People's Dependency on Wetlands: South Asia Perspective with Emphasis on Nepal

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Abstract

Wetland ecosystem is a lifeline for people both in a global and regional scale. Different resources are being provided by this ecosystem for the welfare of humankind since ancient times in the form of food, drinking and irrigation water, fuel wood, timber, medicinal herbs, and non-wood forest products. People's dependency on wetland ecosystems has been increasing in recent years, and South Asia is a good example. However, the booming population and increasing dependency have threatened the wetlands due to unsustainable resource harvesting. Wetlands in Nepal are spatially distributed from lowlands to highlands and are of great value to local people for sustaining their livelihood. However, the degree of their dependency differs with their location. Though the dependency on wetland resources is high in Nepal, people still do not recognize all the ecosystem services of wetlands.

Keywords

Conservation • Nepal • South Asia • Wetland dependency • Wetland resource

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21.1 Wetland and People: An Overview from South Asia

Wetland resources have been used by humans since ancient time, probably from their very origin. Wetlands produce a variety of goods and services essential for sustaining human life on this planet. Food, fiber, timber, medicine, and drinking water are some of the resources that wetland ecosystems provide us, without which our livelihood would not be possible. The dependency, however, constantly increases with a booming population and, as a result, threatens the fragile wetland ecosystems with ongoing unsustainable resource consumption. It is therefore imperative to conserve wetland resources and make sustainable use of these for the welfare of humans.

Based on the hydrological, ecological, and geological characteristics, Cowardin et al. (1979) classified wetlands into marine, estuarine, lacustrine, and palustrine. Similarly, the Ramsar Convention (Article 1.1, 1971) defines most of the natural water bodies such as rivers, lakes, coastal lagoons, mangroves, peat land, coral reefs, and manmade wetlands such as ponds, farm ponds, irrigated fields, sacred groves, salt pans, reservoirs, gravel pits, sewage farms, and canals as wetland ecosystems. These classifications and definitions themselves clearly depict the broader wetland boundary and thus signify its importance. The wetland resources are further significant in the context of developing countries in general and South Asia in particular. South Asia includes eight countries, *viz*., Afghanistan, Bangladesh, Bhutan, India, Maldives, Nepal, Pakistan, and Sri Lanka. This region occupies 3.3% of the global land surface, while it is home for over 25% of global population. The majority of people in this region lives in rural areas and depends on natural resources to sustain their livelihood. The region is rich in different types of wetland ecosystems on which rural populations are highly dependent. Around 39,000 ha (1%) of land area is occupied by wetlands in Bhutan. With about 3027 lakes, high-altitude wetlands (HAWs) cover an estimated 0.3% of Bhutan's land area. India has about 757,000 wetlands, covering an area of 15.3 million ha that accounts for 4.7% of the total geographical area. It includes inland wetlands (69%), coastal wetlands (27%), and wetlands smaller than 2.25 ha (4%). Maldives is a group of tiny islands surrounded by the Indian Ocean, where five types of wetlands exist, *viz*., mangroves, marsh lands, inland water bodies, sea grass beds, and coral reefs. Pakistan has more than 225 significant wetlands, covering around 9.7% of land surface. Both natural and manmade wetlands occur throughout Sri Lanka and comprise about 15% of the land area. Around 21 wetlands of potential significance have been documented in Afghanistan; however, the people's dependence on wetland resources is not well documented. Despite the considerable number of wetlands in South Asia, their contribution to people's livelihood is less understood, though considerable amount of resources are harvested from them.

21.2 Major Wetland Resources

The goods and services provided by the wetlands are relevant differently to diverse groups of people in the society depending on the nature of use. Wetland benefits can either be direct harvest from wetlands, functions, or services coming from them and ecosystem-scale attributes (Claridge 1991). The direct harvests include food resources, water for drinking and irrigation, and other wetland resources such as fuel wood, timber, and non-wood forest products (NWFPs) such as fodder and medicinal herbs. The wetland functions include biodiversity conservation, water storage, groundwater replenishment, sediment retention, plant nutrient retention, flood buffering, and carbon sink. Wetlands also provide recreational and water purification services. The ecosystem-scale attributes include cultural uniqueness, wildlife habitat, and biological diversity at a larger scale. This chapter discusses the dependency of South Asian people in general and of Nepal people in particular on the wetland resources to sustain their livelihoods.

21.2.1 Aquatic Food Resources

Aquatic food resources include all the goods that local people consume for meeting the body nutrient needs, such as proteins and vitamins, and those that could be sold in the market for financial returns. Around 13 million people in Bangladesh are dependent on fisheries for sustaining their livelihood, and 80% of them are considered as belonging to the lower-income group (Sultana n.d.). Fishing in wetlands, ponds, and rivers is the only household income source in many rural areas. Inland fisheries in Bangladesh include 260 finfish and 25 shellfish species, major sources of animal protein. Mangrove and salt marsh wetlands are also important for shrimp farming that provides employment to thousands of low-income people from neighboring villages and towns. In the fishing industry in Bangladesh, one million people are full-time employees and 11 million are part-time workers, contributing to 3.3% of the gross domestic product (GDP), earning more than 11% of the total export revenue (Parveen and Islam 2001).

Similarly, in Sri Lanka, 91% of the total fish production was managed by marine fishery in the year 2003, of which 64% was from coastal waters contributing significantly to the local food security. It has been estimated that wetland-based fishery sector provides direct employment to 150,000 people while sustaining at least 1,000,000 people (Atapattu et al. 2010). In Maldives, fish, crabs, and mussels are the major food for people. Similarly, the occupation of 84% people of the Indus Delta in Pakistan is primarily fishing, with estimated catch of fish and shrimps being about 247,000 tonnes per annum.

In India, inland fisheries from wetlands contribute 61% of total production, accounting for more than 5,000,000 t of catch per annum. This sector provides direct and indirect employment to millions of low-income families and supports their livelihood. The Indian Sundarbans mangrove wetlands, in the delta of the Ganga and the Brahmaputra, are vital for people in the West Bengal state. Brackish

water fishes, shrimps, crabs, honey, wax, and tannin are some of the resources that cater to both local people and the demands of the metropolitan city. Export of dried fish, shrimps, crabs, and honey brings in substantial foreign exchange, benefiting the local community directly.

Up to 80% of people in Afghanistan are dependent on natural resources for income and sustenance (BW-WG 2008). Hamoun wetland, an inland delta created by the Helmand River, located at the international border between Afghanistan and Iran is an important source of livelihood for the Afghan people living near the delta. It is the source of fishes, medicinal herbs, and other aquatic food resources. The annual fish catch in Hamoun wetland exceeds 5000 kg.

21.2.2 Drinking and Irrigation Water Supply

Water from wetlands has been used for drinking and irrigation since a long time. The case of South Asia is important as it has to feed nearly 25% of the world's population with its limited water resources, and thus freshwater wetlands in particular are significant in this region. In India, human-made wetlands that collect surface runoff during monsoon and then allow water to be used during non-monsoon seasons are important for irrigating large portion of farmland in the northern and southern states. They are also a reliable source of drinking water supply in rural areas. Around 4700 large reservoirs exist in India and they are being used for agricultural irrigation and domestic water supply in villages, towns, and cities across the country (Bassi et al. 2014). Similarly, large lakes, such as Carambolim, Chilika, Dal *Jheel*, Deepor *Beel*, Kabar Tal, Kolleru, Loktak, Nainital, Nal Sarovar, and Vembanad, are traditionally used for agricultural irrigation and domestic water supply (Jain et al. 2007).

Ancient village irrigation water storage tanks and reservoirs are common in Sri Lanka. Over 12,000 tanks and reservoirs exist in the country, covering 4.6% of land surface, and are the major source of water for irrigated agriculture. The Parakrama, Samudraya, and Minneriya tanks are a few examples. Many reservoirs in the country are the source of drinking water to villages, towns, and cities, in addition to being used for irrigation. Some of them include Castlereagh, Norton, Lakshapana, and Mousakelle. The river Mahaweli has been dammed to create a series of multipurpose reservoirs, including Kotmale, Victoria, Randenigala, and Rantambe. Inland freshwater wetlands such as Mahaweli riverine floodplain are also used for drinking and irrigation water supply (IUCN Sri Lanka 2004).

In Bhutan, water from HAW such as glacial lakes and ponds is used for agriculture, mostly to irrigate the downstream paddy field. Apart from irrigation, drinking water supply is also heavily dependent on them.

Hamoun wetland in Afghanistan is channeled for irrigation and covers thousands of hectares of drought-affected agricultural land. Through irrigated agriculture from this wetland, subsistence farmers cultivate a wide range of fruits and vegetables. Kole Hashmat Khan wetland, a shallow freshwater wetland in Kabul, has been used for supplying irrigation and domestic water for a long time. Riverine floodplain

basins such as Amu Darya and Helmand are the major sources of water supply for irrigating most of the arable agricultural land in Afghanistan (Boere et al. 2006).

21.2.3 Fuel Wood, Timber, Medicinal Herbs, and NWFPs

The socioeconomic status of South Asian people, especially those living in the rural areas, is low. This has led to more dependency on wetland resources from which they receive livelihood supportive goods. In India, many tribal and indigenous communities live in different states and most of them depend on wetland resources for livelihood. Tribal communities like Boro, Rabha, and Garo in Northeastern India are traditionally wetland dependent for resources such as food, medicinal herb, as well as NWFPs for making handicraft, roofing material, basket, and mat. The mangrove wetlands in the West Bengal Sundarbans are the source of fuel wood for cooking, timber for domestic purposes, and fruits and medicinal herbs for poor income groups.

The Maldives lacks permanent rivers and streams, but brackish ponds/mangroves and freshwater lakes, also called *kulhis*, are available. Maldivian people harvest many freshwater and mangrove wetland goods such as wood for fuel; materials for house posts, fishing gear, and charcoal production; and tannins. They are also the source of food in the form of fish, crabs, and mussels to thousands of local people. Apart from this, diverse medicinal herbs for local healing are obtained from these wetlands, and local production of vinegar and cooking oil from such wetland resources is a well-known economic activity in Maldives.

Sundarbans is an important estuarine mangrove wetland, shared by both Bangladesh and India. Bangladesh occupies 62% of this mangrove ecosystem, which is considered a lifeline for the low-income people of the area. The major dependency is for fuel wood for cooking; timber for boat building; poles for building houses; *Nypa fruticans* leaves for roofing; grass species such as *Cyperus javanicus*, *Imperata cylindrica*, and *Eriochloa procera* for weaving mat; reeds for fencing; and medicinal herbs for local healing. Inland wetlands are used for activities such as extraction of reed and harvesting of edible aquatic vegetation and their products such as medicinal herb in rural areas. Other economic benefits local people derive include agricultural and wild food productions, livestock grazing, timber, fuel wood, fodder, and aquatic fruit harvesting.

Most of the low-income people in Pakistan depend on wetlands for various socioeconomic activities. For example, in Taunsa Barrage, 87% of local people depends on the wetland for fuel wood, livestock grazing, fishing, and collection and trading freshwater turtles. In Indus Delta, local people rely on the floodplain and mangrove wetlands for timber, fuel wood, and NWFPs and for grazing livestock, camels, and other domestic animals. Inland wetlands are equally important as source of staple food, livestock grazing and fodder, and fuel wood and for transport and irrigation and as a significant means of living for low-income people.

Most of the inland freshwater wetlands in Sri Lanka are used by local people for harvesting agricultural products such as rice and leafy vegetables, collection of

medicinal herbs for primary healing, and raw materials for small-scale microenterprises (*viz*., making handicrafts and weaving mat). Mangroves and salt marshes are the source of fuel wood for cooking energy, light timber for temporary dwellings, fish traps, and fence posts, while tanbarks are used for tanning sails and nets.

Livestock grazing is a common practice in the Hamoun wetland area of Afghanistan, which is a major source of cash earnings for the dependent people.

21.3 Wetland Dependency: The Case of Nepal

21.3.1 Country Background

Nepal, covering an area of 147,181 km^2, is located in the southern lap of the Himalayas between the latitudes 26°22′ and 30°27′ N and longitudes 80°40′ and 88°12′ E. The elevation ranges from 58 m in the southern Terai lowland to 8848 m in the north at Mt. Everest, the highest peak in the world. This extreme altitudinal gradient has resulted in five broad physiographic regions, *viz*., Terai (<300 m), Siwalik (300–1000 m), Mid Hill (1000–3000 m), Middle Mountain (3000–5000 m), and High Mountain (>5000 m). Physiographic variation has also led to six distinct climatic regions such as tropical, subtropical, temperate, subalpine, alpine, and nival. A land cover mapping during 2010 indicated 39.1% forest land, 29.83% agricultural land, 10.65% barren land, 8.20% snow/glaciers, 7.90% grassland, 3% shrub land, 0.60% water body, and 0.32% built-up area (Uddin et al. 2015). About 83% of the total area consists of mountain and hilly regions, while the remaining consists of Terai low land. The total population of the country, based on 2011 census, stood at 26.5 million. Terai lowland accommodates almost 60% of the total population. Four major river systems, originating from the High Himalayan zone draining 70% of the country, are Koshi in the eastern region, Narayani in the central region, Karnali in the western region, and Mahakali in the far-western region. Apart from these, several medium-sized rivers originate in the Mid Hills (Rapti, Bagmati, Kamala, Kankai, Tinau, etc.), whereas small rivers, mostly seasonal in character, originate from the Siwalik (Churia) ranges and dissect the Terai lowland. Nepal is primarily an agricultural country, and its economy is mostly dependent on the use of available natural resources. Agriculture depends heavily on rainfall, groundwater recharge, and wetlands. The geography is dotted with farmlands, snow lands, and small freshwater wetlands such as rivers, lakes, ponds, marshes, swampy lands, irrigation canals, fishponds, and reservoirs.

21.3.2 Status of Wetlands

Nepal has four decades of history of wetland conservation. The first wetland enlisted as a Ramsar site was Koshi Tappu wetland, an important habitat for the last surviving species of wild water buffalo (*Bubalus arnee* Kerr, 1792). The wetlands in the country attracted attention only after the Department of National Parks and Wildlife

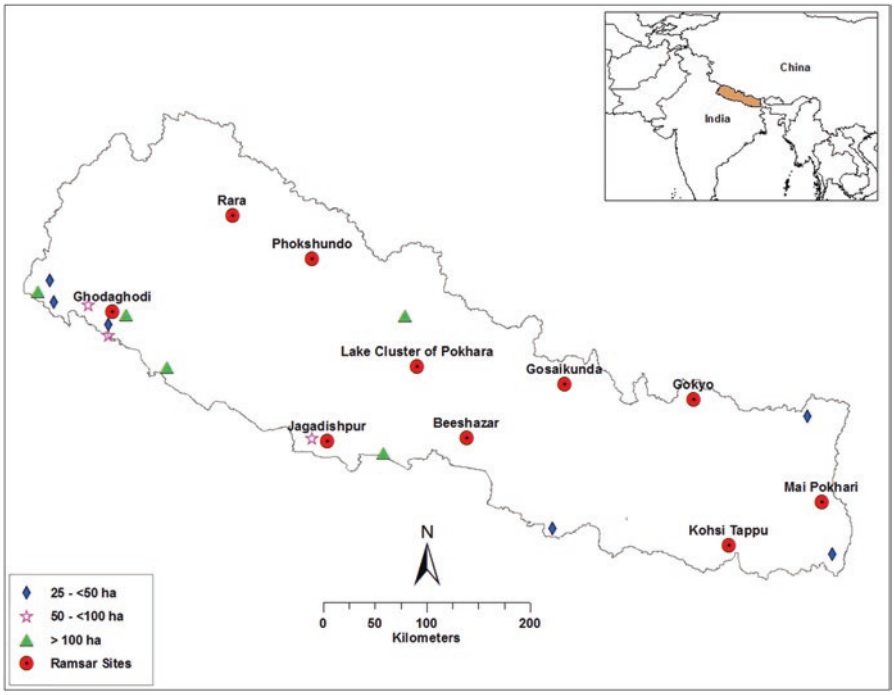

Fig. 21.1 Spatial distribution of Ramsar and other important wetlands in Nepal

Conservation succeeded in listing Koshi Tappu as a Wetland of International Importance in 1988. So far, ten wetlands, covering an area of 60,561 ha, are listed in the Ramsar Site of International Importance (Fig. 21.1).

Out of the ten Ramsar wetlands, four are located in the Terai lowland, two in Mid Hill, while four are in high-altitude region. Terai lowland region being highly populous, the wetlands here support the livelihood of large populations through their provisional goods. One Ramsar wetland in Mid Hill bears great religious-cultural values, while the other provides economic, recreational, and religious-cultural values. The HAWs are important for maintaining ecological functions and services that sustain livelihood of both upstream and downstream populations.

In addition to ten Ramsar sites, there are several other wetlands (about 5000 lakes, 1380 reservoirs, and 5183 village ponds) in Nepal. Around 3252 glaciers and 2323 glacial lakes are identified in the high-altitude regions of the country. Other wetland categories include irrigated paddy fields, rivers, and swamps (Table 21.1), which bear significance in terms of livelihood support to the local people. The wetlands of Nepal, including Ramsar sites, occupy 5.6% of the total land surface, of which rivers and irrigated paddy fields hold the major proportion (i.e., 97%).

Table 21.1 Wetland types and their estimated areas in Nepal

SN	Wetland types	Estimated area (ha)	%
1	Irrigated paddy fields	398,000	48.58
2	Rivers	395,000	48.21
3	Marginal swamps	12,500	1.53
4	Ponds	7277	0.89
5	Lakes	5000	0.61
6	Reservoirs	1500	0.18
	Total	819,277	100.00

Source: Directorate of Fisheries Development, Kathmandu, Nepal (DoFD 2012)

21.3.3 Wetland Dependence of Local People

Like other South Asian neighboring countries, wetland ecosystems in Nepal support many local people, mainly low-income rural groups, for sustaining their livelihood. As mentioned earlier, the wetlands of Nepal are geographically categorized as high-altitude, Mid Hill, and Terai lowland wetlands and people's dependency on those wetlands differs accordingly.

21.3.3.1 High-Altitude Wetlands (HAWs)

Rara, Phokshundo, Gosainkunda, and Gokyo are the Ramsar listed wetlands of high-altitude regions. All of them support tourism and are important sources of income generation for the local people. These HAWs are the source of drinking and irrigation water supply to the downstream communities. The major river basins in Nepal and even for India and Bangladesh originate from these HAWs and Himalayan glaciers on which water-based livelihood of millions of people depends. Livestock grazing is a common practice in all HAWs catchment and people in these areas rear cows and sheep for milk and meat as a means of livelihood. Apart from the Ramsar sites, numerous other wetlands bear equal significance for sustaining livelihood at local level. Some such wetlands are Panch Pokhari, Khaptad Daha, Kyangjing, Parbati Kunda, Singjema, Thulo Pokhari, Timbung, and Warmi. High-altitude wetlands bear religious-cultural significance to Hindu and Buddhist communities as thousands of devotees visit the HAW in different seasons of the year. They are considered sacred in Hindu mythology, and in *Janai Purnima*, a religious festival, thousands of people visit these wetlands to perform rituals. The catchment of HAW is a source of various medicinal herbs, and among them, yarsagumba (*Ophiocordyceps sinensis)* is economically important. During summer season, thousands of low-income people of western Nepal flock to the High Himalayan region for harvesting this herb, which is in high demand and fetches good price in national and international markets. Shrestha and Bawa (2014) reported that yarsagumba is the second largest economic contributor to the people of Western Nepal after farm income, accounting for more than 21% of the household income and 53% of the total cash income.

21.3.3.2 Mid Hill Wetlands (MHWs)

Mai Pokhari was the lone wetland of eastern Mid Hills listed as a Ramsar site. Lake Cluster of Pokhara Valley of western Mid Hills is the latest addition to this list in early 2016. In Mai Pokhari, local people depend for irrigation and drinking water on this wetland and its catchment. People from the adjoining villages collect fuel wood, fodder, timber, leaf litter, wild mushroom, and diverse medicinal herbs from the lake complex. Tourism is a major industry of the lake complex; both national and international tourists visit the area round the year. Tourism has promoted employment opportunities to the people of this area.

Lake Cluster of Pokhara Valley consists of series of nine different lakes, located within a close proximity of Pokhara city in Kaski district of western Mid Hill Nepal, with Phewa being the largest one. Begnas Lake is a source of fuel wood and fodder collection, timber harvesting, livestock grazing, bathing, and commercial cage fish culture. The water from the lake has been diverted and used for irrigating downstream agriculture land parcels. Tourism in the area employs many local people, making them economically stable. In Rupa Lake, around 15,000 local ethnic low-income people residing in the catchment area are fully dependent on fisheries and other provisional resources to sustain their households. The ethnic Pode, Bote, and Majhi are traditional fishing communities living in the Mid Hill of Western Nepal, whose livelihood is based entirely on the wetland fisheries. Gurung et al. (2012) reported that each household of Pode community generates around US$ 635 per annum from capture and cage culture fisheries at the Phewa Lake. Fishery activities have been a significant income-generating and employment opportunity for these ethnic communities for a long time. Cage fish culture and capture fisheries are popular economic activities in most of the MHWs. For example, in Phewa Lake, Rupa Lake, Begnas Lake, and Kulekhani reservoir catchment area, it is thought that fishery shares over 75% of the total gross annual income of low-income group fisher households (Wagle et al. 2012). Similarly, wetland-related tourism plays an important role for both rural and urban people of MHWs. For instance, economic activities of people in the vicinity of Phewa, Rara, and Rupa Lakes mostly revolve around the flux of national and international tourists the year round.

21.3.3.3 Lowland Wetlands (LWs)

Ghodaghodi, Jagdishpur, Beeshazar, and Koshi Tappu are the four Ramsar sites located in the Terai lowland. Multiple resource extraction is a common practice in most of the lowland wetlands. For instance, local people in Ghodaghodi Lake Complex have collected fuel wood, timber, fodder, and fruits for generations. Many plant species of the complex bear medicinal properties and are good sources for curing diseases locally. Fisheries, snails (*Helix* sp.), sal (*Shorea robusta*) leaf, and lotus (*Nelumbo nucifera*) leaf collection are other important sources of economic activities in the complex. Wetland resources at Ghodaghodi Lake Complex contribute 12.4% of the total gross annual income of the local wetland-dependent people (Lamsal et al. 2015). The wetland water is also used for irrigating agricultural fields in the southern side of the lake during summer and winter seasons.

Table 21.2 Tangible uses of wetlands in the Terai lowland of Nepal

Uses	No. of wetlands under the specific use	% of resource users
Fishing	153	94
Grazing	113	70
Irrigation	112	69
Plant harvest[a]	96	59
Domestic use[b]	52	32
Fuel wood	32	20
Wildlife use	20	13
Religious use	18	11
Other uses[c]	23	14

Source: IUCN Nepal (1996)
[a]Thatch grass, timber, aquatic crops, fodder
[b]Washing clothes and kitchenware, bathing
[c]Travel routes, waste disposal

The livelihood of more than 100,000 people of the buffer/catchment zone of Koshi Tappu Riverine wetland depends on its resources. Livestock rearing, rice paddy cultivation, fishery, firewood and driftwood collection, mat weaving, and selling edible wild vegetable plants are routine activities of these people, thus making wetland resources a reliable source of income. An ethnic fishing community, *Malaha*, fully depends on fishery at Koshi Tappu. Apart from fishery, they also utilize wetland plant *Typha elephantina* for weaving mats and other nonusable wetland plant species for bio-briquette and compost that fetch good money in the local markets. Of the 103 ethnic groups, 20 are wetland dependent, most of which live in the Terai lowland (IUCN Nepal 2004). Some such ethnic groups are Sunuha, Mallah, Kewat, Bote, Musahar, Gongi, Darai, Kumal, Dasuhad, Sahani, Bantar, Danuwars, Barthamus, Majhis, Tharus, and Kushar. Jagdishpur reservoir, another Ramsar site, was originally created for irrigation and is said to irrigate more than 6000 ha of agricultural land during lean periods. Apart from irrigation, local people depend on this reservoir for fishing, livestock grazing, fuel wood, and fodder. More than 40 species of fish exist in this reservoir and are the main source of income for poor. Bishazari Lake, located in Central Nepal, has been used as a source of irrigation water. Apart from irrigation, local people extract resources such as fuel wood, fodder, timber, medicinal herb, and fish from the wetland. Livestock grazing at the dyke and buffalo wallowing in lake water are the other common activities in the area. Local ethnic *Tharu* community collects NWFPs for making mat, rope, and carpet as an alternative source of income and snails as food supplement.

IUCN Nepal (1996) portrayed the most common nine uses of the wetlands in the Terai lowland (Table 21.2) that shows fishing as the most important economic activity of the local people.

Apart from Ramsar sites, there are numerous other wetlands in Terai lowland that bear equal significance for sustaining livelihood, such as Bedkot Tal, Paderni Tal, Deukhuria Tal, Rampur Tal, Badhaiya Tal, and Gaindahawa Tal. People use all the wetlands in Terai lowland for carrying out Hindu religious-cultural activities.

Table 21.3 Major uses of wetland in Nepal

Wetland types	Wetland uses					
	Aquatic food	Drinking and irrigation	Fuel wood, timber, medicinal, NWFPs	Tourism	Livestock grazing	Religious and cultural
HAWs	+	+	++	+++	+	+++
MHWs	++	++	+++	++	++	+++
LWs	+++	+++	+++	+	+++	+++

+++ high, ++ medium, + low

Popular Chhat and Maghi festivals in Terai lowland are celebrated along rivers, ponds, and lakes.

Thus, it is clear that in Nepal, local people depend on wetlands to sustain their livelihood like other South Asian countries. However, the degree of dependency on wetlands varies with geographic location (Table 21.3).

Overall, it can be said that people nearby HAWs mainly use wetlands for tourism-related activities, performing religious-cultural practices, and collecting medicinal herbs and NWFPs. People nearby MHWs mainly collect fuel wood, timber, and NWFPs, worship wetlands as a religious practice, and, in some areas, harvest fishes either by capture or by cage fishery. On the other hand, people nearby LWs are more dependent on wetland resources compared to the people nearby HAWs and MHWs. They use them for collecting aquatic food such as fishes and crabs, drinking and irrigation water supply, fuel wood and NWFPs, livestock grazing, and religious practices. Wetland uses are classified into four types: provisioning, regulating, cultural, and supporting (MEA 2005). Provisioning service, due to its tangible nature, is only considered as wetland use by common people in Nepal. Though regulating, cultural, and supporting services are equally important for human society, it is generally not considered explicitly due to its intangible nature.

21.4 Conclusion

A large number of people in South Asian region, particularly low-income groups, are dependent on wetland resources to sustain their livelihood. Though the way of using wetlands is diverse based on locality and culture, major uses are harvesting wetland resources and using the wetlands in situ. Wetland ecosystem has been a major provider of food resources, drinking and irrigation water, as well as fuel wood, timber, medicinal herbs, and NWFPs to this region for a long time. Wetlands are also used for recreation and tourism. Therefore, conservation, sustainable management, and wise use of the wetland ecosystems are critical for realizing long-term benefits to the local people. Though the local communities depend heavily on wetland resources in South Asia, they still do not recognize the full ecosystem services of wetlands. Highlighting the importance of the wetland's goods and services to

their livelihood can help motivate them to support conservation of wetlands. Recognizing the importance of wetland resources to their livelihood can help in effective policy making for the conservation of the wetlands and sustainable use of wetland resources.

References

Atapattu SS, De Silva S, Senaratna SS (2010) Wetland and agriculture: a case for integrated water resource management in Sri Lanka. International Water Management Institute. Available via http://publications.iwmi.org/pdf/H042855.pdf. Accessed 20 Dec 2015

Bassi N, Kumar MD, Sharma A et al (2014) Status of wetlands in India: a review of extent, ecosystem benefits, threats and management strategies. J Hydrol Reg Stud 2:1–19

Boere GC, Galbraith CA, Stroud DA (eds) (2006) Waterbirds around the world. The Stationery Office, Edinburgh, p 960

BW-WG (2008) Biodiversity and wetlands working group. Final Technical Report of NCSA and NAPA projects, p 52

Claridge GF (1991) An overview of wetland values: a necessary preliminary to wise use. PHPA/AWB Sumatra Wetland Project Reports No 7, AWB Bogor

Cowardin LM, Carter V, Golet FC et al (1979) Classification of wetlands and deepwater habitats of the United States. U.S. Department of the Interior, Fish and Wildlife Service, Washington, DC

DoFD (2012) Country profile – Nepal 2011/2012, fisheries sub-sector. Directorate of Fisheries Development (DoFD), Kathmandu

Gurung R, Glaser M, Hofmann AM et al (2012) Resource use and dependency on wetlands: a study of the Jalari fishing community of Phewa Lake, Nepal. In: Shrestha MK, Pant J (eds) Small-scale aquaculture for rural livelihoods: proceedings of the national symposium on small-scale aquaculture for increasing resilience of rural livelihoods in Nepal. Institute of Agriculture and Animal Science, Tribhuvan University, Nepal, and the World Fish Center, Penang, p 191

IUCN Nepal (1996) An inventory of Nepal's wetlands. IUCN-Nepal, Kathmandu

IUCN Nepal (2004) A review of the status and threats to wetlands in Nepal: IUCN wetland and water resources programme. IUCN, the World Conservation Union

IUCN Sri Lanka (2004) Wetland conservation in Sri Lanka. Proceedings of the National Symposium on Wetland Conservation and Management. Sri Lanka, p 75

Jain SK, Agarwal PK, Singh VP (2007) Hydrology and water resources of India. Springer, Dordrecht

Lamsal P, Pant KP, Kumar L et al (2015) Sustainable livelihoods through conservation of wetland resources: a case of economic benefits from Ghodaghodi Lake, western Nepal. Ecol Soc 20(1):10. http://dx.doi.org/10.5751/ES-07172-200110

MEA (2005) Ecosystems and human well-being: synthesis, Millennium Ecosystem Assessment. Island Press, Washington, DC

Parveen S, Islam MF (2001) Fisheries in Bangladesh: a critical review, Environment and Development Series No. 08/2002. North South University, Dhaka

Shrestha UB, Bawa KS (2014) Economic contribution of Chinese caterpillar fungus to the livelihoods of mountain communities in Nepal. Biol Conserv 177:194–202

Sultana P (n.d.) Improving livelihoods of wetland users: MACH lessons. Policy Brief 4: 4. Available via http://www.nishorgo.org/tbltd/upload/pdf/0.76065300%201357812118_Improving%20Livelihoods%20of%20Wetland%20Users.pdf. Accessed 06 Aug 2015

Uddin K, Shrestha HL, Murthy MSR et al (2015) Development of 2010 national land cover database for Nepal. J Environ Manag 148:82–90

Wagle SK, Shrestha HK, Bista JD et al (2012). Cage fish culture and capture fishery as dominant livelihood sources for fisher community in Pokhara Valley, Nepal: A socio-economic update. In: Shrestha MK, Pant J (eds) Small-scale aquaculture for rural livelihoods: proceedings of the national symposium on small-scale aquaculture for increasing resilience of rural livelihoods in Nepal. Institute of Agriculture and Animal Science, Tribhuvan University, Nepal and the World Fish Center, Penang, p 191