5 Inventory Data Collation

5.1 Level 1 Data – Major River Basins

The data fields recommended for an inventory at Level 1 are described below; a datasheet format is given in Annex 2. The datasheet should be accompanied by base maps available from existing secondary sources, for example topographic or thematic maps (scale approx. 1:500,000 to 1:1,000,000), or GIS-based maps, or maps derived from satellite data (e.g., MODIS, NOAA) for each basin in which the wetland inventory is to be compiled.

5.1.1 River basin code system

The GHWI uses the logical code system for river basins developed by Finlayson et al. (2002) in which the first two letters of the river basin name is the code for the main basin. For sub-basins within this basin, the first two letters of the sub-basin's name is added to the first two letters of the main basin, making a four-letter code ID. Similarly, at Level 3 (wetlands complex) the first two letters of the name are added to the four letters of main basin + sub-basin, describing the wetland complex with a six-letter code. The same approach is followed for the Level 4 wetland habitat/site. This coding system is illustrated in Figure 6. The proposed codes for selected rivers draining the Himalayas are presented in Table 3.

Figure 6: **Code system adopted by the GHWI from Level 1 (river basin) to Level 4 (wetland habitat)**

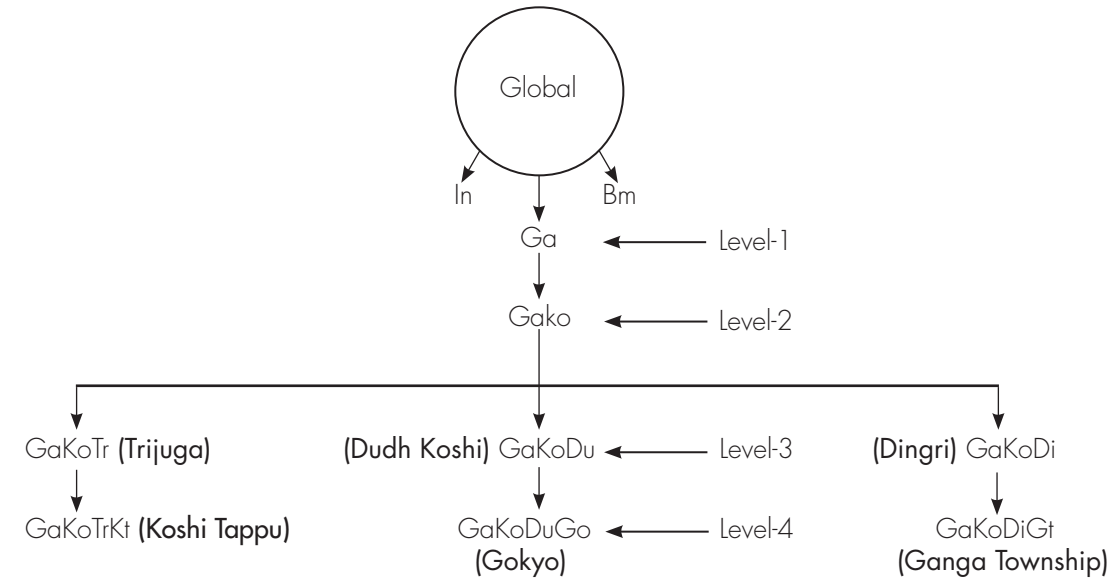


Table 3: **Names, proposed codes, and some basic statistics of the major river basins of the Himalayan region**

Name	Code[a]	Area (km²)[b]	Mean discharge[b] (m³/s)	Population density[b] (No./km²)
Amu Darya	Am	534,739	1,376[c]	39
Brahmaputra	Bm	651,335	21,261[c]	182
Ganges	Ga	1,016,124	12,037[c]	401
Indus	In	1,081,718	5,533	165
Irrawaddy	Ir	413,710	8,024	79
Mekong	Me	805,604	9,001[c]	71
Salween	Sw	271,914	1,494	22
Tarim	Ta	1,152,448	1,262	7
Yangtze (Chiang Jiang)	CJ	1,722,193	28,811[c]	214
Yellow (Huang He)	Hh	944,970	1,438[c]	156

Sources : [a] adapted from Finlayson et al. 2002; [b] Xu, Jianchu et al., 2008; [c] Data were obtained from the Global Runoff Data Centre (GRDC) for the following lowest downstream stations of the river basin: Chatly (Amu Darya), Bahadurabad (Brahmaputra), Farakka (Ganges), Parse (Mekong), Datong (Yangtze), Huayuankou (Yellow)

5.1.2 Geographic extent

Define the geographic extent of the river basin by using standard geographical coordinates from an appropriate map or geo-corrected image. The coordinates are determined by taking the latitude of the most northern and southern extremes and the longitude of the most eastern and western extremes of the area.

The geographic extent recorded in this section will be used as a base reference for the spatial data query and display facility in the information system. Hence it is recommended to record a slightly greater extent of the basin than the exact limits to enable proper display of the spatial data in the system. This is applicable for all levels from 1 to 4. The geographic extent of the ten major river basins as listed in Table 5 is being uploaded in the GHWIS. The basin boundary is updated using HYDRO1k data and SRTM DEM. Other thematic maps for the Ganges basin have been uploaded in the system as an example product.

5.1.3 Geology

General descriptions of the main geological provinces of the river basins are available from datasets which can be downloaded from the website of the U.S. Geological Survey (http://certmapper.cr.usgs.gov/rooms/we/index.jsp). They can also be provided on a CD ROM upon request.

5.1.4 Climate

The major river basins of the region can be divided into one or more climate classes using the Koeppen climate classification (http://koeppen-geiger.vu-wien.ac.at/). A description of each climate zone (based on monthly rainfall and temperature data) is available from datasets on the United Nations Food and Agricultural Organization (FAO) web site (http://www.fao.org/sd/EIdirect/climate/EIsp0002.htm).

5.1.5 Ecoregions

Recently (May 2008), the system of 'Freshwater Ecoregions of the World' (FEOW) has been introduced, which provides a new global biogeographical regionalisation of the Earth's freshwater biodiversity. Covering virtually all 426 freshwater ecoregions on Earth, this first-ever ecoregion map, together with associated species data, is a useful tool for underpinning global and regional conservation planning efforts, particularly for identifying outstanding and imperilled freshwater systems; for serving as a logical framework for large-scale conservation strategies; and for providing a global-scale knowledge base for increasing freshwater biogeographical literacy. The freshwater ecoregion maps can be downloaded from the FEOW web site (http://www.feow.org/). Reports for each ecoregion synthesising biodiversity and threat data are also available online.

The freshwater ecoregion map serves as a complement to the global terrestrial (http://www.worldwildlife.org/science/ecoregions/item1267.html) and marine ecoregion maps (http://www.worldwildlife.org/science/ecoregions/marine/item1266.html) and differs from them in that freshwater species (primarily fish) and freshwater processes drove the map delineation. More information on ecoregions can be downloaded from the WWF web site (http://worldwildlife.org/science/index.html).

5.1.6 Vegetation

Datasets suitable for describing the vegetation of the geographical regions can be obtained from the Global Land Cover 2000 database, European Commission Joint Research Centre, 2003 (http://www-tem.jrc.it/glc2000). The database provides two types of products, the global land cover dataset, which is a harmonisation of all the regional products into a global product with a generalised legend, and regional land cover datasets with a regionally specific legend, to provide as much detail as possible. The regional land cover datasets can be used for describing the vegetation within the basin.

5.1.7 Hydrological regime

Describe the hydrological regimes of the basin, including overall water availability, lean and peak season flows, and degree of basin fragmentation, with reference to published data or sources such as the Watersheds of the World, published by World Resources Institute (WRI), International Union for the Conservation of Nature (IUCN), Ramsar Convention on Wetlands, and International Water Management Institute (IWMI) (IUCN 2003, no date) which provides data on water availability and extent of fragmentation.

5.1.8 Wetland area and type

Record the approximate amount of wetland for each major river basin in the region (in sq.km) and the proportion of the river basin that is known to be occupied by wetlands. The Global Lakes and Wetland Database created by using all published sources (Lehner and Doll 2004) is available for free download at (http://www.worldwildlife.org/science/data/item1877.html). The lakes, reservoirs, rivers, and different wetland types are provided in the form of a raster map at 30-second resolution and can be used to describe wetland types and area for major river basins.

5.1.9 Wetland ecosystem services

Describe the goods and services that are provided by wetlands in the region using the information developed by the Millennium Ecosystem Assessment (MA 2005) (www.millenniumassessment.org) as a guide (Table 4). As per the MA framework, ecosystem services are defined as the range of benefits people derive from the ecosystems, and have been broadly classified into provisioning, regulating, cultural, and supporting.

Provisioning services are products obtained from wetlands, including food and fibre, fuel, genetic resources, biochemicals, natural medicines, pharmaceuticals, ornamental resources, and freshwater (see Table 4).

Regulating services are benefits obtained from the regulation of wetland processes, including air quality maintenance, climate regulation, water regulation, erosion control, water purification and waste treatment, regulation of human diseases, biological control, pollination and storm protection.

Cultural services are non material benefits people obtain from wetland ecosystems through spiritual enrichment, cognitive development, reflection, recreation, and aesthetic experiences, including cultural diversity, spiritual and religious values, knowledge systems, educational values, inspiration, aesthetic values, social relations, sense of place, cultural heritage values, recreation, and eco-tourism.

Table 4: **Categorisation of region-wide goods and services provided by wetlands** (MA, 2005)

Ecosystem services	Examples
Provisioning	Food, freshwater*, fibre fuel
Regulating	Climate regulation, water, erosion, disease
Cultural	Spiritual, recreational, aesthetic, educational
Supporting	Primary production, soil formation, nutrient cycling

Supporting services are services necessary for the production of all other ecosystem services and include soil formation, nutrient cycling, and primary production.

The wetland ecosystem services within an inventory context have to be interpreted hierarchically. For example, the regulating services are more explicit at the basin and sub basin level, the cultural and provisioning services are more obvious at lower hierarchies, i.e.,wetland complex and wetland site scale. Document the ecosystem services that are dominant at basin scale. Watersheds of the World, published by WRI, IUCN, Ramsar convention on wetlands and IWMI can provide additional inputs for such information (http://www.iucn.org/about/work/programmes/water/wp_resources/wp_resources_eatlas).

5.1.10 Development activities

Describe the most important development activities within the basin. Conservation and management of wetlands has to be placed in the context of development activities which take place at various scales and thereby influence, or have a potential to influence, the values and functions of the wetlands. These include urbanisation, agricultural development, industrial development, and others which have the potential to affect wetlands through influencing water use, resource use patterns, or even the functional role of wetlands.

5.1.11 Management issues and threats

Identify the primary reasons for the loss and degradation of wetlands in the region by using information drawn from the WWF Ecoregion Maps for Asia (www.wwfus.org/ecoregions/index.htm) and the MA Framework for Assessment (MA 2003). The threats or pressures concerned (Table 5) are referred to as 'indirect drivers' in the MA framework and are regarded as the major forces which influence one or more of the 'direct drivers' that are described in Level 2.

Note that the difference between issues and threats has been defined by Ntiamo-Baidu (2001):

- A wetland issue is an underlying socioeconomic and/or political factor (e.g., urbanisation, population pressure, sectoral structures) that could lead to adverse change in the ecological character of a wetland.
- A threat to a wetland is a specific natural or human-induced factor (e.g., landslides, volcanic eruptions, water pollution, siltation, agricultural expansion, over-exploitation) that could have a detrimental effect on the ecological character of the wetland or even cause its disappearance.

Table 5: **Indirect drivers of major management issues and threats** (source MA 2003)

Indirect driver	Examples
Demographic	Population growth and demographic structure; spatial distribution of population
Economic	Globalisation and trade policy; economic growth and structures; consumption patterns; income and wealth distribution; agriculture, forestry and fishery policies
Socio-political	Governance/collective action; democracy; institutional settings; attitude towards gender; involvement in conflict/war
Science and technology	Agricultural innovation; information technology; rate of technical change; access to information/intellectual property rights
Cultural and religious	Beliefs, consumption choices

5.1.12 Data sheet completion

- Name and address of compiler: the name and address of the compiler should be stated as shown in the datasheet.
- Date sheet completed/updated: state the date of data sheet completion or update.

5.2 Level 2 Data — Sub-basins

Data collection at Level 2 focuses on sub-basins within each of the major river basins determined earlier at Level 1. Depending on the size of the areas concerned, one or more sub-basins of a major river basin can be regarded as a single unit.

The Level 2 data sheet should be accompanied by base maps available from existing secondary sources, for example topographic or thematic (scale approx. 1:250,000 to 1:500,000), or GIS-based maps, or maps derived from medium to low resolution satellite data (e.g., MODIS, NOAA) for the sub-basin for which the inventory is being compiled.

Data on some wetland regions can be derived from the International Union for the Conservation of Nature (IUCN) web site (IUCN 2003, no date). This provides information about large sub-basins within a river basin. In most cases the watersheds of each sub-basin will need to be defined manually and a decision made about whether or not the area shown comprises a distinct wetland region as it is, whether it needs further subdivision, or whether it warrants being grouped with adjoining sub-basins. In making the decisions required, access to a topographic map or a digital elevation model (DEM) of the primary river basin is of considerable assistance. The SRTM DEM (http://srtm.csi.cgiar.org/) can serve as a good source for such purposes. If a reasonably good DEM is available, the sub-basin boundary can be delineated using a hydro-processing tool in GIS software like ArcGIS or ILWIS.

5.2.1 Name and code of sub-basin

Identify each sub-basin by a discrete name (using the name of the largest river draining the area) and a code (e.g., numeric or text). Note that the unique code initially used for the major river basin (Level 1, see Section 5.1.1) in which the sub-basin is located, always remains the same. A coding system is adopted for this inventory as illustrated in Figure 4, in which the first two characters of the code describe the main basin in which the sub-basin is located and next two characters define the name of the sub-basin. A similar approach is adopted for coding Levels 3 and 4.

5.2.2 Geographic location

Define the location of a sub-basin using standard geographical coordinates. Determine the coordinates by using an appropriate map or geo-corrected image and taking the latitude of the most northern and southern extremes and the longitude of the most eastern and western extremes of the area.

It is recommended to include a centroid to identify the geometric centre of the sub-basin. The centroid can be obtained from GIS-based maps and it can be useful for quickly identifying the location of the area and possible sources of information from maps and remotely sensed imagery.

5.2.3 Climatic characteristics

The resolution of the global climatic classification map (http://www.fao.org/waicent/faoinfo/sustdev/Eldirect/climate/Elsp0002.htm) appears to be too coarse for the sub-basin level due to the high variation in climate within short spatial distances in the Himalayan region. The Koeppen classification description can be used to describe climatic characteristics based on the observed precipitation and temperature within and around the sub-basin. If climatic characteristics are described based on published stations' information, it is recommended to record the name, code, and geographic location of the station (latitude and longitude), which will enable spatial visualisation of the climatic data in the GHWIS.

The World Water and Climate Atlas published by the International Water Management Institute (http://www.iwmi.cgiar.org/WAtlas/Default.aspx) provides eleven agro-climatic parameters including mean monthly air temperatures and precipitation. This can be an alternative source for climatic characteristics.

5.2.4 Physical features

Altitude range

Define the altitude range of the area by providing the minimum and maximum elevation. The SRTM, which can be downloaded from the CGIAR consortium for spatial information (http://srtm.csi.cgiar.org/Index.asp) can be used to compile altitude information.

Wetland area and type

Record the spatial extent of wetland (in km^2) using Table 6 as a guide. Many attempts have been made to map wetland extent in the region using remotely sensed data (see Garg et al. 1998, Vijayan et al. 2004, ICIMOD 2007). If such data exists and covers the entire sub-basin, it can supplement the Global Lakes and Wetlands Database (Lehner and Doll 2004) for recording wetland types and area in the sub-basin.

Table 6: **Surface area of wetland in the sub-basin**

Category	Extent (%)
Very large	>75
Large	50 - 75
Medium	25 -50
Small	<25

In the case of wetlands that have a linear form (i.e., channel features such as rivers and streams), record the cumulative length of the channel (in km) and, if possible, differentiate between the extent of the stream orders concerned (i.e., compare the sizes of the different rivers in the region). The smallest streams, which have no tributaries, are called first order streams; when two of these coalesce they form second order streams; and when two second order streams join they form third order streams; and so on).

Geological characteristics

Describe the specific geological features of the area, noting that these should be a more detailed sub-set of the information presented in the Level 1 data sheet. The major geological classes published by Wandrey and Law (1999) for South Asia and Steinshouer et al. (1999) for Asia Pacific including China can be used for describing geological characteristics at sub-basin level.

Water regime

Provide data on mean annual runoff (MAR) and seasonality of flows in the river system of the sub-basin, with reference to published data on river discharge. It is suggested to record basic station information and geographical location for such published river discharge data. Long-term mean monthly discharges provided by the Global Runoff Data Centre (GRDC) (http://www.bafg.de/GRDC) operated by the World Meteorological Organization (WMO) can serve as an additional source of data to describe the water regime.

5.2.5 Ecoregion

Describe the bio-geographical unit or ecoregion within the sub-basin from the same ecoregion map used in Level 1 (see 5.1.5). The freshwater ecoregion maps can be downloaded from the FEOW web site (http://www.feow.org/). Reports for each ecoregion synthesising biodiversity and threat data are also available online and can be helpful for describing the ecoregion.

5.2.6 Vegetation

Describe the major vegetation features of the area, noting that at the very least this should be more detailed than the information presented at Level 1. Sources of such data can be sought in country/region vegetation maps and descriptions from well-established organisations such as the Space Application Centre in India. If this type of data is not available for the entire sub-basin (or difficult to assess), use the same major vegetation features used in Level 1.

5.2.7 Wetland ecosystem services

Describe the wetland ecosystem services which manifest themselves at the sub-basin level using the same classification scheme as in Section 5.1.9. At sub-basin level, some of the cultural functions will become more prominent in addition to the regulatory services.

5.2.8 Development activities

Describe the developmental activities at the sub-basin level which have the potential to influence wetland values and functions. These may include such things as channelisation schemes, floodplain conversion schemes, and settlement expansion.

5.2.9 Management issues and threats

Identify the specific reasons for the loss and degradation of wetlands in the region and expand on the management issues and threats identified at Level 1. The threats concerned are referred to as 'direct drivers' in the MA framework (Table 7) and are regarded as the forces that have direct influence on the ecosystem services described earlier.

Table 7: **Direct drivers of management issues and threats** (adapted from MA 2003)

Direct driver	Examples
Changes in local land use and cover	Landscape fragmentation, cover change, dewatering
Species introduction or removal	Invasive plants and animals that subsequently become declared weeds, pests, or vermin
Technology adaptation and use	Advanced fishing technologies leading to depletion of fish stocks, pesticide usage, irrigation
External inputs	Fertiliser use, pest control
Harvest and resource consumption	Fishing, logging, sand and gravel extraction
Climate change	Glacier retreat, glacial lake outburst flood (GLOF)
Natural, physical, and biological drivers	Desertification, volcanoes

5.2.10 Jurisdiction

Describe each sub-basin in terms of its national and local jurisdiction. The International Organisation of Standardisation (ISO) codes should be used to show national jurisdiction and the names of provinces, counties and city administration units stated under each relevant ISO country code (if available).

5.2.11 Data sheet completion

- Name and address of compiler: state the name and address of the compiler as shown in the datasheet.
- Date sheet completed/updated: state the date of data sheet completion or update.

5.3 Level 3 Data — Wetland Complexes

Level 3 data collection focuses on defining and describing 'wetland complexes' (the maximum inundated area of the wetlands) within the sub-basin identified at Level 2.

The Level 3 data sheet should be accompanied by base maps available from existing secondary sources, for example topographic or thematic maps (scale approx. 1:25,000 to 1:250,000), or GIS-based maps at a suitable scale, depending on the extent of the wetland complex concerned.

The larger the river basin, the larger is the number of sub-basins (or sub-catchments) within it. Wetland complexes are hydrologically linked because they lie within the same sub-catchment and can either be entire sub-catchments, a group of individual wetlands (also of various types), or a number of smaller discrete wetlands (sometimes only a few hectares in size). The watersheds between wetland complexes serve to distinguish the sub-catchments involved.

In addition to the hydrological boundary, it is recommended to considered the ecological region, or existing conservation units where applicable (e.g., national parks), or administrative units (e.g., county) while delineating a wetlands complex. This will facilitate collation of the non-spatial information required at Level 3, such as demographic data.

As considerably more data are required at this level, it is recommended that data collection is conducted on a priority basis and in conjunction with other parties and wetland programmes. As a wetland region (sub-basin) can contain a number of wetland complexes, it is also noted that data collection should be done efficiently as similar data is required for all wetlands within each complex.

5.3.1 Name and code of wetland complex

State the name and code to identity each wetland complex by using the procedure followed for Levels 1 and 2. A subsidiary code (using decimals) can be used to further define the primary code at Level 3. Alternately, the name and code can be derived from local maps by adopting the name of the largest river draining the complex. Where no river name exists for the wetland complex, the name of the province, county or other administrative unit in which the complex is located should be used.

5.3.2 Geographic location

State the geographic extent of the wetlands complex, recording latitude and longitude from its delineated boundary within the sub-basin in the same manner as in Levels 1 and 2 (at a minimum, the upper left and lower right extremities of the complex must be recorded).

In most cases, like topographic maps, a projected coordinate system such as the Universal Transverse Mercator (UTM) system is used. In such a system, the coordinates would be expressed as metres of Eastings and Northings (e.g: 211396E 8489624N). Recording the coordinates as metres increases the relative accuracy with which the boundary of the wetland complex is defined. It also assists with area and distance calculations. In this case, translate the projected coordinate system to a geographic coordinate system using the detailed projection parameter normally provided in maps.

The current version of the GHWIS database management system does not have a facility to provide geographic extent in metric coordinates. In addition, it is important to recognise that projected coordinate systems may not be suitable for recording the geographic locations of all wetland complexes. In some situations, for example when the boundary of two projected system zones run through the complex, it is recommended that a geographic coordinate system be used. In such a situation, the coordinates should be recorded as decimal degrees of latitude and longitude.

Those responsible for entering data must therefore specify whether they are using a geographic or projected coordinate system, and if the latter, the type of projection that is applied (for example, the WGS 1984 UTM projection) and, where appropriate, the map grid zone in which the complex occurs.

5.3.3 Climatic characteristics

Record general information on average rainfall, temperature range (including average temperatures), relative humidity (9 am and 3 pm), prevailing winds, and evaporation (Class A pan) and note the location of the weather station (name, latitude and longitude, altitude).

5.3.4 Ecological character

The 7th Ramsar Conference in San Jóse, Costa Rica, in 1999 revised and adopted the definition of 'ecological character' based on expert advice from the Convention's Scientific and Technical Review Panel (STRP). This definition, as adopted by Resolution VII.10, is as follows:

> "Ecological character is the sum of the biological, physical, and chemical components of the wetland ecosystem, and their interactions, which maintain the wetland and its products, functions, and attributes."

On this basis, the core data required to describe the 'ecological character' of a wetland complex should be grouped under three headings describing the physical, physico-chemical, and biological features of the complex.

Physical features

Altitude range

Record the altitudinal range of the wetland complex by defining its minimum and maximum elevation in metres above n sea level (m amsl). This information is normally available from topographical maps, orthophotographs, and/or national and regional land survey or mapping services.

Spatial extent

Establish/describe the spatial extent of the wetland complex (in km^2).

Soil types

Describe the dominant soil type(s) within the area of the wetland complex using standardised soil classifications taken from national soil maps. Depending on the size of the wetland complex, the FAO digital soil map of the world (http://www.fao.org/geonetwork/srv/en/metadata.show?id=14116&currTab=distribution) can serve as an additional source of such information.

Water regime

Describe the mean monthly and annual inflow and run-off generated by the catchment, based on availability of measuring-station data. If such data is unavailable, predictive models can be used for runoff estimation, but such techniques will obviously involve considerably more time and expertise. Record the cumulative length of the main rivers and streams draining the complex (in km) and, as done at Level 2 (section 5.2.4), differentiate between the extent of the stream orders concerned.

The distribution and extent of wetlands habitat classes is dependent on the seasonal dynamics of the water cycle. The water cycle regime provides information on the dynamics of wetlands with respect to the high and low water level situations. This can be described by a hydroperiod (inundation pattern) map using temporal time-series satellite images (particularly radar data, as optical images often fail in the wet season due to cloud cover). For this purpose, at least two radar images of two major extreme hydroperiods (peak flow season and low flow season) are required to enable classification of the water cycle regime into three basic classes: i) permanent water body, ii) seasonally inundated area, and iii) permanent land (Figure 4).

Groundwater

Record water table average and range if ground water monitoring stations are available within the wetland complex. Provide basic information on monitoring wells, such as their location (latitude, longitude) and unique ID.

As groundwater has a very important role in wetland hydrology and many wetland complexes are located in groundwater discharge areas, it is advisable to search for information about the hydrogeology of the area in which the wetland complex is situated. These data are generally found in reports on the underlying geology (lithology and stratigraphy) of the area and include information on the aquifer systems that may be present in these subterranean flow paths, the base-flows of rivers that drain the region, springs, and seepage zones. Provide a brief summary of this kind of information as a free text description.

Physico-chemical features

Water quality

Provide an overview of river health with specific reference to stressors such as the level of nutrients/toxicants (during low flow periods), sediment inputs (during high flow periods), acidification, and salinisation, where water quality data are available. These data can be drawn from existing reports in liaison with the local water authority or ministries (e.g., hydro-meteorology, water resources, irrigation, industry, agriculture, mining). Wherever possible, indicate the sources of contributing nutrients (e.g., fertilised crop or pasture land, sewage outfalls), toxicants (e.g., mining, industrial effluents) and sediments (e.g., cropland, irrigation return waters). Additional information on wastewater discharges and point or non-point source of polluters, indicating specific type of pollutants, can be comprehensive information for assessment of water quality.

Categorise the sediment input as negligible, intermediate, or high, and, where wastewater discharges are known to contaminate streamflows, try to estimate the proportion of wastewater to streamflow using the guidelines provided in Table 8. However, it is acknowledged that as compliance to discharge standards is rarely met in developing countries, the relevance may well be questionable. If insufficient data are available, this should be stated.

Table 8: **Likely level of impact of wastewater discharges on water quality** (after Kotze et al. 1994)

Wastewater input (%)	Probable impact assuming compliance with discharge standards
<5	Low
5 - 20	Intermediate
>20	High

Biological features

The biological features of the wetland complex should be described using general indices that give an overview of the importance of the region for biodiversity. The indices include vegetation cover, dominant vegetation types, the biological importance of the wetland, and noteworthy species (endemic or threatened species of flora and fauna).

Biological condition of the complex

Describe the vegetation cover in the wetland complex by estimating the relative proportions of the dominant vegetation types in the landscape using existing reports or maps. Describe known trends in the status and condition of vegetation (with specific reference to the occurrence of introduced and natural weeds – beneficial and noxious) and similar trends (if any) in fauna populations. If insufficient data are available this should be stated.

Species and associations of biological significance

List all the wetland-dependent threatened plant and animal species in the complex, indicate their status and the habitats in which they occur. Additionally, if the wetland complex regularly supports 1% of the individuals in a population of a threatened species, this should be stated.

Use information on the WWF (http://www.worldwildlife.org/science/index.html) and IUCN (www.iucnredlist.org) web sites for assessing the species of biological importance in the complex.

Other biodiversity databases containing information on the status of species poorly represented in the 2008 IUCN Red List of Threatened Species include those for fish (http://www.fishbase.org) and plants (UNEP-WCMC Threatened Plant Database – www.unep-wcmc.org/species/plants/overview.htm). For the purpose of determining species of national significance supported by the area, use other local data sources include National Red Data Books (if available) and local experts.

Habitat(s)

Name or list the habitats and sites which are found in the complex using the Ramsar classification for guidance and provide the area of each habitat in hectares (ha) or square kilometres (km^2), in preparation for, or in anticipation of, launching Level 4 of the inventory procedure (section 5.4). It is important to note the unit clearly.

In the event of a habitat classification system other than the Ramsar classification being used, provide the bibliographic details and date of the classification adopted.

5.3.5 Population demographics

Describe the characteristics of the human population in the wetland complex with the aid of government statistics (census data), Note, that as official population and demography data are generally related to administrative regions, population density data can be recorded either as the number of villages/towns/cities in the area with populations greater than a certain number, or as the number of inhabitants per km^2 (Table 9). Where possible, describe demographic characteristics in the complex (like population, age structure, seasonal variation in numbers, long-term trends) and the principle activities of people living in the complex (like agriculture, grazing, aquaculture, forestry).

Table 9: **Population density categories** (using inhabitants per km^2)

Population density	Inhabitants per km^2
Very dense	>500
Dense	200-500
Moderate	100-200
Low	20-100
Sparse	1-20
Uninhabited	<1

5.3.6 Wetland ecosystem services

Describe the major goods and services of the wetland habitat using the information presented in Table 4 as a guide, but adding site-specific details that may not have been apparent at previous levels. The services derived from the habitat include products that are obtained directly from the wetland as well as some less tangible services based on social or cultural values. At wetland complex level, provisioning services will become more prominent in addition to the cultural functions.

5.3.7 Land and water use

Describe and, where possible, map the manner in which the complex is used by local people. The categories presented in Table 10 can be used as a guide noting, where appropriate, whether or not these are undertaken for subsistence or for commercial purposes and using mainly traditional or modern techniques.

Table 10: **Classification of major land and water uses of wetland complexes** (example from Trijuga complex, Nepal)

Land/water use	Example of use by people
Cropland	Rice, other cereals
Grazing	Pasture for cattle, buffalo
Horticulture	Mango orchards, bananas
Urban	Rural roads
Fishing	Ponds for fisheries, traditional fishing in rivers and wetlands
Forestry	Timber, fuelwood
Water supply	Surface water for irrigation and domestic use
Transport	Ferry, houseboat, canoe for crossing river
Extractive industry	Sand/gravel extraction from river
Conservation	Wildlife reserve, Ramsar site (Koshi Tappu Wild Life Reserve)
Recreation	Bird watching, rafting, picnics

5.3.8 Institutional arrangements

Describe the management jurisdiction over the wetland complex and, where necessary, the proportion of the area managed by one or other jurisdiction. This includes the following categories: national, provincial, and local authorities; private ownership; and any legal instruments that may be in force (e.g., legislation and/or policies).

5.3.9 Management issues and threats

Describe the management issues that specifically confront local communities as users of the system (e.g., overfishing, illegal hunting, decline in agricultural or fisheries production) and human threats to sustainable use of the area that may well be beyond their control (e.g., herbicide/pesticide use in the surrounding croplands, eutrophication, upstream use of the river system that supplies water to the complex). Describe the impacts of the development activities mentioned in Levels 1 and 2. Use Table 11 as a guide for each wetland complex. Describe also the management practices and plans (if any) being

Table 11: **Management issues and threats to wetland complexes**

Direct driver	Examples of management issues and threats
Climate change	Flooding of residential areas, roads and infrastructure, bank erosion, siltation
Desertification	Irrigation, water diversion and wetland drainage
Species introduction and biotic invasion	Alien invasive species and environmental weeds, vermin and pest animals
Natural resource extraction	Agriculture, grazing, fishing, fuel, forage, thatch, hunting, aquaculture, forestry, mining
Industrialisation and urbanisation	Flooding/flood control, vegetation clearance and fire, sedimentation, infrastructure/housing, quarrying/sand mining, recreational activities, agricultural expansion
Pollution	Expansion of existing and development of new industries without adequate regulation and planning controls
Waste disposal systems	Solid waste, faecal contamination, pesticides, fertilisers
Land and water use	Lack of awareness on wetland values, environmental flows for wetlands ecosystem
Agricultural production systems	Ownership and access to land and resources
Disease emergence and drug resistance	Increasing population and pressure due to poverty; urban or rural expansion; poorly resourced government agencies, shortage of trained personnel; weak implementation of legislation

employed or developed by agencies working in the area. Record the number of people interviewed, and the names and status of the informants. Describe the incidence of disease within the human population (in %), where the utilisation of a wetland complex presents risks to human health, and the type of disease carrying organisms living in the wetland (e.g., mosquitoes, liver flukes, snails). Describe the underlying reasons for, and extent of, any habitat loss or degradation that is evident, and where wetland complexes are subject to natural threats (e.g., from climate change, floods, erosion, sediments).

5.3.10 Data sheet completion

- Name and address of compiler: state the name and address of the compiler, as shown in the datasheet
- Date sheet completed/updated: state the date of data sheet completion or update.

5.4 Level 4 Data — Wetland Habitat/s or Wetland Site

Level 4 data collection focuses on defining and describing the 'wetland habitats' that occur within the wetland complexes identified at Level 3. Even if they lie within the same complex, wetland habitats do not necessarily have the same characteristics. For example, they would not necessarily experience the same water regime or have the same ecological characteristics. Nor would they provide the same goods and services or require the same form of management.

The AWI approach aims to record a core data set at Level 4 for each individual habitat identified within the complex. For the purpose of the GHWI, a wetland site identified for some specific management purpose is considered as Level 4 (e.g., Gokyo and associated wetlands – a Ramsar site in Nepal). This does not mean that all Ramsar sites should be considered as Level 4. The decision can be made based on the area of the site and diversity of the habitats.

The Level 4 data sheet should be accompanied by base maps available from existing secondary sources, for example topographic or thematic maps (scale approx. 1:5,000 to 1:50,000), or GIS-based maps at a suitable scale, depending on the extent of the wetland habitat/s or site concerned.

The data collection for wetland habitats must be done efficiently because similar information is needed for all habitats within a given wetland complex or region. Therefore, it is inevitable that substantially more groundtruthing, analysis of existing maps, and use of existing references is required. As such, Level 4 data becomes the core data set relevant to the primary interests of the managers of a particular wetland habitat or individual site. Wherever possible, it is recommended to use high-resolution optical data for classifying wetland habitats. However, extensive field survey is required to conduct groundtruthing for classification and clarification of the satellite data.

5.4.1 Name and code of the wetland habitat

State a name and a code for each habitat. This must be done. The name can be derived from local communities or existing references. Where multiple names exist (e.g., in the case of transboundary wetlands where names in different languages or dialects are used for the same site), use them all. And where no name exists, a descriptive qualifier or typology used by the Ramsar or any other classification can be used. Use the code as described in Figure 4.

5.4.2 Geographic location

Define the extent of the wetland habitat or wetlands site as accurately as possible. This is important. At a minimum, the coordinates representing the upper-left and lower-right extremities must be recorded. Record coordinates in latitude and longitude for the purpose of uploading information in the database system (GHWIS) in the same way as for Level 3.

For spatial analysis purposes, it is recommended to use a projected coordinate system the same as the reference map for the site (e.g., topographic map). The use of this system enhances the ability to extract additional information, particularly those items relating to area calculations. It is necessary to record complete information about the type of projection system used, which is normally provided in the reference map (topographic map).

5.4.3 Climatic characteristics

Describe the average and the range of precipitation, noting the wettest and driest months; monthly temperature, noting the hottest and coolest months; the range of relative humidity (9 am and 3 pm) and the most and least humid months; the range of annual evaporation (Class A pan); and the prevailing winds and time of year when the wind regime changes. In each case, provide the source and date of the information used. Note the location of the nearest meteorological recording station (name, latitude and longitude, altitude, period of records).

5.4.4 Ecological character

Physical features

Geomorphic setting

Describe the landform (or cross-sectional geometry) of the habitat/site using the terms supplied in Table 12. In general, there are at least six basic landform types that determine the occurrence of wetlands, and whilst they are intergradational, it is important to describe the entire landform in which the habitat/site is situated and not just parts of it (adapted from Semeniuk and Semeniuk 1995).

Table 12: **Categories of landforms that are host to wetlands**
(adapted from Semeniuk and Semeniuk 1995 and Kotze et al 1994)

Landform	Definition	
Basins	Basins are depressed basin shaped areas in the landscape with no external drainage. They may be shallow or deep and may have flat or concave bottoms. They usually have clearly defined margins.	
Channels	Channels refer to any incised water course. They may be shallow or deep but always have clearly defined margins.	
Flats	Flats have a slope of less than 1%, little or no relief, and diffuse margins. Flats can be incised by a channel thereby giving rise to the term 'channelled flats'.	
Slopes	Slopes are areas with a gradient of greater than 1%, which may be concave or convex.	
Crest of hills or highlands	Crests of hills or highlands are generally convex areas on the top of mountains, hills, or similarly raised areas.	

Altitude range

Record the altitude range of the habitat in metres above mean sea level (m amsl). This information is normally available from topographical maps, orthophotographs, and/or national and regional land survey or mapping services.

Note: Wetlands located at 3,000 m amsl and above should be considered as high altitude wetlands (HAWs). This name should be stated after the category they belong to (as stated in Table 13), e.g.: 'slope/high altitude wetland', or 'crest/high altitude wetland'.

Spatial

Define the areal extent of the habitat/site using the scale shown in Table 13.

Table 13: **Terms for defining the areal extent of a wetland complex** (adapted from Semeniuk and Semeniuk 1995)

Classification	Frame of reference for all categories except channels	Frame of reference for channels (width to length relationship)
Very large	>10 x 10 km	> Several km wide; hundreds of km long
Large	1000 x 1000 m to 10 x 10 km	Several hundred m wide; several to tens of km long
Medium	500 x 500 m to 1000 x 1000 m	Hundreds of m wide; thousands of m long
Small	100 x 100 m to 500 x 500 m	Tens of m wide; hundreds of m long
Very small	<100 x 100 m	Several m wide; tens of m long

In addition, obtain the following spatial data

Surface area – Measure the surface area using GIS applications and record the area in hectares. Provide an indication of the extent to which a wetland may vary in size from one season to another. After flood events, inundation maps can be a source of information about the variation in wetland extent (drawn from remotely sensed data as described above); aerial photographs (where available) can be another useful source of reference.

Length – measure the maximum length of the wetland habitat in kilometres.

Width – measure the maximum and average width of the wetland habitat, in metres or kilometres. The average width can be recorded as the average of five equal segments drawn perpendicular to the flow.

Basin morphology

Bathymetry – Record any existing information about the depth of the basin (i.e., maximum depth and, where known, average depth). If these data are not available, they should be obtained by taking the measurements needed using either a depth sounder or a hand held plumb line graduated in metres (at 10 cm intervals).

Erosional status

Describe the susceptibility of the habitat/site to erosion (wind, storm, or current-induced, e.g., flash flood).

Soil types

Describe the dominant soil type(s) within the habitat of interest, using existing soil maps and/or reports. State what soil classification system is used and the date of data collection (if known). The FAO soil classification scheme (Purnell et al. 1994) is one of the most commonly used systems for naming soils in a consistent way and is recommended on the grounds that it provides an adequate description of the general nature of the soil mantle and has been well tested in the field. Where remotely sensed data are available, these can also serve as a useful source of information about soil saturation within the habitat.

Bottom sediments/substrata

Search for and document any information about the nature of the sediments and/or substrata on the floor of the wetland. Sediments include organic and mineral particles of all sizes and composition. However, in the event of such data not being available, a simple visual or textural method of classifying the substrata in situ may need to be used, noting that core samples may be necessary where the water depth is in excess of approx. 1.5m (Table 14).

Water regime

Describe the water regime (or hydroperiod) using one or more of the four terms shown in Table 15. The water regime can be further described by supplying information on the seasonal and inter-annual depth (maximum, minimum and average), the pattern of flows into and out of the wetland and the period(s) of inundation and the area flooded. The source of inflow should be recorded (e.g., river, groundwater, spring, rainfall only, artificial) and, if possible, both the inflow and outflow recorded as permanent, seasonal, intermittent, episodic, or none, on hydrographs.

Supplement the water regime information with a water cycle regime map that can be derived from radar data as described in Figure 4.

Table 14: **Texture based substrate classification** (adapted from Begg 1984)

Textural class	Texture /general appearance	Percentage composition[a]	
		% clay	% sand
Stoney	Rough or gritty texture, evidence of small stones and pebbles	n/a	n/a
Coarse sand	Disintegrates readily, individual sand grains can be readily seen and felt, shell fragments are common	n/a	80
Fine sand	Well packed, clean, disintegrates readily and individual sand grains hard to distinguish	10	90
Muddy sand	Sandy material noticeably discoloured by mud	20	80
Sandy mud	Muddy material with equal quantities of sand and mud	50	50
Silt or mud	Silty or muddy material, loose when moist, with traces of sand	70	30
Silty clay	Sand barely evident; usually grey, sometimes containing iron concretions	90	10
Clay	Sand not evident; stiff and tenacious material, greasy when moist; solid grey to blue grey in colour	100	n/a
Peat	Organically laden substrata containing partly decomposed plant remains; spongy when wet	n/a	n/a
Ooze	Fine black, organically laden sludge, generally smelling of hydrogen sulphide	n/a	n/a

an/a = not applicable

Table 15: **Categories of non-tidal water regimes for wetland habitats** (adapted from Semeniuk and Semeniuk 1995)[a]

Water regime	Definition
Permanently inundated	Areas where land surface is permanently covered with free-standing water (except in years of extreme drought)
Seasonally inundated	Areas where land surface is semi-permanently flooded; when surface water is absent, water table is at or near surface
Intermittently inundated	Areas where the land surface is temporarily flooded; surface water is present for a brief period during the year but water table is otherwise well below the soil surface
Seasonally waterlogged	Areas where land surface is saturated for extended periods but surface water is seldom present

[a]Note: Inundated means soils that are covered with free-standing water; the soil below the surface in these situations is also saturated (waterlogged)
Waterlogged means soils that are saturated with water, but where the water does not inundate the soil surface

Groundwater

Record information on the depth of the water table and the seasonal variation in depth in the near vicinity of the wetland habitat, as data availability and/or local knowledge allows.

Physio-chemical features

The following features describe the water quality of the wetland habitat and, unless known, are measured using standard techniques as given in 'Standard methods for the examination of water and wastewater' (Clesceri et al. 1998) and general limnological texts such as those of Moss (1980), Wetzel and Likens (1991), and Wetzel (2001).

Surface water

Temperature – Describe the annual range of water temperature of the major part of the flooded area and the annual average temperature. Note details of the recording station(s) and depth and time of measurements. If data are available, this can be recorded for each season or each month of the year and a mean annual value given. If insufficient data are available, this should be stated. Where possible, classify the water body according to the thermal characteristics shown in Table 16.

Table 16: **Categories of thermal characteristics based on different types of mixing** (adapted from Bayly and Williams 1981)

Category	Definitions
Amictic	Never mixes (remains permanently ice-covered)
Oligomictic	Rarely mixes (remains warm at all depths)
Monomictic	Mixes once a year
Dimictic	Mixes twice a year
Polymictic	Mixes many times in a year

Salinity – Provide the annual range of the salinity of the major part of the flooded area, noting details of the recording station(s) and depth and time of measurements, where known. If data are available, these can be recorded for each season or each month of the year and a mean annual value given. If insufficient data are available this should be stated. Where possible classify the water body according to the salinity characteristics shown in Table 17.

Wetland habitats with seasonal variability in salinity are categorised by the salinity status which exists for most of the year. For example, a wetland that ranges from freshwater for most of the year, to brackish during the short dry season, would be classified as 'freshwater'. The salinity can further be described as 'constant' (salinity remains within a single salinity range) or 'fluctuating' (salinity that markedly fluctuates throughout the year).

In the event of salinity data being unavailable, conductivity measurements can be used to calculate the salinity using a conversion factor.

pH (hydrogen ion concentration) – Provide the annual range of the pH of the major part of the flooded area, noting details of the recording station(s) and depth and time of measurements. If data are available, these can be recorded for each season or each month of the year and a mean annual value given. If insufficient data are available this should be stated.

Where possible classify the water body using the scale shown in Table 18, with pH 6.6-7.5 being 'neutral', lower numbers being more acidic and higher numbers alkaline.

Transparency – Provide the annual range of water transparency of the major part of the flooded area as recorded with a 20-30 cm diameter Secchi disc and note details of the recording station(s) and depth and time of measurements. If data are available these can be recorded for each season or each month of the year and a mean annual value given. If sufficient data are not available this should be stated. Where possible, classify the water body according to the transparency categories shown in Table 19.

Whilst the term 'colour' should not be confused with 'transparency', it should be noted that the 'opaque' category can be subdivided into the following:

- 'Black'/tea-coloured water – indicates staining by peat in the catchment
- Greenish water – indicates relatively high productivity
- Brown/cloudy water – indicates high concentrations of suspended solids

Nutrients – Provide the known annual range of nitrogen (nitrate and total nitrogen) and phosphorous (ortho-phosphate and total phosphorous) concentrations in the major part of the flooded area, noting details of the recording station(s) and depth and time of measurements. If data are available these can be recorded for each season or each month of the year according to the categories shown in Table 20. If insufficient data are available this should be stated.

Table 17: **Salinity classification**

Classification	Salinity (gL^{-1})
Fresh	<0.5
Brackish	0.5-18.0
Semi-saline	18.0-30.0
Saline	30.0-40.0
Hypersaline	40-100
Ultrasaline	>100

Table 18: **Acidity/alkalinity classification based on pH units**

Classification	Range (pH)
Very strongly acidic	1.0-2.9
Strongly acidic	3.0-3.9
Acidic	4.0-4.9
Weakly acidic	5.0-6.5
Neutral	6.6-7.5
Weakly alkaline	7.6-8.5
Alkaline	8.6-9.9
Strongly alkaline	10.0-11.5
Very strongly alkaline	11.5 +

Table 19: **Classification of transparency as measured with a Secchi disc** (adapted from information provided in Moss 1980)

Category	Secchi disc depth (m)
Opaque	<0.05
Very turbid	0.05-0.25
Turbid	0.25-2.50
Clear	2.5-25.0
Very clear	>25

Table 20: **General relationship of wetland productivity to average concentrations of total phosphorous** (from Wetzel 2001)

Category	Total P (µgm/l)
Ultra-oligotrophic	<5
Oligo-trophic	5-10
Meso-eutrophic	10-30
Eutrophic	30-100
Hyper-eutrophic	>100

A test kit can also be used for rapid determination of the trophic status of a wetland. In the case of phosphorous, the test is based on the classic molybdenum blue colorimetric test for 'weakly coordinated' phosphate, otherwise known as orthophosphate, or filterable reactive phosphorous (FRP). Instead of using a spectrophotometer, a simple colour comparison is made using a disc.

Groundwater – if available, provide information on the chemical composition of groundwater in unconfined shallow aquifers in the general area.

Biological features

Vegetation

Dominant assemblages – List all the vegetation assemblages present, using the classifications used during the vegetation studies of the site and, if available, the most widely accepted vegetation classifications at regional and state levels. For open water areas, indicate the stable state, i.e., whether the water body is macrophyte or phytoplankton dominated. Use Table 21 as a guide.

Table 21: **Example format for categorisation of vegetation assemblages** (example from Tasek Bera, Malaysia)

Vegetation assemblage	Total area in wetland (km^2)	% of total area covered	Physical/hydrographic setting
Freshwater swamp forest	4100	67	seasonally inundated mineral soils with some peat areas
Pandanus/Lepironia marsh	2050	32	fringing open water areas, rarely drying out
Open water	100	1	
Total	**6250**		

Dominant species – Provide a list of species (as shown in Table 22) indicating growth strategy (annual, perennial, geophytic, perennial), growth form (terrestrial or aquatic species), and the structural type (grasses, herbs, sedges, shrubs, ferns, palms, trees). For aquatic species (i.e., plants that have vegetative parts that are permanently or seasonally inundated) indicate if they are emergent, floating-leaved, free-floating, submerged rooted, or free floating submerged. It should be noted that Specht (1981) and Walker and Hopkins (1984) define a tree as a 'woody plant with a single stem within 2m of the ground'; a shrub as a 'woody perennial plant with multiple stems arising within 2m of the base'; grass as 'herbaceous plants in the family Poaceae'; sedges as 'herbaceous plants, normally with tufted growth habit and from the family Cyperaceae or Restionaceae'; forbs as 'herbaceous plants that are not grasses or sedges'; and the term aquatic to mean 'herbaceous plants that live only in water'.

Table 22: **Example format for categorisation of plant species** (current application of AWI in Koshi Tappu, Nepal)

Species	Common/local name	Growth strategy	Growth form
Dalbergia sissoo	Sissoo	Perennial	Riverine successional tree
Acacia catechu	Khair	Perennial	Riverine successional tree
Saccharum spontaneum	Kans	Perennial	Terrestrial grass
Phragmites karka	Narkat	Perennial	Wetland dependent grass
Typha angustifolia	Pater	Perennial	Wetland dependent grass
Cymbopogon pendulus		Perennial	Terrestrial grass
Tamarix dioica	Jhauwa	Perennial	Riverine shrub (salt tolerant)
Digitaria adscendens		Annual	Terrestrial grass
Fimbristylis squomosa	Motha	Annual	Sedge
Persicaria lapathifolia		Annual	Wetland dependent herb
Echinochloa crusgalli	Sama	Annual	Wetland dependent grass
Echinochloa colona	Sama	Annual	Wetland dependent grass
Eicchornia crassipes	Jal Kumbhi	Perennial	Floating aquatic weed
Paspalum disticnum		Annual	Wetland dependent grass
Cyperus compressus		Annual	Wetland dependent sedge
Alternanthera sessilis		Annual	Wetland dependent grass

Alien invasive species and environmental weeds – List alien invasive species and natural weed species, beneficial and noxious, indicating which species are introduced and providing estimates of cover for each as area (ha) or percentage cover (%) of the site.

Species and assemblages of conservation significance – List the plant species and/or assemblages present by status (endangered, vulnerable, rare, threatened), level (global, national, state, regional), and, where appropriate, indicate the legislation applicable to each level of significance. For plant assemblages it is advisable to record the source of the information used as the same assemblage may be recorded differently in subsequent surveys. Use Table 23 as a guide. Use the UNEP-WCMC Threatened Plants Database as a reference (http://www.unep-wcmc.org/species/plants/overview.htm). This contains information on the status of plant species of conservation significance throughout the world.

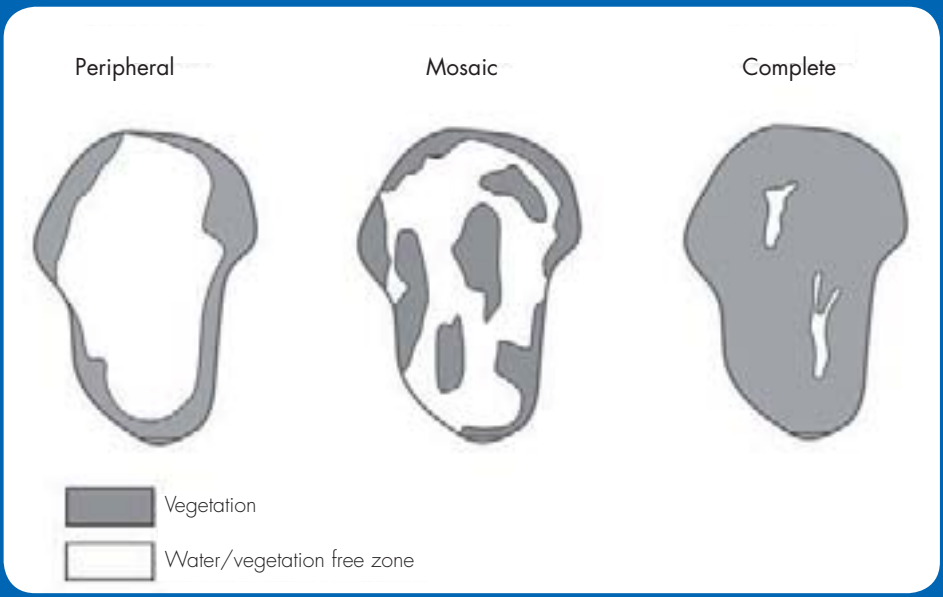
Table 23: **Example format for recording plant species and assemblages of conservation significance** (example from Koshi Tappu, Nepal)

Taxon	Taxonomic group	Distribution	Status	Level
Begonia tribenensis	Begoniaceae	Endemic to central and Eastern Nepal	Very rare	National
Oroxylum indicum	Bignoniaceae	East to West region of Nepal between 200-1400m	Vulnerable	National (IUCN)
Rauwolfia serpentine	Apocynaceae	East to West region of Nepal between 100-1000m	[a]Protected Endangered CITES-II	National (IUCN)
Acacia catechu	Leguminosae	Lowland riverbed, East to West region	[b]Protected	National, GoN
Bombax malabaricum	Bombacaceae	Lowland Terai to midland	[b]Protected	National, GoN

[a] Banned for export except processed with permission of Dept. of Forest Description
[b] Banned for transportation, export and felling for commercial purposes

Vegetation cover – Describe the 'vegetation cover' by estimating the relative proportions of vegetation cover and open water using the categories proposed by Semeniuk and Semeniuk (1995). Make use of aerial photographs or cover maps of the habitat, normally obtainable from the offices of local planning authorities and/or government agricultural or forestry services. High resolution satellite data (e.g., IKONOS, Quickbird, IRS LISS4) are also highly useful in categorisation of vegetation cover. These are illustrated in Figure 6 below. Note that due to the gradational nature of vegetation cover, the temptation to attribute more precise categories of 'percentage cover' should be avoided. However, where the areal extent of the vegetation cover is greater than 90%, the cover can be considered as 'complete'.

Figure 6: **Categories of vegetation cover (after Semeniuk et al 1990)**



Fauna

Dominant assemblages and species – Provide a list of animal species associated with the site (vermin and pest species included), with the view of providing a record of species richness and diversity for each of the main taxonomic groups present (i.e., invertebrates, vertebrates – mammals, birds, fish, and so on). Make specific reference to any species that may have declined or increased over time.

Species of conservation significance – List species of conservation significance (endangered species first, followed by vulnerable and rare species), including those listed in national, or state legislation as threatened or as listed migratory species, and so on. Use Table 24 as a guide. Use the '2008 IUCN Red List of Threatened Species' (http://www.iucnredlist.org) to determine internationally important and endangered species supported by the habitat (similar to the case for species of conservation significance at Level 3). For fish species the following can also be used (http://www.fishbase.org). For the purpose of determining species of national significance supported by the habitats of interest, use other local data sources include National Red Data Books (if available) and local experts.

Table 24: **Example format for recording animal species of conservation significance** (example from Koshi Tappu, Nepal)

Taxon	Taxonomic group	Distribution	Status	Level
Bubalus arnee	Bovidae	S & SE Asia	Endangered	(P), III
Bos gaurus	Bovidae	S & SE Asia	Endangered	(P), I
Platanista gangetica	Platanistidae	S Asia	Endangered	(P), I
Elephus maximus	Elephantidae	Asia	Endangered	(P), I
Gavialis gangeticus	Gavialidae	S & SE Asia	Endangered	(P),I
Crocodylus palustris	Crocodylidae	S Asia	Vulnerable	IUCN
Varanus flavescens	Varanidae	S Asia	Endangered	P
Python molurus bivittatus	Boidae	SE Asia		2
Francolinus gularis	Phasianidae	Nepal, India, Bangladesh	Globally threatened–Vu National threatened–EN	BI 2001
Anas formosa	Anatidae	S Asia (N): winter vagrant	Globally threatened	Unknown

Note: Rare = <5% chance to be seen at the site Very Rare = <5 records at the site

Populations – in situations where abundance data are available, tabulate the average and maximum estimated population numbers present as shown in Table 25a. Describe the abundance of the fauna (e.g., key species, largest concentrations) paying particular attention to breeding populations (where data available tabulate as in Table 25b), migratory populations (e.g., birds, fish) and key migration periods in wetland. Where known, draw attention to populations of wetland species that may have declined or increased over time.

In the event of abundance data being unavailable, provide an indication of the abundance of the species concerned (e.g., A = abundant ; C = common ; U = uncommon; R = rare) and status (e.g., B = breeding; W = wintering; R = resident; V = vagrant).

Table 25: **Example format for the tabulation of population abundance data (a) and information on breeding populations (b)**

(a) Population abundance

Species	Status	Average number	Maximum number	Date of census (month / year)

(b) Breeding populations

Species	Number of breeding records

Alien invasive and vermin/pest species – list and describe the alien invasive and vermin/pest species present in each habitat, indicating which species are introduced.

Habitats

Tabulate the wetland habitats using the most widely accepted existing habitat classification scheme (Box 2). As shown in Table 26, list the key taxa of the fauna that occur in each habitat. Where known, draw attention to what are considered to be key habitats for breeding fauna or for species of conservation significance and indicate whether any such habitats may have declined or increased in area and/or quality over time. Where possible, describe the faunal characteristics of each habitat using species richness data to give an indication of the importance of the habitat for the maintenance of biodiversity.

Table 26: **Example format for listing of key faunal taxa associated with each major habitat together with an indication of the available information for each**

Habitat type	Key fauna taxa	Available information
Open water	Invertebrates, amphibia, waterbirds	September 1992; December 1996, very limited, numerous surveys (50+) have been conducted over the period 1965 – present
Fringing bushes and reeds	Waterbirds	Numerous surveys (50+) have been conducted over the period 1965 – present
River channel	Fish	August 1994

Biological significance of the habitat

Describe the biological importance of the habitat by using the criteria defined by the Ramsar Convention for identifying wetlands of international importance (http://www.ramsar.org/key_criteria.htm). The Ramsar Convention presents nine criteria to assess the importance of a wetland habitat with a specific emphasis on birds and fish, see Table 27. Determine population estimates of water birds that meet the criteria of internationally important sites by using the 'Waterbird Populations Estimates' from Wetlands International (Delany and Scott 2006).

Table 27: **Summary of the criteria for listing a wetland as internationally important under the Ramsar Convention**

Criterion	Description
1	A representative, rare, or unique example of a natural or near-natural wetland type found within the appropriate biogeographic region
2	Supports vulnerable, endangered, or critically endangered species or threatened ecological communities
3	Supports populations of plant and/or animal species important for maintaining the biological diversity of a particular biogeographic region.
4	Supports plant and/or animal species at a critical stage in their life cycles, or provides refuge during adverse conditions
5	Regularly supports 20,000 or more waterbirds
6	Regularly supports 1% of the individuals in a population of one species or subspecies of waterbird
7	Supports a significant proportion of indigenous fish subspecies, species or families, life-history stages, species interactions and/or populations that are representative of wetland benefits and/or values and thereby contributes to global biological diversity
8	Important source of food for fishes, spawning ground, nursery and/or migration path on which fish stocks, either within the wetland or elsewhere, depend
9	Regularly supports 1% of the individuals in a population of one species or subspecies of wetland-dependent non-avian animal species

Socioeconomic features

Provide information on communities living in and around the wetland. Classify these into the following:

1 Demographic features: population, growth rates

2 Social profile: access to social amenities, viz safe drinking water and sanitation, education, medical facilities, and others

3 Economic profile: income, access to banking and credit facilities, resource linkages, contribution of wetlands to incomes and livelihoods, seasonality of resource use

4 Institutional arrangements: community institutions, governance structure, belief systems (include taboos) in relation to the wetlands and other natural resources

5 Stakeholders and conflicting interests

6 List any particular spiritual or medicinal or sacrosanct significance, by any group or stakeholder

5.4.5 Habitat classification

The GHWI/AWI approach focuses on collecting the core data that may be required, amongst other things, to classify wetland habitats. Users of this manual are entitled to use whatever classification system they prefer. However, it is recommended to convert the classification into the Ramsar classification system (see Box 1).

5.4.6 Wetland ecosystem services

Describe the major goods and services of the wetland habitat using the information presented in Table 7 as a guide, but add site-specific details that may not have been apparent at previous levels. The goods and services derived from the habitat include products that are obtained directly from the wetland as well as some less tangible services based on social or cultural values.

5.4.7 Land and water use

Describe and, where possible, map the manner in which the habitat is used by local people: note matters such as the yield obtained from crops or fisheries; whether wetland use is seasonal or year-round; the extent of cultivated areas; the type of gear used for fishing; whether there are any social, economic, or political conflicts (e.g., conversion to farmland, dam construction).

Describe the land and/or water use made of the habitat by local communities by refining or expanding upon the data collated earlier at Level 3 (Table 11). Note, where appropriate, whether or not these are undertaken for subsistence or for commercial purposes and use mainly traditional or modern techniques.

5.4.8 Management issues and threats

For each habitat, describe the management issues that confront local communities as users of the habitat by refining/expanding upon the data collated earlier at Level 3 (Table 11). Deliberately highlight the management practices or plans (if any) being employed or developed by agencies working in the area and record the number of people interviewed, and the names and status of the informants. Similarly, where the utilisation of a wetland habitat presents risks to human health, the type of disease carrying organisms living in the wetland and the incidence of disease within the human population should also be described.

5.4.9 Monitoring and management programmes

Provide details of any existing or proposed monitoring programmes and management plans for the habitat. This includes the names of any government agencies, NGOs, or other interest groups working in the area and a brief indication of the programmes active (title of project, objectives, time frame, applicability to wetland management, and person(s) or organisation(s) responsible).

5.4.10 Data sheet completion

- Name and address of compiler: state the name and address of the compiler as shown in the datasheet.
- Date sheet completed/updated: state the date of data sheet completion or update.