UNIT 7 WETLAND ECOSYSTEM

Structure

7.1 INTRODUCTION

Wetlands are one of the most productive ecosystems of the world. They are considered fundamental for human well-being and environmental sustainability. Wetland are very rich in biodiversity as more than 40% of all the world's species live and propagate in wetlands. As a result, the types of ecosystem services provided by wetlands are considered higher as compared to other ecosystems of the world. The various life sustaining services provided by the wetlands include maintenance of water quantity and quality, source and sink for greenhouse gases, retention of soils and sediments, livelihoods, food security and provide a wide range of ecological niches, supporting extensive biodiversity, etc. Despite these vital roles, wetlands are one of the most threatened ecosystems. Approximately 40% of wetlands have being lost over the last 40 years, 76 % species are threatened and approximately 81% of populations of freshwater species have been decline globally. The rate of decline of wetland species is much sharper than any other terrestrial or marine biome. In fact, the significance of wetlands have been highlighted way back in 1971 through "The Ramsar Wetland Convention". Further, it is one of the important ecosystems to attract the attention of the global community and hence a global environmental agreement on "the conservation, protection and sustainable use of wetlands".

Anthropogenic climate change is one of the main drivers of wetland loss or decline. Climate change along with industrialization, urbanization, resource exploitation, and environmental pollution threaten the wetlands across the world. Consequently, the ecosystem services provided by the wetlands such as "water recharge and discharge", "flood control", "wildlife habitats", and "nutrient storage

functions and services" are severely affected. The potential impact of climate change on wetland ecosystem and species are recognised by the "Ramsar Convention (RC) on Wetlands", the "Intergovernmental Panel on Climate Change (IPCC)" and the "United Nations Framework Convention on Climate Change (UNFCCC)". Keeping in view the impacts of climate change on wetland productivity and sustainability, this unit delves into inter-linkages between climate change and wetland and how wetland restoration and conservation play a crucial role for climate change resilience and sustainable development.

7.2 OBJECTIVES

After studying this unit, you should be able to:

- explain the importance of wetlands;
- explain the interactions between wetlands and climate change;
- discuss the vulnerability and impact assessment of wetlands to climate change; and
- discuss the role of wetlands in climate change resilience.

7.3 WETLANDS

7.3.1 Overview

Wetlands are areas where water is the primary factor controlling the environment and the associated plant and animal life. They occur where the water table is at or near the surface of the land, or where the land is covered by water (https://www.ramsar.org/sites/default/files/documents/library/info2007-01-e.pdf). Article 1 of the Convention states that "wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water, the depth of which at low tide does not exceed six metres". Ramsar Convention has adopted a Ramsar classification of wetland type which includes 42 types, grouped into three categories:

- "Marine and coastal wetlands;
- Inland wetlands; and
- Human-made wetlands".

Five major wetland types that are generally recognized by the conventions are:

- "Marine wetlands viz. coastal lagoons, rocky shores, and coral reefs;
- Estuarine wetlands viz. deltas, tidal marshes, and mangrove swamps;
- Lacustrine wetlands viz. lakes;
- Riverine wetlands; and
- Palustrine wetlands viz. marshes, swamps and bogs".

Further, the human-made wetlands include "fish and shrimp ponds", "farm ponds", "salt pans", "reservoirs", and "sewage farms".

7.3.2 Significance

Wetlands are found at the intersection of the terrestrial habitats and aquatic habitats. It is construed as one of the biologically productive ecosystem on the Planet Earth. They are significant for their services rendered to mankind. They play a significant role in hydrological cycle by "receiving, storing, and releasing" water and immensely supporting the fauna and flora. Also wetlands play a vital role in pollution control and regulation of nutrients. In other words, wetlands role in biogeochemical cycling of nutrients cannot be overemphasized. They are storehouse of the majority of the global soil carbon. In addition to the water purification service, wetlands provide food security to billions as they provide fish and paddy. Wetlands along with the rivers and streams play a critical role in hydrology. Also, wetlands act as a "natural sponge" and hence aid in mitigating floods and droughts. The marshy wetlands and mangroves along the coastlines act as bulwark against extreme weather events. The significance of the wetlands can be summarized as:

- **Wetlands maintain the hydrological cycle**

  As stated earlier, wetlands play a critical role in hydrological cycle by "receiving, storing, and releasing" water and hence maintaining the "water flows" which are essential for the sustainability of life support system. The hydrological regime is a "*measure of the levels, volume, timing and frequency of water flows into and out of wetlands*". The hydrological regime in a way decides the structure and function of wetlands. The structure and function of wetlands provide unique services such as pollution control, flood control, nutrient cycling, etc. It is important to note that the changes in the hydrological cycle would eventually influence the processes that are taking place in wetland ecosystem. Along with human intervention, climate change, precipitation and temperature regime influence the hydrological processes.

- **Wetlands are the world's largest carbon stores**

  Not only wetland plays a major role in water cycling but they are the world's largest carbon stores. The majority of the global soil carbon pool is held in wetlands. Carbon sequestration and storage are result of mainly the processes like primary production and taking in carbon dioxide for photosynthesis and producing organic matter and secondly respiration or decomposition which generate carbon dioxide or methane from organic matter. Wetland facilitates slow decomposition and when decomposition is less than plant productivity, carbon accumulates or stored. These processes get affected mainly by changing temperature and precipitation regimes. With rich biodiversity, wetlands are a vital means of storing carbon. Wetlands are also tremendously productive ecosystems that provide a myriad of services to society worldwide. As a result, change in climate can shift the balance of these processes, causing wetlands to become a potential carbon sources. For example, peatlands are powerful carbon sinks, holding the largest, long-term store of any ecosystem which makes peatlands one of the largest global reserves. Peatlands occupy only 3% of the land surface but they store twice as much carbon as the world's forest. Same way, if we take the example of coastal and marine wetlands, including salt marshes, mangroves and seagrass beds, they are also important sites of carbon uptake and storage. Another example is mangrove forests

which are some of the most "carbon dense" ecosystems in the world. This "blue carbon" accumulates due to high primary production and sediment trapping, enabling carbon to accumulate over long time periods. In river deltas, these processes may allow wetlands to keep pace with sea level rise. When sediment inputs are cut off, sediment starvation and subsidence of delta wetlands can occur. Anthropogenic disturbances in coastal zones causes loss of carbon from wetland soils.

- **Wetlands are unique ecosystems**

  Wetlands are unique ecosystems because they are in general sinks for carbon dioxide and sources of methane. Wetlands are the world's largest carbon stores, but also release methane. Their climate footprint therefore depends on the inter-linkages of the land-atmosphere exchange of these two major greenhouse gases. The net climate impact of wetlands is strongly dependent on whether they are natural or managed. Freshwater wetlands are also the largest natural source of methane, a greenhouse gas, especially when not well managed. Tropical reservoirs also release methane, sometimes offsetting the reported low-carbon benefits of hydropower.

7.3.3 Ecosystem Services

Wetlands comprise approximately 6% of the Earth's surface area and are essential for many ecosystem services such as water purification, flood attenuation, and climate change mitigation. The services rendered by the wetland ecosystem outweigh the services provided by terrestrial ecosystems. Wetland ecosystems as stated earlier provide nutritional and food security through provision of food such as rice, fish, etc. As regards the regulating services, wetlands provide ecosystem services such as climate regulation, and regulation of hydrological regimes. Further, the services provided by wetlands have both cultural and spiritual connotations. In addition to providing recreational services, the wetlands act as a repository of carbon, and hence playing a vital role in regulating global climate. Wetlands are particularly important provider of all water-related ecosystem services. They regulate water quality, groundwater recharge, and can contribute to regulating floods and the impacts of storms. Wetlands also help in erosion control and sediment transport, thereby contributing to land formation and increasing resilience to storms.

Table 7.1: Ecosystem Services provided by Wetlands

Ecosystem Services	**Examples**
Provisioning Services	
Food	Fish, wild game, grains
Fresh water	Storage and retention of water; supply of drinking water
Fibers and fuel	Production of logs, fuelwood, and fodder
Bio-chemicals	Medicines from flora and fauna
Regulating *Services*	
Climate regulation	Source and sink for greenhouse gases; Regulation of local and regional climate.

Water regulation and ecological flows	Groundwater recharge and discharge
Pollution control	"Retention, recovery and removal" of excess nutrients, and pollutants
Others: Erosion control	Flood control; Retention of soil particles
Cultural Services	
Spiritual services	Spiritual and religious values associated to wetlands
Recreational services	Wildlife tourism
Aesthetic services	Aesthetic value of wetland ecosystems
Educational services	Education and training
Supporting Services	
Soil formation	Organic matter accumulation; soil formation.
Biogeochemical cycle	Cycling of nutrients
Biodiversity	Ecological niches to many species

- **Wetlands are key habitat for migratory species and important source of food**

  In fact, most of the water birds depend on the wetlands for the purpose of feeding, and breeding. Since the migratory birds travel long distances, covering even many countries, there is a need for concerted action by countries towards wetland conservation. Wetlands are generally rich in biodiversity. The diverse group of organisms in fact increase the biological productivity of the ecosystem. For instance, lowland paddy cultivation, in addition to providing food crop, the system provides habitat to variety of organisms such as fish, molluscs and crustaceans. These organisms aid in nutrient cycling and biological pest management.

Check Your Progress 1

Note: 1) Use the space given below for your answers.
2) Check your answers with those given at the end of this unit.

1. Define wetlands. List the types of wetlands?

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2. Discuss the ecosystem services provided by the wetlands.

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7.4 WETLANDS AND CLIMATE CHANGE INTERACTIONS

"Current ecosystem services from the ocean are expected to be reduced at 1.5°C of global warming, with losses being even greater at 2°C of global warming"**.** The risks of declining ocean productivity, shifts of species to higher latitudes, damage to ecosystems (e.g., coral reefs, and mangroves, seagrass and other wetland ecosystems), loss of fisheries productivity (at low latitudes), and changes to ocean chemistry (e.g., acidification, hypoxia and dead zones) are projected to be substantially lower when global warming is limited to 1.5°C. Similar is the case with another aquatic ecosystem - the wetlands.

Despite this, within the last century, the destruction of wetlands has accelerated rapidly. For their ability to simultaneously sequester CO_2 and emit CH_4, wetlands are unique ecosystems that may potentially generate large negative climate feedbacks over centuries to millennia and positive feedbacks over years to several centuries. Wetlands are among the major biogenic sources of CH_4, contributing to about 30% of the global CH_4 total emissions, and are presumed to be a primary driver of inter annual variations in the atmospheric CH_4 growth rate. Meanwhile, peatlands, the main subclass of wetland ecosystems, cover 3% of the Earth's surface and are known to store large quantities of carbon (about 500 ± 100 Gt C). The controversial climate footprint of wetlands is due to the difference in atmospheric lifetimes and the generally opposite directions of CO_2 and CH_4 exchanges, which leads to an uncertain sign of the net radiative budget. Wetlands in fact have a great potential to preserve the carbon sequestration capacity because near water-logged conditions reduce or inhibit microbial respiration and promote CH_4 production. Potential variations of the CO_2/CH_4 stoichiometry in wetlands exposed to climate and land use change require the development of mitigation-oriented management strategies to avoid large climatic impacts.

Wetlands and climate change are interlinked. As regards the interactions, climate change greatly impact the "water flow and volumes", temperature, "nutrient balance", and "invasive species" as well. Intergovernmental Panel on Climate Change projected climate change to "significantly reduce surface water and groundwater resources in dry subtropical regions, intensifying competition for water; increasing extinction risk in freshwater species, especially due to synergistic effects with other drivers; posing a high risk of abrupt and irreversible regional-scale change in the composition, structure, and function of freshwater ecosystems; and damaging coastal ecosystems through sea level rise" (IPCC 2014). Use of wetlands for carbon sequestration can eventually lead to conservation and also restoration of wetlands. Though the ecosystem services provided by wetlands are significant, due to anthropogenic activities, land-use changes, climate induced changes, wetlands are challenged. Further, people dependent on the wetlands for their livelihood are struggling to exist in the era of climate change.

Due to climate change effects, wetland dependent communities are adopting other land-use practices and aquaculture for their livelihood. However, the aquaculture by itself is affected by climate change. Also, the coastal communities experience multiple stresses such as sea-level rise, sea water intrusion, and extreme weather events.

It is reported that carbon sequestration benefits of wetlands are partially offset by methane release. It is estimated that wetlands produce about 100 Tg of methane per annum which amounts to about 20-25% of total global methane emissions. The global methane emissions also varies based on the structure and function of wetlands. Generally, while methane emissions are more in freshwater wetlands, they are low in saltwater wetlands. It is projected that the warming temperature may melt the permafrost leading to the increase in methane emissions from the permafrost regions.

7.5 VULNERABILITY AND IMPACT ASSESSMENT OF WETLANDS TO CLIMATE CHANGE

Climate change may have its most pronounced effect on wetlands through alterations in hydrological regimes: specifically, the nature and variability of the hydroperiod and the number and severity of extreme events. However, other variables related to climate may play an important roles in determining regional and local impacts, including increased temperature and altered evapotranspiration, altered biogeochemistry, altered amounts and patterns of suspended sediment loadings, fire, oxidation of organic sediments and the physical effects of wave energy. Pressures on wetlands are likely to be mediated through changes in hydrology, direct and indirect effects of changes in temperatures, as well as land-use change. Examples of impacts resulting from projected changes in extreme climate events according to Ramsar (2002) includes:

- "change in base flows; altered hydrology (depth and hydroperiod);
- increased heat stress in wildlife;
- extended range and activity of some pest and disease vectors;
- increased flooding, landslide, avalanche, and mudslide damage;
- increased soil erosion;
- increased flood runoff resulting in a decrease in recharge of some floodplain aquifers;
- decreased water resource quantity and quality;
- increased risk of fires;
- increased coastal erosion and damage to coastal buildings and infrastructure; and
- increased damage to coastal ecosystems such as coral reefs and mangroves and increased tropical cyclone activity".

Wetland systems are vulnerable and particularly susceptible to changes in quantity and quality of water supply. Climate change will affect the hydrology of individual

wetland ecosystems mostly through changes in precipitation and temperature regimes with great global variability. Given the diversity of wetland types and their individual characteristics, the impacts resulting from climate change will vary according to different temperature and precipitation regimes and so will the restoration remedies.

7.6 ROLE OF WETLANDS IN CLIMATE CHANGE ADAPTATION

Although the importance of wetland ecosystems is widely acknowledged, the Ramsar Secretary General, Martha Rojas Urrego recently stated that "wetlands are being lost faster than forests." In fact, it is estimated that approximately 64% of wetlands have been lost globally since 1900 (Ramsar 2017). According to WWF (2017) "principal threats to wetlands on a global scale are drainage and development of wetlands for industrial and agricultural use, invasive species, pollution, climate change and the erection of dams".

Billions of people rely on the wetlands for their livelihood. Nevertheless, due to ever increasing demand for food, water, land resources, and climate variability and climate change, the wetlands are under severe stress. Due to the declining areal extent and productivity of wetlands, the environment, integrity and health, and human wellbeing may be affected. This may lead to social tensions and conflicts and eventually migration due to water shortage and water crisis.

Adaptation to climate change is defined as "the adjustment of natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities". Vulnerability is a central concept to adaptation and is defined as "the degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes" (IPCC 2014). In other words, non-success to climate change adaptation would increase the vulnerability of wetlands and also dependent communities to climate change. So, it is essential to adapt the wetlands to climate change, as they provide diverse ecosystem services such as flood protection, food security, and livelihood security. Further, the degraded wetlands have potential to augment the vulnerability of the communities, as the degraded wetlands constrain the adaptive capacity of the communities. Also, adaptation of wetlands to climate change is essential so that the ecosystem functions and services are maintained. For the success of adaptation programme pertaining to wetlands, there is a need to minimise the threats to wetlands including anthropogenic threats.

7.6.1 Priorities on Wetlands for Enhancing Climate Action

- Protection and restoration of production systems associated with wetlands
- Improving the integrity of peatlands, floodplains and mountain lakes.
- Augmenting the investments in the green infrastructure.
- Protect and restore the floodplains, salt marshes, mangroves, and coastal wetlands.

- Conservation and restoration and sustainable use of inland wetlands.
- Identifying, protecting, restoring and conservation of wetland hotspots.

Source: https://unfccc.int/sites/default/files/resource/77_Wetlands%20International%20input%20into%20the%20Talanoa%20Dialogue.pdf

Check Your Progress 2

Note: 1) Use the space given below for your answers.
2) Check your answers with those given at the end of this unit.

1. Identify the inter-linkages between climate change and wetlands?

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2. Enlist the priorities on wetlands for enhancing climate action?

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7.7 WETLAND RESTORATION FOR CLIMATE CHANGE RESILIENCE

The climate is changing at an unprecedented rate and the effects of a changing climate can be widely seen in all the ecosystems including terrestrial, aquatic or marine ecosystems. The effect of climate change on wetland varies by location. It is reported that across the world, the climate-related risks and disasters are increasing recently, and about 90% of such disasters are linked to water. In this regard, it is important to note here that there is a dire need to protect and restore wetlands so as to mitigate climate change and at the same time to adapt to changing climate. Wetlands such as peatlands, salt marshes, mangroves, etc. are repository of carbon. Such wetlands, if degraded, not only release carbon, but also lose its ability to sequester carbon substantially. In the era of climate change, as regards the wetlands management, responses like "sustainable use of wetlands"; and "restoration of degraded wetlands"; are essential.

Ramsar Convention on Wetlands (Resolution X.24) "Climate change and wetlands" highlights "*how wetlands deliver a wide range of ecosystem services that contribute to human well-being, climate change mitigation and/or adaptation and calls upon Parties to include in national climate change strategies the protection of all types of critical wetlands*". Resolution XII.13, "Wetlands and Disaster Risk Reduction" points at "*the devastating impacts of disasters on the maintenance of healthy wetlands, and the role of fully functioning wetland ecosystems in enhancing local resilience, and calls for the integration of wetland-based disaster risk reduction into national strategic plans and relevant policies and planning*".

The recent Paris Agreement on climate change categorically recognises the importance of ecosystems and biodiversity for climate change mitigation and adaptation. The important component of Sustainable Development Goals is to protect the planet Earth from degradation, and this has been addressed as part of Goals 2, 6, 8, 11, 14 and 15. Further, the goals are interlinked and the successful achievement of the many SDGs is intricately linked to the protection, and sustainable use of wetlands. The Global Land Outlook, UNCCD, 2017 underscores the important role of wetlands from the perspective of "water security", "social instability" and "political insecurity". Also the UNCCD's 10-year Strategic Plan and Framework (2008-2018) underlines the ecosystem services rendered by wetlands in semi-arid ecosystems for drought proofing and climate resilience.

Wetland Restoration for Climate Change Resilience

1. "*The wise use and restoration of wetlands is essential to protect stored carbon and reduce avoidable carbon emissions.*
2. *Prioritizing wetland protection and restoration can enhance climate adaptation and resilience.*
3. *Wetlands play a vital role in retaining water on the landscape, maintaining local climate and water cycles and reducing temperature extremes.*
4. *Protecting and restoring wetlands to increase climate mitigation and resilience delivers many co-benefits.*
5. *Protecting and restoring wetlands for climate mitigation and adaptation reflects a key tenet of Ramsar's Strategic Plan and represents progress towards meeting the Sustainable Development Goals and the Paris Agreement on Climate Change".*

Source: Ramsar Briefing Note No.4; www.ramsar.org

7.8 LET US SUM UP

Wetlands are considered fundamental for human well-being and environmental sustainability. They are one of the most productive ecosystems of the world. Life sustaining services provided by the wetland include maintenance of water quantity and quality, source and sink for greenhouse gases, retention of soils and sediments, livelihoods, food security and provide a wide range of ecological niches, supporting extensive biodiversity, etc. Anthropogenic climate change is one of the main drivers of wetland loss or decline. Climate change along with industrialization, urbanization, resource exploitation, and environmental pollution threaten the wetlands across the world. In this unit, we have learned about wetland and their significance in maintaining hydrological cycle and ecosystem services provided by them in detail. In this unit, we have discussed about the interactions between wetlands and climate change, including the climate change impacts. Further, we have discussed role of wetland restoration and conservation for climate change resilience and sustainable development.

7.9 KEYWORDS

Carbon Sequestration : Removal of carbon from the atmosphere and its storage in an ecosystem in a given area over a given time.

Carbon Sink : Long term (of at least one year) sequestration of carbon by an ecosystem (i.e., more carbon is taken up than is released). Living and dead vegetation, as well as soil carbon, constitute the carbon sink.

Carbon Stock : Carbon stored in an ecosystem, regardless of the time it took to build up this stock.

Resilience : The capacity of social, economic, and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganizing in ways that maintain their essential function, identity, and structure, while also maintaining the capacity for adaptation, learning, and transformation.

7.10 SUGGESTED FURTHER READING/ REFERENCES

Ramsar Convention on Wetlands. (2018). Global Wetland Outlook: State of the World's Wetlands and their Services to People. Gland, Switzerland: Ramsar Convention Secretariat.

WWAP (United Nations World Water Assessment Programme)/UN Water. 2018. The United Nations World Water Development Report 2018: Nature-Based Solutions for Water. Paris, UNESCO

IPCC, 2014: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y .O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P .R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, 1132 pp.

IPCC, 2014: Annex II: Glossary [Agard, J., E.L.F. Schipper, J. Birkmann, M. Campos, C. Dubeux, Y. Nojiri, L. Olsson, B. Osman-Elasha, M. Pelling, M.J. Prather, M.G. Rivera-Ferre, O.C. Ruppel, A. Sallenger, K.R. Smith, A.L. St. Clair, K.J. Mach, M.D. Mastrandrea, and T.E. Bilir (eds.)]. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part B: Regional Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Barros, V.R., C.B. Field, D.J. Dokken, M.D. Mastrandrea, K.J. Mach, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken,

P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1757-1776.

Web Links

https://unfccc.int/sites/default/files/resource/77_Wetlands%20International%20input%20into%20the%20Talanoa%20Dialogue.pdf

https://www.ramsar.org/sites/default/files/flipbooks/ramsar_gwo_english_web.pdf

https://www.ramsar.org/sites/default/files/documents/library/bn10_restoration_climate_change_e.pdf

https://mafiadoc.com/global-wetland-outlook-2018_5c188a43097c47250b8b46a7.html

www.ramsar.org

http://www.unesco.org/new/en/natural-sciences/environment/water/wwap/

https://www.globalpeatlands.org/

http://www.ramsar.org/pdf/info/services_07_e.pd

7.11 ANSWERS TO CHECK YOUR PROGRESS

Check Your Progress 1

1. Wetlands are areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres. Wetlands can be grouped into marine and coastal wetlands; inland wetlands; and human-made wetlands.

2. Wetlands are essential as they provide many ecosystem services such as water purification, flood attenuation, and climate change mitigation. Wetland ecosystems provide nutritional and food security through provision of food such as rice, fish, and etc. As regards the regulating services, wetlands provide ecosystem services such as climate regulation, and regulation of hydrological regimes. Additionally, the services provided by wetlands have both cultural and spiritual connotations. In addition to providing recreational services, the wetlands act as a repository of carbon, and hence playing a vital role in regulating global climate. They regulate water quality, groundwater recharge, and can contribute to regulating floods and the impacts of storms. Wetlands also help in erosion control and sediment transport, thereby contributing to land formation and increasing resilience to storms.

Check Your Progress 2

1. Wetlands and climate change are interlinked. As regards the interactions, climate change greatly impact the “water flow and volumes”, temperature, “nutrient balance”, and “invasive species” as well. Use of wetlands for carbon sequestration can eventually lead to conservation and also restoration of wetlands. Though the ecosystem services provided by wetlands are significant, due to anthropogenic activities, land-use changes,

climate induced changes, wetlands are challenged. Further, people dependent on the wetlands for their livelihood are struggling to exist in the era of climate change. Due to climate change effects, wetland dependent communities are adopting other land-use practices and aquaculture for their livelihood. Carbon sequestration benefits of wetlands are partially offset by methane release. It is projected that the warming temperature may melt the permafrost leading to the increase in methane emissions from the permafrost regions.

2. The priorities on wetlands for enhancing the climate action are as follows:

   - Protection and restoration of production systems associated with wetlands
   - Improving the integrity of peatlands, floodplains and mountain lakes.
   - Augmenting the investments in the green infrastructure.
   - Protect and restore the floodplains, salt marshes, mangroves, and coastal wetlands.
   - Conservation and restoration and sustainable use of inland wetlands.
   - Identifying, protecting, restoring and conservation of wetland hotspots.