Chapter 1

Introductory Chapter: Wetland Importance and Management

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http://dx.doi.org/10.5772/intechopen.82456

1. Introduction

Water is an important resource for all living beings. Therefore, the use of water and its supply from sources are very important. Wetlands are an ecosystem from mangrove to subarctic peatlands that have affected human. The earliest civilizations were established near the river, lake, and floodplains [1]. The Mesopotamian civilization is authoritatively accepted to have started around 4000–3500 BC between the Euphrates and Tigris River. The other ancestral civilization, Egypt, commenced in the Nile Valley at around 3200 BC. This represents the importance of the water and wetlands. The fact that people are in these regions is a reflection of how important it is for biotic diversity. Therefore, wetlands are a very critical ecosystem, and some of them are the most productive habitats.

Wetlands occur where the water table is at or near the surface of the land or where the land is covered by water [2]. Wetlands are the only ecosystems for whose conservation an international convention (Ramsar Convention) had been adopted as early as 1971. Ramsar Convention defined wetlands as "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 meters" [2]. Wetlands have about 6% of the earth although they play an important role in hydrology and include mangroves, peatlands and marshes, rivers and lakes, deltas, floodplains and flooded forests, and even coral reefs. A wetland is a generalized concept including coastal wetlands. It exists in every climatic region, ranging from the polar zones to the arid zones.

Many wetlands are transitional area between aquatic and terrestrial ecosystems. These ecosystems are divided into two groups depending on the quantity of water: permanent and temporal flooded. Since wetlands are distributed in many different habitats on earth, they

reflect different responses and behaviors to environmental changes. Therefore, wetland classification is important, and differences can be found. It is basically divided into natural and human-made constructed wetlands. In general, abiotic environmental factors, habitat differences, and biotic factors are considered to have a wide range of classification. Physical, chemical, and sediment quality determine wetland functions and classification. These situations classify its types [3].

Wetland ecosystems rapidly get worse due to various reasons. The environmental quality gradually deteriorates, and biotic diversity decreases in these habitats. It is estimated that more than 50% of specific wetland types in Europe, North America, Australia, and New Zealand were modified or changed during the twentieth century [4, 5]. Coastal wetland ecosystems are under extreme pressure, and it is estimated that about 35% of mangrove have been lost during the last two decades due to increasing agricultural area, deforestation, and freshwater reduction [6, 7].

Monitoring is the long-term regular observation and recording of current and altering situations. In the environmental assessment, these data were utilized to evaluate wetlands based on decision-making and planning processes. Consequently, wetland surveys have possessed a multidisciplinary perspective. The fact that the recognition of wetlands supplies many values for people and is an important case for global conservation has led to an increase in research and management activity.

2. Importance of wetland management

Because of urbanization, economic growth, industrialization, and increasing population, more wastes were discharged into nature. Wetlands carry through some beneficial functions in the protection of whole balance of the nature.

Wetlands are ecologically sensitive systems and provide many significant services to the human population. The evaluation of wetlands with a multidisciplinary perspective in the natural sciences and social sciences provides efficient results. This perspective can give an increased understanding of the processes and problems associated with such strategies. It is clear that wetlands expose noteworthy economic value (depending on the cost-benefit analysis) and they are under severe stress. The reasons for wetland loss and deterioration implicate excessive use, land degradation, urbanization, pollution, climate change, decrease biotic diversity, and invasive species. Since wetlands are complex multifunctional systems, they are likely to be the most beneficial if conserved as integrated ecosystems (within a catchment area) rather than their individual component parts.

Anthropogenic activities (urbanization, water and land uses, land cover changes, industrial activity, pollution, climatic change, etc.) have direct and indirect effects on wetlands. The degradation degree of an ecosystem is depended on temporal variation. Ecosystem recovery level and duration have two main factors. Firstly, anthropogenic pressures can increase or decrease due to the usage grade. Secondly, wetland's carrying capacity is changed due to spatial and

temporal variation. For these reasons, positive and negative feedback mechanisms at the wetland are critical control systems. Therefore, the wetland is considered as holistic ecosystem perspective from its basin scale. Odum and Soto–Ortiz [8, 9] concluded that the natural balance is not a steady state and has a homeorhesis. As shown in **Figure 1**, the feedback mechanism occurs to control the wetland ecosystem dynamics. In the natural ecosystems, feedback control processes are repeated between environmental factors and population growth rates in their carrying capacities. However, when the human population intervenes and extremely uses wetlands, this tolerance is destructed, and ecosystems wander off their homeorhesis.

The exponential human population growth reflects why environmental problems appear suddenly [10]. Due to the excess use of wetlands in different ways in time, wetlands have lost

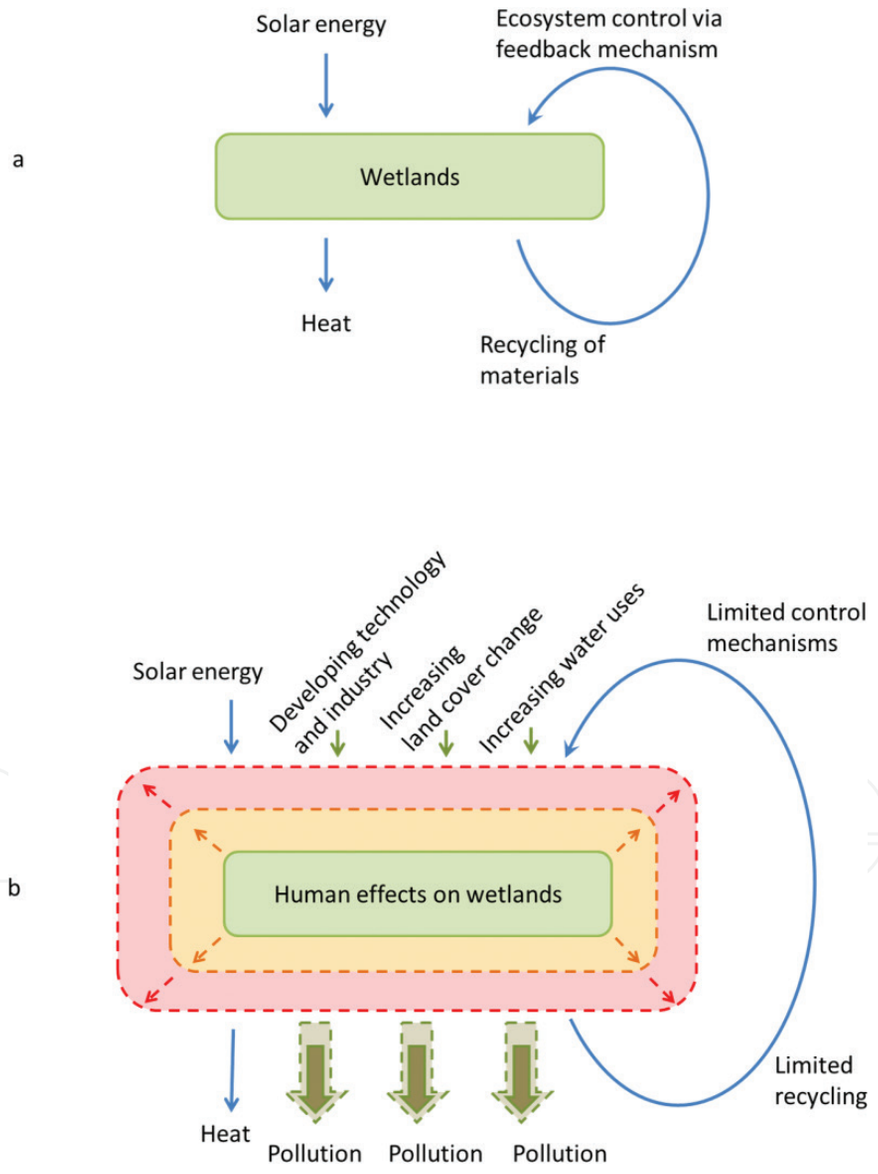

Figure 1. Comparison of natural wetlands (a) and human effects on wetlands (b). Many complex relationships exist in a wetland. Ecosystem feedback control mechanisms play a critical role in the functioning of wetland balance (homeorhesis).

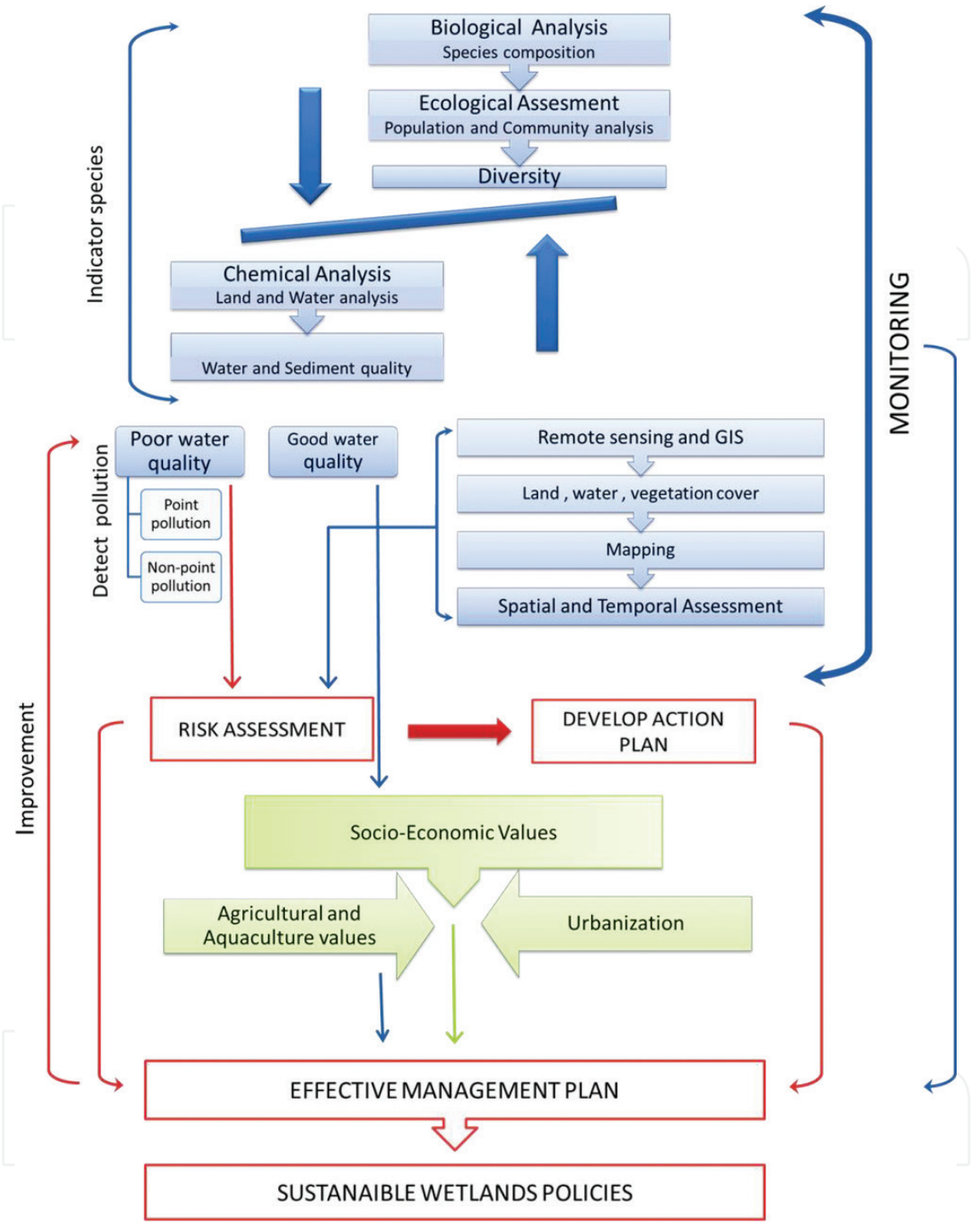

Figure 2. The summary of an effective wetland management process.

completely their natural feedback process. The exponential growth in natural resource utilization and the pollution from industrialization can reach the limits of ecosystems to provide the resource [9–11]. Eighty-seven percent of the wetlands in the world have been lost since 1700. Wetlands have been damaged by anthropogenic sources three times faster than natural forests. Therefore, there are direct and indirect negative impacts on biodiversity and carbon sequestration. Eighty-one percent of inland wetland species and 36% of coastal and marine species have been influenced since 1970 [2].

Wetlands in and around city provide significant services such as water supply and climate regulation [12]. However, the value of these ecosystems remains largely unrecognized by policy- and decision-makers [13].

We need to accept natural balance and geochemical cycles as a wetland ecosystem modulator. Assessment of water quality is classified based on physical, chemical, and biological parameters. While physicochemical characteristics are defined as snapshot industrial pollution, any change in water quality has a controlling effect on integrated community structure. The fauna and flora compositions not only reflect the certain situation of ecosystems but also the previous situation of habitat quality. Bioindicator species that occur according to environmental quality factors are the more reliable assessment for long-term ecological effects in wetland quality. Moreover, biological quality and monitoring give strong evidence for ecosystem problem (**Figure 2**). Water monitoring and assessment develop based on biology, hydrology, and water chemistry. In addition, nowadays, geographic information system and remote sensing data detect any change in the wetland area, vegetation cover, and the water level in spatial and temporal variation and supply crucial information about habitat variations [14–17].

Managing wetland ecosystems gives a substantial contribution to biodiversity conservation and restoration. Also, it may be actualized with a holistically multidisciplinary strategy. The variation of management strategy may be caused by a more different urban wetland area with various levels of success.

It needs decision-makers who are involved in different management strategies to cause restoration and improvement of an ecosystem due to globally ecological and regional economic values of wetlands. Therefore, integrated decision-making process and wetland perspective provide a sustainable ecosystem management and utilization of wetland resources.

Consequently, an effective management plan provides a crucial basis for maintaining the bioecological characteristics of a wetland, a dynamic ecosystem, and allowing to use resources economically.

3. Wetlands in the future

Wetlands that may be accepted as ecosystems on edge because of their importance for the future have gained a crucial role to climatic change. Wetland management policies and simulations of their ability to absorb major quantities of carbon from the atmosphere as more than five times from tropical forest show an important solution in future climate [6, 12, 18–21]. It seems clear that wetlands are balanced due to mechanism of geochemical cycles (natural control-feedback mechanism).

As a result of the floods increasing based on climate change, the decrease in drinking water and the increasing human population, the future tasks of wetlands on the negative effects of urbanization are increasing for sustainable urban. It is estimated that at least 64 of the global wetlands have disappeared since 1900 due to cities and exponential human population growth. For this reason, the main mechanism of pollution removal from domestic and industrial wastewater in constructed wetlands will have much importance in their fixation

and precipitation capacities [22]. Furthermore, constructed wetland systems would be good alternative technologies in the future, which have wastewater treatment standards as compared to conventional methods [23, 24].

We would also like to stress the great potential that such investigations have in the understanding and protection of these fragile, but extremely important, coastal ecosystems and encourage their incorporation into future wetland management tools.

Wetland degradation usually impacts environmental quality and can lead to major changes in the community composition. Therefore, a recent paradigm that alters within wetland science toward integration of social, all environmental, and life sciences is further appealing to the historical linkage between wetland and special kinds of science today.

Modern wetland science has become a multidisciplinary, interdisciplinary, and sometimes transdisciplinary study that melds the social with the life sciences to understand wetlands as social-ecological systems.

4. Conclusions

The wetland ecosystems have vital values and functions in the world. Human (controlling factor), as an ecosystem stakeholder, benefit from this. Rapidly developing technology enables us to better understand the planet we live in. Due to technological development and increasing human population, all ecosystems are inevitably deteriorated by domestic, agricultural, and industrial pollution; climate change; reducing biodiversity; invasive species; and change of land use. Sustainability includes a greater and more explicitly long-term situation and target than environmental quality increment. Sustainable environmental management depends mainly on ecosystem stability, ecologic tolerance, and biotic diversity. Sustainable environmental management plans need to be implemented and controlled.

Therefore, the role of decision-maker authority is important. The fact that the research institutes and the sciences in different disciplines form a consortium and maintain their management plans with a holistic approach has a critical value in this respect. Due to the different kinds of wetlands and the case study of multidisciplinary approaches in the world, the book *Wetlands Management: Assessing Risk and Sustainable Solutions* can be considered as an important source.

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