

From ecology to health policy: Integrating coastal wetlands into national health and climate strategies

Muhammad Naveed^{1,2,3} and Faming Wang^{1,2,4,*}

¹Xiaoliang Research Station for Tropical Coastal Ecosystems, South China Botanical Garden, Chinese Academy of Sciences, Guangzhou 510650, China

²South China National Botanical Garden, Guangzhou 510650, China

³University of Chinese Academy of Sciences, Beijing 100049, China

⁴Southern Marine Science and Engineering Guangdong Laboratory (Zhuhai), Zhuhai 519082, China

*Correspondence: wangfm@scbg.ac.cn

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Climate change is heightening various health risks for coastal populations, including storm injuries, flooding, heat stress, salinity-induced disease, climate-sensitive infectious diseases, and psychological trauma. Although health systems often respond through clinical care and emergency preparedness, important preventive measures exist beyond the healthcare sector. Coastal wetlands mitigate storm surges, flooding, heat stress, saltwater intrusion, and other climate-related health risks.¹ Although all coastal wetlands contribute to climate health resilience, their primary health protection functions differ. Mangroves mainly reduce storm surges and coastal flooding; salt marshes enhance flood attenuation and water quality; and peatlands contribute to climate regulation through carbon storage and reduced wildfire risk. Healthy wetlands reduce climate-related risks, whereas their degradation increases community vulnerability.²

Healthy coastal wetlands generally provide substantial public health benefits; these outcomes depend on ecological condition and adaptive management. Poorly managed or degraded wetlands may locally increase the risk of vector-borne diseases, while conservation policies should be accompanied by livelihood-support measures to avoid unintended health inequities among vulnerable coastal communities.

Despite substantial evidence, wetlands remain largely overlooked in terms of health governance and financing. They are typically managed as environmental assets rather than components of public health systems. This Commentary contends that wetlands should be formally recognized, governed, and financed as public health infrastructure, and presents a practical roadmap for implementation.

Unlike existing One Health, EcoHealth, and nature-based adaptation approaches, this framework explicitly positions coastal wetlands as a preventive public health infrastructure and links ecosystem condition with

measurable health outcomes and avoided healthcare burdens to support policy and investment decisions.

Wetlands as public health infrastructure

A three-pillar strategy was proposed to reposition wetlands within health systems. First, it is essential to integrate health and ecosystem data to pinpoint where wetland loss directly affects human health. Second, wetlands should be incorporated into health policy and financing frameworks, redirecting investment towards prevention. Third, the health benefits of wetlands must be quantified in economic terms, such as reduced hospital burden and healthcare cost savings, to enable them to compete for funding within national health economies.

A health-integrated wetland vulnerability framework

A key obstacle in recognizing wetlands as health assets is the absence of a systematic connection between ecosystem degradation and quantifiable health outcomes. Environmental assessments typically focus on shoreline erosion, vegetation changes, inundation exposure, and hydrological shifts, whereas health assessments concentrate on disease burden, hospital admissions, mortality, and vulnerability indicators. These systems rarely intersect, resulting in wetland loss seldom being viewed as a health emergency.³

The Health Integrated Wetland Vulnerability Framework addresses this gap. Initially, governments should pinpoint coastal areas already facing significant pressure, such as flooding, storms, salinity intrusion, heatwaves, or recurring vector-borne diseases. Environmental agencies then gather indicators such as wetland extent and fragmentation, flood recurrence probability, storm-surge exposure, salinity intrusion risk, and susceptibility to peat or marsh fires.^{1,2} Health authorities align these with datasets on storm-related injuries and mortality, heat-related hospital admissions, cardiovascular and

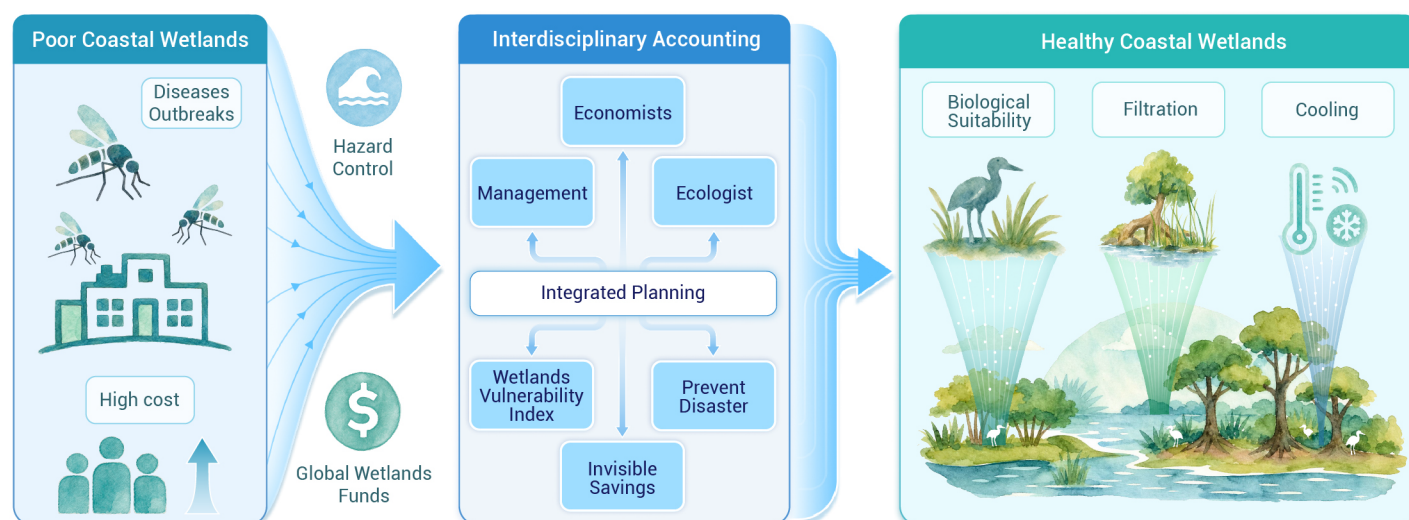


Figure 1. Conceptual framework illustrating coastal wetlands as a preventive public health infrastructure Healthy wetlands reduce climate-related health risks through cooling, filtration, and hazard control, whereas poor wetland conditions increase disease outbreaks and healthcare costs. Integrated governance, interdisciplinary planning, and diversified financing mechanisms enable cost-effective risk reduction and health resilience.

maternal outcomes associated with drinking saline water, vector-borne disease burden, healthcare access, and population vulnerability. Countries with limited monitoring capacity may initially rely on freely available remote-sensing products, census information, and routine health surveillance data, allowing gradual expansion toward more comprehensive environmental-health monitoring systems.

To address differences in spatial resolution, high-resolution environmental indicators can be aggregated to administrative units using zonal statistics or spatial overlay techniques, enabling direct linkage with routinely reported district-level health data. Where finer-resolution health information is available, multilevel spatial modelling can further strengthen environmental-health integration and improve reproducibility.

By integrating these data, we can classify critical health-risk wetland hotspots, identify emerging risk areas that require preventive action, and identify resilience zones where wetlands offer measurable protection. The outputs consisted of risk maps, estimates of populations at risk, and priority intervention zones, all justified both medically and ecologically. This framework can be operationally implemented within one to two years using existing national systems under the coordinated leadership of the Ministries of Health, Environment, Disaster Risk Authorities, academic institutions, and local governments. The primary outcome is a conceptual transformation: wetlands become integral to health risk management rather than being confined to environmental reporting.

Health planning and financing in wetlands

Investments must follow recognition. At present, wetlands are mainly funded through conservation budgets, which are consistently underfunded, whereas health systems increasingly bear climate-related burdens. By reimagining wetlands as a preventive health infrastructure, we can facilitate a shift akin to investments in vaccination, surveillance, or early warning systems.

Policy integration begins by explicitly including wetlands in national strategies for climate and health adaptation, health security frameworks, and disaster preparedness plans. This approach legitimizes governance, allowing health agencies to co-finance ecosystem protection. Consequently, financing can extend beyond environmental allocations to encompass national health budgets, climate adaptation funding, international Loss and Damage support, and insurance or resilience funding mechanisms.

Effective implementation requires coordinated governance among health, environmental, and disaster-management agencies. However, institutional fragmentation, competing funding priorities, and land-use pressures may constrain adoption, particularly in resource-limited settings. These challenges can be addressed through inter-ministerial coordination mechanisms, joint financing arrangements, and phased implementation approaches aligned with existing adaptation and public health programs. Crucially, health outcomes, such as reduced admissions, lower mortality risk, and enhanced community recovery, should be monitored alongside ecological indicators. Monitoring both ecological condition and health outcomes will be essential to demonstrate effectiveness and support long-term investment (Figure 1).

Quantifying avoided hospital burden

Health systems are guided by quantifiable values. Hospitals justify their budgets based on patient volume, treatment demands, and cost-effectiveness. Similarly, wetlands must be assessed in equally tangible terms to compete for funding. Recent studies highlight the significant economic benefits of wetlands. Coastal wetlands prevented approximately US\$625 million in flood damages during Hurricane Sandy, while wetland loss since 1985 has increased in the USA.⁴ These findings demonstrate the potential of avoided-burden accounting to quantify the economic value of wetland conservation and support investment decisions. Beyond direct economic savings, this approach can estimate reductions in hospital admissions, emergency response expenditures, climate-related injuries, and productivity losses, thereby enabling wetlands to be evaluated alongside conventional public health interventions.

Evidence to implementation

Coastal wetlands reduce flood exposure, storm losses, heat stress, and

drinking-water salinization while supporting ecological processes that influence disease regulation. In Bangladesh, intact mangrove belts in the Sundarbans reduced storm-surge exposure and damage during Cyclone Amphan, demonstrating the protective role of wetlands for vulnerable coastal communities. Similar evidence from coastal regions worldwide indicates that wetland degradation amplifies environmental hazards, public health risks, and community vulnerability. Collectively, these findings support recognizing wetlands as preventive public health infrastructure.

Emerging governance initiatives further demonstrate the feasibility of this approach. Large-scale coastal wetland restoration programmes in Louisiana, USA, illustrate how ecosystem restoration can be institutionalized through coordinated long-term resilience planning, while European climate adaptation initiatives promote wetland restoration as nature-based solutions for reducing climate risks and strengthening community resilience.⁵ Although these initiatives were not established explicitly as public health programmes, they provide practical governance and financing foundations upon which integrated climate health strategies can be developed.

A phased implementation pathway could begin with pilot assessments and governance mechanisms, followed by national integration into climate adaptation and health-security planning, and ultimately institutionalization of avoided-burden accounting and long-term financing mechanisms.

CONCLUSION

Coastal wetlands are not only environmental assets but also a preventive public health infrastructure. Integrating wetlands into health risk assessments, financing mechanisms, and climate adaptation strategies can reduce disease burdens, lower healthcare costs, and strengthen resilience in vulnerable coastal communities. Protecting wetlands, therefore, represents both an environmental and public health imperative.

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AUTHOR CONTRIBUTIONS

M. Naveed and F. Wang developed the original idea. M. Naveed wrote the original draft; F. Wang reviewed and edited the manuscript and acquired funding. Both authors have read and approved the final manuscript.

DECLARATION OF INTERESTS

The authors declare no competing interests.