the use of these monitoring results for implementing management actions.

COP (2005) under Resolution IX.1 defines Wetland Inventory as the collection and /or collation of core information for wetland management, including the provision of and information base for specific assessment and monitoring activities; Wetland Assessment as the identification of the status of, and threats to Wetlands as a basis for the collection of more specific information through monitoring activities: and Wetland Monitoring as the collection of specific information for management purposes in response to hypothesis derived from assessment activities and the use of these monitoring results for implementing management.

It has largely been recognized that Wetland Inventory, Assessment and Monitoring cannot be treated in isolation and are vital components of effective wetland management thereby providing essential information to support policy and management decisions.

## 2. Objectives

Conservation and Sustainable Use of Wetlands in Nepal (CSUWN) is a joint undertaking of the Government of Nepal (GoN), Global Environment Facility (GEF) and United Nations Development Programme (UNDP). The project is executed by Ministry of Forests and Soil Conservation (MFSC). Department of Forests (DoF) and Department of National Parks and Wildlife Conservation (DNPWC) are the major partners of the project. The project is being implemented in two Ramsar sites of Nepal: Koshi Tappu Wildlife Reserve (KTWR) and Ghodaghodi Lake Area (GLA) since 2009.

The project has a broader goal to ensure the maintenance and enhancement of wetland biodiversity and environmental goods and services for improved local livelihoods in Nepal. With a view to develop and enhance wetland related technical knowledge base at various levels, the Project has undertaken different activities to realize the above needs. Accordingly, to fill these gaps, CSUWN has for the first time embarked on developing a standard tool for Wetland Inventory, Assessment and Monitoring. It is also expected that this WIAM Tool will become a common tool for experts and practitioners working in the area of wetlands.

## 3. About the Tool

This WIAM Tool has been practically designed to cater to the needs of Nepalese wetlands; however this tool has been standardized for use within the regional context as well. This Tool has been made to be participatory without diluting the technical essence. As such, this Tool has been a blend of science and practice. We believe that this Tool should not be seen as a static document. Updates and improvements on its contents should be carried out with new techniques and technologies to value add and enrich on the existing Tool.

The layout of the document is structured as follows. The main text is preceded by an Introduction, Objective and its Limitation. The entire WIAM Tool is then further divided into two parts. Part I includes the Tool and Part II consists of the Guidelines giving a step wise methodology for data collection. Some of the important information that needs to be filled in at each level is presented in Annexes.

## 4. Limitation of the Tool

Inventory, Assessment and Monitoring provide essential information to support management decisions. However, wetlands that are larger and trans-boundary in nature require special attention given the time and resources to capture the required information at that scale. Therefore, in such cases, it is recommended that site specific interventions be carried out where the management requires a set of data on indicators like water quality, biodiversity and socio-economic status.

# Part I
# WIAM Tool

***Read carefully guidelines before using the tool***

# Wetlands Inventory, Assessment and Monitoring Tool

| | |
|---|---|
| **Name of wetland:** | **Wetland code:** ..... |
| | **Toposheet no:** ..... |

## 1. General Feature

| | | | | | | |
|---|---|---|---|---|---|---|
| **Date of inventory:** | | | | | | |
| **Compiler's name:** | | | | | | |
| **1.Conservation status** (mark withV) | **Ramsar site** | **Natural heritage** | **Religious site** | **Protected area** | **KBA** | **Other** |
| | | | | | | |

### 1.1 Geographical Coordination

| Attributes | Values |
|---|---|
| 1. Latitude | |
| 2. Longitude | |
| 3. Altitude (amsl) | |

### 1.2 Geographical Position (mark withV)

| **Tarai** | **Siwalik/Churiya zone** (S/F/V) | **Mahabharat Lekh** (S/F/V) | **Midlands** (S/F/V) | **Himalayan zone** (S/F/V) | **Inner Himalaya** (S/F/V) | **Tibetan marginal mountain** (S/F/V) |
|---|---|---|---|---|---|---|
| | | | | | | |

*Note: S=Slope, F=Flat, V=Valley*

### 1.3 Administrative Feature

| Attributes | Describe |
|---|---|
| **1. Development region** | |
| **2. District (s)** | |
| **3. Metropolitan/municipality/VDC(s)** | |
| **4. Ward number (s)** | |
| **5. Name of the place** | |

### 1.4 Boundary (Exact villages, forest and road surrounding wetlands)

| Attributes | West | East | South | North |
|---|---|---|---|---|
| **1. Core water body boundary** | | | | |
| **2. Basin boundary** | | | | |

### 1.5 Management Responsibility

| Attribute | Brief description |
|---|---|
| **1. Government** (specify) | |
| **2. Private** (specify) | |
| **3. Community** (specify) | |
| **4. Others** (specify) | |

### 1.6 Wetlands Classification Type

| Type | Sub-type 1 | Sub type II | Remarks |
|---|---|---|---|
| **Freshwater/ natural** | **Riverine** | **Perennial** (specify): | |
| | | **Temporary** (specify): | |
| | **Lacustrine** | **Permanent** (specify): | |
| | | **Seasonal** (specify): in | |
| | **Palustrine** | **Emergent** (specify): | |
| | | **Forest** (specify): | |
| **Man-made** | **Aquaculture** (specify): | | |
| | **Agriculture** (specify): | | |
| | **Urban/ industrial** (specify): | | |
| | **Water storage area** (specify): | | |

### 1.7 Map/Photographs/Mosaic

### 1.8 Climatic Feature

| Attribute | Avg. Maximum | | Avg. Minimum | | Source and year of record |
|---|---|---|---|---|---|
| | Month | Value | Month | Value | |
| **Temperature** ($^0$C) | | | | | |
| **Rainfall** (mm/yr.) | | | | | |
| **Humidity** (%) | | | | | |

## 2. Ecological Feature

### 2.1 Physical Structure

| Attribute | Core area | Basin |
|---|---|---|
| 1. **Area** (ha) | | |
| 2. **Average length** (m) | | Not applicable |
| 3. **Average width** (m) | | Not applicable |
| 4. **Maximum depth** (m) | | Not applicable |
| 5. **Maximum/minimum surface water level** (m) | | Not applicable |

## 2.2 Hydrological Feature

### 2.2.1 Water Volume

| Attribute | Peak period | Dry period |
|---|---|---|
| 1. **Water volume** ($m^3$) | | |

### 2.2.2 Water Inflow/Outflow

| Attribute | Name | Discharge rate ($m^3$/ second) | Source and year of record |
|---|---|---|---|
| ***1. Inflow*** | 1. | | |
| | 2. | | |
| | 3. | | |
| ***2. Outflow*** | 1. | | |
| | 2. | | |

### 2.2.3 Water quality (Physico-chemical characters) Location:

| Attribute | Unit | Value | Source and year of record |
|---|---|---|---|
| 1. **Temperature** | $^0C$ | | |
| 2. **pH** | - | | |
| 3. **Transparency** | m | | |
| 4. **Electric conductivity** | µS/cm | | |
| 5. **Dissolved oxygen** | mg/L | | |
| 6. **Chemical oxygen demand** | mg/L | | |
| 7. **Biological oxygen demand** | mg/L | | |
| 8. **Total dissolved solid** | mg/L | | |
| 9. **Total suspended solid** | mg/L | | |
| 10. **Nutrients** ($NO_3$, $NH_4$, K, Ca, Mg, Na,, $CO_3$, $HCO_3$, dissolved Silica) | mg/L | | |

**2.3 Shocks and Vulnerability** i.e., natural disaster/flood/landslide/GLOF (time series events if known)

## 2.4 Soil Feature

### 2.4.1 Soil Color (mark with√)

| Dark | Red | Grey | White | Others |
|---|---|---|---|---|
| | | | | |

### 2.4.2 Soil Texture (mark with√) Location:

| Boulders | Rocky sand | Sand | Loamy sand | Sandy loam | Sandy silt loam | Silt loam | Clay loam | Sandy clay loam | Silty clay loam | Sandy clay | Silty clay | Clay | Peat |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |
| | | | | | | | | | | | | | |

## 2.5 Biological Feature (*Use separate sheet if needed)*

### 2.5.1 Micro-Biota (Plankton)

**A. Phytoplankton**

| Species name | Density (ind./ $m^2$) | Source and year of records |
|---|---|---|
| **1.** | | |
| **2.** | | |
| **3.** | | |
| **4.** | | |

**B. Zooplankton**

| Species name | Density (ind./ $m^2$) | Source and year of records |
|---|---|---|
| **1.** | | |
| **2.** | | |
| **3.** | | |
| **4.** | | |

### 2.5.2 Macro-Biota (common plants and animals including IUCN Red List, CITES and government protected species)

**A. Major Aquatic Plants in Core Area (**Ff=Free floating, Sm=sub-merged and Em=emergent)

| Local name | Scientific name | Local use | Habitat type ( mark with √) | | | Threat/ conservation status |
|---|---|---|---|---|---|---|
| | | | Ff | Sm | Em | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
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| | | | | | | |

***Source:***

**B. Major Plants of Basin Area** (Habit type: Tree, Herb, Shrub, Climber and Epiphyte)

| Local Name | Scientific Name | Local use | Habit type | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
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| | | | | |
| | | | | |
| | | | | |
| | | | | |

***Source:***

**C. Fish Species in Aquatic Habitat**

| Local Name | Scientific Name | Number per catch | Local use | Threat/ conservation status | Remarks (Resident/ migratory/ introduced sps.) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
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| | | | | | |
| | | | | | |
| | | | | | |

***Source:***

**D. Herpeto-Fauna in Aquatic and Peripheral Habitat**

| Local Name | Scientific Name | Observed number | Local use | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | - |

***Source:***

**E. Birds in Aquatic and Peripheral Habitat**

| Local Name | Scientific Name | Observed number | Local use | Threat/ conservation status | Remarks *(resident/ migratory)* |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

***Source:***

**F. Mammals in Aquatic and Peripheral Habitat**

| Local Name | Scientific Name | Observed number | Local use | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

***Source:***

**G. Invertebrates** (Molluscs, Arthropods, Annelids of core area and fringes)

| Local Name | Scientific Name | Observed number | Local use | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

***Source:***

## 2.6 Invasive Alien Species in Core and Basin Area

### 2.6.1 Plants

| Local Name | Scientific Name | Coverage (%) | Local use | Mark with√ | | Approx. year of appearance |
|---|---|---|---|---|---|---|
| | | | | Core | Basin | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

***Source:***

### 2.6.2 Animals

| Local Name | Scientific Name | Observed Number | Local use | Mark with√ | | Approx. year of appearance |
|---|---|---|---|---|---|---|
| | | | | Core | Basin | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

***Source:***

## 2.7 Endemic Plant and Animal Species

| Local name | Scientific name | Mark with√ | | Remark (status, use, etc.) |
|---|---|---|---|---|
| | | Plant | Animal | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

***Source:***

### 2.8 Abundance of Plant Species

#### 2.8.1 Core Area Location:

| Species name | Coverage (%) | Remarks |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

***Source:***

#### 2.8.2 Basin Area Location:

| Species name | Coverage (%) | Remarks |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

***Source:***

### 2.9 Biomass in Core Area Location:

| Species | Value ($g/m^2$) | Source and year of record |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |

***Source:***

## 3. Socio-Economic Feature in Basin

### 3.1 Nearby Settlement to Wetland

| | |
|---|---|
| **1. Name and distance** (km) **to nearest settlement** | |
| **2. Name of the main road/trail linking wetland site** | |

### 3.2 Land Use Pattern

| Attributes | Coverage (%) | Remarks |
|---|---|---|
| **1. Forest land** | | |
| **2. Shrub land** | | |
| **3. Grass land** | | |
| **4. Agriculture** | | |
| **5. Settlement** | | |
| **6. Wetlands** | | |
| **7. Others** (barren, snow, glacier etc.) | | |

***Source:***

### 3.3 Demography

| Attributes | Brief description | Remarks |
|---|---|---|
| **1. Population (number)** | | |
| *1. Male* | | |
| *2. Female* | | |
| **2. Total household (number)** | | |
| **3. Caste/ethnic group** (%) | | |
| *(i) Brahmin/Chettri* | | |
| *(ii) Janajati* | | |
| *(iii) Dalit* | | |
| *(iv) Others* (specify) | | |
| **4. Major religion** | | |
| **5. Major dialect** | | |
| **6. Average land hold size/ HH** (Ha/Ropani/ Bigha) | | |

***Source:***

### 3.4 Education (> 6 years)

| Attributes | Percent | Remarks |
|---|---|---|
| **1. Primary level** | | |
| **2. School level certificate (+ 2)** | | |
| **3. University level** | | |

***Source:***

### 3.5 Occupation

| Attributes | Percent (Households) | Remark |
|---|---|---|
| **1. Agriculture** | | |
| **2. Employment** (government/corporate) | | |
| **3. Trade and business** | | |
| **4. Tourism** | | |
| **5. Fishing** | | |
| **6. Boating** | | |
| **7. NTFPs** | | |
| **8. Wages/labor** | | |
| **9. Remittance** | | |
| **10. Others** (specify) | | |

***Source:***

### 3.6 Jurisdiction/Land Ownership (mark withV)

| State | Gazetted | Trust | Corporate | Private | Other (specify) |
|---|---|---|---|---|---|
| | | | | | |

### 3. 7 Wetlands dependent community/ies

| Community name | Population & (HHs) number | Distance to site (m/km) | Literacy (%) | Occupation | Wetland Dependency (month/yr) | Annual income (Rs/HH) |
|---|---|---|---|---|---|---|
| 1. | | | | | | |
| 2. | | | | | | |
| 3. | | | | | | |

***Source:***

### 3.8 Livestock in Wetland Basin

| Attribute | | |
|---|---|---|
| 1. **Livestock** (cattle, buffalo, sheep, goat) | | |

***Source:***

### 3.9 Traditional Production System

| Attributes | Brief description |
|---|---|
| 1. **Rice fields** (estimate area in Ha) | |
| 2. **Traditional fishery** (type, beneficiary HH) | |
| 3. **Major NTFPs type** | |
| 4. **Others** (specify) | |

***Source:***

### 3.10 Traditional Water Use Techniques/Practices

| Attribute | Numbers | **Brief description** (status and use) |
|---|---|---|
| 1. **Water mill** (Ghatta) | | |
| 2. **Local irrigation system** (Rajkulo, FMIS/ Agency managed) | | |
| 3. **Community pond** | | |
| 4. **Religious/ritual pond** | | |
| 5. **Well and *kuwa*** | | |
| 6. **Spring and stone spout** (other traditional taps) | | |
| 7. **Traditional navigation** (wooden/ bamboo boats) | | |
| 8. **Others** (specify) | | |

***Source: Field Survey (2010)***

### 3.11 Cultural Record

| Attribute | Brief description |
|---|---|
| 1. **Paleontological record** | |
| 2. **Archaeological record** | |
| 3. **Religious site record** | |
| 4. **Cultural landscape/ religious belief and myth** | |
| 5. **Others** (oral tradition/ Arts/music/ song/ dance/ painting/literature/drama | |

***Source:***

### 3.12 Describe Genesis/Origin of Wetland, if known (use separate sheet if needed)

## 4. Ecosystem Goods and Services of Wetlands

### 4.1 Provisional Services

| Attributes | Brief description of services | Source |
|---|---|---|
| 1. Drinking water supply | | |
| 2. Irrigating water supply | | |
| 3. Domestic water supply | | |
| 4. Industrial water supply | | |
| 5. Fish supply | | |
| 6. Timber supply | | |
| 7. Fiber supply | | |
| 8. Fuel wood supply | | |
| 9. Fodder/forager/grass supply | | |
| 10. Food (plants and animals) | | |
| 11. Medicine | | |
| 12. Hydropower | | |
| 13. Mining and extraction | | |
| 14. Handicraft material | | |
| 15. Genetic material | | |
| 16. Others (specify) | | |

### 4.2 Cultural Services

| Attributes | Brief description |
|---|---|
| 1. Aesthetic and scenic service | |
| 2. Religious/spiritual service | |
| 3. Historic site | |
| 4. Recreational/tourism | |
| 5. Educational resource services | |
| 6. Festivals/hat bazzar/mela | |

## 5. Restoration/Management Responses

### 5.1 Structural Management Responses (mark with√)

| Attributes | Yes | No | Remarks |
|---|---|---|---|
| 1. Any sewerage systems | | | |
| 2. Any wastewater treatment systems | | | |
| 3. Build up of dikes/dams | | | |
| 4. Afforestation | | | |
| 5. Others (specify) | | | |

### 5.2 Non-Structural Management Responses (mark with√)

| Attributes | Yes | No | If yes, list them |
|---|---|---|---|
| Any conservation plan | | | |
| Any monitoring plan | | | |

## 6. Assessment of Wetlands

### 6.1 Change Assessment in Physical Structure before 10 Years and Now

| Attributes | Core area | | Remarks |
|---|---|---|---|
| | Before (Yr) | Now (Yr) | |
| 1. **Area** (ha) | | | |
| 2. **Water volume** ($m^3$) | | | |

***Source:***

### 6.2. Indicator Assessment Change in Water Quality before 10 Years and Now

| Attribute | Unit | Values | | Source & years of record |
|---|---|---|---|---|
| | | Before | Now | |
| 1. **pH** | - | | | |
| 2. **Transparency** | m | | | |
| 3. **Total dissolved solid** | mg/L | | | |
| 4. **Dissolved oxygen** | mg/L | | | |
| 5. **Chemical oxygen demand** | mg/L | | | |
| 6. **Biological oxygen demand** | mg/L | | | |
| 7. **Total suspended solid** | mg/L | | | |
| 8. **Nutrients** ($NO_3$, $NH_4$, $PO_4$, Cl, Na, K, Ca, Mg, $CO_3$, $HCO_3$, dissolved Silica) | mg/L | | | |

### 6.3. Change in Species Composition and Abundance of Plankton before 10 Years and Now

(Use separate sheet if need)

| Species name | | Density (ind./ $m^2$) | | Remarks |
|---|---|---|---|---|
| Before | Now | Before | Now | |
| | | | | |
| | | | | |
| | | | | |

### 6.4 Species Specific Assessment before 10 Years and Now

**(**-0 = no change, +1 = moderately increasing, +2 = rapidly increasing, -1 = moderately declining, **-**2 = rapidly declining)

#### 6.4.1 Change in Abundance of 3 Major Species of Aquatic Plants

| Species name | Coverage (%) | | Local perception on change (mark with√) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

#### 6.4.2 Change in Occurrence and Abundance of 3 Major Species of Fish(s)

| Species name | Catch no. (size and weight) | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

### 6.4.3 Change in Occurrence and Abundance of 3 Major Species of Herpeto-Fauna

| Species name | Observed number | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

### 6.4.3 Change in Abundance of 3 Major Species of Birds

| Species name | Observed number | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

### 6.4.5Change in Abundance of 3 Major Species of Mammals

| Species name | Observed number | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

### 6.4.6 Disappearance/Reappearance of Species in the Past 10 Years

**A. Plant Species Disappeared**

| Species name | Local perception on what made disappearance of species? |
|---|---|
| | |
| | |

***Source:***

**B. Plant Species Reappeared/Introduced**

| Species name | Local perception on what made reappearance of species? |
|---|---|
| | |
| | |

***Source:***

**C. Animal Species Disappeared**

| Species name | Local perception on what made disappearance of species? |
|---|---|
| | |
| | |

***Source:***

**D. Animal Species Reappeared/Introduced**

| Species name | Local perception on what made reappearance of species? |
|---|---|
| | |
| | |

***Source:***

## 7. Change in Abundance of Problematic Invasive Alien Species (IAS)

{0 = no change, +1 = moderately increasing, +2 = rapidly increasing, -1 = moderately declining, -2 = rapidly declining}

### 7.1 Plants

| Species name | Mark with √ | | Coverage (%) | | Local perception on change (Mark with √) | | | | | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| | Core | Basin | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

***Source:***

### 7.2 Animals

| Species name | Mark with √ | | Catch/observed number | | Local perception on change (Mark with √) | | | | | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| | Core | Basin | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

***Source:***

### 7. 3 Name of Plant/Animal IAS Species Previously Recorded but Not Seen Now (if any)

| |
|---|
| **1.** |
| **2.** |
| **3.** |
| **4.** |

## 8. Change in Plant Biomass

| Attribute | Before | Now |
|---|---|---|
| **Dry weight of aquatic plants** ($gm/m^2$) | | |

## 9. Resource Use Assessment Since 10 Years Ago

(0= no change, +1 = good, +2 = better; -1 = bad, -2 = worse)

### 9.1 Rank 5 Major Wetlands Resource Use on Priority Base (1 as the top priority) and Their Status

| Attributes | Rank (1-5) | Value status (marked with√) | | | | |
|---|---|---|---|---|---|---|
| | | -2 | -1 | 0 | +1 | +2 |
| 1. Drinking water supply | | | | | | |
| 2. Irrigation water supply | | | | | | |
| 3. Domestic water supply | | | | | | |
| 4. Industrial water supply | | | | | | |
| 5. Fish supply | | | | | | |
| 6. Timber supply | | | | | | |
| 7. Fiber supply | | | | | | |
| 8. Fuel wood supply | | | | | | |
| 9. Fodder/forage/grass supply | | | | | | |
| 10. Food (plant and animal) | | | | | | |
| 11. Medicine | | | | | | |
| 12. Hydropower | | | | | | |
| 13. Biochemical | | | | | | |
| 14. Handicraft material | | | | | | |
| 15. Genetic materials | | | | | | |
| 16. Others (specify) | | | | | | |

### 9.2 Five Economically/Nutritionally/Culturally Important Plant Species in Core and Basin Area, and Assessment of Their Status

| Species name | Value category (mark with √) | | | Abundance status (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | Econ. | Cult. | Nutri. | -2 | -1 | 0 | +1 | +2 | |
| *1.* | | | | | | | | | |
| *2.* | | | | | | | | | |
| *3.* | | | | | | | | | |
| *4.* | | | | | | | | | |
| *5.* | | | | | | | | | |

***Source:***

### 9.3 Five Economically/Nutritionally/Culturally Important Animal Species in Core and Basin Area, and Assessment of Their Status

| Species name | Value category (mark with √) | | | Abundance Status (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|
| | Econ. | Cult. | Nutri. | -2 | -1 | 0 | +1 | +2 | |
| *1.* | | | | | | | | | |
| ***2.*** | | | | | | | | | |
| ***3.*** | | | | | | | | | |
| ***4.*** | | | | | | | | | |
| ***5.*** | | | | | | | | | |

***Source:***

## 10. Change in Cultural Values Before 10 Years and Now

(0= no change, +1 = good, +2 = better; -1 = bad, -2 = worse)

| Attributes | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. **Aesthetic and scenic service** | | | | | | |
| 2. **Religious/spiritual service** | | | | | | |
| 3. **Recreational/tourism** | | | | | | |
| 4. **Educational resource services** (Opportunity for formal and non-formal education and training) | | | | | | |

## 11. Change in Traditional Water Use Techniques/Practices

(0= no change, +1 = good, +2 = better; -1 = bad, -2 = worse)

| Attributes | Local perception on change(mark with √) | | | | | Replaced |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. **Water mill** | | | | | | |
| 2. **Community channel** (Rajkulo) | | | | | | |
| 3. **Community pond** | | | | | | |
| 4. **Religious/ritual pond** | | | | | | |
| 5. **Well and *kuwa*** | | | | | | |
| 6. **Stone spout/traditional taps** | | | | | | |
| 7. **Transportation** | | | | | | |
| 8. **Others** | | | | | | |

## 12. Assessment of Threats before 10 Years and Now

**12.1 Rank Degradation Category of Wetlands** (1 as the worse)

| Attributes | Rank (1-5) | Remarks |
|---|---|---|
| 1. **Destruction in core area** | | |
| 2. **Destruction in wetland basin** | | |
| 3. **Excess water withdrawals** | | |
| 4. **Declining fish stock** | | |
| 5. **Declining in birds' number** | | |
| 6. **Declining in availability of other resources in basin** | | |
| 7. **Increased water pollution** | | |
| 8. **Increased algal/vegetation growth** | | |
| 9. **Others** (specify) | | |

**12.2 Assessment of Proximate Threats in Wetlands Management** (0= no change, +1 = good, +2 = better; -1 = bad, -2 = worse)

| Attributes | Local perception on change (mark with √) | | | | |
|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 |
| 1. Encroachment | | | | | |
| 2. Grazing | | | | | |
| 3. Poaching/hunting | | | | | |
| 4. Fishing | | | | | |
| 5. Poisoning | | | | | |
| 6. Solid waste disposal | | | | | |
| 7. Sewage disposal | | | | | |
| 8. Erosion and landslide in upstream/downstream | | | | | |
| 9. Siltation/floods | | | | | |
| 10. Increased algal/vegetation growth | | | | | |
| 11. Deforestation | | | | | |
| 12. Over extraction of resources for fodder and fuel wood | | | | | |
| 13. Over harvest of NTFPs | | | | | |
| 14. Introduction of invasive alien species | | | | | |
| 15. Infrastructure development | | | | | |
| 16. Use of chemical fertilizers and pesticides | | | | | |
| 17. **Others** (Specify) Disaster like floods | | | | | |

**12.3 Climate Change** (0= no change; +1 = gradually increasing; +2 = rapidly increasing; -1 = gradually decreasing; -2 = rapidly decreasing)

| Attributes | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. Change in temperature pattern | | | | | | |
| 2. Shift in rainfall pattern | | | | | | |
| 3. Non-seasonal flood | | | | | | |
| 4. Unpredictable and longer period drought | | | | | | |
| 5. Glacial melt | | | | | | |
| 6. Increase water volume in glacial lakes | | | | | | |
| 7. Change in phenology of plants | | | | | | |
| 8. Altitudinal shift of plants/animals | | | | | | |

## 13. Governance in Wetlands Management

### 13.1 Policy in Wetlands Governance

| Attributes | Status (mark with√) | | Remarks |
|---|---|---|---|
| | Exist | Do not exist | |
| 1. Site specific policy | | | |
| 2. **Others** (specify) | | | |

### 13.2 Institution in Wetlands Governance

| Attributes | Status (mark with√) | | Remarks |
|---|---|---|---|
| | Exist | Do not exist | |
| 1. **Central govt. agency**(Ministry, Department, etc) | | | |
| 2. **Local govt. agency** (District, VDC, Municipality) | | | |
| 3. **Non-government organizations** | | | |
| 4. **Donors and international conservation partners** | | | |
| 5. **Community based organization** | | | |
| 6. **Private organization** | | | |

### 13.3 Participation in Wetlands Governance (0= Indifferent, -1 = No, -2 = Low, +1 = good, +2 = Better)

| Attributes | Status (mark with√) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. **Participation from central govt. agency** | | | | | | |
| 2. **Participation from local govt. agency** | | | | | | |
| 3. **Participation from NGO(s)** | | | | | | |
| 4. **Participation from donors and international conservation partners** | | | | | | |
| 5. **Participation from local community** | | | | | | |

### 13.4 Access to Technology in Wetlands Governance (0= Indifferent, -1 = No, -2 = Low, +1 = fair, +2 = good)

| Attributes | Status (mark with√) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. **Traditional technology** | | | | | | |
| 2. **Improved technology** | | | | | | |
| 3. **Higher technology** | | | | | | |

### 13.5 Information Sources in Wetlands Governance (0= Indifferent, -1 = No, -2 = Low, +1 = fair, +2 = good)

| Attributes | Status (mark with√) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. **Source of information** (university curricula, research, etc) | | | | | | |
| 2. **Symposium/workshop/other events** | | | | | | |
| 3. **Documentation capability**(Library, data bank, etc) | | | | | | |
| 4. **Dissemination capability** (Journal, media, awareness campaign, celebration, informal means, etc) | | | | | | |

### 13.6 Finance in Wetlands Governance (0= Indifferent, -1 = No, -2 = Low, +1 = fair, +2 = good)

| Attributes | Status (mark with√) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. **Financial inputs** | | | | | | |
| (i) Central government | | | | | | |
| (ii) Local government | | | | | | |
| (iii) Community donation/participation | | | | | | |
| (iv) Private investment | | | | | | |
| (v) Local taxes | | | | | | |
| (vi) Donors/NGOs | | | | | | |

# Part II
# Guidelines for the Use of WIAM

# Guidelines for the Use of WIAM

The purpose of this guideline is to facilitate and assist users in the process of implementing WIAM Tool to document the status of wetlands, and prioritize issues for the sustainable conservation and wise use of wetlands resources in Nepal. The effectiveness of this WIAM exclusively depends on a team work that comprehends WIM at first about its features. For this, the team members who are assigned to conduct Wetlands Inventory, Assessment and Monitoring should follow each step of this guideline.

### *Step 1 Understanding about the Approaches*

This WIAM is prepared by realizing wetlands body in a basin frame covering a wide area around water body connecting land, biodiversity, culture, human being and their collective actions. Nepal has been successful to demonstrate collaborative management of NR and biodiversity conservation with communities. Such kind of management experiences should be internalized to generate knowledge like wetlands information about inventory, assessment and monitoring at broader levels. Hence, this WIAM has four interacting pillars moving simultaneously with the knowledge of communities, government representatives and scientists during the process of WIAM implementation. Those building blocks of WIAM are:

- *Ecosystem approach covering wider areas around water body.*
- *Wetlands basin management approach extending up to watersheds and sub-watersheds.*
- *Participatory under the structure of local governance (i.e. policy, participation, institution, information, technology and finance) with the involvement of government, institution and community.*
- *Inclusive of successful learning from participatory assessment and monitoring of NRM.*

### *Step 2 Understanding about the Framework of WIAM*

This tool has two domains. The first is an inventory and the next is assessment. Inventory component generates set of data like general features; ecological features; socio-economy; ecological goods and resources and management responses. This information helps us understanding about our wetlands, people living around it, extent of resources wetlands deliver to people and the country, and management responses we're extending for the sustainability of wetlands. Assessment components basically see the changes in physical and ecological characters of wetlands and our governing capacity over a period of 10 years in the past. Data on assessment helps management to track changes in wetlands, and prioritize issues and future actions. Table 1 shows the framework of WIAM.

**Table 1 Framework of WIAM**

| Contents | Description |
|---|---|
| ***A. Inventory***<br>**1. General feature** | Wetlands name, date of inventory, conservation status, geographical coordination (longitude and latitude); geographical location; administrative feature; boundary; management responsibility; wetlands type; map/photographs/mosaic; and climatic feature. |
| **2. Ecological feature** | Physical structure; hydrological feature (water volume, inflow/outflow, water quality); natural shock and vulnerability; soil feature (color and texture); biological feature {phytoplankton; zooplankton; aquatic plants with habitat type and conservation status; major plants of basin area with habit type and conservation status; fish (species number, number per catch, use, conservation status); herpeto-fauna, birds and mammals in aquatic and peripheral habitat (species number, observed number, use and conservation status); invertebrates (annelids, arthropods, molluscs); invasive alien species in core and basin area; endemic species; abundance of plants; and biomass}. |
| **3. Socio-economic feature** | Nearby settlement (distance and link road/trail); land use pattern; demography (population number; male/female; household number, cast/ethnic groups; major religion; major dialect; and average land hold size); education; occupation; jurisdiction/land ownership; wetlands dependent community); livestock; traditional production system; traditional water use techniques/practices; cultural record; genesis/origin of wetland; and natural disaster, shocks and vulnerability. |
| **4. Ecosystem goods and services** | Provisional and cultural services. |
| **5. Restoration/management responses** | Structural and non-structural management responses, and conservation and monitoring plans. |
| ***B. Assessment***<br>**6. Assessment of wetlands** | Change assessment in physical structure (area and volume); indicator assessment change in water; species composition and abundance of planktons; species specific assessment (change in abundance of major species of aquatic plants; fish(s) or herpeto-fauna; and birds or mammals); disappearance/reappearance of species; change in abundance of problematic IAS; Change in plant biomass; resource use assessment; change in cultural values; traditional water use techniques/practices and analyzing threats (ranking threats, proximate threats and climate change). |
| **7. Assessment of governance** | policy, institution, participation, information, finance and technology |
| **8. Mapping the wetlands** | Ranking wetlands |

### *Step 3 Team Composition for WIAM implementation*

Who should be using this WIAM? Institution and individuals correlating their actions in wetlands conservation may use this tool. However, this tool generates the minimum set of data for the purpose of wetlands management. Producing a comprehensive research data therefore may require consolidating some items of this tool with more technical methods. Depending on the objectives of institution involved in wetlands management, this WIAM is applicable with or without any modification provided that *Step-1 understanding about the approaches* should be an integral part of WIAM implementation. For this purpose, a semi-technical team with a lead role undertaken by a member is a prerequisite. This team should have composition of a botanist and zoologist; overseer or sub-overseer from VDC/municipality, forest officer or ranger from DFO and DSCO and key informant from community including local conservation NGOs. These team members should work together through out entire process of inventory and assessment. However, number of community participation can be up scaled depending on how bigger is wetlands, and availability of time and resources. Table 2 explains about team composition, minimum number of HR and their subject background.

**Table 2 Team composition and eligibility criteria**

| Team composition | Number | Criteria |
|---|---|---|
| **1. Zoologist preferably a taxonomist** | 1 | With taxonomy or ecology background and working experience on participatory approach with community and local government. |
| **2. Botanist preferably a taxonomist** | 1 | With taxonomy or ecology background and working experience on participatory approach with community and local government. |
| **3. Over seer or sub-overseer** | 1 | From VDC or municipality where wetlands locate particularly for area measurement. |
| **4. Forest officer or ranger** | 2 | Representative from DFO and DSCO. |
| **5. Officer or ranger** | 1 | Applicable if wetlands fall within protected areas. |
| **6. Key informants** | 5-10 | At least 5 community participants are required for inventory. |

### *Step 4 Time Plan for WIAM*

WIAM team members should meet together in preparing a detail workplan of 3-5 days in the field. A three-day field work is recommended for wetlands that are smaller in size with basin structure pretty limited within sub-watershed like Dipang lake (Pokhara), Jagadispur reservoir (Kapilvastu) and Maipokhari (Ilam). Wetlands that has bigger basin cover spreading over many districts and VDCs at watershed level normally needs additional time. In such case workplan of 5 days is recommended, for example, KTWR in Sunsari, Udayapur and Saptari districts and Rara lake in Mugu and Jumla districts. There may be many arguments about time insufficiency. But we need to look at available resources that are always constraints. So, we should be strict in allocating 3 days for small and 5 days for bigger wetlands.

### *Step 5 Approaches for Inventory and Assessment of Wetlands*

Two different approaches should be applied to explore information about inventory and assessment. Refer Table 3 to know about those two different approaches.

**Table 3 Approaches for inventory and assessment**

| Attributes | Approaches |
|---|---|
| **Wetland inventory** | Transect walk, field observation, community consultation and sampling. |
| **Wetlands assessment** | Organize 1 day intensive workshop with 5-10 community people and team members from DFO, DSCO and VDCs to assess changing scenario on structure, function, use and management issues of wetlands ecosystem. The outputs of workshop thereafter must be verified during transect walk, field observation and community consultation. |

### *Step 6 Communicating about the Purpose and Objective of WIAM*

Government representatives and key informants as members of WIAM team should clearly know the purpose and objectives of wetlands inventory, assessment and monitoring in their area. They should also know their roles during WIAM implementation. For this purpose, an hour brief orientation meeting should be organized at office of DFO or DSCO or Park or VDC. This meeting would help making WIAM as a participatory process and builds their ownership on it. Table 4 explains about the checklist of works to clarify among team member of WIAM at field.

**Table 4 Checklist of orientation program**

| Attributes | Check list |
|---|---|
| **1. Orientation** | 1. Clarify about the purpose and objectives of WIAM implementation.<br>2. Communicate about the time and resources limitation.<br>3. Clarify about the roles of local government and key informants.<br>4. Clarify about the benefits and incentives for local government and communities during pre- and post- WIAM implementation. |
| **2. Workplan** | 1. Share draft workplan to finalize and make it as much participatory as possible. |
| **3. Resource sharing opportunities** | 1. Explore secondary sources of information available in government, non-government, academic institution and CBOs like **a) Ecosystem: land capability, soil, hydrology, water potential and other natural resources b) People: population, ethnicity, livelihood, income, settlements, infrastructure and so on, and c) Activities and investments of local and external agencies working in the areas, and their recent programs, projects and investment i.e., loan and grants.**<br>2. Explore opportunities for local services and facilities like vehicle and so on that could help minimizing cost of WIAM implementation. |

## *Step 7 Naming and Coding Wetlands*

Start filling up the first part of datasheet with name and code of wetlands. This information is obtainable from the reference sheet or community and institution. Coding is important to maintain database of particular wetlands that can be retrieved anytime for management and research purposes.

Refer Annex-1 for the district-wise coding of wetlands developed by NLCDC. One can refer district code prepared by Department of Forest for the management of CFs. Any code number given to particular wetlands should be mentioned after initial of district name followed by a hyphen and a numerical figure. For example, Sunsari district may possess a total of 200 wetlands. Each wetlands of Sunsari must have its own district code followed by numerical figure starting from 1 to 200 with specific name i.e., SUN-1, SUN-2, ..., and SUN-200. Now, take an example of wetlands in KTWR which is one of 200 wetlands of Sunsari district. Give code number for it as SN-1. This means, there are 200 wetlands in Sunsari district and wetlands with code SN-1 is the only Koshi Tappu Wildlife Reserve in Nepal. This is also important to mention the topo-sheet number(s) as reference to particularize wetlands in a specific location. Fill datasheet in appropriate order as:

| | |
|---|---|
| **Name of wetland:** | **Wetland code:**<br>**Toposheet no:** ..... |

## *Step 8 Exploring General Features*

### Step 8.1 General Feature

This step intends to explore information about conservation status; geographical coordination (longitude and latitude); geographical location; administrative feature; boundary; management responsibility; and wetlands type. Photographs/map/mosaic also should be placed in datasheet. Mention the date following the A.D calendar (month/day/year) of inventory period in the first row of datasheet followed by compilers' name including key informants and government representatives. The third row is for compiling information about conservation status of particular wetlands which may be either Ramsar site or natural heritage site or religious site or protected area or key biodiversity area (KBA) and others. Sometime, one wetlands may have many conservation portfolios. In such case; mark with √ in all corresponding row and column. At the last column, a little specification is required to explain if wetlands belong to other status. Information about conservation status of wetlands is obtainable from secondary sources.

**General feature**

| | | | | | | |
|---|---|---|---|---|---|---|
| **Date of inventory:** | | | | | | |
| **Compiler's name:** | | | | | | |
| **1. Conservation status** (mark withV) | **Ramsar site** | **Natural heritage** | **Religious site** | **Protected area** | **KBA** | **Other** |
| | | | | | | |

**Step 8.2 Geographical Coordination**

In this step, refer GPS value or topo-sheet map or any secondary information to provide data on latitude, longitude and altitude. Information about latitude and longitude should be expressed in degree (°), whereas data on altitude should be in meter (m) with the use of altimeter or any references.

**Geographical coordination**

| Attributes | Describe |
|---|---|
| **1. Latitude** | |
| **2. Longitude** | |
| **3. Altitude** (masl) | |

**Step 8.3 Geographical Location**

This step helps generating information about geographical location - particularly the physiographic region - where the specific wetlands is located in Nepal. This information is obtainable from literature and maps. For the purpose of WIAM implementation, we refer physiographic features from Hagen (1998), Box 1. Information about slope, flat and valley features can be easily noticed during field observation. There may be an argument like wetlands in Humla district which is absolutely a high mountain area in Himalayan zone, and there may be a general impression about wetlands which is always in mountain. In fact, mountain district like Humla has many flat and valleys areas in addition to slope.

**Geographical location** (mark with √)

| Tarai | Siwalik/Churiya zone (S/F/V) | Mahabharat Lekh (S/F/V) | Midlands(S/F/V) | Himalayan zone (S/F/V) | Inner Himalaya(S/F/V) | Tibetan marginal mountain (S/F/V) |
|---|---|---|---|---|---|---|
| | | | | | | |

**Box 1 Physiographic Features of Nepal (Hagen, 1998)**

**1. Tarai:** Southern flat low land (60-300m);
**2. Bhabar:** Northern belt of the Tarai holding forest strip from east to west called Charkoshe Jhadi;
**3. Siwaliks/or Churiya hills:** Abruptly raised landmass north to the Bhabar zone (150-150m);
**4. Mahabharat Lekh:** Landmass north to the Siwaliks (1500-2700m);
**5. Dun or Bhitri Madhes:** Gently sloping valleys between the Siwaliks and Mahabharat Lekh;
**6. Midlands:** Northern part of the Mahabharat Lekh (600-3500m) important for agricultural lands;
**7. Himalayan zone:** North to midlands lower part which has coniferous vegetation (to 4000m), middle part alpine scrubs and meadows (4000- 5500m) and upper part above 5500m is under snow covered;
**8. Inner Himalayan valleys:** North of the Himalayan zone (Kaligandki and Bheri valleys - above 3,600m) with desert like climate; and
**9. Tibetan Marginal Mountai:** Mountainous north to Dhaulagiri and Annapurna Himalayas (Manang, Mustang and a part of Dolpa) with arid climate like a Tibetan plateau.

***Step 8.4 Administrative Feature***

This step provides information about administrative features such as development region; district; metropolitan; municipality; VDC; ward number (s) and name of village or a particular locality where wetlands is physically eventful. Sometime or many cases, one wetlands may fall within many DDCs and VDCs. In such case, mention the name of all DDCs and corresponding VDCs and wards numbers that physically connect wetlands. Such information is obtainable from community consultation or from government offices or secondary literatures.

**Administrative feature**

| Attribute | Describe |
|---|---|
| **1. Development region** | |
| **2. District (s)** | |
| **3. Metropolitan/municipality/VDC(s)** | |
| **4. Ward number (s)** | |
| **5. Name of the place** | |

**Step 8.5 Boundary**

This step explores information about boundary of wetlands at core and basin levels. Core is an area that is under water where as a basin is the peripheral parts and fringes of core area that receive water in and out of wetlands. In some smaller wetlands - particularly lying at the top of hill/mountain - settlements are very close like in Maipokhari. In such case, it is difficult to separate core and basin area so one should not differentiate about core and basin areas but consider the entire area as the core area. Boundary data with all possible four directions are obtainable from literature, maps, government institution, communities and so on and verified later during transect walk. Note down all the bordering villages; roads; forests and so on.

**Boundary**

| Attribute | West | East | South | North |
|---|---|---|---|---|
| **1. Core body** | | | | |
| **2. Basin** | | | | |

**Step 8.6 Management Responsibility**

Management responsibility refers to any institute or individual that is legitimate to manage wetlands under existing rules/regulations and common practices. Such informations can be obtainable upon normal inquiry during consultative meeting. Other complementary information can be referred from records/reports, literature and so on.

**Management responsibility**

| Attribute | Brief description |
|---|---|
| **1. Government** (specify) | |
| **2. Private (specify)** | |
| **3. Community (specify)** | |
| **4. Others** (specify) | |

**Step 8.7 Wetlands Classification**

This step helps identifying wetlands type by using widely accepted habitat classification. There are many wetlands categories classified by different authors. Annex 2 explains about wetlands type referred by the Ramsar under general framework of inventory. For the case of Nepal, wetlands classification by Scott is recommended (Table 4).

## Table 4 Modified wetlands type (Scott, 1989)

| Type | Sub-type 1 | Sub-type 2 | Sub-type 3 |
|---|---|---|---|
| Freshwater/ natural | Riverine | Perennial | 1. Permanent rivers, streams, and waterfalls |
| | | | 2. Inland deltas |
| | | Temporary | 3. Seasonal and irregular rivers and streams |
| | | | 4. Riverine floodplains (river flats, flooded river basins, seasonally flooded grasslands) |
| | Lacustrine | Permanent | 5. Permanent freshwater lakes (>8 ha area), including shores subject to seasonal irregular inundation |
| | | | 6. Permanent freshwater ponds (<8 ha area) |
| | | Seasonal | 7. Large seasonal freshwater lakes |
| | | | 8. Seasonal fresh water lakes (>8 ha area), including floodplain lakes |
| | | | 9. Small seasonal freshwater ponds (<8 ha area) |
| | Palustrine | Emergent | 10. Permanent freshwater marshes and swamps on inorganic soils, with emergent vegetation whose bases lie below the water table for most of the growing season |
| | | | 11. Permanent peat-forming freshwater swamps, including tropical upland valley swamps dominated by *Typha* |
| | | | 12. Seasonal freshwater marshes on inorganic soil, including sloughs, potholes, seasonally flooded meadows, sedge marshes, and dambos |
| | | | 13. Peatlands, including acidophilous, ombrogenous, or soligenous mires covered by moss, herbs or dwarf shrub vegetation, and fens of all types |
| | | | 14. Alpine and polar wetlands, including seasonally flooded meadows moistened by temporary water from snowmelt |
| | | | 15. Freshwater springs and oases with surrounding vegetation |
| | | | 16. Volcanic fumaroles continually moistened by emerging and condensing water vapor |
| | | Forest | 17. Shrub swamps, including shrub-dominated freshwater marsh, shrub carr and thickets, on inorganic soils |
| | | | 18. Freshwater swamp forest, including seasonally flooded forest, wooded swamps on inorganic soils |
| | | | 19. forest peatlands including peat swamp forest |
| Man-made | Aquaculture | | 20. Aquaculture ponds (fish ponds and shrimp ponds |
| | Agriculture | | 21. Ponds, including farm ponds, stock ponds, small tanks |
| | | | 22. Irrigated land and irrigation channel (rice fields, canals and ditches) |
| | | | 23. Seasonally flooded arable land |
| | Urban/ industrial | | 24. Excavation (gravel pits, borrows pits and mining pools) |
| | | | 25. Wastewater treatment areas (sewage farms, setting pods and oxidation basins) |
| | Water storage area | | 26. Reservoir holding water for irrigation and/or human consumption with a pattern of gradual, seasonal, draw down of water level |
| | | | 27. Hydro-dams with regular fluctuations in water level on a weekly or monthly basis. |

It is not necessary that one wetland specifically should fall under one category. In some bigger wetlands, there may be many wetlands types. In such case, note down all wetlands types with remark at the end column. Mention all habitat types.

**Wetlands types**

| Type | Sub-type 1 | Sub type II | Remarks |
|---|---|---|---|
| **Freshwater/ natural** | **Riverine** | **Perennial:** | **Composite type** |
| | | **Temporary:** | |
| | **Lacustrine** | **Permanent:** | |
| | | **Seasonal:** | |
| | **Palustrine** | **Emergent:** | |
| | | **Forest:** | |
| **Man-made** | **Aquaculture:** | | |
| | **Agriculture:** | | |
| | **Urban/ industrial** (specify) | | |
| | **Water storage area:** | | |

**Step 8.8: Map/Photographs/Mosaic**

**Table 5 Proposed scales of maps by the Ramsar**

| Size of wetlands (ha) | Preferred (minimum) scale of map |
|---|---|
| **1. 1,000,000** | 1: 1,000,000 |
| **2. 100,000** | 1: 500,000 |
| **3. 50,000** | 1: 250,000 |
| **4. 25, 000 to 50, 000** | 1: 100,000 |
| **5. 10,000 to 25,000** | 1: 50,000 |
| **6. 1,000 to 1: 10,000** | 1: 25,000 |
| **7. < 1,000** | 1: 5,000 |

Maps and photographs are visual documents that help reader or user to generalize nature and properties of wetlands in picture form. Further, a standard map provides a lot of information like length, width and areas of wetlands which are very useful for the management of wetlands. Mosaic is a mixture of many photographs especially prepared at landscape level which is instrumental to illustrate wetlands in a bigger scale. Fixed point SLR photographs in landscape mode to monitor changes in wetlands condition. GIS maps at 1: 10,000 scales to 1: 50,000 scales are normally useful. Table 5 illustrates on appropriate scales of maps that the Ramsar recommends especially for designation purposes.

**Step 8.9 Climatic Feature**

This step provides information about climatic feature of wetlands like maximum and minimum temperature, rainfall and humidity in a particular month. These data are obtainable from the nearest meteorological station. For the temperature, data of the hottest and coolest months are recommended. Similarly, for rainfall data: wettest and driest month while for humidity; most and least humid months are recommended. At the end column of datasheet, quote down the source and year of record.

| Attribute | Average Maximum | | Average Minimum | | Source and year of record |
|---|---|---|---|---|---|
| | Month | Value | Month | Value | |
| **Temperature** ($^0$C) | | | | | |
| **Rainfall** (mm/yr.) | | | | | |
| **Humidity** (%) | | | | | |

## *Step 9 Exploring Ecological Features of Wetlands*

This step explores the information about structure and functions of wetlands ecosystem like physical, hydrological, pedological and biological features including information about alien invasive, endemism, species abundance and biomass in core and basin areas.

**Step 9.1 Physical Feature**

**Table 6 Methods proposed for the measurement of physical features of wetlands**

| Attributes | Recommended methods |
|---|---|
| **Area (ha)** | 1. Use a planimeter for measuring core area. In case of basin use secondary resources from VDC, DFO or DSCO or |
| | 2. Place a grid over a map of appropriate scale and measure area accordingly. This is applicable for both core and basin areas or |
| | 3. Some wetlands are not seen in map because of their placement within dense forest or their smaller size. In such case, field measurement by using a measuring tape around wetlands is recommended. |
| **Average length (km/m) and width (m)** | 1. Use grid map technique with the use of thread if map is available or |
| | 2. Boat travel in transect method, and take measurement, if wetlands is bigger or |
| | 3. Use secondary sources available in DFO, DSCO and VDC. VDC normally possesses cadastral map. |
| **Maximum depth (m)** | 1. Use bathymetric map and secondary literature or |
| | 2. Use stick graduated at 10 cm intervals or any locally used stick or poles or thread. |
| **Maximum/minimum surface water level (m)** | 1. use gauze to measure change in water level in case of wetlands where intervention is already in place, or<br>2. Indirect evidences like mark water level at shore line of wetlands in rainy and dry season. |
| | 3. Ask local community to make visual assessment on water levels. |
| | 4. Secondary sources. |

Physical feature of wetlands includes area, length, width and depth of wetlands. An average length and width and maximum depth of wetlands should be generated by simple measurement of length, breadth and area measurement tool. Apply any methods proposed in Table 6. Some of the data can be taken in average by using standard map, but field work is required to generate some data like depth of wetlands if secondary source is not available. Maximum and minimum surface water level is required to characterize wetlands ecosystem during peak rainy and dry periods[1]. This information may be available from scientific studies in some popular and significant wetlands like Phewa lake, Koshi Tappu, Mai Pokhari, Rara lake and Jagadishpur reservoir. For those less known wetlands, such information should be generated by applying simple but standard technique as in table 6. put data in appropriate order in datasheet.

**Physical feature**

| Attribute | Core area | Basin |
|---|---|---|
| 1. **Area** (ha) | | |
| 2. **Average length** (km/m) | | |
| 3. **Average width** (m) | | |
| 4. **Maximum depth** (m) | | |
| 5. **Maximum/minimum surface water level** (m) | | |

1 *Wetlands should have at least 30 percent of its cover under water in volume and surface area*

### Step 9.2 Water Volume

The total water content in wetlands is referred as water volume which is measured in cubic meter during peak dry and rainy periods of a year. Use secondary sources of information, if available. Otherwise, take a rapid measurement of cross section area and depth at more than three to five places depending on size of wetlands, and calculate an average water volume by using simple arithmetic technique.[2]

For deeper wetlands like lakes use of a safety boat is recommended. Role of sub-overseer is important here. Put data in appropriate order in datasheet i.e., 2.2.1.

### Step 9.3 Inflow and Outflow Features

Inflow refers to the physical structure like stream that drain water into wetlands and outflow that drain water out from wetlands in the form of outlet(s). Inflow and outflow may be eventful with one or many rivers, channels, streams and springs and may be permanent or seasonal. Some wetlands may not have inflow and outflow but water is often regulated from groundwater sources.

Refer standard map like topo-sheet to identify inflow and outflow sources, and verify these from field observation and community consultation. Use secondary sources to collect discharge rate of each inflow and outflow water bodies if available. Otherwise, use current meter or leaf floating method to measure an average discharge rate. Put data in appropriate order in datasheet with source and year of record.

**Water inflow/outflow**

| Attribute | Name | Discharge rate ($m^3$/second) | Sources and year of record |
|---|---|---|---|
| ***1. Inflow*** | 4. Saptakoshi | | |
| | 5. Trijuga | | |
| | 6. Mahuli, Sundari | | |
| ***2. Outflow*** | 3. Saptakoshi | | |

### Step 9.4 Physico-Chemical Features

Physico-chemical feature refers to physical and chemical water qualities of Wetland. Physical water quality includes temperature, electrical conductivity, DO, TSS, TDS etc. where as chemical parameters includes nutrients like $NO_3$, $NH_4$, K, Ca, Mg, Na,, $CO_3$, $HCO_3$, dissolved Silica, COD and so on. Table 7 summarizes on the standard methods for the analysis of physico-chemical parameters of wetlands.

**Table 7 Methods for physico-chemical test of water quality**

| Attributes | Unit | Methods | References |
|---|---|---|---|
| **1. Temperature** | $^0C$ | Thermometer | |
| **2. pH** | - | pH meter, litmus paper | Wilkinson and Baker 1997 |
| **3. Transparency** | m | Secchi disc measurement | Wilkinson and Baker 1997 |
| **4. Electric conductivity** | µS/cm | Conductivity bridge | |
| **5. Dissolved oxygen** | mg/L | DO meter, titration | |
| **6. Chemical oxygen demand** | mg/L | Reflux method | |
| **7. Biological oxygen demand** | mg/L | Titration | |
| **8. Total dissolved solid** | mg/L | Oven dry method | |
| **9. Total suspended solid** | mg/L | Oven dry method | |
| **10. Nutrients ($NO_3$, $NH_4$, K, Ca, Mg, Na, $CO_3$, $HCO_3$, dissolved Silica)** | mg/L | Spectro-photometry or flame photometry | |

2 *Two measurements should be done for peak rainy and dry periods that appear unpractical in a single event. So, second peak reading, either dry or rainy periods, should be done by sub-overseer right in the field and later, data be sent to concerning institution.*

Use of secondary sources of information is recommended. Water quality is very important to monitor wetlands health. These days, a field kit for analysis of water parameters is readily available. If secondary source is unavailable, use field kit for analysis of water with sample preferably collected in morning then followed by laboratory analysis (Trivedi and Goel, 1986). Put data in appropriate order with source, year of record and location of water sample site.

| **Water quality** (Physico-chemical characters) | | **Location:** Saptakoshi near Kushaha, Sept. 2004. | | |
|---|---|---|---|---|
| **Attribute** | | **Unit** | **Value** | **Source and year of record** |
| **1.** | **Temperature** | $^0$C | | |
| **2.** | **pH** | - | | |
| **3.** | **Transparency** | m | | |
| **4.** | **Electric conductivity** | µS/cm | | |
| **5.** | **Dissolved oxygen** | mg/L | | |
| **6.** | **Chemical oxygen demand** | mg/L | | |
| **7.** | **Biological oxygen demand** | mg/L | | |
| **8.** | **Total dissolved solid** | mg/L | | |
| **9.** | **Total suspended solid** | mg/L | | |
| **10.** | **Nutrients** ($NO_3$, $NH_4$, K, Ca, Mg, Na,, $CO_3$, $HCO_3$, dissolved Silica) | mg/L | | |

**Step 9.5 Natural Shocks and Vulnerability**

This step is to enlist any natural shock and vulnerability like natural disaster, flood, landslide, glacial lake outburst flood that wetlands used to face in past. Time series data on such records are always useful to adopt mitigation measures in the management of wetlands. A rapid vulnerability mapping of such shock and vulnerability should be done during community consultation. Make a brief note in nutshell not exceeding 4-5 lines. For example, *unprecedented river flood of August 18, 2008 destroyed the eastern embankment near Kushaha (Jhhyali tole), and damaged several hectares of paddy field and settlement in KTWR. Because of this outbreak, previously seepage areas important wetlands habitat from Kushaha to Bhantabari has been converted to sand field.*

**Step 9.6 Soil Features**

This step helps to explore information about soil feature of wetlands like soil color and texture. It is recommended to follow soil texture classification (WHO, 2006) used by FRA in Nepal (2010) with a certain modification. FRA has classified 13 types of soil texture {i.e., boulders (grain size 200 mm); rocky sand (sand mixed with stones with grain size 60-200mm); sand; loamy sand; sandy loam; sandy silt loam; silt loam; clay loam; sandy clay loam; silty clay loam; sandy clay; silty clay and clay (Annex 3). For WIAM implementation, one additional texture group is included as Peat - which means *organically laden substrata containing partly decomposed plant remains*. *It is spongy when wet*, and normally occur in alpine and sub-alpine wetlands.

Soil color is firmly determined during field study by comparing with Munsell's soil colour chart. If color chart is not available, this can be done through direct field observation. Similarly, soil texture can be witnessed from secondary information. Otherwise, it should be determined either by sieve method or manual analysis by examining soil sample under hand lens and pressing a little soil loaf between thumb and fingers both in dry and moist condition. Be careful that soil sample must be collected by digging 10-30cm below ground level from the margins of four corners or exposed portions of wetlands. Place data in appropriate order in datasheet.

| **Soil color** (mark with√) | | | | |
|---|---|---|---|---|
| **Dark** | **Red** | **Grey** | **White** | **Others** |
| | | | | |

| Soil texture (mark with√) Location: | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Boulders | Rocky sand | Sand | Loamy sand | Sandy loam | Sandy silt loam | Silt loam | Clay loam | Sandy clay loam | Silty clay loam | Sandy clay | Silty clay | Clay | Peat |
| | | | | | | | | | | | | | |

**Step 9.7 Biological Features**

**A. Micro-Biota**

Micro-biota (planktons) is the organism seen with the help of a compound microscope. Collect this information by referring secondary sources. Otherwise, collect water sample in a liter capacity beaker using plankton net for laboratory analysis and enumerate species and their density. A limnologist or phycologist or microbiologist is helpful in identifying phytoplankton and zooplankton and their density. Besides, species identification can be done by using monographs and standard literature (Needham and Needham, 1966; Smith, 1933, 1950; Tonapi, 1980). Fill up information in datasheet 2.5.1 A and B with source and year of records at the end column:

**A. Phytoplankton**

| Species name | Density (ind./ $m^2$) | Source and year of record |
|---|---|---|
| 1. | | |
| 2. | | |

**B. Zooplankton**

| Species name | Density (ind./ $m^2$) | Source and year of record |
|---|---|---|
| 1. | | |
| 2. | | |

Normally, information about micro-biota during rapid inventory may not be possible, so it may require a mini-research work.

**B. Macro-Biota**

Macro-biota includes big size organism than are seen by normal human eyes. It involves enumeration of common plants and animals in core and basin of wetlands with their habitat, local use and conservation status under the provisions of IUCN Red list, CITES and government laws.

**B.1 Major Aquatic Plants**

Use secondary literature first to enumeration of major aquatic plants (macrophytes) in core area. Otherwise, observation along transect is a proper way for species enlisting with local name, use and habitats (i.e., submerged, floating and emergent). A frequent conversation should be made among key informants, DFO and DDC personnel during transect walk to figure out their perception about major aquatic plants and their use. Those perceptions should be documented well. In case of non-identified species, collect specimen with flowers and fruits - dried and preserved specimens following herbarium technique (Cook, 1996; Needham and Needham, 1966). For threats and conservation status, refer Annex 5 and 8. Fill datasheet in appropriate order with source.

**Major aquatic plants in core area (**Ff=Free floating, Sm=sub-merged and Em=emergent)

| Local name | Scientific name | Local use | Habitat type ( mark with √) | | | Threat/ conservation status |
|---|---|---|---|---|---|---|
| | | | Ff | Sm | Em | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

***Source:***

Apply similar methods and approaches used in B.1 to enumerate macrophytes of basin, mostly in the terrestrial but adjoining habitats of wetlands. Identification of species should be done by consulting taxonomist or tallying specimens with authentically identified specimen or using literature (Siwakoti &Varma, 1999 for tropical plants; Polunin & Stainton, 1997 for high altitude plants). For threats and conservation status, refer Annex 5 and 8. Put data in appropriate order in datasheet 2.5.1 B.

**Major plants of basin area** (Habit type: Tree, Herb, Shrub, Climber and Epiphyte)

| Local Name | Scientific Name | Local use | Habit type | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |

***Source: Field Survey, September, 2010***

**B.2 Fish Species in Aquatic Habitat**

Fishes are one of the key biological components of wetlands. There may not be fishes in some alpine wetlands with harsh and cold climate. Enumeration of fishes should be done during inventory with their local and scientific names; number per catch; local use and threat/conservation status mentioned in datasheet (see 2.5.2 C). Such information is obtainable from secondary sources. Otherwise, solicit local fishermen of nearby settlements to provide information on species composition, catch number, size and weight. This step needs facilitation works in guiding fishermen and community to generate anticipated information through frequent and cohesive interactions. Further, WIAM team may need using fishing net to verify fish number per catch. For unidentified species, preserve specimen in a container with 10% formalin, and subject specimen for proper identification (Jayram, 1981; Jhingran, 1991, Shrestha, 1981). Refer Annex 7 for threat and conservation category. Fill up datasheet in appropriate order with sources. At the end column, specify either species are resident, migratory or endemic or introduced.

**Fish species in aquatic habitat**

| Local Name | Scientific Name | Number per catch | Local use | Threat/ conservation status | **Remarks** (Resident/ migratory/ introduced sps.) |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

***Source:***

**B.3 Herpeto-Fauna in Aquatic and Peripheral Habitats**

Approaches explained above in B.2 applicable to fishes are equally relevant to explore information about herpeto-fauna. Ask local people of nearby settlements or key informants about major reptiles and amphibians that are found in wetlands with their local name, use and observed numbers. Trap or hand picking is valid method to collect amphibians and reptiles. Direct and indirect evidences are normally used for species enlisting later verified by anecdotal evidences. In case of unidentified species, specimens should be preserved in a container with 5% formalin and by soliciting herpetologist or tallying them in monographs or literature ((Shah and Tiwari, 2004). Refer Annex7 for the threat and conservation status. Provide source in case of referring secondary information. Fill up datasheet 2.5.2.D in appropriate order.

**Herpeto-fauna in aquatic and peripheral habitat**

| Local Name | Scientific Name | Observed number | Local use | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

***Source:***

**B.3 Birds of Aquatic and Peripheral Habitats**

Avian are key indicators to characterize wetlands. Use secondary literature at first to enumerate major birds with their scientific and local name; observed number; local use and threat/conservation status. In case of data gap, zoologist of WIAM team should request local people to provide information what they know about major birds of wetlands, verify those results from indirect evidences like birds' call; feather; nest holes; fecal residue and so on.

Birds watching using binocular or telescope; visual count from a vantage point nearest to bird crowding site; and transect walk during morning or evening are simple but popular methods in avian study. In case of unidentified species, specimens should be collected, preserved and brought to identification process with the help of ornithologists or using manual books (Ali and Ripley, 1987; Baral et al., 1996; Inskipp and Inskipp 1991). Stuffing is strictly not recommended since this process consumes much time. Refer Annex7 for the threat and conservation status. Provide source in case of using secondary information. At the end column, specify information about resident or migratory behavior of birds. Fill up datasheet 2.5.2.E in appropriate order.

**Birds in aquatic and peripheral habitat**

| Local Name | Scientific Name | Observed number | Local use | Threat/conser-vation status | Remarks *(resident/ migratory)* |
|---|---|---|---|---|---|
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |

***Source:***

**B.4 Mammals of Aquatic and Peripheral Habitats**

Mammals are comparatively larger animals that occur in a wide range of habitats and easier to enumerate. Apply all possible methods used earlier in enumerating fishes, herpeto-fauna and birds to enlist mammals of wetlands. A field manual is helpful in identifying species (Baral and Shah, 2008). Indirect evidences like call; drops; pawmark; peat-hole; depredation; killing; attack and so on are helpful to verify records obtained from communities. Refer Annex 7 for the threat and conservation status. Provide source in case of using secondary information. Fill up datasheet 2.5.2.F in appropriate order.

**Mammals in aquatic and peripheral habitat**

| Local Name | Scientific Name | Observed number | Local use | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

***Source:***

**C. Invertebrates (Annelids/Arthropods/Molluscs) of Aquatic and Peripheral habitats**

Invertebrates are lower animal groups. Expertise and literature about this group are very limited in Nepal and their biodiversity information is difficult to enumerate in the field. Use secondary literature at first, and request community what they know about major invertebrates in their wetlands with their local name, observed number and use.

Ekman's dredge (15 X 15 X 7.5 $cm^3$) method along with other bottom biota and preserved specimen in 5% formalin is recommended for annelids. Manual collection or insect net is recommended for arthropods like crabs, butterflies and insects. Crabs should be preserved in 5% formalin. A manual collection of or use of specially designed cube (1 X 1 X 1 $m^3$) for sampling Molluscs is recommended and specimens preserved in 10% formalin. Identification of all collected specimens should be done with the help of subject experts or use of standard literature (Needham and Needham, 1966; Subba Rao, 1989; Tonapi, 1980). Provide source in case of using secondary information. Fill up datasheet 2.5.2.G in appropriate order.

**Invertebrates** (Molluscs, Arthropods, Annelids of core area and fringes)

| Local Name | Scientific Name | Observed number | Local use | Threat/conservation status |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

***Source:***

**Step 9.8 Invasive Alien Species (IAS) in Core and Basin Area**

Invasive Alien Species are those whose introduction and/or spread outside their natural past or present distribution threaten biological diversity. IAS occurs in all taxonomic groups, including animals, plants, fungi and microorganisms, and can affect all types of ecosystems. While a small percentage of organisms transported to new environments become invasive, the negative impacts can be extensive and over time, these additions become substantial. For a species to become invasive, it must successfully out-compete native organisms, spread through its new environment, increase in population density and harm ecosystems in its introduced range.

Common characteristics of IAS include rapid reproduction and growth, high dispersal ability, phenotypic plasticity (ability to adapt physiologically to new conditions), and ability to survive on various food types and in a wide range of environmental conditions. When a biological species occurs artificially in locations beyond the native range is called alien, if alien species spread out of management or control from their native habitat to a new location and cause enormous ecological, economic or health problems is called invasive alien species (IAS), also known as pest species. Plant originated IAS is more commonly encountered than animal originated IAS (http://www.cbd.int/invasive/WhatareIAS.shtml).

**A. Plant Alien Invasive**

Local and scientific name, species specific percentage cover and year of occurrence of plant alien invasive are important information for the management of wetlands. A good predictor of invasiveness is whether a species has successfully or unsuccessfully invaded elsewhere, IAS of plants introduced in core and basin area of some wetlands can be available in literature. Otherwise, facilitate community to provide information. Subject expert would help providing scientific name of plant alien invasive (Tiwari *et al.*, 2005). Visual estimation is a rapid tool recommended for estimating percent cover during transect walk. Provide source for referring secondary information. Fill up datasheet 2.6.1 in appropriate order.

**Plants alien invasive**

| Local Name | Scientific Name | Coverage (%) | Local use | Mark with√ | | Approx. year of appearance |
|---|---|---|---|---|---|---|
| | | | | Core | Basin | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |

***Source:***

**B. Animal Alien Invasive**

Use same step and methods as applied in plant alien invasive to explore information about animal alien invasive but replacing percent cover by observed number in 3rd column of datasheet. Fill datasheet 2.6.2 in appropriate order.

**i. Animals**

| Local Name | Scientific Name | Observed Number | Local use | Mark with√ | | Approx. year of appearance |
|---|---|---|---|---|---|---|
| | | | | Core | Basin | |
| | | | | | | |

***Source:***

**Step 9.9 Endemic Plant and Animal Species**

Population of native species has relatively restricted distributions and confined to a certain environment or geographical or political region is known as endemic species. Endemic species are usually rare and valuable asset of wetlands. Information on endemic plant and animal is usually available in literature (Rajbhandari and Adhikari, 2009; Rajbhandari and Dungel, 2010). Otherwise, assist community to produce information about availability of such kind of species with their local name. Mention status and use of species at end column. Refer Annex 8 for wetlands dependent endemics of plant. Provide source in case of using secondary information. Fill datasheet 2.7 in appropriate order.

**Endemic species (plant/animal)**

| Local name | Scientific name | Mark with√ | | Remark (status, use, etc.) |
|---|---|---|---|---|
| | | Plant | Animal | |
| | | | | |

***Source:***

**Step 9.10 Abundance of Plants in Core and Basin Areas**

Coverage indicates the percent cover of a species per unit area that is defined as a vertical projection of crown of shoot area of a species to the ground surface, expressed in percentage to the total ground surface. In case of plant, visual estimation is a rapid tool to assess abundance of species in a specific area of 1 x 1 m size. However, quadrat sampling of 1 x 1m followed by visual estimation of individual species by percentage inside quadrat to analyze herbaceous type of vegetation in lacustrine, palustrine and riverine types of wetlands is also recommended. Number of quadrat sampling depends on size of wetlands, though 5 quadrat at random are suggested in core area by using boat.

In basin area, depending on nature of vegetation 10 x 10 m for trees and 5 x 5 m quadrat for shrub is recommended with sufficient numbers of sampling with visual estimation of individual species by percentage within each quadrat plot. Use quantitative analysis by referring standard procedure of Zobel *et al. (*1987). Quadrat sampling is an intensive method that may demand higher time and resources. In many cases, community forests in an adjoining of wetlands may have monitoring plots and data on abundance of plants from such plots are referable. Also make a brief note about location where sampling was done. Provide source for use of secondary information. Fill up datasheet 2.8.1 and 2.8.2 in appropriate order.

**Core area Location:**

| Species name | Coverage (%) | Remarks |
|---|---|---|
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |

***Source:***

**Basin area Location:**

| Species name | Coverage (%) | Remarks |
|---|---|---|
| | | |
| | | |
| | | |
| | | |

***Source:***

**Step 9.11 Biomass in Core Area**

Biomass of aquatic plants is a total dry weight of all the above ground parts. Use secondary data if available. Otherwise, harvest method is recommended. For this, use quadrat sampling of 1 x 1m size in at least four different corners of wetlands. Collect all above ground biomass available within the quadrat and oven dry the mass for 24 hours at 72° or sun dry for a sufficient period. Take the measurement in weight *i,e.,* g/$m^2$. Also make a brief note bout location where sampling was performed. This note will be helpful for assessment and monitoring purpose of wetlands. Provide source for the use of secondary information. Fill up datasheet 2.9 in appropriate order.

### *Step 10 Socio-Economic Feature in Basin*

This step generates data on nearby settlement; land use pattern; demography (i.e., population (number); total household number; caste/ethnic group; major religion; major dialect; average land hold size/ HH); Education; occupation; Jurisdiction/land ownership; wetlands dependent community/ies; livestock in wetland basin; traditional production system; traditional water use techniques/practices; cultural record; and genesis/origin of wetland.

#### Step 10.1 Nearby Settlement

Nearby settlement is referred as the major human settlement closest to wetlands like sub-urban or village or hamlet. Topo-sheet or district map is very much usable to notice such settlement. Write the name of settlement, how far it is from wetlands in km and mention about the main trail or road that links to wetlands. Fill up datasheet 3.1 in appropriate order.

**Nearby settlement to wetland**

| | |
|---|---|
| **1. Name and distance** (km) **to nearest settlement** | |
| **2. Name of the main road/trail linking wetland site** | |

#### Step 10.2 Land Use Pattern

Land use pattern at basin level provides data on how lands are being used in terms of forest land; shrub land; grass land; agriculture; settlement; wetlands are so on. Use recent secondary sources like topo-sheet; GIS based map; district map; aerial photos; VDC profile and so on and convert data in percentage form. Verify these data during field observation. Provide source for the use of secondary information. Fill up datasheet 3.2 in appropriate order.

**Land use pattern**

| Attributes | Coverage (%) | Remarks |
|---|---|---|
| **1. Forest land** | | |
| **2. Shrub land** | | |
| **3. Grass land** | | |
| **4. Agriculture** | | |
| **5. Settlement** | | |
| **6. Wetlands** | | |
| **7. Others** (barren, snow, glacier etc.) | | |

***Source:***

#### Step 10.3 Demography

This step intends to record a minimum set of data about population number (male and female); total household number; caste/ethnic group (percent composition of Brahmin/Chettri; Janajati and Dalit); major religion; major dialect; and average land hold size/ HH (Ha/Ropani/Bigha) of adjacent areas of wetlands that are direct users of wetlands resources. Use population census report (2001); district profile; VDC profile; project reports and so on later verified from field study. Note that demography data are extremely important for management because it provides substantial information about human and their practices.

Normally, wetlands do not strictly belonging to a particular ward or a VDC or a district. In reality, single wetlands may cover areas of some VDCs in one or many districts and some wards of one or many VDCs which make collection of demography data difficult. Hence, segregation and integration of data from different DDCs, VDCs and wards of wetlands should carefully be done one by one. Provide source for the use of secondary information. Fill up datasheet 3.3 in appropriate order. Put some note at the end column if incredible information is to document.

**Demography**

| Attributes | Brief description | Remarks |
|---|---|---|
| **1. Population (number)** | | |
| *1. Male* | | |
| *2. Female* | | |
| **2. Total household (number)** | | |
| **3. Caste/ethnic group** (%) | | |
| *(i) Brahmin/Chettri* | | |
| *(ii) Janajati* | | |
| *(iii) Dalit* | | |
| *(iv) Others* (specify) | | |
| **4. Major religion** | | |
| **5. Major dialect** | | |
| **6. Average land hold size/ HH** (Ha/Ropani/Bigha) | | |

***Source:***

**Step 10.4 Education**

This section records data about education of > 6 years of age at varying levels from primary to SLC and university who are residing at wetlands basin that are obtainable from the secondary sources. Careful attention should be given while segregating data from one or different wards and VDCs as in step 10.3. Please quote source for the use of secondary information. Fill up datasheet 3.4 in appropriate order.

**Education** (> 6 years)

| Attributes | Percent | Remarks |
|---|---|---|
| **1. Primary level** | | |
| **2. School level certificate (+ 2)** | | |
| **3. University level** | | |

***Source:***

**Step 10.5 Occupation**

Occupation stands for major practices that engage people for making ample earning in wetlands basin. The major occupation in Nepal includes agriculture; employment (government/corporate); trade and business; tourism; fishing; boating; NTFPs; wages/labor; remittance and so on. Data on occupation provides existing information that helps setting priority in scaling means and opportunities for the conservation of wetlands that ultimately contributing to livelihoods of wetlands dependent communities. Follow 2nd paragraph of step 10.3 to ease the process, which is a careful step. Compile data in percentage from secondary sources. Otherwise, approximate data though consultative process. Fill datasheet 3.5 in appropriate order with source. Any notable information should be explained at the end column.

**Occupation**

| Attributes | Percent (Households) | Remark |
|---|---|---|
| **1. Agriculture** | | |
| **2. Employment** (government/corporate) | | |
| **3. Trade and business** | | |
| **4. Tourism** | | |
| **5. Fishing** | | |
| **6. Boating** | | |
| **7. NTFPs** | | |
| **8. Wages/labor** | | |
| **9. Remittance** | | |
| **10. Others** (specify) | | |

***Source:***

**Step 10.6 Jurisdiction/Land Ownership**

Jurisdiction/land ownership stands for the legitimate authority that own wetlands. There are five types of wetlands ownerships in Nepal (IUCN, 1998). For example, wetlands not registered under the title of individual or institution belongs to the state itself. The wetlands inside the NPs and reserves gazetted by law go under the ownership of park. Some wetlands (ponds) of religious values are owned by Guthi Santhan under Trust. Corporate institution involved in management and use of wetlands like Indrasarovar reservoir fall under the corporate ownership. Similarly, private institution or individuals involved in managing and using fish ponds; nurseries and deepwater rice fields with a nominal tax paid to government are considered as private wetlands. Such information is obtainable from government records and community itself. If different type of ownership than the above stated is found, mark with√ under "others" column with specification. Fill up datasheet 3.6 in appropriate order.

**Jurisdiction/land ownership (**mark with√)

| State | Gazetted | Trust | Corporate | Private | Other (specify) |
|---|---|---|---|---|---|
| | | | | | |

**Step 10.7 Wetlands Dependent Community/ies (WDC)**

WDCs are indigenous people for which wetlands are utmost necessary for their livelihoods, and have no or a little alternative option rather than wetlands resources. This step generates information about WDCs like their population; approximate distance of their settlement from wetlands; literacy; occupation other than wetlands related works; their dependency on wetlands in months and annual household income. Some WDCs may reside outside but closet to wetlands basin - for example 'X' - but their dependency depends on resources of 'X' place. In this case, information about WDC residing out of basin like 'X' should be incorporated in datasheet. Refer secondary information like DDC and VDC profiles. Otherwise, focus group discussion among WDC should be organized. Provide source for the use of secondary information. Fill datasheet 3.7 in appropriate order.

**Wetlands dependent community/ies**

| Community name | Popⁿ and HH No. | Distance to site (m/km) | Literacy (%) | Occupation | Wetland Dependency (month/yr) | Annual income (Rs/HH) |
|---|---|---|---|---|---|---|
| | | | | | | |

***Source:***

**Step 10.8 Livestock in Wetlands Basin**

Use secondary sources for exploring cumulative data on livestock population of cattle; buffalo; sheep and goat in wetlands basin. Livestock census data must be available in District Livestock Offic. Fill up datasheet 3.8 in appropriate order with source.

**Livestock in wetland basin**

| Attribute | Number | Average/HH |
|---|---|---|
| 1. **Livestock** (cattle, buffalo, sheep, goat) | | |

***Source:***

**Step 10.9 Traditional Production Systems**

Traditional production system implies to the circumstances that communities have been practicing production system in wetlands basin without any changes and modification since many decades and years. Those systems are often valuable to adopt coping strategies over natural and cultural shocks.

Use first secondary sources to collect data. Otherwise, organize focus group discussion among key informants and community people. Request them to provide information about how much ha of land under traditional rice/millet/wheat/fruits cultivation using indigenous practices and seeds? Any traditional irrigation practices, animal husbandry, fisheries, boating and so on? How many households benefitting from such practices? Which indigenous species in use and practices? What major NTFPs available in *in situ* condition? How many households depend on traditional collection and trade of NTFPs? Fill datasheet 3.9 in appropriate order with source.

**Traditional production system**

| Attributes | Brief description |
|---|---|
| 1. **Rice fields** (estimate area in Ha) | |
| 2. **Traditional fishery** (type, beneficiary HH) | |

**Step 10.10 Traditional Water Use Techniques**

Traditional water use techniques/practices such as water mills, farmer managed local irrigation systems, community ponds, waterholes, grazing marshes, religious/ritual ponds, well, springs, stone-spouts, traditional wooden /bamboo boats and so on are earmark information to characterize wetlands. Follow approaches of step 10.9 to generate data. Fill up datasheet 3.10 in appropriate order with source.

**Traditional water use techniques/practices**

| Attribute | Numbers | Brief description (status and use) |
|---|---|---|
| 1. **Water mill** (Ghatta) | | |
| 2. **Local irrigation system** (Rajkulo, FMIS/Agency managed) | | |
| 3. **Community pond** | | |
| 4. **Religious/ritual pond** | | |
| 5. **Well and *kuwa*** | | |
| 6. **Spring and stone spout** (other traditional taps) | | |
| 7. **Traditional navigation** (wooden/ bamboo boats) | | |
| 8. **Others** (specify) | | |

***Source:***

**Step 10.11 Cultural Records**

Some wetlands are valuable because of their history and culture. For example, Niglihawa Tal of Kapilvastu district which is important for archeological record because of the Ashoka pillar; Kaligandaki for Saligram and Bagmati for Pashupatinath. Describe briefly on cultural and archeological records; cultural landscape/religious belief and myth; oral tradition/ arts/music/dance/ painting/literature/ drama and so on. Refer secondary literature and historical records or organize focus group discussion. Fill datasheet 3.11in appropriate order with source.

**Cultural record**

| Attribute | Brief description |
|---|---|
| **1. Paleontological record** | |
| **2. Archaeological record** | |
| **3. Religious site record** | |
| **4. Cultural landscape/ religious belief and myth** | |
| **5. Others** (oral tradition/ Arts/music/ song/ dance/ painting/literature/drama | |

***Source:***

**Step 10.12 History/Genesis/Origin of Wetlands**

Some wetlands hold remarkable and interesting history that enriches value of wetlands. Old scripts and literatures may provide these kinds of information. Based on the orals of elderly persons, origin and history of wetlands can be documented. For example, people say that many wetlands in the east of Koshi river created due to extreme meandering of river that drained to Mechi river before 100 years. The river shows ever shifting nature and changes it course from over the period time. A gradual westward shift of Koshi has formed many lakes in south alluvial flat plain like Barju lake in Sunsari and Betana in Morang districts. So, facilitate or assist elderly persons to recapitulate history about their wetlands. Document that information in five short sentences in datasheet 3.12 in appropriate order.

## *Step 11 Ecosystem Goods and Services of Wetlands*

Wetland ecosystems offer a diversity of services vital for human well-being. It is well established that provisioning services from wetlands, such as food (notably fish) and fiber are essential for human well-being. Supporting and regulating services (such as nutrient cycling) are critical to sustaining vital ecosystem functions that deliver many benefits to people. The delivery of fresh water is a particularly important service both directly and indirectly. In addition, wetlands have significant aesthetic, educational, cultural, and spiritual values and provide invaluable opportunities for recreation and tourism. Summary statements are:

- The principal supply of renewable fresh water for human use comes from an array of inland wetlands, including lakes, rivers, swamps, and shallow groundwater aquifers.
- Wetlands provide an important service by treating and detoxifying a variety of waste products.
- Wetlands are important tourism destinations because of their aesthetic value and the high diversity of the animal and plant life they contain.
- Wetlands play an important role in the regulation of global climate by sequestering and releasing significant amounts of carbon.
- Wetlands provide many non-marketed and marketed benefits to people, and the total economic value of unconverted wetlands is often greater than that of converted wetlands (*medium certainty*).
- The declining condition of wetlands has placed their ecosystem services and the people who depend on them at increasing risk.
- Water scarcity and declining access to fresh water is a globally significant and accelerating problem for 1–2 billion people worldwide, leading to reductions in food production, human health, and economic development.

- It is well established that inland wetlands provide a wide array of hydrological services, but the nature and value of these is not consistent, and many are not well understood.
- Maintenance of the key hydrological services performed by wetlands enables them to continue to deliver a wide range of critical and important regulatory and provisioning ecological services to humans.
- Maintaining the hydrological regime of a wetland and its natural variability is necessary to maintain the ecological characteristics of the wetland, including its biodiversity (*high certainty*).
- Wetlands such as floodplains, lakes, and reservoirs help to attenuate floods.

In the process of developing WIAM, it has been decided to cover provisional and cultural services keeping regulatory services aside, considering that present capacity of Nepal may not be sufficient to explore regulatory services of wetlands with participatory use of WIAM. Perhaps, it demands more time; resources; advance technology; and research.

**Setp 11.1 Provisional Services**

Table 8 presents a checklist of information this step intends to explore about provisional services of wetlands. Compile these information from the secondary sources at first, otherwise request community in enlisting number of services wetlands offers to them. This step needs facilitation work which equally provides an opportunity for bidirectional flow of knowledge and learning among WIAM team and community. Use both hard and soft wares during facilitation process. Let consultation go steadily in a slow pace unless the purpose of table 8 is substantially met.

**Table 8 Checklist of data requirement for to document provisional services of wetlands.**

| Attributes | Brief description of services |
|---|---|
| **1. What are drinking water facilities?** | No. of taps, beneficiary HH numbers |
| **2. What are irrigation facilities?** | Name of major canals and approx. land under irrigation |
| **3. What about domestic water supply?** | No. of consumer for bathing and washing, approx. no. of livestock drinking water and so on |
| **4. Any industrial water supply?** | Type of benefitting industries and their numbers |
| **5. Any fish supply?** | Approx. weight in kg traded or in local use |
| **6. Any timber supply?** | Approx. timber in quantity ($m^3$) from drift wood or basin forest. |
| **7. Any fiber supply i.e., hatibar &allo?** | Approx. quantity in Kg. |
| **8. Any fuel wood supply?** | Approximate quantity in Kg, beneficiary HH numbers |
| **9. Any fodder/forager/grass supply?** | Approximate quantity in Kg, beneficiary HH numbers |
| **10. What about food supply (plant+animal)?** | Approximate quantity in Kg, beneficiary HH numbers |
| **11. What about medicine (animal and plant base)?** | Approximate quantity in kg, beneficiary HH numbers |
| **12. What about hydropower facility?** | Approx. Kw power harnessed, beneficiaries HH numbers |
| **13. Any mining and extraction?** | Specify on sand, gravels, pebbles, minerals and so on. Approx. quantity in Kg., local use or trade. No. of people employed, local beneficiary HH no. |
| **14. Any handicraft materials like Pater?** | Approx. quantity in Kg., major products' name, approx. no of beneficiary HH |
| **15. Any genetic materials like genes of wild plant and animal?** | Name of wild, endemic and indigenous plants and animals |
| **16. Any others services?** | About X no. of HHs collect thatch @ Y Bhari/year/HH |

Fill up datasheet 4.1in appropriate order with source at end column. Be careful while segregating and integrating data from districts, VDCs and wards.

| Attributes | Brief description of services | Source |
|---|---|---|
| **1. Drinking water supply** | | |
| **2. Irrigating water supply** | | |
| **3. Domestic water supply** | | |
| **4. Industrial water supply** | | |
| **5. Fish supply** | | |
| **6. Timber supply** | | |
| **7. Fiber supply** | | |
| **8. Fuel wood supply** | | |
| **9. Fodder/forager/grass supply** | | |
| **10. Food (plant + animal)** | | |
| **11. Medicine** | | |
| **12. Hydropower** | | |
| **13. Mining and extraction** | | |
| **14. Handicraft material** | | |
| **15. Genetic material** | | |
| **16. Others** (specify) | | |

***Source:***

**11.2 Cultural Services**

Wetlands are unique gift of nature that form fundamental base for cultural and inspirational development; tourism and recreation; appreciation for nature (aesthetic) and opportunities for formal and non-formal training. Organize a focus group discussion. Request villagers about what they understand about their wetlands in term of aesthetic and scenic service; religious/spiritual service; historic site; recreational/tourism; educational resource services and festivals/*hat-bazar/mela*. Document the information in datasheet 4.2 in appropriate order.

**Cultural services**

| Attributes | Brief description |
|---|---|
| **1. Aesthetic and scenic service** | |
| **2. Religious/spiritual service** | |
| **3. Historic site** | |
| **4. Recreational/tourism** | |
| **5. Educational resource services** | |
| **6. Festivals/hat bazzar/mela** | |

## *Step 12 Restoration/Management Responses*

The degradation and loss of inland wetlands has been driven by infrastructure development (such as dams, dikes and levees); land conversion; water withdrawals; pollution; overharvesting and the introduction of invasive alien species. Hence, future scenario of wetlands greatly relies on how government and local institution are responding wetlands issues in term of restoration and management.

**Step 12.1 Structural Management Responses**

The structural management includes those responses made by government, non-government institution and local community often with high-scale actions that are physically observable sewerage system; waste water treatment facility; construction of dike/dam/embankment; afforestation and so on. Compile this information from government records and field observation. Fill datasheet 5.1 in appropriate order.

**Structural management responses** (mark with√)

| Attributes | Yes | No | Remarks |
|---|---|---|---|
| **1. Any sewerage systems** | | | |
| **2. Any wastewater treatment systems** | | | |
| **3. Build up of dikes/dams** | | | |
| **4. Afforestation** | | | |
| **5. Others** (specify) | | | |

**Step 12.2 Non-Structural Management Responses**

Non-structure management includes physically invisible responses that are non-tangible like formal rules and regulations adopted and in use by government; informal and voluntary restrictions by community institution; and taxes/subsidies in place to enhance management practices. Compile these data from government and community organization. Fill up datasheet 5.2 with mark √ in appropriate row and column.

**Non-structural management responses** (mark with√)

| Attributes | Yes | No | Remarks |
|---|---|---|---|
| **1. Any informal rules** | | | |
| **2. Any formal rules** | | | |
| **3. Any economic incentives like subsidies and taxes** | | | |

**Step 12.3 Conservation and Monitoring Plan**

Wetlands without conservation and monitoring plans are in higher risk of degradation because it is an indication of no priority actions undertaken to address wetlands issues over a period of time. Sustainable conservation and use of wetlands is only possible when there are planned intervention guided by plans and actions. Ask to institution or villagers if there exist any plans. Fill datasheet 5.3 with mark √ in appropriate row and column.

**Conservation and monitoring plans** (mark with√)

| Attributes | Yes | No | If yes, list them |
|---|---|---|---|
| **Any conservation plan** | | | |
| | | | |
| | | | |
| | | | |
| **Any monitoring plan** | | | |

## *Step 13 Wetlands Assessment*

Unlike inventory, wetland assessment must be done by organizing an intensive workshop during field study (step 5). In this process, we compare changes in the structure and functions of wetlands before 10 years and now. Measure indicators like change in physical structure; change in water quality; change in species composition

and abundance of planktons; species specific assessment; change in abundance of major species of aquatic plants; change in abundance of major species of fish(s), herpeto-fauna, birds and mammals; disappearance/ reappearance of species of plants and animals; abundance of problematic IAS plants and animals; change in plant biomass; resource use assessment; change in cultural values; change in traditional water use techniques/ practices; threats; climate change; and wetlands governance.

**Step 13.1 Change Assessment in Physical Structure**

Measure change in core water area and volume before 10 years and now is one of easiest ways to assess wetlands condition. Select any of 3 methods explained below to generate information to assess changes in physical structure of wetlands. First, explore if university students or researches had done study on physical structure of wetlands. Refer such data as baseline information with specific remarks. Second, refer a recent map and compare it with previous map of similar scale. It is very unusual to find maps of similar scale at 10 years of time interval. If such maps are available, thread measurement or grid analysis of wetlands area is recommended. Third, LRMP is acceptable as base map to compare with present situation; however preference assessment period is 10 years.

Facilitate community participants how they perceive changes in water area - either increased or decreased or no-change. Once this trend is known, solicit community to approximate changes in area in ha or percent. Repeat similar approach to assess changes in water volume. An extensive facilitation work in workshop is required. Place data in datasheet 6.1 in appropriate order with source.

**Change assessment in physical structure before 10 years and now**

| Attributes | Core area | | Remarks |
|---|---|---|---|
| | Before (Yr) | Now (Yr) | |
| **1. Area** (ha) | | | |
| **2. Water volume** ($m^3$) | | | |

***Source:***

**Step 13.2 Change Assessments in Water Quality**

Measuring change in water quality is purely a scientific study comparing water quality data of two different periods. Use secondary literature as a baseline and produce recent data by following step 9.4. Place comparative data in datasheet 6.2 in appropriate order with source and years of record at the end column as in table below.

**Indicator assessment change in water quality before 10 years and now**

| Attribute | Unit | Values | | Source & years of record |
|---|---|---|---|---|
| | | Before | Now | |
| **1. pH** | - | | | |
| **2. Transparency** | m | | | |
| **3. Total dissolved solid** | mg/L | | | |
| **4. Dissolved oxygen** | mg/L | | | |
| **5. Chemical oxygen demand** | mg/L | | | |
| **6. Biological oxygen demand** | mg/L | | | |
| **7. Total suspended solid** | mg/L | | | |
| **8. Nutrients** ($NO_{3,}$ $NH_4$, $PO_{4,}$ Cl, Na, K, Ca, Mg, $CO_3$, $HCO_{3,}$ dissolved Silica) | mg/L | | | |

**Step 13.3 Change in Species Composition and Abundance of Plankton**

Plankton is good indicators of wetlands health so changes in their species composition and abundance determines the level of eutrophication. The changes in species composition and abundance are often expressed

by comparing present data with previous one. Compile the data from secondary sources as baseline. Otherwise, facilitate community how they see changes in species composition like blue green algae, chironomids and so on. Community normally answers on a trend how plankton are gradually emerging or disappearing by year. Once, this trend is explored request them again how they see changes in their composition in terms of density i.e., individual per $m^2$. Assist community to reach to an unanimous decision to see changes in species composition. Note down approximate figure in datasheet 6.3 in appropriate order with source.

**Change in species composition and abundance of plankton**

| Species name | | Density (ind./ $m^2$) | | Remarks |
|---|---|---|---|---|
| Before | Now | Before | Now | |
| | | | | |
| | | | | |
| | | | | |

***Source:***

**Step 13.4 Species Specific Assessment**

In this step we assess wetlands quality by analyzing changes in abundance of major aquatic plants; fishes; herpeto-fauna; birds and mammals before 10 years and now. These data helps monitoring trends in occurrence and abundance of major biodiversity at species levels.

**Step 13.4.1 Change in Abundance of Major Species of Aquatic Plants**

Assess only 3 major aquatic plants in term of abundance over a period of 10 years and now. This should be done by comparing secondary data with present one. It may be difficult to find secondary data specifically identifying 3 major aquatic species for comparison. In that case, we should apply ecological and economic use value criteria to identify 3 major aquatic plants from the list of secondary sources by involving participants in species selection. This step will identify 3 major species from the list of secondary study like *species a, b and c*. After this, participants must visit wetlands site and place 1 x 1m quadrat randomly at 3 or 4 point sites. Visually estimate of abundance in an average percent of *species a, b and c*.

If secondary source is not available, assist participants to find out answer about 3 major aquatic plants in terms of ecological and socio-economic uses. This exercise will identify 3 major aquatic plants for example *species x, y and z.* After this, participants are requested to visit wetlands site along with WIAM team and place 1 x 1 m quadrat randomly at 3 or 4 point sites. Estimate an approximate but average percentage of *species x, y and z*. The participants must see changes in abundance of *species x, y and z* before 10 years. Comparison of this data with the data derived from quadrat sampling is done. Note down figure in datasheet 6.4.1 in appropriate order with source and remarks.

**Table 9 Crude criteria for change assessment in abundance**

| Rank | Description | Status |
|---|---|---|
| **-2** | Rapidly decreasing by >20% | |
| **-1** | Moderately decreasing approx. by 10-20% | |
| **0** | Neither increasing nor decreasing | |
| **+1** | Moderately increasing approx. by 10-20% | |
| **+2** | Rapidly increasing by >20% | |

The very essence of this WIAM is to assess change context about abundance of species by assessing local perception of community. For this the participant are requestes to rank on changes in abundance of *species x, y and z* i.e., either declining or increasing or no change based on local perception. Refer Table 9 for ranking changing context. Facilitate and assist participants to reach to a unanimous decision with potential reasons for increasing or decreasing in abundance of species. The reasons that made species to change should be explained briefly in remark column.

**Change in abundance of major species of aquatic plants**

| Species name | Coverage (%) | | Local perception on change (mark withV) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

**Step 13.4.2 Change in Abundance of Major Species of Fishes, Herpeto-Fauna, Birds and Mammals**

Steps and approaches applied in step 13.4.1 are applicable to assess change is abundance of major fishes; herpeto-fauna; birds and mammals, though, participants here needs a brief explanation to qualify "major" species. For the wetlands assessment purpose, "major" species are those species which are economically high value and ecologically very significant in their conservation status. Further, catch number with size and weight is recommended for fishes where as observed number is recommended for herpeto-fauna, birds and mammals for their assessment. Facilitate participants to identify major animals of each taxa, and assist them to measure changes in their occurrence and abundance before 10 years and now in a unanimous way.

**Table 10 Crude criteria for change assessment in abundance of fishes, herpeto-fauna, birds and mammals.**

| Rank | Description | Status |
|---|---|---|
| **-2** | Rapidly decreasing by >20% | Non-recoverable |
| **-1** | Moderately decreasing approx. by 10-20% | Recoverable |
| **0** | Neither increasing nor decreasing | Fair |
| **+1** | Moderately increasing approx. by 10-20% | Good |
| **+2** | Rapidly increasing by >20% | Better |

Note that rank on changing context based on local perception seem different here than what is in step 13.4.1 (Table 10). Abundance increase for economically high value species and significant species in terms of conservation status is widely accepted as good. Similarly, decrease in abundance of economically important and higher conservation status animals implies to bad situation. Write down approximate figure in datasheet in appropriate order i.e., catch number or observed number column as appropriate to taxa with source and remark. Assist participants to identify potential reasons for increasing or decreasing in abundance.

**Change in occurrence and abundance of 3 major species of fish(s)**

| Species name | Catch no. (size and weight) | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| *Rohu/ Labeo rohita* | | | | | | | | |
| *Sinhi / Clarias batrachus* | | | | | | | | |
| *Barilius jalkapoorei* | | | | | | | | |

***Source:***

**Change in occurrence and abundance of 3 major species herpeto-fauna**

| Species name | Observed number | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

**Change in abundance of 3 major species of birds**

| Species name | Observed number | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

**Change in abundance of 3 major species of mammals**

| Species name | Observed number | | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|
| | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

**Step 13.4.2 Disappearance/Reappearance of Species in the Past 10 Years**

Disappearance and reappearance of species in the past 10 years are entirely associated with wetlands conditions. Use secondary sources to fill datasheet, or simply request participants what species they had seen before which by now has been disappeared, and what species they hadn't seen before which by now has been appeared. Assist them to explore potential reasons for disappearance and reappearance of species. Place data in datasheet 6.4.6 (A, B, C, D) with source and remarks.

## *Step 14 Change in Abundance of Problematic IAS*

Compare changes in abundance of problematic IAS of plants and animal in their percent cover for plants and catch/observed numbers for animals. Compile secondary sources as baseline information for comparison. Otherwise, prepare participants through facilitation process to make them understand about invasive alien. Species mapping can easily be done by using PRA skills. Assist them to identify 3 problematic plant and animal invasive in core and basin of wetlands from past 10 years to now. Once the problematic IASs are known; then assist participants again to approximate changes in their abundance. Note that catch number is applicable for fish group where as observed number is good for herpeto-fauna; birds and mammals. Ask them about their perception why there are changes in abundance of IAS - decreasing or increasing or no change; what could be the potential reasons for such changes? Fill datasheet 7.1 for plants and 7.2 for animals with data appropriately placed in order with source and remarks. Explain in nutshell about the potential reasons for any changes in abundance in remark column.

**Table 11 Crude rank criteria to assess abundance of IAS**

| Rank | Description | Status |
|---|---|---|
| **-2** | Rapidly decreasing by >10% | Better |
| **-1** | Moderately decreasing approx. by 5-10% | Good |
| **0** | Neither increasing nor decreasing | Fair |
| **+1** | Moderately increasing approx. by 5-10% | Controllable |
| **+2** | Rapidly increasing by >10% | Non controllable |

Table 11 presents crude rank criteria to asses change in abundance of based on local perception. Decrease in abundance of IAS is a positive indication of improvement in the condition of wetlands; however increase in abundance of IAS is an appalling scenario. Note that, even a small percent increment in abundance of IAS may have detrimental impacts on wetlands particularly in Nepal that has higher topographic variations.

**Abundance of plant IAS**

| Species name | Mark with √ | | Coverage (%) | | Local perception on change (Mark with √) | | | | | Remark |
|---|---|---|---|---|---|---|---|---|---|---|
| | Core | Basin | Before | Now | -2 | -1 | 0 | +1 | +2 | |
| | | | | | | | | | | |
| | | | | | | | | | | |
| | | | | | | | | | | |

***Source:***

Repeat similar kind of approaches to document plant and animal invasive that were previously seen but completely disappeared by now. Fill datasheet 7.3 in appropriate order with source and remarks.

### *Step 15 Change in Plant Biomass*

Use secondary source to measure changes in biomass of aquatic plants before 10 years and now. For comparison, conduct 1 x 1m quadrat sampling at 3 or 4 point sites in wetlands by using boat or base materials to ease sampling process depending on depth of wetlands. Collect all green biomass separately that fall within each quadrat. Then, subject biomass materials of each quadrat in separate containers for oven-dry or sun-dry unless biomass materials get completely dry. Take measurement of dry weight in gram. Make an average estimation of biomass. Fill datasheet 8 in appropriate order with source and remarks. Note that biomass value can vary by seasons and locations.

### *Step 15 Exploring Resource Use Values of Wetlands*

This step explores information about use values of wetlands with 5 priority resource use area, and economically, culturally and nutritionally five most important plants and animals.

**Step 15.1 Ranking Resource Use Areas**

**Table 12 Crude rank criteria for resource use assessment**

| Rank | Description | Status |
|---|---|---|
| **-2** | Resource scarcity by >20% | Worse |
| **-1** | Resource scarcity by 5-20% | Bad |
| **0** | No change | Fair |
| **+1** | Resource increased by 5-20% | Good |
| **+2** | Resource increased by >20% | Better |

Datasheet 9.1 has list of resource use areas. Of this list, particular wetlands may provide all resources for livelihoods but we need to identify only 5 major resources use area. For this, facilitate and assist participants to select the best resource use areas giving weight '1' for highly preferred then gradually followed by 2, 3, 4 and 5. Once top 5 priority areas are dentified, request participants how easily these resources are available from last 10 years. Are they scarcer or glut? Assist them to reach to a common decision. Based on their response, rank on priority resources areas by following crude rank criteria - Table 12. Fill datasheet 9.1 with data appropriately placed in order.

**Rank 5 major wetlands resource use on priority base and their status**

| Attributes | Rank (1-5) | Value status (marked with√) | | | | |
|---|---|---|---|---|---|---|
| | | -2 | -1 | 0 | +1 | +2 |
| 1. Drinking water supply | | | | | | |
| 2. Irrigation water supply | | | | | | |
| 3. Domestic water supply | | | | | | |
| 4. Industrial water supply | | | | | | |
| 5. Fish supply | | | | | | |
| 6. Timber supply | | | | | | |
| 7. Fiber supply | | | | | | |
| 8. Fuel wood supply | | | | | | |
| 9. Fodder/forage/grass supply | | | | | | |
| 10. Food (plant and animal) | | | | | | |
| 11. Medicine | | | | | | |
| 12. Hydropower | | | | | | |
| 13. Biochemical | | | | | | |
| 14. Handicraft material | | | | | | |
| 15. Genetic materials | | | | | | |
| 16. Others (specify) | | | | | | |

**Step 15.2 Five Major Economically/Nutritionally/Culturally Important Plant and Animal Species**

Apply all processes of step 15.1 to identify 5 major economically, culturally and nutritionally important plant and animal. Use Table 12 for crude ranking in abundance. One species may have many important values; so select one best use value. Fill datasheet 9.2/9.3.

**Five economically/nutritionally/culturally important plant species of KTWR**

| Species name | Value category (mark with √) | | | Abundance status (mark with √) | | | | |
|---|---|---|---|---|---|---|---|---|
| | Economic | Cultural | Nutritional | -2 | -1 | 0 | +1 | +2 |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |

***Source:***

## *Step 16 Change in Cultural Values of Wetlands*

**Table 13 Crude ranking criteria to assess cultural values of wetlands**

| Attributes | Worse | Bad | Fair | Good | Better |
|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 |
| **Aesthetic/scenic services** | Deforestation, pollution, unplanned development increased by >25% | Deforestation, pollution, unplanned development increased by 10-25% | No change | Gardening, afforestation, sanitation and so on increased by 10-25% | Gardening, afforestation, sanitation and so on increased by >25% |
| **Religious/spiritual services** | Past cultural facilities lost or degraded or no more in use | Past cultural facilities un addressed or ignored or insufficient for recent visitors | No change | Cultural facilities (taps, sheds, temples, resting places, restoration and so on) improved by 10-25% | Cultural facilities (taps, sheds, temples, resting places, temples, restoration and so on) improved by >25% |
| **Recreation/ tourism** | No recreational and tourism facilities or whatever available before are no more in use | Recreational and tourism facilities gradually declining | No change | Lodging/ fooding facility, transportation, media and communication, safety and visitors increased by 10-25% | Lodging/ fooding facility, transportation, media and communication, safety and visitors increased by >25% |
| **Educational resource services** | No student visitors and researchers | Earlier trend of student visitors and researchers gradually declining by 10-20% | No change | Study tour, excursion and researches enhanced by 10-20% | Study tour, excursion and researches enhanced by >20% |

Assessing change in cultural values of wetlands is difficult since valuing aesthetic, religious, recreational and educational importance requires standard methods and techniques. For the purpose of WIAM implementation, use local perception on change in assessing cultural values of wetlands. Facilitate and assist participants to comprehend the context and objectives of assessing cultural values of their wetlands. Request them about what scenic and aesthetic services of wetlands that have been improved or degraded in past 10 years. Further, repeat similar questions to know about religious and spiritual services; recreational and tourism services; and educational opportunities that wetlands providing. Assist participants to reach to a common decision. Refer Table 13 to assess cultural values. Fill datasheet 10 properly.

**Change in cultural values of wetlands of KTWR**

| Attributes | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| **1. Aesthetic and scenic service** | | | | | | |
| **2. Religious/spiritual service** | | | | | | |
| **3. Recreational/tourism** | | | | | | |
| **4. Educational resource services** (Opportunity for formal/non-formal education and training) | | | | | | |

## *Step 17 Change in Traditional Water Use Techniques/Practices*

Apply all processes and approaches of step 16 to assess change in traditional water use techniques and practices. Table 14 presents crude ranking criteria that guide evaluation process of measuring changes in traditional water use techniques and practices. It is well understood that many traditional water use techniques/practices in Tarai have been replaced by new technologies and practices where as in high mountains and mid-hill such practices

are still popular and in use. Facilitate and assist participants unless they reach to a consensus on their perception; how they generalize changing context of traditional water use practices?

**Table 14 Crude rank criteria to assess traditional water use techniques/practices**

| Attributes | Non-recoverable | Recoverable | Fair | Good | Better |
|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 |
| **Water mill** | Water mills declining by >25% or not in use | Water mills declining by 10-25% | No change | Water mills in a little use | Water mills in full use |
| **Community channel** (Rajkulo) | Users of channel declined by >20% or not in function | Users of channel declined by 10-20% | No change | Channel in use by 10-25% HHs | Channel in use by 25% HHs |
| **Community pond** | Users of pond declined by >25% or pond not in function | Users of pond declined by 10-20% | No change | Ponds in use | Pond condition improved by >25% |
| **Religious/ritual pond** | Pollution increased, area encroached by >25 or pond not in use | Pollution increased , area encroached by 10-20% | No change | Ponds in use | Pond condition improved by >25% |

Fill datasheet 10 in appropriate order. If traditional water use techniques are replaced by new technology; explain briefly at the end column.

**Change in traditional water use techniques/practices**

| Attribute | Local perception on change (mark with √) | | | | | Replaced |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| **1. Water mill** | | | | | | |
| **2. Community channel** (Rajkulo) | | | | | | |
| **3. Community pond** | | | | | | |
| **4. Religious/ritual pond** | | | | | | |
| **5. Well and *kuwa*** | | | | | | |
| **6. Stone spout/traditional taps** | | | | | | |
| **7. Transportation** | | | | | | |
| **8. Others** | | | | | | |

## *Step 18 Exploring Threats of Wetlands*

This step explores information about 5 main degradation categories followed by assessment of proximate threats, climate change and wetlands governance.

### Step 18.1 Ranking Degradation Category

There are 9 degradation categories selected by referring lake-brief guidelines prepared by ILEC, Japan. These attributes are equally applicable for the wetlands of Nepal. They are: destruction in core area; destruction in wetland basin; excess water withdrawals; declining fish stock; declining in birds' number; declining in availability of other resources in basin; increased water pollution; increased algal/vegetation growth; and others. Facilitate and assist participants to comprehend all these contexts and objective of this step. Request them to prioritize degradation categories based on their perceptions giving weight '1' to the worst degradation category gradually followed by 2, 3, 4 and 5 in a period of 10 years and now. Assist them to reach to consensus on their judgments. Ask them, why such degradations had happened? Fill datasheet 12.1 properly in order with remarks at the end column.

**Rank degradation category of wetlands** (1 as the worst)

| Attributes | Rank (1-5) | Remarks |
|---|---|---|
| 6 **Destruction in core area** | | |
| 7 **Destruction in wetland basin** | | |
| 8 **Excess water withdrawals** | | |
| 9 **Declining fish stock** | | |
| 10 **Declining in birds' number** | | |
| 11 **Declining in availability of other resources in basin** | | |
| 12 **Increased water pollution** | | |
| 13 **Increased algal/vegetation growth** | | |
| 14 **Others** (specify) | | |

**Step 18.2 Assessment of Proximate Threats**

Step 18.1 deals about degradation category. In this step, we do an assessment of what makes degradation to happen? Note that some degradation category looks like threats; for example declining fish stock (see step 18.1). There may be an argument that how come "decline in fish" becomes a "degradation category". Be clear that "cause" and "effect" in conservation flow simultaneously. In general, decline in fish abundance is the impact of cumulative effect of many threats at one point of time, but now this situation has entered to a stage of "degradation category" in KTWR. Further decline in fish population may jeopardize ecological equilibrium of wetlands ecosystem and livelihoods of fish dependent community.

Proximate threats are immediate threats that wetlands are facing. There are 15 attributes to assess these threats like encroachment; grazing; poaching/hunting; fishing; poisoning; solid waste disposal; sewage disposal; erosion and landslide in upstream/downstream; siltation/floods; increased algal/vegetation growth; deforestation; over extraction of resources for fodder and fuel wood; over harvest of NTFPs; introduction of invasive alien species; infrastructure development; use of chemical fertilizers and pesticides and others. Compile secondary sources for generating baseline data. Facilitate and assist participants to clearly understand the context and objectives of this step. Ask participants to use their own value judgments on the magnitude of threats they feel and understand - there is no change in threat level, threats are slightly (good) or substantially improving (better), or threats are increasing (bad) or alarming to non-addressable stage (worse). This is a simple judgment criterion people do respond very easily. Assist participants to reach a consensus on their judgments in each 15 attributes; one by one. Fill datasheet 12.2 in appropriate order.

**Assessment of proximate threats in wetlands management**

| Attributes | Local perception on change (mark with √) | | | | |
|---|---|---|---|---|---|
| | **-2** (Worst) | **-1** (Bad) | **0** (no change) | **+1** (Good) | **+2** (Best) |
| **1. Encroachment** | | | | | |
| **2. Grazing** | | | | | |
| **3. Poaching/hunting** | | | | | |
| **4. Fishing** | | | | | |
| **5. Poisoning** | | | | | |
| **6. Solid waste disposal** | | | | | |
| **7. Sewage disposal** | | | | | |
| **8. Erosion and landslide in upstream/downstream** | | | | | |
| **9. Siltation/floods** | | | | | |
| **10. Increased algal/vegetation growth** | | | | | |
| **11. Deforestation** | | | | | |
| **12. Over extraction of resources for fodder and fuel wood** | | | | | |
| **13. Over harvest of NTFPs** | | | | | |
| **14. Introduction of invasive alien species** | | | | | |
| **15. Infrastructure development** | | | | | |
| **16. Use of chemical fertilizers and pesticides** | | | | | |
| **17. Others** (Specify) | | | | | |

**Step 18.3 Climate Change**

Climate change is understood as one of main drivers of wetlands degradation in Nepal. Non-seasonal floods; shift in rainfall pattern; unpredictable drought in Tarai; glacial lake outburst and so on are exemplary evidences Nepal already started to face these days

There are many standard techniques and methods including GIS application to assess and monitor climate change indicators. Here, 7 attributes are identified like temperature pattern; shift in rainfall pattern; non-seasonal flood; unpredictable and longer period drought; glacial melt; increase water volume in glacial lakes; phenology of plants; and altitudinal shift of plants and animals. Assessment of these attributes may demand higher technology, resources and time. Besides, each attribute also requires time series data including disaster records. However, examining local perception is one of the rapid and cost effective ways to estimate attributes of climate change.

We apply rapid assessment. For this, facilitate participants to understand the contexts and objective of assessing climate change using aforesaid 7 attributes. Let them know about present scenario of climate change and its impacts that Nepal has been facing. Request them, what is their opinion about change in temperature pattern in the last 10 years; either increasing or decreasing? Once the trend is identified, asks them what they feel about such trend, do they think that there is (i) no change in temperature pattern; (ii) temperature is gradually increasing; or (iii) temperature is rapidly increasing; (iv) temperature is moderately decreasing; (v) temperature is rapidly decreasing. Assist them to translate their perceptions following 0= no change; +1 = gradually increasing; +2 = rapidly increasing; -1 = gradually decreasing; -2 = rapidly decreasing. Based on their response, mark with √ to qualify each attributes in appropriate rows and columns in datasheet 12.3. Repeat similar processes in assessing shift in rainfall pattern and other 6 attributes - one by one. Note down remark at the end column if participant has any say.

**Climate change**

| Attribute | Local perception on change (mark with √) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| **1. Change in temperature pattern** | | | | | | |
| **2. Shift in rainfall pattern** | | | | | | |
| **3. Non-seasonal flood** | | | | | | |
| **4. Unpredictable and longer period drought** | | | | | | |
| **5. Glacial melt** | | | | | | |
| **6. Increase water volume in glacial lakes** | | | | | | |
| **7. Change in phenology of plants** | | | | | | |
| **8. Altitudinal shift of plants/animals** | | | | | | |

## *Step 19 Assessing Governance in Wetlands Management*

Wetlands governance is a management prescription that integrates policy; institution; participation; information; technology and financial aspects to address wetlands issues.

**Step 19.1 Policy and Institution in Wetlands Management**

This is well understood that wetlands are greatly subjected to higher risk of degradation in absence of state policy and authorized institution. Make an enquiry with government personnel if there exist any policy and institution for wetlands management. Generalize the assessment with a peer view of state and other relevant policy at upper tier, and levels of institution from grass-root to central government. Fill datasheet 13.1 and 13.2. For example, policy and institution for the management of wetlands of KTWR are:

**Policy in wetlands governance**

| Attributes | Status (mark withv) | | Remarks |
|---|---|---|---|
| | Exist | Do not exist | |
| 1. **Site specific policy** | | | |
| 2. **Others** (specify) | | | |

**Institution in wetlands governance**

| Attributes | Status (mark withv) | | Remarks |
|---|---|---|---|
| | Exist | Do not exist | |
| 1. **Central govt. agency**(Ministry, Department, etc) | | | |
| 2. **Local govt. agency** (District, VDC, Municipality) | | | |
| 3. **Non-government organizations** | | | |
| 4. **Donors and international conservation partners** | | | |
| 5. **Community based organization** | | | |
| 6. **Private organization** | | | |

***Step 19.2 Participation in Wetlands Governance***

**Table 15 Crude criteria to assess participation attribute for wetlands management**

| Attributes | No | Lower | Indifferent | Good | Better |
|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 |
| **1. Participation from central government** | No physical presence, | One or two participation in past 10 yrs | Policy and plan in place | Occasional physical presence | Regular interventions |
| **2. Participation from local government** | No physical presence | One or two participation in past 10 yrs | Plan and program in place | Occasional physical presence | Regular interventions |
| **3. Participation for NGOs** | No physical presence | NGO with one or two programs in past | Plan and programs in place | NGOs with more than five/six interventions | Regular interventions |
| **4. Participation from donors and partners** | No physical presence | One or two intervention in the past | Plans and programs in place | Frequent support | Regular support |
| **5. Participation from CBOs** | No events | Uncertain events and actions | CBOs with plans/ programs | Frequent activities, occasional lobbying & advocacy | Regular activities |

State policy and institution in isolation has a little meaning if participation at different tiers of management is negligible. Sustainable conservation of wetlands demands for higher participation. Hence, this step makes a cross-sectional overview of participation of central government; local government; NGOs; donors and INGOs; and community and private organization. Refer Table 15 to follow crude criteria to assess participation attribute. Make an enquiry with government personnel and community if participation of different institution is in place and functional. Verify such information with existing documents; reports; photographs and so on. A simple conversation can generate all desirable information. Fill datasheet 13.3. Refer remark column for specific notes to present.

**Participation in wetlands governance** (0= Indifferent, -1 = No, -2 = Low, +1 = good, +2 = Better)

| Attributes | Status (mark withV) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. Participation from central govt. agency | | | | | | |
| 2. Participation from local govt. agency | | | | | | |
| 3. Participation from NGO(s) | | | | | | |
| 4. Participation from donors and international conservation partners | | | | | | |
| 5. Participation from local community | | | | | | |

### Step 19.3 Access to Technology in Wetlands Governance

Technology is a means to appropriate management effectively and efficiently in a particular time. Effectiveness of policy, institution and participation rely on availability of technology in managing wetlands. Nevertheless, state policy, committed institution and strong participation also imply to explore ways and means to access suitable technology for interventions.

**Table 16 Crude criteria for the assessment of technology for wetlands management**

| Attributes | No | Lower | Indifferent | Fair | Good |
|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 |
| **1. Traditional technology** | Do not exist | Occasional use | Exist, do not know status | In use by 5-20% | In use by >20% |
| **2. Improved technology** | Do not exist | Occasional use | Exist, do not know status | In use by 5-20% | In use by >20% |
| **3. High technology** | Do not exist | Occasional use | Exist, do not know status | In use by 5-20% | In use by >20% |

This step makes an assessment of available technologies for managing wetlands. Refer Table 16 that elaborates crude criteria to assess traditional, improved and high technologies. Ask participants, what are the traditional technologies they used earlier for wetlands conservation? What's their present status in terms of their number, frequency in use and effectiveness? Repeat similar enquiry to access on status of improved and higher technology. Facilitate participants to reach a common decision whilst ranking. Discuss carefully among WIAM team and participants to rank on access to technology by referring table 16. Fill datasheet 13.4 with remarks at the end column.

**Access to technology in wetlands governance**

| Attributes | Status (mark withV) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. Traditional technology | | | | | | |
| 2. Improved technology | | | | | | |
| 3. Higher technology | | | | | | |

### Step 19.4 Access to Information in Wetlands Governance

**Table 17 Crude criteria to assess information in wetlands governance**

| Attributes | No | Lower | Indifferent | Fair | Good |
|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 |
| **1. Source of information** | No curricula, no researches | Occasional researches | Status unkown | Curricula, researches in place | High and regular facilities in university |
| **2. Symposium, workshop, other events** | No symposium and workshop | Occasional symposium, workshop in past 10 yrs. | Status unkown | 2 symposium, workshop a year | >2 workshops a year from 5-10 years. |
| **3. Documentation facility** | No library, data bank | Library, data bank least referred | Status unkown | Library, data bank in moderate operation | Library, data bank in full operation |
| **4. Dissemination capability** | No journal, media, campaign | Occasional cover in local media | Status unkown | Media and campaign 2-3 times a year | Regular journal, media and campaign coverage |

This step intends to explore status of information that flow for wetlands conservation, either formally or informally, through different media and communication. Refer Table 17 for with attributes of information and crude criteria to rank. Discuss among team members and community about attributes, and build consensus while ranking. Fill up datasheet 13.5 with remarks at the end column.

**Information sources in wetlands management**

| Attributes | Status (mark with√) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| 1. **Source of information** (university curricula, research, etc) | | | | | | |
| 2. **Symposium/workshop/other events** | | | | | | |
| 3. **Documentation capability**(Library, data bank, etc) | | | | | | |
| 4. **Dissemination capability** (Journal, media, awareness campaign, celebration, informal means, etc) | | | | | | |

### Step 19.5 Finance in Wetlands Management

Finance is often a guiding and competing resource, and an investment in wetlands conservation. Flow of financial resources - irrespective to any amount - from different tiers of institution manipulates governance structure and eventually influences wetlands management.

Financial inputs for wetlands from all tiers of institution entail that particular wetlands is very significant for conservation and management. No investment is normally made to wetlands that are non-priority. This step helps assessing on financial status that institution are making investment in conserving and managing their wetlands. Table 18 summarizes on attributes of finance with crude criteria to assess. Discuss about different attributes among team members including local government personnel, VDC representatives and participants. Futher rank on attributes are recommended.

**Table 18 Crude criteria to assess finance for wetlands management**

| Attributes | No | Lower | Indifferent | Fair | Good |
|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 |
| **1. Central government input** | No input | Occasional inputs | Status unkown | 3-5 support in past 10 yrs. | Plan based regular inputs |
| **2. Local government input** | No input | Occasional inputs | Status unkown | Regular inputs | Inputs increased by 5-10% from 5 years |
| **3. Community donation and participation** | No input | Occasional inputs | Status unkown | Regular inputs | Participation increased by 5-10% from 5 years. |
| **4. Private investment** | No input | Inputs initiated but least addressed | Status unkown | Inputs initiated from 5 years | Investment from 7-10 years |
| **5. Inputs from donors/NGOs** | No input | Occasional inputs | Status unkown | Inputs initiated from 5 years | Regular inputs from 7-10 years |

through a common decision. Fill datasheet 13.6 with remark in the end column.

**Finance in wetlands management**

| Attributes | Status (mark withV) | | | | | Remarks |
|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | |
| **2. Financial inputs** | | | | | | |
| (i) Central government | | | | | | |
| (ii) Local government | | | | | | |
| (iii) Community donation/participation | | | | | | |
| (iv) Private investment | | | | | | |
| (v) Local taxes | | | | | | |
| (vi) Donors/NGOs | | | | | | |

***Step 20 Mapping the Wetlands***

**Table 19 Mapping the wetlands of KTWR**

| Attributes | Rank | | | | | Band assessment | | | | | Remarks |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | -2 | -1 | 0 | +1 | +2 | | | | | | |
| 1. Change in physical structure | | | | | | | | | | | |
| *i. Change in area* | | | | | | | | | | | |
| *ii. Water volume* | | | | | | | | | | | |
| 2. Change in water quality | | | | | | | | | | | |
| 3. Change in species composition and abundance of plankton | | | | | | | | | | | |
| 4. Change in abundance of major species of plants | | | | | | | | | | | |
| 5. Change in abundance of major species of animals | | | | | | | | | | | |
| *i. Fishes* | | | | | | | | | | | |
| *ii. Herpeto-fauna* | | | | | | | | | | | |
| *iii. Birds* | | | | | | | | | | | |
| *iv. Mammals* | | | | | | | | | | | |
| 6. Disappearance/ reappearance of species | | | | | | | | | | | |
| 7. Change is abundance of problematic IAS | | | | | | | | | | | |
| 8. Change in plant biomass | | | | | | | | | | | |
| 9. Change in 5 major resource use values (availability of resources) | | | | | | | | | | | |
| 10. Change in 5 major economically, nutritionally and cultrually important plant and animal species | | | | | | | | | | | |
| 11. Change in cultural values | | | | | | | | | | | |
| 12 Change in traditional water use techniques and practices | | | | | | | | | | | |
| 13. Assessment of threats | | | | | | | | | | | |
| *i. Proximate threats* | | | | | | | | | | | |
| *ii. Climate change* | | | | | | | | | | | |
| 14. Change in governance | | | | | | | | | | | |
| *i. Policy* | | | | | | | | | | | |
| *ii. Institution* | | | | | | | | | | | |
| *iii. Participation* | | | | | | | | | | | |
| *iv. Technology* | | | | | | | | | | | |
| *v. Information* | | | | | | | | | | | |
| *vi. Finance* | | | | | | | | | | | |

How to do mapping is the last step in assessment of wetlands. There are 14 major parameters used in this tool. Some parameters are measurable from scientific methods whereas others are measureable through direct observation, consultation and analysis of local perception. Hence, there are challenges in mapping the wetlands with scores justifying the status of wetlands particularly in a situation when there are multi-attributes. Because, one attribute may not comply with another one with similar weight given or identified (Table 19). For example, change in area under 1(i) has '0' score which means there is no change in core water area since 10 years, but there are significant changes in species abundance under 3, 4, and 5. Such sort of changes indicates that no change in physical structure *i.e.,* core area of wetlands does not mean no change in wetlands' condition. Core area does not function in isolation, there must be other factor(s) influencing wetlands. There are positive progresses on policy, institution and participation, but poor financial, technical and information structures (see under 14 in Table 19) that has possibly accelerated level of threats (see Table 13).

Preparing an assessment table is important to generalize wetlands condition. For this, refer Table 19. Put all attributes with sub-attributes in the first column. Second column is about crude sore. On the basis of crude score, band assessment is prepared in 3rd column with 5 different color boxes **{Red = worst (non-recoverable stage); Pink = bad (recoverable stage), Blue = no change; dark green = good; and Light Green = better)} to generalize wetlands condition in a simple way.**

Prepare an assessment table as in Table 19. Refer all attribute that start measuring changes from physical structure of wetlands to the governance - from step 13.1 to step18.5. Mention all attributes and sub-attributes in appropriate order giving crude rank score as in guidelines mentioned earlier under different steps. Be careful that one attribute may have many qulaifying sub-attributes, for example proximate threats with 17 qualifying sub-attributes. Generalize rank score of proximate threat (Step 17.2) that has 4 sub-attributes assessed worst; 7 assessed bad and 6 assessed as no change). Most of sub-attributes *i.e.,* 11 are qualifying deteriorating condition of wetlands of KTWR.

Be careful that any positive and negative change in species composition and abundance of plankton is detrimental to wetlands ecosystem. Increase in abuncance of plankton accelerates eutrophication which eventually degrades the quality of wetlands. Similarly, decrease in abundance increases the risk of species loss. So, in both case impact is negative. Similarly, increase in abundance of IAS indicates about increasing risk so it has RED Band eventhough it has scre as +1.

# Bibliography


1. Adhikari, B, Siwakoti, M and Subedi, K 2005. An Inventory and Assessment of Invasive Alien Plant Species of Nepal. IUCN Nepal, Kathmandu.
2. Ali, S. and Ripley, S.D. 1987. Compact Handbook of the Birds of India and Pakistan (sec. ed.). Oxford University Press, Delhi, India.
3. Baral, H.S., Inskipp, C., Inskipp, T. and Regmi, U.R. 1996. Threatened Birds of Nepal. Bird Conservation Nepal and epartment of National Park and Wildlife Conservation. Kathmandu.
4. Baral, H.S. and C. Inskipp (2005).Important Bird Areas in Nepal: Key Sites of Conservation. Bird Conservation Nepal and Birdlife International. Kathamndu and Cambridge.
5. Baral, H.S. and Shah, K.B. 2008. *Wild Mammals of Nepal* (Nepali language). Himalayan Nature, Kathmandu.
6. Bhandari, B. 2009. Preliminary Inventory of Nepal's Wetlands. IUCN Nepal, Kathmandu.
7. CBS 2002. Nepal Population Census Report 2001. Central Bureau of Statistics, Kathmandu.
8. Colleen A. Hatfield, Jennifer T. Mokos, and Jean Marie Hartman (2004). Development of Wetland Quality and Function Assessment Tools and Demonstration. Rutgers University, New Brunswick, NJ08901-8524.
9. Cook, C.D.K. 1996. Aquatic and Wetland Plants of India. Oxford University Press, Delhi.
10. Costa, L.T, Farinha, J.C, Hecker, N & Tomàs-Vives, P. 1996. *Mediterranean Wetland Inventory. Reference Manual.* MedWet Publication, ICN/Wetlands International.
11. DOF (2002). Community Forestry Programme in Nepal (Samudayik Van Vikas Karyakram) in Our forests (Hamro Van). Annual Progress Report of the Department of Forests, Kathmandu, Nepal.
12. Dugan, PJ (ed) 1990. *Wetland Conservation: A Review of Current Iissues and Required Action*. IUCN, Gland, Switzerland.
13. FAO 2006. Guidelines for Soil Description (4th ed.) Food and Agriculture Organization of the United Nations, Publishing Management service, information division, Rome, Italy.
14. Finlayson, CM 1996a. Information Required for Wetland Management in the SouthPacific. In *Wetland Conservation in the Pacific Islands Region.* (ed. Jaensch R) Proceedings of the regional workshop on Wetland Protection and Sustainable Use in Oceania, Port Moresby, Papua New Guinea, June 1994. Wetlands International-Asia/Pacific, Canberra: 185–201.
15. Finlayson, C M 1996b. The Montreux Record: A Mechanism for Supporting the Wise Use of Wetlands. In. Proceedings of the 6th Meeting of the Conference of the Contracting Parties, Technical Sessions: Reports and Presentations, Technical Sessions B and D. pp. 32.8. (Ramsar Convention Bureau: Gland, Switzerland.).
16. Finlayson, CM & Davidson, NC 2001. Wetland Inventory, Assessment and Monitoring: Practical Techniques and Identification of Major Issues. Introduction and review of past recommendations. In *Wetland Inventory, Assesssment and Monitoring: Practical Techniques and Identification of Major Issues* (eds. Finlayson CM, Davidson NC & Stevenson NJ). Supervising Scientist Report 161,Supervising Scientist, Darwin, Australia: 1–10.
17. Finlayson, CM, Begg G.W, Howes J, Davies J, Tagi K & Lowry J. 2002. *A Manual for an Inventory of Asian Wetlands: Version 1.0*. Wetlands International Global Series 10, Kuala Lumpur, Malaysia.
18. Fitoka, E & Keramitsoglou I 2008 (Editors). *Inventory, Assessment and Monitoring of Mediterranean Wetlands: Mapping Wetlands using Earth Observation techniques*. EKBY & NOA. MedWet publication. (Scientific reviewer Nick J Riddiford).
19. FRA 2010. Forest Resource Assessment in Nepal. Draft of the Field Manual for the Test Inventory 2010.
20. Hagen, T 1998. *Nepal – The Kingdom in the Himalaya*. Himal Books, Kathmandu (4th ed).
21. HMG/MFSC 2003. *National Wetland Policy*. The Ministry of Forests and Soil Conservation, Kathmandu, Nepal.

22. Inskipp, C. and Inskipp, T. 1991. A Guide to the Birds of Nepal. Groom Helm, London.
23. IUCN 1998. An Inventory of Nepal's Terai Wetlands (ed. Bhandari,B.). IUCN Nepal, Kathmandu.
24. IUCN 2004. A Review of the Status and Threats to Wetlands in Nepal. IUCN Nepal, Kathmandu.
25. Jayaram, KC 1981. The Freshwater Fishes of India, Pakistan, Bangladesh, Burma and Sri Lanka. A Handbook, Zoological Survey of India, Culcutta.
26. Jhingran, VG 1991. Fish and Fisheries of India. Hindustan Publishing Cooperation, Delhi.
27. Mool, PK, Bajracharya, SR and Joshi, SP 2001. Inventory of Glaciers, Glacial Lakes and Glacial Lake Outburst Floods, International Centre for Integrated Mountain Development (ICIMOD), Kathmandu.
28. Munsell 2009. The Munsell Soil Color Charts, 2009 revision.
29. Needham, JG and Needham, P.R. 1966. A Guide to the Study of Fresh Water Biology. Holden-Day, Inc. San Fransisco.
30. National Lake Conservation Development Committee, 2009. Lake Strategy. Draft report.2009.
31. Nepal Biodiversity Strategy (2002).*Nepal Biodiversity Strategy*. The Ministry of Forests and Soil Conservation, Kathmandu, Nepal.
32. Pokharel, Shailendra (2010). ILBM for the Sustainability Conservation of Himalayan lakes of Nepal. Proceeding of the National Workshop for the Sustainability of Himalayan Lakes. March 26-31, 2010. Kathmandu. Nepal.
33. Pokharel, Bharat K Dr. (2010). Contribution of Community Forestry to People's Livelihoods and Forest Sustainability: Experience from Nepal. www.ICIMOD_Net_Jully20_10r.
34. Polunin, O and Stainton, A 1997. Flowers of the Himalaya. Oxford University Press, New Delhi.
35. Pradhan, S. and Shilpkar, R. 2007. The Asian Wetlands Inventory (AWI) approach in the Himalayas. Himalayan Wetlands: Risks, Challenges and Opportunities (ed. Bhandari, B. and Gae Jae J.). Changwon: Ramsar Wetlands Centre, Korea.
36. Prasad, S. N; Ramachandra, V; Ahalya, N; Sengupta, T; Alok Kumar; Tiwari, AK; Vijayan, VS; & Vijayan Lalita (2002). Conservation of Wetlands of India – A review. *Tropical Ecology* **43**(1): 173-186, 2002.
37. Ramsar Convention Secretariat, 2007. *Inventory, Assessment, and Monitoring: An Integrated Framework for Wetland Inventory, Assessment, and Monitoring.* Ramsar handbooks for the Wise Use of Wetlands, 3rd edition, vol. 11. Ramsar Convention Secretariat, Gland, Switzerland.
38. Ramsar Convention Secretariat, 2007. *Wetland Inventory: A Ramsar framework for Wetland Inventory.* Ramsar Handbooks for the Wise Use of Wetlands, 3rd edition, vol. 12. Ramsar Convention Secretariat, Gland, Switzerland.
39. Rajbhandari, KR.and Adhikari, MK 2009. Endemic Plants of Nepal Part I. Department of Plant Resources, Kathmandu.
40. Rajbhandari, KR and Dungel, SK 2010. Endemic Plants of Nepal Part II. Department of Plant Resources , Kathmandu.
41. Scott, DA (ed.) 1989. *A Directory of Asian Wetlands*. IUCN Gland, Switzerland.
42. Secretariat of the Convention on Biological Diversity 2006. Guidelines for the rapid ecological assessment of biodiversity in inland water, coastal and marine areas. Secretariat of the Convention on Biological Diversity, Montreal, Canada, CBD Technical Series no. 22 and the Secretariat of the Ramsar Convention, Gland, Switzerland, Ramsar Technical Report no. 1.
43. Shah, KB and Tiwari, S 2004. *Herpeto Fauna of Nepal*. IUCN Nepal, Kathmandu.
44. Sharma, Sudhindra; Juhani, Koponen; Dipak Gyawali and Ajaya Dixit (2004). Aid under Stress. Water, Forest and Finish support in Nepal. Published by Himal Books for Institute of Development Studies. University of Helsinki, and Interdisciplinary Analyst, Kathmandu.

45. Shrestha, J 1981. Fishes of Nepal. Curriculum Development Centre, Tribhuvan University, Kathmandu.

46. Siwakoti, M and Varma SK 1999. Plant Diversity of Eastern Nepal: Flora of Plains of Eastern Nepal. M/S Bishen Singh Mahendra Pal Singh, Dehra Dun, India.

47. Siwakoti, M 2007a. Wetlands Conservation and Sustainable Livelihoods in Nepal. *Souvenir,* pp. 45-50. National Seminar on Sustainable Use of Biological Resources (April 22-23, 2007), Pokahara, Nepal organized by Ecological Society.

48. Siwakoti, M 2007b. Wetland Types and Associate Vegetation in Nepal: An Overview. *Wetland Science, 5(3*): 193-200. P.R. China.

49. Smith, GM 1933, 1950. The Fresh Water Algae of the United States, McGraw-Hill Book Company Inc., New York.

50. Subba Rao, NV 1989. Handbook of Freshwater Molluscs of India. Zoological Survey of India, Culcutta.

51. Thapa Chhetry, D 2006. Studies on Physico-chemical Parameters and Macro-Biota with Special Reference to Fishes in the Koshi Tappu Wildlife Reserve and Its Surroundings, Nepal.

52. Tonapi, GT 1980. Fresh water Animals of India. Oxford and IBH Publishing Co, New Delhi.

53. Trivedi, RK and Goel, P 1986. Chemical and Biological Methods for Water Pollution Studies. Environmental Publications, Karad, India.

54. WECS 2002. Water Resource Strategy Nepal, HMG/Nepal, Kathmandu.

55. Woodlands Mountain Institute and IUCN Nepal 1994. Biodiversity of Koshi Tappu Wildlife Reserve and its Adjacent Area. Applied Database for Integrated Biodiversity Conservation in Nepal. WMI/IUCN Nepal, Kathmandu.

56. Zobel, DB, Jha, PK, Behan, MJ and Yadav, UKR 1987. A Practical Manual for Ecology, Ratna Pustak Bhandar, Kathmandu.

# ANNEXES

## Annex 1 : Code for Wetlands based on Initials of District

| SN | District | Code | | SN | District | Code |
|---|---|---|---|---|---|---|
| 1 | Accham | AC | | 39 | Lalitpur | LP |
| 2 | Argakhachi | AK | | 40 | Lamjung | LJ |
| 3 | Baglung | BG | | 41 | Mahottari | MH |
| 4 | Bajhang | BA | | 42 | Makawanpur | MP |
| 5 | Bajura | BJ | | 43 | Manang | MN |
| 6 | Baitadi | BT | | 44 | Morang | MR |
| 7 | Banke | BK | | 45 | Mugu | MU |
| 8 | Bara | BR | | 46 | Mustang | MS |
| 9 | Bardiya | BD | | 47 | Myagdi | MY |
| 10 | Bhaktapur | BP | | 48 | Nawalparasi | NP |
| 11 | Bhojpur | BH | | 49 | Okhaldhunga | OD |
| 12 | Chitawan | CH | | 50 | Palpa | PP |
| 13 | Dadheldhura | DR | | 51 | Panchthar | PT |
| 14 | Dailekh | DI | | 52 | Parbat | PB |
| 15 | Dang | DD | | 53 | Parsa | PA |
| 16 | Darchula | DA | | 54 | Pyuthan | PY |
| 17 | Dhading | DH | | 55 | Ramechhap | RM |
| 18 | Dhankuta | DK | | 56 | Rasuwa | RS |
| 19 | Dhanusa | DS | | 57 | Rautahat | RT |
| 20 | Dolakha | DL | | 58 | Rolpa | RO |
| 21 | Dolpa | DP | | 59 | Rukum | RU |
| 22 | Doti | DO | | 60 | Rupendehi | RP |
| 23 | Gorkha | GO | | 61 | Salyan | SL |
| 24 | Gulmi | GU | | 62 | Sankhuwasabha | SS |
| 25 | Humla | HU | | 63 | Saptari | ST |
| 26 | Humla | HU | | 64 | Sarlahi | SA |
| 27 | Ilam | IL | | 65 | Sindhuli | SI |
| 28 | Jajarkot | JA | | 66 | Sindhupalchwok | SP |
| 29 | Jhapa | JH | | 67 | Siraha | SR |
| 30 | Jumla | JU | | 68 | Solukhumbu | SK |
| 31 | Kabhrepalanchok | KP | | 69 | Sunsari | SN |
| 32 | Kailali | KA | | 70 | Surkhet | SU |
| 33 | Kailali | KA | | 71 | Syangja | SY |
| 34 | Kanchanpur | KN | | 72 | Tanahau | TN |
| 35 | Kapilbastu | KV | | 73 | Taplejung | TJ |
| 36 | Kaski | KS | | 74 | Terathum | TT |
| 37 | Kathmandu | KM | | 75 | Udayapur | UP |
| 38 | Khotang | KT | | | | |
| | | | | | | |

*Source: National Lake Conservation Development Committee (2010)*

# Annex 2 : The Ramsar Classification of Wetlands

| Wetland type | Sub type | Description |
|---|---|---|
| **1. Marine/Coastal Wetlands** | | |
| **2. Inland Wetlands** | L | **Permanent inland deltas** |
| | M | **Permanent rivers/streams/creeks**; includes waterfalls |
| | N | **Seasonal/intermittent/irregular rivers/streams/creeks** |
| | O | **Permanent freshwater lakes** (over 8 ha); includes large oxbow lakes |
| | P | **Seasonal/intermittent freshwater lakes** (over 8 ha); includes floodplain lakes |
| | Q | **Permanent saline/brackish/alkaline lakes** |
| | R | **Seasonal/intermittent saline/brackish/alkaline lakes and flats** |
| | Sp | **Permanent saline/brackish/alkaline marshes/pools** |
| | Ss | **Seasonal/intermittent saline/brackish/alkaline marshes/pools**. |
| | Tp | **Permanent freshwater marshes/pools**; ponds (below 8 ha), marshes and swamps on inorganic soils; with emergent vegetation water-logged for at least most of the growing season |
| | Ts | **Seasonal/intermittent freshwater marshes/pools** on inorganic soils; includes sloughs, potholes, seasonally flooded meadows, sedge marshes |
| | U | **Non-forested peatlands**; includes shrub or open bogs, swamps, fens |
| | Va | **Alpine wetlands**; includes alpine meadows, temporary waters from snowmelt |
| | Vt | **Tundra wetlands**; includes tundra pools, temporary waters from snowmelt |
| | W | **Shrub-dominated wetlands**; shrub swamps, shrub-dominated freshwater marshes, shrub carr, alder thicket on inorganic soils |
| | Xf | **Freshwater, tree-dominated wetlands**; includes freshwater swamp forests, seasonally flooded forests, wooded swamps on inorganic soils |
| | Xp | **Forested peatlands**; peatswamp forests |
| | Y | **Freshwater springs; oases** |
| | Zg | **Geothermal wetlands** |
| | Zk (b) | **Karst and other subterranean hydrological systems**, inland |
| **3. Human-made wetlands** | 1 | **Aquaculture** (e.g., fish/shrimp) **ponds** |
| | 2 | **Ponds**; includes farm ponds, stock ponds, small tanks; (generally below 8 ha) |
| | 3 | **Irrigated land**; includes irrigation channels and rice fields |
| | 4 | **Seasonally flooded agricultural land** (including intensively managed or grazed wet meadow or pasture) |
| | 5 | **Salt exploitation sites**; salt pans, salines, etc |
| | 6 | **Water storage areas**; reservoirs/barrages/dams/impoundments (generally over 8 ha) |
| | 7 | **Excavations**; gravel/brick/clay pits; borrow pits, mining pools |
| | 8 | **Wastewater treatment areas**; sewage farms, settling ponds, oxidation basins, etc |
| | 9 | **Canals and drainage channels, ditches** |
| | Zk(c) | **Karst and other subterranean hydrological systems**, human-made |

*Source: Ramsar Convention Bureau : (http://www.ramsar.org/key_ris_types.htm*

# Annex 3 : Soil Classification

| Definition | | | Soil texture class and code | Clay content % |
|---|---|---|---|---|
| **1. Not possible to roll a wire of about 7 mm in diameter (about the diameter of a pencil)** | 1.1 Not dirty, not floury, no fine material in the finger rills | | Sand S | < 5 |
| | | *If grain sizes are mixed* | Unsorted sand US | < 5 |
| | | *If most grains are very coarse (> 0.6 mm)* | Very coarse and coarse sand CS | < 5 |
| | | *If most grains are of medium size (0.2–0.6 mm):* | Medium sand MS | < 5 |
| | | *If most grains are of fine size (< 0.2 mm) but still grainy:* | Fine sand FS | < 5 |
| | | *If most grains are of very fine size (< 0.12 mm), tending to be floury* | Very fine sand VFS | < 5 |
| | 1.2 Not floury, grainy, scarcely fine material in the finger rills, weakly shapeable, adheres slightly to the fingers | | Loamy sand LS | < 12 |
| | 1.3 Similar to 1.2 but moderately floury: | | Sandy loam (clay-poor) SL | < 10 |
| **2. Possible to roll a wire of about 3–7 mm in diameter (about half the diameter of a pencil) but breaks when trying to form the wire to a ring of about 2–3 cm in diameter, moderately cohesive, adheres to the fingers** | 2.1 Very floury and not cohesive | *Some grains to feel* | Silt loam (clay-poor) SiL | < 10 |
| | | *No grains to feel* | Silt Si | < 12 |
| | 2.2 Moderately cohesive, adheres to the fingers, has a rough and ripped surface after squeezing between fingers and | *Very grainy and not sticky* | Sandy loam (clay-rich) SL | 10–25 |
| | | *Moderate sand grains* | Loam L | 8–27 |
| | | *Not grainy but distinctly floury and somewhat sticky* | Silt loam (clay-rich) SiL | 10–27 |
| | 2.3 Rough and moderate shiny surface after squeezing between fingers and is sticky and grainy to very grainy | | sandy clay loam SCL | 20–35 |
| **3. Possible to roll a wire of about 3 mm in diameter (less than half the diameter of a pencil) and to form the wire to a ring of about 2–3 cm in diameter, cohesive, sticky, gnashes between teeth, has a moderately shiny to shiny surface after squeezing between fingers** | 3.1 Very grainy | | Sandy clay SC | 35–55 |
| | 3.2 Some grains to see and to feel, gnashes between teeth | *Moderate plasticity, moderately shiny surfaces* | Clay loam CL | 25–40 |
| | | *High plasticity, shiny surfaces* | Clay C | 40–60 |
| | 3.3 No grains to see & feel, does not gnash between teeth | *Low plasticity* | Silty clay loam SiCL | 25–40 |
| | | *High plasticity, moderately shiny surfaces* | Silty clay SiC | 40–60 |
| | | *High plasticity, shiny surfaces* | Heavy clay | HC >60 |

**Source: FAO (2006)**

# Annex 4 : IUCN Red List Categories (Version 3.1, 2001)

| | |
|---|---|
| **1. EXTINCT (EX)** | A taxon is Extinct when there is no reasonable doubt that the last individual has died. A taxon is presumed Extinct when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form. |
| **2. EXTINCT IN THE WILD (EW)** | A taxon is Extinct in the Wild when it is known only to survive in cultivation, in captivity or as a naturalized population (or populations) well outside the past range. A taxon is presumed Extinct in the Wild when exhaustive surveys in known and/or expected habitat, at appropriate times (diurnal, seasonal, annual), and throughout its historic range have failed to record an individual. Surveys should be over a time frame appropriate to the taxon's life cycle and life form. |
| **3. CRITICALLY ENDANGERED (CR)** | A taxon is Critically Endangered when the best available evidence indicates that it meets any of the criteria A to E for Critically Endangered (see Section V), and it is therefore considered to be facing an extremely high risk of extinction in the wild. |
| **4. ENDANGERED (EN)** | A taxon is Endangered when the best available evidence indicates that it meets any of the criteria A to E for Endangered (see Section V), and it is therefore considered to be facing a very high risk of extinction in the wild. |
| **5. VULNERABLE (VU)** | A taxon is Vulnerable when the best available evidence indicates that it meets any of the criteria A to E for Vulnerable (see Section V), and it is therefore considered to be facing a high risk of extinction in the wild. |
| **6. NEAR THREATENED (NT)** | A taxon is Near Threatened when it has been evaluated against the criteria but does not qualify for Critically Endangered, Endangered or Vulnerable now, but is close to qualifying for or is likely to qualify for a threatened category in the near future. |
| **7. LEAST CONCERN (LC)** | A taxon is Least Concern when it has been evaluated against the criteria and does not qualify for Critically Endangered, Endangered, Vulnerable or Near Threatened. Widespread and abundant taxa are included in this category. |
| **8. DATA DEFICIENT (DD)** | A taxon is Data Deficient when there is inadequate information to make a direct, or indirect, assessment of its risk of extinction based on its distribution and/or population status. A taxon in this category may be well studied, and its biology well known, but appropriate data on abundance and/or distribution are lacking. Data Deficient is therefore not a category of threat. Listing of taxa in this category indicates that more information is required and acknowledges the possibility that future research will show that threatened classification is appropriate. It is important to make positive use of whatever data are available. In many cases great care should be exercised in choosing between DD and a threatened status. If the range of a taxon is suspected to be relatively circumscribed, and a considerable period of time has elapsed since the last record of the taxon, threatened status may well be justified. |
| **9. NOT EVALUATED (NE)** | A taxon is Not Evaluated when it is has not yet been evaluated against the criteria |

# Annex 5 : Plants in the IUCN Red List

| S.N. | Scientific name | Common name | Red List |
|---|---|---|---|
| 1. | *Abies densa* | | LC v2.3 |
| 2. | *Abies pindrow* | | LC v2.3 |
| 3. | *Abies spectabilis* | | LC v2.3 |
| 4. | *Aglai acucullata* | Pacific Maple (E) | NT v2.3 |
| 5. | *Alstonia scholaris* | Blackboard tree (E) | LC v2.3 |
| 6. | *Andrewsianthus ferrugineus* | | EN v2.3 |
| 7. | *Cedrus deodara* | | LC v2.3 |
| 8. | *Chukrasia tabularis* | | LC v2.3 |
| 9. | *Cupressus torulosa* | | NT v2.3 |
| 10. | *Cycas pectinata* | | VU v3.1 |
| 11. | *Dalbergia latifolia* | Bombay Blackwood (E) | VU v2.3 |
| 12. | *Diplocolea sikkimensis* | | EN v2.3 |
| 13. | *Engelhardtia spicata* | | LC v2.3 |
| 14. | *Euonymus grandiflorus* | | LC v2.3 |
| 15. | *Holarrhena pubescens* | Bitter Oleander (E) | LC v3.1 |
| 16. | *Juniperus communis* | | LC v2.3 |
| 17. | *Juniperus indica* | | LC v2.3 |
| 18. | *Juniperus recurva* | | LC v2.3 |
| 19. | *Juniperus squamata* | | LC v2.3 |
| 20. | *Larix griffithii* | | LC v2.3 |
| 21. | *Larix potaninii* | | LC v2.3 |
| 22. | *Mangifera sylvatica* | | LC v2.3 |
| 23. | *Picea smithiana* | | LC v2.3 |
| 24. | *Pinus roxburghii* | | LC v2.3 |
| 25. | *Pinus wallichiana* | Himalayan Pine (E) | LC v2.3 |
| 26. | *Podocarpus neriifolius* | | LC v2.3 |
| 27. | *Scaphophyllum speciosum* | | VU v2.3 |
| 28. | *Shorea robusta* | | LC v2.3 |
| 29. | *Sloanea tomentosa* | | LC v2.3 |
| 30. | *Sorbus wallichii* | | LC v2.3 |
| 31. | *Takakia ceratophylla* | | VU v2.3 |
| 32. | *Taxus wallichiana* | Himalayan Yew (E) | DD v2.3 |
| 33. | *Tsuga dumosa* | | LC v2.3 |
| 34. | *Ulmus wallichiana* | | VU v2.3 |

*Source: IUCN 2006. 2006 IUCN Red List of Threatened Species. <www.iucnredlist.org (Bhuju et al., 2007)*

# Annex 6 : Protected Plants under Forest Act (1993)

**A. Ban on collection, use, sale, distribution, transportation, and export of the following medicinal herbs**

| S.N. | Scientific name | Nepali name | English name |
|---|---|---|---|
| 1. | *Dactylorhiza hatagirea* | Pancha Aunle | |
| 2. | *Juglans regia* * | Okhar | Walnut |
| 3. | *Picrorhiza scrophulariflroa* | Kutki | Gentian |

* Only bark

**B. Ban on export except the processed product on permission of Department of Forest.**

| S.N. | Scientific name | Nepali name | English name |
|---|---|---|---|
| 1. | *Nardostachys grandiflora* | Jatamansi | Spikenard |
| 2. | *Rauwolfia sepentina* | Serpagandha | Serpentina |
| 3. | *Cinnnamimum glausecens* | Sugandhakokila | |
| 4. | *Valeriana wallichi* | Sugandhawal | Indian Valerin |
| 5. | *Lichen species* | Jhyau | |
| 6. | *Abies spectabilis* | Talispatra | Fir |
| 7. | *Taxes wallichiana* | Loth Salla | Himalayan Yew |
| 8. | *Cordyceps sinensis* | Yarsa gomba | |
| 9. | Rock exude | Shilajeet | |

**C. Ban on transportation, export and felling for commercial purpose.**

| S.N. | Scientific name | Nepali name | English name |
|---|---|---|---|
| 1. | *Michaelia champaca* | Champ | |
| 2. | *Acacia catechu* | Khayer | Cutch tree |
| 3. | *Shorea robusta* | Sal | |
| 4. | *Bombax malabaricum* | Simal | Silk cotton tree |
| 5. | *Dipterocarpus marsupium* | Satisal | |
| 6. | *Dalbergia latifolia* | Bijayasal | |
| 7. | *Juglans species* | Okhar | Walnut tree |

*Source: MFSC (2007) Protected Plants of Nepal: Plant Resource Index http://www.biodiv-nepal.gov.np/plant_resource.html*

# Annex 7 : Protected Fauna under NPWCA (1973)

| S.N. | Scientific name | English name | Local name |
|---|---|---|---|
| **A. Mammals** | | | |
| 1. | *Macaca assamensis* | Assamese monkey | Assamis rato bandar |
| 2. | *Manis pentadactyla* | Indian pangolin | Salak |
| 3. | *Caprolagus hispidus* | Hispid hare | Hispid kharayo |
| 4. | *Canis lupus* | Wolf | Bwanso |
| 5. | *Ursus arctos* | Himalayan bear | Himali rato bhalu |
| 6. | *Ailurus fulgens* | Red panda | Habre |
| 7. | *Prionodon pardicolor* | Spotted linsang | Silu |
| 8. | *Felis bengalensia* | Leopard cat | Chari bagh |
| 9. | *Felis lynx* | Lynx | Lynx |
| 10. | *Neofelis nebulosa* | Clouded leopard | Dwanse chituwa |
| 11. | *Panthera tigris* | Tiger | Bagh |
| 12. | *Panthera uncia* | Snow leopard | Hinu chituwa |
| 13. | *Elephas maximus* | Asiatic elephant | Hatti |
| 14. | *Rhinoceros unicornis* | Rhinoceros | Gainda |
| 15. | *Sus salvanius* | Pygmi hog | Pudke Bandel |
| 16. | *Moschus moschiferos* | Musk deer | Kasturi mirga |
| 17. | *Cervus duvauceli* | Swamp deer | Barhasingha |
| 18. | *Bos gaurus* | Gaur | Gauri gai |
| 19. | *Bos grunniens* | Wild yak | Yak |
| 20. | *Bubalus bubalis* | Wild buffalo | Arna |
| 21. | *Ovis ammon* | Great tibetan sheep | Nayan |
| 22. | *Pantholops hodgsoni* | Tibetan antilope | Chiru |
| 23. | *Antilope cervicapra* | Black buck | Krisnasar |
| 24. | *Tetraceros quadricornis* | Four horned antilope | Chauka |
| 25. | *Hyaena hyaena* | Striped hynae | Hundar |
| 26. | *Platanista gangetica* | Gangetic dolphin | Shons |
| **B. Birds** | | | |
| 27. | *Catreus wallichii* | Chir pheasant | Kalij |
| 28. | *Lophophorus impeyanus* | Impeyan pheasant | Danfe |
| 29. | *Tragopan satyra* | Crimson horned pheasant | Monal |
| 30. | *Ciconia ciconia* | White stork | Setosarus |
| 31. | *Eupodotis bengalensis* | Bengal florican | Khar majur |
| 32. | *Sypheotides indica* | Lesser florican | Sano khar majur |
| 33. | *Grus grus* | Sarus crane | Sarus |
| 34. | *Buceros bicornis* | Giant hornbill | Thulo dhanesh |
| 35. | *Ciconia nigra* | Black stork | Kalo sarus |
| **C. Reptiles** | | | |
| 36. | *Gavialis gangeticus* | Ghariyal Gharial | Gohi |
| 37. | *Python species* | Python | Ajingar |
| 38. | *Varanus flavescens* | Monitor lizard | Sun gohoro |
| 39. | | | |
| 40. | | | |

*Source: HMG/MLJP/Law Books Management Committee, 2003. National Parks and Wildlife Conservation Act 1973 and the Relevant Rules and Regulations 2002 (in Nepali).*

## AQUATIC LIFE PROTECTION ACT (1961) - SECTIONS

2059/4/20 Under the Aquatic Life Protection Act 2017, Sections 4 and 5:

Under Section 4, capture, killing and harming the following is prohibited:

SCIENTIFIE NAME

*Schizothorax macropthalmus* (Terashima)
*Schizothorax nepalansis* (Terashima)
*Schizothorax rarenisis* (Terashima)
*Hardella thurjii thurjii*
*Kachuga dhongoka*
*Karchuga kachuga*
*Kachuga teesta*
*Kachuga tetoria flaviventer*
*Melanohchelys tritijuge indopeninsularis*
*Morenia petersi*
*Aspideretes gangeticus*
*Aspideretes hurum*
*Chitra indica*
*Fishemys punctata andersoni*
*Gavialis gangeticus*
*Crocodylys palustris*
*Platanista gangetica*
*Lutra lutra*
*Lutrogale perspicillata*

The following are not allowed to be captured, killed or harmed the following seasons and months in any water:

| *Schizothaichthys anendalai* (Regan) | *Sharad season's Kartik Hemanta season's Mangsir Shishir season's Falgun Basanta season's Chaitra month* |
|---|---|
| *Schizothoraichthys esocinus* (Heckel) | As above |
| *Schizothoraichthys progastus* (McClelland) | As above |
| *Schizothorax molesworthi* (Chandari) | As above |
| *Schizothorax plagiostomus* (Heckel) | As above |
| *Schizothorax richardsonii* (Gray) | As above |
| *Tor putitora* (Hamilton) | *Basanta season's Chaitra and Baishak, Barsha season's Bhadau and Sharad season's Asoj month* |
| *Tor tor* (Hamilton) | As above |
| *Neolissochilus hexagonolepis* (McClelland) | As above |

The following aquatic animals should not be captured, killed or harmed, even in seasons when they are allowed to be harvested, if they are smaller than the size mentioned below. Any animals caught with size smaller than mentioned below should be released back into the water.

| SPECIES | SIZE (CENTIMETERS) |
|---|---|
| *Schizothaichthys anendalai* (Regan) | 15 |
| *Schizothoraichthys esocinus* (Heckel) | 15 |
| *Schizothoraichthys progastus* (McClelland) | 15 |
| *Schizothorax molesworthi* (Chandari) | 15 |
| *Schizothorax plagiostomus* (Heckel) | 15 |
| *Schizothorax richardsonii* (Gray) | 15 |
| *Tor putitora* (Hamilton) | 30 |
| *Tor tor* (Hamilton) | 30 |
| *Neolissochilus hexagonolepis* (McClelland) | 30 |

The following species should not be captured, killed or harmed if they are smaller than the size mentioned below. Any animals caught with size smaller than mentioned below should be released back into the water.

| SPECIES | SIZE |
|---|---|
| *Ailia colia* (Hamilton) | 15 |
| *Amblyceps mangois* (Hamilton) | 5 |
| *Amphipnous cuchia* (Hamilton) | 20 |
| *Anabas testudineus* (Bloch) | 5 |
| *Anguilla bengalensis* (Gray) | 30 |
| *Aplocheilus panchax* (Hamilton) | 2.5 |
| *Badis basis* (Hamilton) | 5 |
| *Bagarius bagarius* (Hamilton) | 50 |
| *Barilius barila* (Hamilton) | 7.5 |
| *Barilius bama* (Hamilton) | 7.5 |
| *Barilius jalkapoorei* (Shrestha) | 10 |
| *Barilius tileo* (Hamilton) | 10 |
| *Barilius vagra* (Hamilton) | 5 |
| *Batasio batasio* (Hamilton) | 2.5 |
| *Botia almorhae* (Day) | 7.5 |
| *Batia lohachata* (Chandari) | 5 |
| *Carassius carassius* (Linnaeus) | 10 |
| *Catla catla* (Hamilton) | 20 |
| *Chaca chaca* (Hamilton) | 5 |
| *Chagunisus chagunio* (Hamilton) | 15 |
| *Chanda nama* (Hamilton) | 2.5 |
| *Chanda ranga* (Hamilton) | 2.5 |
| *Channa maruilius* (Hamilton) | 25 |
| *Channa steworthii* (Playfair) | 7.5 |
| *Channa striatus* (Bloch) | 25 |
| *Cirhinus mrigala* (Hamilton) | 20 |
| *Cirhinus reba* (Hamilton) | 15 |
| *Clarius batrachus* (Linneus) | 15 |
| *Clupisoma gaura* (Hamilton) | 15 |
| *Coliso fasciatus* (Bloch & Schneider) | 7.7 |
| *Danio rereo* (Hamilton) | 2.5 |
| *Esomas dandri* (Hamilton) | 2.5 |
| *Eutropiichthys vacha* (Hamilton) | 15 |
| *Gambusia offinispaturelis* (Baird) | 2.5 |
| *Garra annandalali* (Hora) | 5 |
| *Garra Gotyla* (Gray) | 7.5 |
| *Glyptothorax telchitta* (Hamilton) | 5 |
| *Heteropneustis fissilis* (Shrestha) | 10 |
| *Labeo ongra* (Hamilton) | 10 |
| *Labeo boga* (Hamilton) | 10 |
| *Labeo calbasus* (Hamilton) | 20 |
| *Labeo coerulius* (Day) | 10 |
| *Labeo dero* (Hamilton) | 10 |
| *Labeo dyocheilus* (McClelland) | 20 |
| *Labeo gonius* (Hamilton) | 20 |
| *Labeo pangusia* (Hamilton) | 20 |
| *Labeo rohita* (Hamilton) | 20 |
| *Lepidocephalicthys nepalensis* (Shrestha) | 2.5 |
| *Macrognathuss aculeatus* (Bloch) | 7.5 |

| SPECIES | SIZE |
|---|---|
| *Mastacemballus armatus* (Hamilton) | 7.5 |
| *Mastacemballus puncatus* (Lacepedo) | 7.5 |
| *Mystus oar* (Hamilton) | 25 |
| *Mystus seenghala* (Sykes) | 15 |
| *Mystus vittatus* (Bloch) | 2.5 |
| *Nandus nandus* (Hamilton) | 5 |
| *Nemacheilus bevani* (Gunther) | 2.5 |
| *Nemacheilus botia* (Hamilton) | 2.5 |
| *Nemacheilus rupicola* (Hora) rupicola | 2.5 |
| *Notopterus notopreruss* (Pallas) | 10 |
| *Ompak bimaculatus* (Bloch) | 15 |
| *Osteobrama cotio* (Hamilton) | 2.5 |
| *Oxygaster bacaila* (Hamilton) | 7.5 |
| *Pseudoecheneis sulcatus* (Hamilton) | 7.5 |
| *Pseudotropius atherinoides* (Bloch) | 5 |
| *Pseudotropius murius* (Bloch) | 15 |
| *Psilorthynchus pseudoechinius* (Menon & Dutta) | 5 |
| *Psilorhynchus sucatio* (Hamilton) | 5 |
| *Puntius opogon* (Valancies) | 5 |
| *Puntius chilinoid* (McClelland) | 10 |
| *Puntius ticto* (Hamilton) | 5 |
| *Rita rita* (Hamilton) | 30 |
| *Sciaena coitor* (Hamilton) | 10 |
| *Semiplones semiplones* (Hamilton) | 10 |
| *Sicamugil cascasia* (Hamilton) | 2.5 |
| *Sisor rhabdophores* (Hamilton) | 5 |
| *Tetradon cutcutia* (Hamilton) | 2.5 |
| *Wallago attu* (Schneider) | 20 |
| *Xenentodon cancilla* (Hamilton) | 7.5 |

## IUCN 2003 RED LIST OF THREATENED SPECIES FOR NEPAL

| Scientific Name | Common Name | Red List |
|---|---|---|
| *Kachuga kachuga* | bengal roof turtle (E) | CR A1cd ver 2.3 (1994) |
| *Gyps bengalensis* | asian white-backed vulture (e) | CR A1Ce+2ce ver 2.3 (1994) |
| *Gyps tenuirostris* | slender-billed vulture (E) | CR A4ce ver 3.1 (2001) |
| *Elachistodon westermanni* | indian egg-eater (E) | DD ver 2.3 (1994) |
| *Macrognathus aral* | spiny eel (e) | DD ver 2.3 (1994) |
| *Myotis csorbai* | | DD ver 2.3 (1994) |
| *Hylopetes alboniger* | particolored flying squirrel (e) | EN A1c ver 2.3 (1994) |
| *Caprolagus hispidus* | assam rabbit (e) | EN A1cd+2c, B1+2abcde, C1 ver 2.3 (1994) |
| *Elephas maximus* | asian elephant (E) | EN A1cd ver 2.3 (1994) |
| *Indotestudo elongate* | elongated tortoise (e) | EN A1cd+2cd ver 2.3 (1994) |
| *Kachuga dongoka* | three-striped roof turtle (e) | EN A1cd+2cd ver 2.3 (1994) |
| *Leptoptilos dubius* | greater adjutant (e) | EN A2cde, C1 ver 2.3 (1994) |
| *Pantholops hodgsonii* | chiru (e) | EN A2d ver 3.1 (2001) |
| *Bubalus bubalis* | asian buffalo (e) | EN A2e, C1 ver 2.3 (1994) |
| *Rhinoceros unicornis* | great indian rhinoceros (E) | EN B1+2cde ver 2.3 (1994) |
| *Ailurus fulgens* | lesser panda (e) | EN C2a ver 2.3 (1994) |
| *Panther tigris* | tiger (e) | EN C2a(i) ver 3.1 (1994) |
| *Gavialis gangeticus* | fish-eating crocodile (e) | EN C2a, E ver 2.3 (1994) |
| *Aegypius monachus* | black vulture (e) | LR/nt ver 2.3 (1994) |
| *Alcedo Hercules* | blyth's kingfisher (e) | LR/nt ver2.3 (1994) |
| *Amblonyx cinereus* | asian small-clawed otter (e) | LR/nt ver 2.3 (1994) |
| *Anhinga melanogaster* | oriental darter (e) | LR/nt ver 2.3 (1994) |
| *Aythya nyroca* | ferruginous duck (e) | LR/nt ver 2.3 (1994) |
| *Belomys pearsonii* | hairy-footed flying squirrel (e) | LR/nt ver 2.3 (1994) |
| *Buceros bicorni* | GREAT HORNBILL (E) | LR/nt ver 2.3 (1994) |
| *Circus macrourus* | PALE HARRIER (E) | LR/nt ver 2.3 (1994) |
| *Cyclemys dentate* | ASIAN LEAR TURTLE (E) | LR/nt ver 2.3 (1994) |
| *Diomys crumpi* | crump's mouse (e) | LR/nt ver 2.3 (1994) |
| *Ephippiorhynchus asiaticus* | black-necked stork (e) | LR/nt ver 2.3 (1994) |
| *Graminicola bengalensis* | rufous-rumped grassbird (e) | LR/nt ver 2.3 (1994) |
| *Haiaeetus albicilla* | grey sea eagle (e) | LR/nt ver 2.3 (1994) |
| *Hyaena hyaena* | striped hyaena (e) | LR/nt ver 2.3 (1994) |
| *La io* | grey sea eagle (e) | LR/nt ver 2.3 (1994) |
| *Ichthyophaga humilis* | lesser fish-eagle (e) | LR/nt ver 2.3 (1994) |
| *Ichthyophaga ichthyaetus* | great evening bat (e) | LR/nt ver 2.3 (1994) |
| *Indicator xanthonotus* | yellow-rumped honeyguide (e) | LR/nt ver 2.3 (1994) |
| *Macaca mulatta* | rhesus macaque (e) | LR/nt ver 2.3 (1994) |
| *Manis pentadactyla* | chinese pangolin (e) | LR/nt ver 2.3 (1994) |
| *Melanochelys trijuga* | indian black turtle (e) | LR/nt ver 2.3 (1994) |
| *Miniopterus schreibersi* | common bentwing bat (e) | LR/nt ver 2.3 (1994) |
| *Moschus chrysogaster* | alpine musk deer (e) | LR/nt ver 2.3 (1994) |
| *Myotis longipes* | kashmir cave bat (e) | VU B1+2c, D2 ver 2.3 (1994) |
| *Aquila clanga* | greater spotted eagle (e) | VU C1 ver 2.3 (1994) |
| *Aquila heliacal* | imperial eagle (e) | VU C1 ver 2.3 (1994) |
| *Cervus duvaucelii* | barasingha (e, f) | |
| *Gallinago nemoricola* | wood snipe (E) | |
| *Grus nigricollis* | black-necked crane (e) | |
| *Haliaeetus leucoryphus* | band-tailed fish-eagle (e) | |
| *Leptoptilos javanicus* | lesser adjutant (e) | |

| Scientific Name | Common Name | Red List |
|---|---|---|
| *Catreus wallichii* | cheer pheasant (e) | |
| *Cuon alpines* | asiatic golden cat (e) | |
| *Catopuma temminckii* | asiatic golden cat (e) | |
| *Neofelis nebulosa* | clouded leopard (e) | |
| *Pardofelis marmorata* | marbled cat (e) | |
| *Prionailurus viverrinus* | fishing cat (e) | |
| *Moschus fuscus* | Black musk deer (e) | LR/nt ver 2.3 (1994) |
| *Murina aurata* | little tube-nosed bat (e) | LR/nt ver 2.3 (1994) |
| *Murina huttoni* | hutton's tube-nosed bat (e) | LR/nt ver 2.3 (1994) |
| *Mycteria leucocephala* | painted stork (e) | LR/nt ver 2.3 (1994) |
| *Naemorhedus goral* | goral (e, f, s) | LR/nt ver 2.3 (1994) |
| *Nyctalus montanus* | mountain noctule (e) | LR/nt ver 2.3 (1994) |
| *Petaurista magnificus* | hodgson's giant flying squirrel (e) | LR/nt ver 2.3 (1994) |
| *Petaurista nobilis* | bhutan giant flying sqwuirrel (e) | LR/nt ver 2.3 (1994) |
| *Python molurus* | asiatic rock python (e) | LR/nt ver 2.3 (1994) |
| *Antilope cervicapra* | blackbuck (e) | NT ver 3.1 (2001) |
| *Lynx lynx* | eurasian lynx (e) | NT ver 3.1 (2001) |
| *Phylloscopus tytleria* | tytler's leaf-warbler (e) | NT ver 3.1 (2001) |
| *Crocodylus palustris* | broad-snouted crocodile (e) | VU A1a, C2a ver 2.3 (1994) |
| *Lutrogale perspicillata* | indian smooth-coated otter (e) | VU A1acd ver 2.3 (1994) |
| *Falco naumanni* | lesser kestrel (e) | VU A1bce+2bce ver 2.3 (1994) |
| *Rattus sikkimensis* | sikkim rat (e) | VU A1acd ver 2.3 (1994) |
| *Orubua cinereocapilla* | grey-crowned prinia (e) | VU A1c+2c ver 2.3 (1994) |
| *Chaetornis striatus* | bristled grass-warbler (e) | VU A1c+2c ,C1 ver 2.3 (1994) |
| *Chrysomma altirostre* | jerdon's babbler (e) | VU A1c+2c, C1 ver 2.3 (1994) |
| *Paradoxormis flavirostris* | black-breasted parrotbill (e) | VU A1c+2c,C1 ver 2.3 (1994) |
| *ploceus megarhynchus* | finn's baya weaver (e) | VU A1c+2c, C1+2a ver 2.3 (1994) |
| *Callosciurus pygerythrus* | irrawaddy squirrel (e) | VU A1cd ver 2.3 (1994) |
| *Macaca assamensis* | assam macaque (e) | VU A1cd ver 2.3 (1994) |
| *Anas Formosa* | baikal teal (e) | VU A1cd+2cd ver 2.3 (1994) |
| *Francolinus gularis* | swamp francolin (e) | VU A1cd+2cd ver 2.3 (1994) |
| *Hardella thurjii* | crowned river turtle (e) | VU A1cd+2cd ver 2.3 (1994) |
| *Aceros nipalensis* | rufous-cheeked hornbill (e) | VU A1cd+2cd, C1 ver 2.3 (1994) |
| *Aythya baeri* | baer's pochard (e) | VU A1cd+2cd, C1 ver 2.3 (1994) |
| *Bos grunniens* | wild yak (e) | VU A1cd+2cd, C1 ver 2.3 (1994) |
| *Bos frontalis* | garr (e, f) | VU A1cd+2cd, C1+2a ver 2.3 (1994) |
| *Morenia petersi* | indian eyed turtle (e) | VU A1cd+2d ver 2.3 (1994) |
| *Pelecanus philippensis* | grey pelican (e) | VU A1cde, C1 ver 2.3 (1994) |
| *Grus antigone* | sarus crane (e) | VU A1cde+2cde ver 2.3 (1994) |
| *Hystrix brachyuran* | malayan porcupine (e) | VU A1d+2d ver 2.3 (1994) |
| *Geoclemys hamiltonii* | black pond turtle (e) | VU A1d+2d ver 2.3 (1994) |
| *Myotis sicarius* | mandelli's mouse-eared bat (e) | VU A2c, D2 ver 2.3 (1994) |
| *Capricornis sumatraensis* | serow (e) | VU A2cd ver 2.3 (1994) |
| *Melurusus ursinus* | sloth bear (e) | VU A2cd, C1+2a ver 2.3 (1994) |
| *Hemitragus jemlahicus* | himalayan thar (e) | VU A2cde ver 2.3 (1994) |
| *Lutra lutra* | common otter (e) | VU A2cde ver 2.3 (1994) |
| *Ovis ammon* | argali (e, f) | VU A2cde ver 2.3 (1994) |
| *Ficedula subrubra* | kashmir flycatcher (e) | VU B1+2abcde, C1 ver 2.3 (1994) |
| *Epiophlebia laidlawi* | relict himalayan dragonfly (e) | VU B1+2c ver 2.3 (1994) |
| *Melanochelys tricarinata* | three-keeled land tortoise (e) | VU B1+2c ver 2.3 (1994) |
| *Houbaropsis bengalensis* | bengal bustard (e) | |

| Scientific Name | Common Name | Red List |
|---|---|---|
| *Rhinolophus ferrumequinum* | greater horseshoe bat (e) | LR/nt ver 2.3 (1994) |
| *Rhinolophus subbadius* | little nepalese horsheshoe bat (e) | DD ver 2.3 (1994) |
| *Rhodonessa caryophyllacea* | pink-headed duck (e) | CRD ver 2.3 (1994) |
| *Rynchops albicollis* | indian skimmer (e) | VU A1ce+2ce, C1 ver 2.3 (1994) |
| *Sarcogyps calvus* | indian black vulture (e) | LR/nt ver 2.3 (1994) |
| *Saxicola insignis* | hodgson's bushchat (e) | VU C1 ver 2.3 (1994) |
| *Scotomanes ornatus* | harlequin bat (e) | LR/nt ver 2.3 (1994) |
| *Semnopithecus entellus* | common langur (e) | |
| *Serex excelsus* | lofty shrew (e) | DD ver 2.3 (1994) |
| *Spelaeornis caudatus* | rufous-throated wren-babbler (e) | LR/nt ver 2.3 (1994) |
| *Stema acuticauda* | black-bellied tern (e) | LR/nt ver 2.3 (1994) |
| *Sus salvanius* | pygmy hog (e)<br>sanglier nain (f) | CR A1c, B1+2cd, E ver 2.3 (1994) |
| *Sypheotides indiac* | lesser florican 9e) | EN A2be, C1 ver 2.3 (1994) |
| *Teinopalpus imperialis* | kaiserihind (e) | LR/nt ver 2.3 (1994) |
| *Tetracerus wquadricomis* | chousingha (e) | VU C2a(i) ver 3.1 (2001) |
| *Threskiomis melanocephalus* | black-headed ibis (e) | LR/nt ver 2.3 (1994) |
| *Tragopan satyra* | crimson horned-pheasant (e) | LR/nt ver 2.3 (1994) |
| *Turdoides longirostris* | slender-billed babbler (e) | VU A1c+2c, C1 ver 2.3 (1994) |
| *Uncial uncial* | ounce (e) | EN C2a(i) ver 3.1 (2001) |
| *Ursus thibetanus* | asiatic black bear (e) | VU A1cd ver 2.3 (1994) |
| *Vulpes bengalensis* | bengal fox (e) | DD ver 2.3 (1994) |

Source: IUCN 2003. Red List of Threatened Species www.redlist.org
Note: Critically Endangered, CR; Endangered, EN; Vulnerable, VU; Near Threatened, NT; Least Concern, LC; Data Deficient, DD; Not Evaluated, NE
For more on IUCN Red List categories and criteria, definitions and assessments, please visit http://www.redlist.org/inf

# Annex 8 : Wetlands Dependent Endemic Species

| S.n. | Name | Habitat | Distribution ranges | Region |
|---|---|---|---|---|
| 1 | *Oreorchis porphyranthes* | River bed | 3100- 3800m | C |
| 2 | *Eriocaulon staintonii* | Marshes | 700-1800m | C, E |
| 3 | *Carex himalaica* | Very wet grounds | 3500-4200m | C, E |
| 4 | *Kobresia gandakiensis* | Near rivers | 1200-2000 m | C, E |
| 5 | *Deyeuxia nepalensis* | Along river and stream banks | 3500-4600m | W, C |
| 6 | *Poa imperialis* | Edge of streams | 4400m | E. |
| 7 | *Poa langtangenis* | Along riversides | 4000m | C. |
| 8 | *Aconitum amplexicaule* | Forest clearings near rivers | 3800-4200m | W, C |
| 9 | *Aconitum balangrense* | Near streams | 3300-3900m | W |
| 10 | *Berberis hamiltoniana* | River banks | 2700-4200m | W, C |
| 11 | *Corydalis brevicalcarata* | Drained with flowing stream | 3700m | W |
| 12 | *Corydalis clavibracteata* | Melting streams and stream side gravels | 3600-4700m | W |
| 13 | *Silene stellarifolia* | On sunny stream banks | 1700m | C |
| 14 | *Impatiens insignis* | Along water bodies/lakes | 900-2200m | C, E |
| 15 | *Impatiens leptoceras* | Along streams | 1400-1800m | C |
| 16 | *Impatiens sunkoshiensis* | Along streams | 2550-3200m | C, E |
| 17 | *Oxytropis arenae-ripariae* | Riverside | 4500-4700m | W, E |
| 18 | *Oxytropis williamsii* | Riverside | 2500-4400m | W, C |
| 19 | *Cotoneaster poluninii* | River terraces | 2500-2900m | W |
| 20 | *Saxifraga alpigena* | Streamside | 3450-4250m | C |
| 21 | *Saxifraga namdoensis* | Stream banks | 4500m | C |
| 22 | *Rhododendron lowndesii* | River banks | 2450-4500m | W, C |
| 23 | *Pedicularis pseudoregeliana* | Stream banks | 4000-4700m | E, C |
| 24 | *Pedicularis tamurensis* | Along stream banks | 3300-3400m | E |
| 25 | *Goldfussia acuminata* | River banks | 2100-2300m | C, E |
| 26 | *Salix eriostachya* | River beds | 3200-4500 | C, E |

*Source : Shrestha & Joshi, 1996. Rare, Endemic and Endangered Plants of Nepal.*

E.=East, W.= West, C. = Central

# Annex 9 : Structured Frameworks for Planning a Wetland Inventory

| Step | Guidance |
|---|---|
| **1. State the purpose and objective** | State the reason(s) for undertaking the inventory and why the information is required, as the basis for choosing a spatial scale and minimum data set. |
| **2. Review existing knowledge and information** | Review the published and unpublished literature and determine the extent of knowledge and information available for wetlands in the region being considered. |
| **3. Review existing inventory methods** | Review available methods and seek expert technical advice to: a) choose the methods that can supply the required information; and b) ensure that suitable data management processes are established. |
| **4. Determine the scale and resolution** | Determine the scale and resolution required to achieve the purpose and objective defined in Step 1. |
| **5. Establish a core or minimum data set** | Identify the core, or minimum, data set sufficient to describe the location and size of the wetland(s) and any special features. This can be complemented by additional information on factors affecting the ecological character of the wetland(s) and other management issues, if required. |
| **6. Establish a habitat classification** | Choose a habitat classification that suits the purpose of the inventory, since there is no single classification that has been globally accepted. |
| **7. Choose an appropriate method** | Choose a method that is appropriate for a specific inventory based on an assessment of the advantages and disadvantages, and costs and benefits, of the alternatives. |
| **8. Establish a data management system** | Establish clear protocols for collecting, recording and storing data, including archiving in electronic or hardcopy formats. This should enable future users to determine the source of the data, and its accuracy and reliability.<br><br>At this stage it is also necessary to identify suitable data analysis methods. All data analysis should be done by rigorous and tested methods and all information documented. The data management system should support, rather than constrain, the data analysis.<br><br>A meta-database should be used to: a) record information about the inventory datasets; and b) outline details of data custodianship and access by other users. |
| **9. Establish a time schedule and the level of resources that are required** | Establish a time schedule for: a) planning the inventory; b) collecting, processing and interpreting the data collected; c) reporting the results; and d) regular review of the program.<br><br>Establish the extent and reliability of the resources available for the inventory. If necessary make contingency plans to ensure that data is not lost due to insufficiency of resources. |

# Annex 10 : Alien Invasive Plants

| SN | Name of Species | Family | Local Name | Habit/Habitat | Native Country/ region |
|---|---|---|---|---|---|
| 1. | *Acacia famesiana* | Fabaceae | Ganhaune Kyayar | Shrub or tree/ moist & open places | Pantropics |
| 2. | *Acacia nilotica* | Fabaceae | Babul | Tree/moist &places | North Africa and Arab |
| 3. | *Acanthospermum hispidum* | Asteraceae | | Herb/moist fields | Brazil |
| 4. | *Achyranthes aspera* | Amaranthaceae | Apamarg, Datiwan | Herb/open waste places | Tropical America |
| 5. | *Adenostemma lavenia* | Asteraceae | | Herb/moist places | South America |
| 6. | *Aeschynomone aspero* | Fabaceae | Tal Khukuri | Herb /rice field & moist places | Tropical America |
| 7. | *Aeschynomone indica* | Fabaceae | Tal Khukuri | Herb /rice field & moist places | America |
| 8. | *Ageratina adeno-phora* | Asteraceae | Banmara | Herb/moist places | Mexico |
| 9. | *Ageratum conyzoides* | Asteraceae | Ganaune jhar, Boke jhar, lame jhar | Herb/moist places | South America/ Tropical America |
| 10. | *Ageratum housto-nianum* | Asteraceae | Ganaune jhar | Herb/moist places | Mexico |
| 11. | *Altermanthera paronychioides* | Amaranthaceae | | Herb/moist places | Tropical America |
| 12. | *Altermanthera philoxeroides* | Amaranthaceae | | Herb/moist places | Brazil |
| 13. | *Altermanthera ses-silis* | Amaranthaceae | | Herb/moist places | Tropical America |
| 14. | *Amaranthus spinosus* | Amaranthaceae | Kande lunde, Ban lunde | Herb/moist waste & cultivated fields | Tropical America |
| 15. | *Amaranthus viridis* | Amaranthaceae | Latte sag, lunde sag | Herb/moist & open places | Pantropical |
| 16. | *Anagallis arvensis* | Primulaceae | Krisna nell, amale | Common in winter crops as a weed | Europe |
| 17. | *Aniseia martinicensis* | convolvulaceae | | Herbaceous climber | Pantropical |
| 18. | *Argemone mexicana* | Papaveraceae | Satyanashi, thakal | Herb/roadside & wet places | Central America, Mexico, West Indies |
| 19. | *Argemone ochro-leuca* | Papaveraceae | Satyanashi, thakal | Herb/moist places | Central America |
| 20. | *Axonopus compres-sus* | Poaceae | | Herb/moist places | South America, Mexico, Brazil |
| 21. | *Bidens bitemata* | Asteraceae | Kuro | Herb/roadside, waste places | America |
| 22. | *Bidens pilosa* | Asteraceae | Kalo kuro, kurkur | Herb/roadside, waste places | Tropical America |
| 23. | *Bidens sulphurea* | Asteraceae | Kuro | Herb/ waste places cultivated areas | Maxico |

| SN | Name of Species | Family | Local Name | Habit/Habitat | Native Country/ region |
|---|---|---|---|---|---|
| 24. | *Biophyfum sensetivum* | Oxalidaceae | Lajawati | Herb/moist forest floor | Tropical Africa |
| 25. | *Biainvilea acmella* | Asteraceae | | Herb/shady forest areas | South America |
| 26. | *Boerhavia diffusa* | Nyctaginaceae | Lalgaipumi, punarva sanupate | Herb/moist places & roadside | Pantropical |
| 27. | *Borreria alata* | Rubiaceae | Ganele jhar | Herb/sandy soil | South America |
| 28. | *Brachiana mutica* | Poaceae | | Herb/moist places along rice field bunds | Europe |
| 29. | *Bromus wildenowi* | Poaceae | | Herb | South America |
| 30. | *Caesalpinia bonduc* | Fabaceae | Kanju, gainde, kanda, karaunji | Woody climber/ along roadside & waste places | Pantropics |
| 31. | *Cardiospermum helicacabun* | Sapindaceae | | Herb places/ climber | South America |
| 32. | *Cassia floribunda* | Fabaceae | Chinchine bis | Shrub/wastelands | Tropical America |
| 33. | *Cassia occidantentalis* | Fabaceae | Kasaundi, panwar | Shrub/wastelands | Tropical America/ South America |
| 34. | *Cassia pumila* | Fabaceae | | Shrub/waste places | Pantropical |
| 35. | *Cassia sophera* | Fabaceae | Kasaundi,tapre | Shrub/waste places | South America |
| 36. | *Cassia tora* | Fabaceae | Chakmake, Charkol tapre | Herb/shrub waste places | South America |
| 37. | *Celosia argentea var. argentea* | Amaranthaceae | Chande phool, Sahastrajari | Herb/weed in cultivated field | Pantropical |
| 38. | *Ceratophyllum demersum* | Ceratophyliaceae | | Herb/lakes and pond | Tropical America, Cosmopolitan |
| 39. | *Cestrum diumum* | Solanaceae | | Shrub/fallowlands | Tropical America |
| 40. | *Chenopodium album* | Chenopodiaceae | Bethe, bethuwa | Herb/wood in cultivated field | Maxico |
| 41. | *Chenopodium ambrosioides* | Chenopodiaceae | | Herb/moist waste places | Tropical America |
| 42. | *Chromolaena odorata* | Asteraceae | Banmara | Sub shrub forest and fellow land | Tropical America, America, West India |
| 43. | *Cissampelos pariera var.hirsuta* | Menispermaceae | Balulolahna | Climber forest | South America |
| 44. | *Cleome gynandra* | Capparaceae | Junge phul | Herb/along roadside | Pantropical |
| 45. | *Cleome specious* | Capparaceae | | Hot/moist places | South America |
| 46. | *Cleome rutidospermum* | Capparaceae | | Herb/open fields | West Tropical Africa |
| 47. | *Cleome spinosa* | Capparaceae | | Herb/moist area | Tropical America |
| 48. | *Convolvulus arvensis* | Convolvulaceae | | Climber/wood in cultivated field | Europe |

| SN | Name of Species | Family | Local Name | Habit/Habitat | Native Country/ region |
|---|---|---|---|---|---|
| 49. | *Coccinea grandis* | Cucurbitaceae | Lonbe | Climber/forest, fellow lands | Pantropical |
| 50. | *Conyza bonariensis* | Asteraceae | | Herb/in moist cultivated & waste land | Tropical America & Argentina |
| 51. | *Conyza Canadensis* | Asteraceae | | Hot fellow land and cultivated field | North America |
| 52. | *Conyza sumatrensis* | Asteraceae | | Herb/moist places | Tropical America |
| 53. | *Corchorus aestuans* | Tiliaceae | | Herb/moist places | Tropical America |
| 54. | *Crassocephalum crepidioides* | Asteraceae | | Herb/moist open places | Tropical America |
| 55. | *Crotalaria pallida* | Fabaceae | | Herb or Shrub/ waste places | Central and Tropical America |
| 56. | *Croton bonplandianum* | Euphorbiaceae | | Waste roadside | South America |
| 57. | *Datura metel* | Solanaceae | Kolo dhalum | Herb/roadside & waste places | Tropical America |
| 58. | *Datura stramonium* | Solanaceae | Dhalura | Herb/roadside & waste places | Tropical America |
| 59. | *Datura suaveolens* | Solanaceae | | Shrub/wet places | Tropical America |
| 60. | *Digitaria ciliaris* | Poaceae | | Herb/moist places | Tropical America |
| 61. | *Drymaria cordata* | Caryophyllaceae | | Herb/humid places | Pantropical |
| 62. | *Duranta repens* | Verbenaceae | | Shurb/along roadside | Central America |
| 63. | *Echinochloa Pyramidalis* | Poaceae | | Herb/wet places | Tropical Africa and America |
| 64. | *Eclipta prostata* | Asteraceae | Alancha | Herb/wet places | South America |
| 65. | *Eichhomia crassipes* | Pontederiaceae | Jalkumbi | Aquatic herb | South America/ Brazil |
| 66. | *Eleocharis acutangula* | Cyperaceae | | Herb/marshy places | Pantropical |
| 67. | *Engeron karvinskianus* | Asteraceae | Halhalo | Herb | Maxico |
| 68. | *Eupatorium capillifolium* | Asteraceae | | Herb | Tropical America |
| 69. | *Euphorbia heterophylla* | Euphorbiaceae | | Herb/waste places | Central America |
| 70. | *Euphoria hirta* | Euphorbiaceae | Dudha jhar | Herb /cultivated field & waste lands | Tropical America |
| 71. | *Euphorbia hypericifolia* | Euphorbiaceae | | Herb/ cultivated lands | Tropical America |
| 72. | *Euphorbia prostata* | Euphorbiaceae | | Herb/moist places & roadside | Jamaica/West Africa |
| 73. | *Fimbristylis complanata* | Cyperaceae | | Herb | Pantropical |

| SN | Name of Species | Family | Local Name | Habit/Habitat | Native Country/ region |
|---|---|---|---|---|---|
| 74. | *Fimbristylis littoralis* | Cyperaceae | | Herb | Pantropical, Maxico |
| 75. | *Fimbrislylis miliacea* | Cyperaceae | Juwane | Herb/wet places, rice fields | Tropical America |
| 76. | *Fimbristylis ovata* | Cyperaceae | | Herb | Pantropical |
| 77. | *Galinsoga parviflora* | Asteraceae | Chillange jhar | Herb/moist crop fields | South America |
| 78. | *Galinsoga quadria-diata* | Asteraceae | Jhuse chillange | Herb/moist places | Maxico/South Americ |
| 79. | *Gamochaete pensyl-vanica* | Asteraceae | | Herb /cultivated field & waste places | Tropical America |
| 80. | *Glinus lotoides* | Molluginaceae | | Herb/moist places | Tropical America |
| 81. | *Gnaphalium poly-caulon* | Asteraceae | Boke phul | Herb/ crop fields | Pantropical |
| 82. | *Gomphrena celo-sioides* | Amaranthaceae | | Herb & roadside | South America |
| 83. | *Heliotropium indicum* | Boraginaceae | | Herb/moist places | South America |
| 84. | *Hyptis suaveolens* | Lamiaceae | | Herb/forest floor | Tropical America |
| 85. | *Ipomoea alba* | Convolvulaceae | Chakmachake, Chandra kali | Herbaceous climber | Tropical America |
| 86. | *Ipomoea aquatica* | Convolvulaceae | Kami sag | Herbaceous climber/marshy watercourses | China |
| 87. | *Ipomoea camea ssp. fistulosa* | Convolvulaceae | Besarmsa | Shurb/moist places | South America |
| 88. | *Ipomoea hederifolia* | Convolvulaceae | | Herbaceous climber/hedges | Tropical America |
| 89. | *Ipomoea nil* | Convolvulaceae | Syude lahara | Herbaceous climber/hedges | Tropical America |
| 90. | *Ipomoea purpurea* | Convolvulaceae | | Herbaceous climber/hedges | Tropical America |
| 91. | *Ipomoea quamoclit* | Convolvulaceae | Jyanti | Herbaceous climber/hedges | Tropical America |
| 92. | *Ipomoea lubinata* | Convolvulaceae | | Herbaceous climber/hedges | Tropical America |
| 93. | *Jatropha curcas* | Euphobiaceae | Sajiwan | Shurb/roadsides | Tropical America |
| 94. | *Jatropha gossypifolia* | Euphobiaceae | | Shurb/waste places | Brazil /Tropical America |
| 95. | *Kyllinga nemoralis* | Cyperaceae | | Herb/moist places | Pantropical |
| 96. | *Lantana camaravar. aculeata* | Verbenaceae | Banphanda van-phanda kanda | Shurb/forest & waste places | Central America |
| 97. | *Lathyrus aphaca* | Fabaceae | | Herb/moist places | Europe |
| 98. | *Leersia hexandra* | Poaceae | | Herb/wet places | Tropical America |

| SN | Name of Species | Family | Local Name | Habit/Habitat | Native Country/ region |
|---|---|---|---|---|---|
| 99. | *Leonotis nepetifolia* | Labiatae | | Herb/fellow land | South America |
| 100. | *Leucaena leucocephala* | Fabaceae | | Shurb/forest cultivated fields | Tropical America |
| 101. | *Lipocarpha sphacelata* | Cyperaceae | | Herb/moist places | Pantropical |
| 102. | *Lolium temulentum* | Poaceae | | Herb/moist places | Mediterranean region |
| 103. | *Ludwigia octovalis* | Onagraceae | | Herb/wet places | South America |
| 104. | *Ludwigia hyssopifolia* | Onagraceae | | Herb/wet places | America |
| 105. | *Mariscus aristatus* | Cyperaceae | | Herb | Pantropical |
| 106. | *Martynia annua* | Martyniaceae | Gridhankki | Herb/waste places | Maxico |
| 107. | *Mecardonia procumbens* | Scrophlariaceae | | Herb/weed in moist places & gardens | Tropical America |
| 108. | *Medicago lupulina* | Fabaceae | | Herb/wet fields | Europe |
| 109. | *Melochia corchorifolia* | Sterculiaceae | Patuvajhar, phulijhar | Herb/shrub /in crop field & waste places | Pantropical |
| 110. | *Mikania micrantha* | Asteraceae | | Herbaceous climber/moist forest thickets | South America |
| 111. | *Mimosa pudica* | Fabaceae | Lajawati | Shrub /moist places | Pantropical, Brazil |
| 112. | *Mitreola petiolata* | Loganiaceae | | Herb | Pantropica |
| 113. | *Murdannia dimorpha* | Commelinaceae | | Herb | Brazil |
| 114. | *Myriophyllum aquaticum* | Haloragaceae | | Herb/ wetlands | South America |
| 115. | *Nicandra physaloides* | Solanaceae | Ishmagoli | Herb/moist places | Central America |
| 116. | *Nicotiana plumbaginifolia* | Solanaceae | | Herb/drains | Tropical America, Maxico |
| 117. | *Oenothera erythrosepala* | Onagraceae | | Herb | Europe |
| 118. | *Oenothera rosea* | Onagraceae | | Herb/open places | Peru |
| 119. | *Opuntia vulgaris* | Caclaceae | | Shrub /roadside and waste places | East and South America |
| 120. | *Oxalis comiculata* | Oxalidaceae | | Herb/moist places | South Europe and North America |
| 121. | *Oxalis latifolia* | Oxalidaceae | Chariamilo | Herb/open places | Brazil |
| 122. | *Oxalis corymbosa* | Oxalidaceae | | Herb/moist places | South America |
| 123. | *Paspalum conjugatum* | Poaceae | | Herb/moist places | South America, Brazil |

| SN | Name of Species | Family | Local Name | Habit/Habitat | Native Country/ region |
|---|---|---|---|---|---|
| 124. | *Paspalum distichum* | Poaceae | | Herb/moist places | Tropical America |
| 125. | *Parthenium hystero-phorus* | Asteraceae | | Herb/waste places | Tropical America |
| 126. | *Peperomia pellucida* | Piperaceae | | Herb/moist places & old walls | Central America |
| 127. | *Phalaris minor* | Poaceae | | Herb/weed on wheat field | Mediterranean region |
| 128. | *Phyllanthus amarus* | Euphorbiaceae | | | Central America |
| 129. | *Phyllanthus urinaria* | Euphorbiaceae | Ajata, bhul amala | Herb/moist places | Pantropical |
| 130. | *Physalis minima* | Solanaceae | | Herb | South America |
| 131. | *Physalis peruviana* | Solanaceae | Lshmgol, jangell meva, Rasbari | Herb/weed in cultivated fields | Tropical Africa/ Tropical South America |
| 132. | *Phytolaca americana* | Phylolacaceae | | Herb | America |
| 133. | *Phytolaca dioica* | Phylolacaceae | | Shrub or tree | South America |
| 134. | *Pistia stratiotes* | Araceae | kumbhika | Aquatic herb | Pantropical |
| 135. | *Populus tremula* | Salicaceae | | Tree | Europe to West Siberia |
| 136. | *Portulaca oleraceae* | Portulacaceae | Nundhiki | Herb/moist places | Pantropical |
| 137. | *Pycreus unioloides* | Cyperaceae | | Herb | Pantropical |
| 138. | *Ricinus communis* | Euphorbiaceae | Ander, Aandiko bot | Shrub or tree/ open places | North East Tropical America |
| 139. | *Ruellia tuberosa* | Acanthaceae | | Herb/moist places | Tropical America |
| 140. | *Sambucus canadensis* | Sambucaceae | Kanikephul | Shrub open places as hedge plant | South and North America |
| 141. | *Scirpus supinus sub sp. supinus* | Cyperaceae | | Herb in rice fields | Europe |
| 142. | *Scoparia dulcis* | Scrophulanaceae | | Herb/moist places | Tropical America |
| 143. | *Sesbania graniflora* | Fabaceae | Agasti | Tree/hedge along roadsides | Indonesia |
| 144. | *Setaria geniculate* | Poaceae | | Herb | Tropical & sub-tropical America |
| 145. | *Sida acuta* | Malvaceae | | Shrub /moist places | Tropical America |
| 146. | *Sida cordata* | Malvaceae | | Herb forest | Tropical America |
| 147. | *Sida cordifolia* | Malvaceae | Balu | Tree | Pantropical weed |
| 148. | *Sida rhombifolia* | Malvaceae | | Shrub /roadside and waste places | Pantropical weed |

| SN | Name of Species | Family | Local Name | Habit/Habitat | Native Country/ region |
|---|---|---|---|---|---|
| 149. | *Solanum aculeatis-simum* | Solanaceae | Kantakari | Herb or shrub / roadside and waste places | Tropical & South North America |
| 150. | *Solanum myriacan-thum* | Solanaceae | | Shrub | South America |
| 151. | *Solanum torvum* | Solanaceae | Bihi | Shrub /moist places | West Indies |
| 152. | *Solanum viarum* | Solanaceae | | Sub shrub /moist places | South America |
| 153. | *Soliva anthemifolia* | Asteraceae | | Herb/dry & moist crop field | South America |
| 154. | *Spergula arvensis* | Caryophyliaceae | | Herb/moist places | Europe |
| 155. | *Spilanthes paniculata* | Asteraceae | | Herb/moist places | Tropical America |
| 156. | *Stellaria media* | Caryophyliaceae | | Herb/moist places | Europe |
| 157. | *Sphenociea zeylanica* | Asteraceae | | Herb/moist places | Tropical Africa |
| 158. | *Syndrella nodiflora* | Asteraceae | | Herb/moist places | Tropical America |
| 159. | *Taraxacum officinale* | Asteraceae | Tukiphul | Herb /dry road-sides | Europe |
| 160. | *Tithonia diversifolia* | Asteraceae | | Shrub / waste places | Maxico |
| 161. | *Trianthema portulac-astrum* | Aizoaceae | Gadpurena, Gajpumi, Setopu-namava | Herb /humus rich soil | Pantropical |
| 162. | *Tridax procumbens* | Asteraceae | Husurejhar, Putali-jhar | Herb/moist grass-land | South America |
| 163. | *Urena lobata* | Malvaceae | Bariyar, Bherejhar, Nalukuro | Herb/forest and waste land | Africa |
| 164. | *Vemonia cinerea* | Asteraceae | Jhurjhure | Herb/moist places | Pantropical |
| 165. | *Xanthium strumar-ium* | Asteraceae | | Herb/cultivated and fallowlands | South America |
| 166. | *Zephyranthes cari-nata* | Amarylidaceae | | Herb/moist places | Maxico |
| 167. | | | | | |

*Source: Hara et al. (1978, 1982): Hara and Williams (1979); Press et al: IUCN (2001); Siwakoti and Varma (1999); IAS Web invasive India.htm: Sharma and Pandey (1984) ; Rao (1994).*

For further information

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