A Comprehensive Review of the Ecological, Economic, and Cultural Significance of Urban Wetlands and Their Susceptibility

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Abstract: Wetlands are essential components of biological systems that provide several ecological services. Urban Wetland (UW) settings enhance city resilience by enhancing water purity, sequestering carbon, offering homes for animals, mitigating heat-island (HI) impacts, and offering recreational possibilities. Nonetheless, the preservation of UW environments encounters several obstacles, including diminished hydrological processes, altered water cycles resulting from barriers, pollution from waterways, habitat degradation owing to land-use changes, and biodiversity decline due to the introduction of invasive species. The article examines the theoretical framework of UW, including its ecological, economic, and cultural significance (EECS) and susceptibility. This biodiversity governs the local environment, carbon storage, fuelwood supply, fishery-related enterprises, and other ecological, social, and economic factors. Furthermore, UW provides other biological functions, such as preserving the purity of water via sedimentation and nutrient retention. Globally, wetlands face several challenges, both man-made and natural.

Keywords: Urban Wetland; Ecological; Economic; Susceptibility; Biodiversity; Cultural factors.

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I. Introduction

Each wetland may function as a distinct ecosystem. They vary in biodiversity, geological location, susceptibility to various landscapes, environment, and several other aspects. Their environment, including water supplies and atmosphere, may govern them, similar to the regulation provided by wetlands Torres-Lima et al., (2018). Therefore, to comprehend the purpose of wetlands, each wetland should be analyzed in light of these and several other variables, reflecting its distinctive characteristics Li et al., (2022).

The ecology, the climate, hydrology regime, ecological services, sediment and debris, human reliance and activities, and pollution levels in and near wetlands are interrelated. Identifying the precise root cause of wetland ecological damage and implementing a rehabilitation method may provide varying degrees of success, depending upon other regulatory elements and unexamined variables. Comprehension of the whole biological and abiotic framework is essential for formulating conservation strategies.

This paper reviews the findings of academics' attempts to comprehend wetlands' ecological and economic significance and the primary factors contributing to their susceptibility. Distinct headers and subheadings are used to emphasize separate characteristics; nonetheless, the interconnections among these elements are well-documented by investigators, and this research review highlights some of those relationships Pedersen et al., (2019). The examples provided to illustrate the significance and function of various factors in regulating the ecology of wetlands represent merely a fraction of the extensive research conducted; additionally, certain variables may be omitted here that are equally crucial for formulating conservation strategies for preserving and rehabilitating wetlands Alikhani, Nummi, & Ojala, (2021).

Wetlands are distinctive ecosystems that support various floral, faunal, and microbiological species globally. The constituents of ecological communities are interdependent, with their diversities influenced by the size, structure, geographical location, temperature, and availability of water and nutritional sources of wetlands. Biological diversity, including plants, animals, and microorganisms, regulates the biological geochemistry of wetlands, whereas alterations in the chemical and physical characteristics of wetlands influence their community structure Díaz-Pinzón et al., (2022).

1. Urban wetlands

The United Nations (UN) reports that 57% of the world's inhabitants live in urban areas. This figure is anticipated to increase to 70% by 2055. The increasing development trend, in both spatial extent and population density, impacts the natural environment and undermines its sustainability processes. It significantly impacts the wellness and ecological functioning of the urban setting, resulting in vegetation deterioration, water contamination, and diminished biodiversity Yang et al., (2021). Furthermore, metropolitan regions often exhibit reduced foliage and water availability relative to adjacent places, with current Green and Blue Infrastructure (GBI) being jeopardized by rising human density Bhowmik, (2022).

Maintaining and developing these infrastructures within metropolitan environments might help mitigate the detrimental impacts of the changing climate. Consequently, it is essential to examine the influence of urban biological infrastructures, including green-blue infrastructure (GBI), on the temperature of metropolitan environments. The influence of climate change may be integrated into urban areas via GBI. GBI facilitates water purification, mitigates city pollution, and offers cognitive and social environmental benefits in metropolitan areas. Water environments, including ponds and UW, which are components of GBI, enhance hydrological processes within metropolitan areas.

UW is regarded as an exceptional ecological assets in urban environments. Wetlands constitute a crucial element of GBI, offering diverse benefits. The optimum utilization of wetlands enhances metropolitan regions' environmental and social viability. UW is a crucial component of urban landscapes. They provide several environmental functions and essential resources to human societies. These include coastal zone preservation, water safety remediation, air pollution mitigation, carbon storage, and recreational activities.

Additional benefits of blue structures, including wetlands and lakes in urban areas, include mitigating heat island effect (HI) impacts. This phenomenon mostly results from changes in surface characteristics that enhance solar radiation intake, diminish convective cooling, and decrease the transpiration of water. Moreover, UW exhibits distinct microclimates and is often colder than its neighboring environments. Consequently, they enhance the standard of existence and the environment, resulting in sustainable growth in cities.

Wetlands are crucial for the preservation of world ecosystems. They are recognized as ecological hotspots. Nevertheless, they represent the most vulnerable ecosystems worldwide due to their ecological sensitivity and compatibility. This attribute has resulted in wetlands providing significant variety according to their source, geographical position, hydrological and chemical conditions, predominant species, sedimentation, and soil characteristics. Numerous cities see the preservation and rehabilitation of UW as a tactic in urban design that might enhance resilience to climate change (CC).

Nonetheless, whereas wetlands are crucial in urban environments and provide several functions, these services are significantly threatened by fast urban development. The growth and development of urban areas have posed many difficulties to wetlands, including (i) direct habitat degradation from land clearing and digging, (ii) altered water regimes due to obstacles, (iii) pollution from wastewater, refuse, and chemicals, and (iv) biodiversity decline resulting from the introduction of invasive species. Consequently, adjacent urban growth and expansion activities have significantly jeopardized wetland conservation. Preserving urban wetlands is essential for mitigating the implications of CC. Consequently, it is important to examine wetlands and their impact on urban environments and residents.

II. Ecological, Economic, and Cultural Significance (EECS)

This paper reviews the findings of researchers' attempts to comprehend the EECS of UW and the primary factors contributing to their susceptibility. Understanding the significance of local ecology in each UW category is essential for formulating conservation approaches. Several risks to ecological diversity are discussed later in this paper. The findings provide an overview of the abundant variety present or still to be discovered in the UW. Biological diversity not only governs ecosystems but also has economic significance.

The varied ecosystems of UW may sustain aquaculture and sustainable tourism, therefore contributing to regional economic growth. Legislatures may acknowledge the economic significance of some unique species in certain UW. Still, the ecological value of the often overlooked or unsupervised wetlands is critical, necessitating their protection for the benefit of future generations.

The elimination of nutrients is a significant ecological function provided by UW. Eliminating nutrients introduced into water from lands or different sources lowers the nutrient burden in rivers and seas, safeguarding the natural ecosystems of these aquatic environments. Consequently, the preservation of their inherent ecology and their value for ecological and economic functions is also maintained. The eliminated nutrients may undergo various transformations during disposal and may be assimilated by live creatures. In severe cases, this may result in eutrophication, potentially causing the demise of existing species and altering the ecosystem in diverse ways and degrees.

The expansion of urban areas has encroached over aquatic ecosystems, including lakes, marshes, and ponds, integrating them into the framework of cities. This potential enables us to address the requirements of rapidly expanding metropolitan regions and adjust to CC. UW engages with multiple factors, including the detrimental impacts of CC, growing population and concentration, the growth of cities, development, public opinion, and long-term viability, and contributes to enhancing wellness and health, fostering biodiversity in the town, and mitigating the HI impact.

III. EECS and their susceptibility

Numerous natural and man-made causes jeopardize wetlands' survival, diminishing their ecosystem services and impacting their biodiversity. Although climate change is progressively becoming a significant issue, current dangers such as pollution and eutrophication persist. The causes and consequences may be interconnected or independent. This text discusses many risks identified by scholars globally.

1.1 CC

CC is a primary issue for scholars globally. It already demonstrates the effects of temperature fluctuations, snowmelt, a spike in catastrophic occurrences, illnesses, and several other manifestations. The majority of CC is attributable to man-made emissions of greenhouse gases (GHGs), and temperature rise may exacerbate itself by, for instance, enhancing the microbial breakdown of organic waste, which releases more GHGs. UW is a significant carbon sink and plays a crucial role in controlling the global climate. However, they are also susceptible to the effects of CC. CC may influence the biological chemistry, ecology, and physical characteristics of wetlands in several manners. Alterations in one or many areas may ultimately impact the others.

1.2 Alteration of Land Utilization and reduction of ecological diversity

Land utilization change is a significant human factor endangering wetlands and is prevalent globally. Land usage alterations may occur via the rehabilitation of UW for agricultural, urban, and other economic objectives, excessive exploitation of UW assets, disruption of the natural world, and other additional methods. In various ways, these mechanisms influence wetland ecological services, soil quality, hydrologic equilibrium, and ecological diversity.

1.3 Pollution

Pollution caused by humans likely commenced with humanity's discovery of fire. Contemporary civilization depends on intensive agriculture, livestock management, industry, transportation, and several other elements, all of which contribute to global pollution. Untreated waterways, waste disposal, industrial effluents, runoff from agriculture, highway runoff, and the excessive application of chemical products in both domestic and commercial contexts primarily contaminate UW. Pollution may originate from various sources, with non-point sources being the most prevalent.

Although CC is a worldwide issue, direct and indirect pollution are regionally specific, akin to alterations in land utilization, and may be addressed by understanding and stringent legislation. Sources must be recognized, and corresponding mitigating actions should be implemented. Artificial UW may serve as an effective mechanisms for such susceptibility.

IV. Conclusion

Urban Wetland (UW) environments bolster urban resilience by improving water quality, sequestering carbon, providing habitats for wildlife, decreasing heat island effects, and giving recreational opportunities. However, the conservation of UW environments faces numerous challenges, including reduced hydrological processes, modified water cycles due to obstructions, pollution from aquatic systems, habitat degradation resulting from land-use alterations, and biodiversity loss attributed to the introduction of invasive species. The essay analyzes the theoretical framework of UW, focusing on its EECS and its vulnerabilities. This biodiversity regulates the local ecosystem, carbon sequestration, fuelwood supply, fishery-related industries, and other ecological, social, and economic elements. Moreover, UW offers other biological services, including preserving water quality via sedimentation and nutrient retention. Wetlands worldwide encounter several difficulties, both anthropogenic and natural.

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