



Implementation of the Colombo wetland management strategy: current status, stakeholder perceptions and recommendations

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Abstract The Colombo Wetland Complex provides vital ecosystem services ranging from flood regulation, thermal cooling to recreational support, that enhance urban well-being and climate resilience. Despite recent conservation efforts, including the 2016 Metro Colombo Wetland Management Strategy, the wetlands face ongoing degradation. This study evaluated the strategy's progress through stakeholder consultations and an online perception survey. Since 2016, key achievements include improved wetland zoning, Ramsar Wetland City accreditation, new protected areas, recreational parks, a ban on wetland filling, and awareness campaigns. Nevertheless, perception surveys indicated that 59% of respondents perceived a reduction in wetland extent, while 43% reported a deterioration in wetland health since 2016. While progress has been made under the strategy's five goals, further action is needed. A major gap is the lack of an agreed management approach among

institutions and a dedicated sub-committee to guide implementation that was called for within the 2016 strategy. To address this, the operationalization of the co-developed Colombo Wetland Management Framework is proposed to ensure better coordination and sustainable outcomes.

Keywords Wetlands · Colombo · Policy · Governance · Perceptions

Introduction

Colombo, a city constructed on wetlands, relies on the health of these wetlands for the well-being of its population, as they provide essential ecosystem services. Although the wetlands cover only 15.4% of the Colombo Metropolitan Region, the Colombo wetland complex (CWC) indirectly and directly provides benefits to the entire population in the urban region with flood regulation being the ecosystem service most valued by policy makers. Flood mitigation by the CWC will become increasingly important under climate change as the frequency and intensity of storms is predicted to increase. Data already indicates that the frequency of flood events, spanning riverine, flash, urban, and heavy rain floods, has increased dramatically, rising tenfold from fewer than 10 events per year in the early 1970s to nearly 130 events annually by 2008 (Disaster Management Centre, 2008). Recent studies by Abeysinghe et al.

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(2025) have further shown an increase in flood affected communities between 1994 and 2022 which make flood attenuation a highly valued wetland ecosystem service. A rapid assessment conducted by McInnes and Everard (2017) observed that the urban population also recognized additional services, such as provisioning of habitats for diverse faunal and floral species, climate regulation, primary production (photosynthesis), and pollination services, to make a significant positive contribution to their well-being. An analysis conducted by the World Bank found that in the majority of scenarios modelled, preserving the wetlands has a net positive value where the benefits from wetlands (e.g. flood prevention, wastewater treatment, cooling, and recreational benefits) are higher than the potential economic benefits from land development (Rozenberg et al. 2015). The study concluded that at least 90% of the remaining wetlands within the CWC must be preserved to ensure that the annual average flood loss does not exceed the tolerable threshold of 1% of national GDP, which reflects the loss and damage incurred during catastrophic floods in 2010.

Anthropogenic pressures induced by increasing population, haphazard development and irregularities in policy enforcement are threatening the health and extent of the CWC. It is recorded that the CWC has declined from an original area of approximately 47.5 km² in the 1980s to approximately 19 km² today, representing a loss of nearly 60% of its historical extent, though this rate of decline varies across the region (GoSL 2016). The impacts of urbanization, including habitat fragmentation, water level fluctuations, excess runoff, invasive species spread, and pollution, have been documented as significant threats to biodiversity. Karunarathna et al. (2011), who conducted a biodiversity assessment at a unique wetland site (Bellanwila-Attidiya Sanctuary) within Colombo district (Fig. 1) during 2005–2006, recorded 152 vertebrate species and 75 butterfly species, yet noted conspicuous absences compared to 1980s surveys. While acknowledging that sampling seasons and methodologies may partially explain these differences, the authors concluded that most "missing" species had likely been locally extirpated due to anthropogenic pressures. Although longitudinal biodiversity studies in Colombo remain sparse, assessments conducted for the 2016 strategy

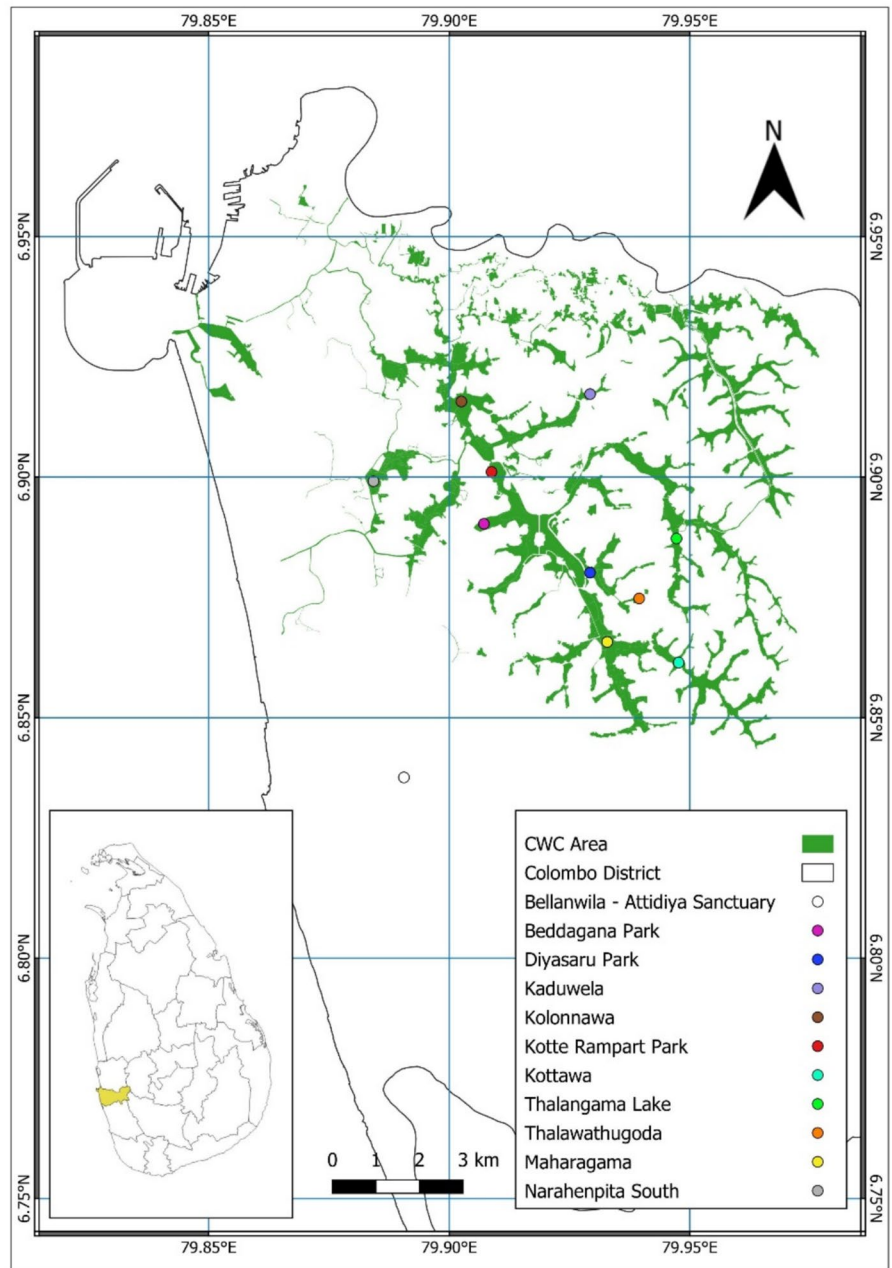
revealed that the Colombo wetland complex (CWC) still harbors substantial biodiversity, supporting over 250 plant species and nearly 280 animal species, including numerous endemics and species of high conservation concern (GoSL 2016).

In response to accelerating wetland degradation and its adverse effects on the urban economy, the government undertook concerted efforts to reverse these negative trends. The dedicated focus and commitment to wetland conservation commenced with the establishment of the Central environmental authority (CEA) and the National Wetlands Steering Committee in 1981 and 1990, respectively (Hettiarachchi et al. 2019). These provided improvements to the wetland management structure, as before the 1980s, only the department of wildlife conservation (DWC) was responsible for the legal protection of designated wetland areas under the Flora and Fauna Ordinance, 1937 (Hettiarachchi 2025). Due to the historical role that DWC has played in protected area management, DWC is the Ramsar Convention on Wetlands focal point for the country with vested responsibilities to report changes to wetland ecological character of all national Ramsar sites.

In 2006, the CEA led the development of the National Wetland Policy which has four main policy levers related to 1) improving wetland management through better spatial zonation for conservation and restoration, 2) enhancing institutional coordination through the establishment of local wetland management committees and the reestablishment of the National wetland steering committee (NWSC) as regular meetings had lapsed in the early 2000s, 3) integrating wetland management into sectoral planning, and 4) advancing research and education of wetland conservation and wise-use.

While the CEA and the DWC have the direct mandate to protect wetlands, there are several key agencies that directly and indirectly influence wetland management in the country. The Sri Lanka land development corporation (SLLDC) established through the Sri Lanka Land Development Corporation Act in the 1968 had a mandate initially to reclaim and develop low lying areas. However, its focus grew to manage wetlands as important storage areas for flood retention, especially after the devastating floods in 2010. The urban development authority (UDA), also established through the Urban Development

Fig. 1 Colombo wetland complex spreading over an extent of 19 km² located within the Colombo District



Authority Law No.41 of 1978, is responsible for state led planning and physical development within UDA declared areas. It incorporates wetlands as a land use category of value during the formulation of land use zones and development plans.

As CWC landscape is a mosaic system with both natural and man-made wetlands consisting of paddy, the department of agrarian services (DAS) also has a direct role in guiding paddy cultivation practices and

managing paddy ecosystems. Activities implemented by the DAS are governed by the Agrarian Development Act, No. 46 of 2000, which outlines procedures related to paddy land ownership, filling up or use of paddy land for any purpose other than cultivation, establishment of farmer organizations and other areas linked to conflict resolution. Additionally, local administrative agencies, such as local Municipal Councils, Urban Councils and Pradeshiya Sabhas,

that provide oversight on matters related to private land ownership, issue permits for land development including building construction, and provide regulations and services for waste and effluent management, have indirect authority on wetland use.

To tackle the increasing threats to wetlands, to emphasize their value as nature-based solutions that can address multiple urban challenges and to bring cohesion amongst different wetland management entities, the Metro Colombo wetland management strategy (CWMS) was developed in 2016. This initiative, led by the World Bank and the SLLDC, was primarily designed to strengthen collaboration among institutions and underscore the importance of community engagement. The CWMS aimed to set high-level ambition for the CWC by uniting different policies, plans, laws, institutions and organizations to achieve commitment among multiple actors towards a goal of promoting wise use and sustainable management of all wetlands. The strategy has five main strategic objectives: 1) recognition of wetland values and integration into development planning, 2) prevention of further wetland loss and degradation and conservation of all remaining wetlands, 3) restoration of wetlands that are degraded to improve ecological functioning, 4) engagement with diverse stakeholders, including communities, through participatory approaches and 5) improved governance with high political to support the CWMS and enhance institutional cooperation to ensure successful implementation across all of the integrated strategic objectives. The CWMS proposed comprehensive activities and outcomes determined under targeted initiatives defined under all five strategic objectives. After the formation of the National Wetland Policy in 2006, the CWMS can be considered the second most influential plan underpinning wetland conservation and wise-use in Colombo.

Although the CWMS was developed collaboratively with the support of key institutions, it was never officially adopted by all relevant agencies. Nevertheless, organizations with conservation and rehabilitation mandates continue to align their efforts with the CWMS's core focus areas. These collective efforts along with growing awareness of the CWC's value, contributed to Colombo receiving Ramsar Wetland City accreditation in 2018, making it the first capital city in Asia to earn this recognition.

This study offers the first empirical assessment of the 2016 CWMS implementation, evaluating institutional adoption of recommended conservation and wise-use practices. The assessment identified gaps, requiring urgent attention to ensure sustainable wetland management. Drawing from these findings, pragmatic recommendations are provided to overcome implementation challenges and enhance overall wetland management approaches.

Study area

The CWC is spread over an area of about 19 km² in the Colombo district (Fig. 1). Nearly 85% of the wetland area is dominated by freshwater wetlands, comprising a diverse mosaic of wetland types. This includes herb-dominated wetlands, such as active and abandoned paddy fields, wetlands with woody vegetation affected by the invasive species *Annona glabra*, and various open water wetlands, including tanks, lakes, and canals (GoSL 2016). There are 46 distinct wetlands identified within the CWC which are managed by diverse stakeholders. The largest wetland within the CWC is the Thalangama Lake (4.57 km²) while the smallest is a canal in Narahenpita South (0.01 km²).

Methodology

The assessment was conducted in two phases. First, projects implemented during the period 2016–2021 were analyzed to determine whether they were influenced by or aligned with the CWMS 2016. Subsequently, a perception study was conducted in 2023 to assess awareness of the Strategy among environmental professionals and enthusiasts, and to capture their perspectives on its relevance and utility. However, to enhance clarity and logical flow, the methods and results are presented in reverse order, with perception study findings discussed first, followed by the assessment of project implementation.

Stakeholder perception survey

This phase consisted of a perception survey designed to assess viewpoints from multiple

stakeholders, including members of the NWSC, state and local agencies, wetland experts, NGOs, International Government Organizations (INGOs), academics, and students. Personnel from the previously mentioned 15 agencies also participated in this survey. The survey was distributed electronically to all relevant stakeholders between May and June 2021, necessitated by COVID-19 pandemic travel restrictions. The English online questionnaire was initially distributed to 78 individuals who represented key Colombo wetland stakeholder institutions. These individuals were encouraged to share it with colleagues within their respective organizations. Participants responded to 24 questions designed to assess their familiarity with the CWMS and their perspectives on its implementation effectiveness. The survey explored respondents' views on; 1) the current condition of wetlands within the CWMS framework, 2) observed changes in wetland conditions over time, 3) positive and negative factors contributing to these changes and 4) key drivers of change impacting these wetlands. This approach enabled an assessment of

how observed changes aligned with or diverged from the objectives established in the CWMS. Survey results were subsequently presented to participants during a stakeholder workshop in June 2021.

Projects on wetlands Post-2016 strategy

This phase involved comprehensive data gathering from 15 diverse agencies with direct involvement in wetland management with the assumption that these the related project documents will have reference to the CWMS. This stakeholder group comprised six state institutions, seven non-governmental organizations (NGOs), and two academic institutes (Supplementary Material Table 1). Each organization was requested to provide detailed information regarding wetland-related initiatives conducted between 2016 and 2021, including conservation programs, rehabilitation efforts, awareness-raising campaigns, and other relevant activities related to CWC. The information collected was systematically organized and classified according to the broader

Table 1 Characteristics of the respondents that participated in the online perception survey

Gender	Male	57%
	Female	43%
Age	> 65	6%
	50–65	27%
	40–49	23%
	30–39	26%
	20–29	18%
	< 20	0%
Organization	National/Regional Government Department/Ministry (e.g. CEA, UDA, SLLDC, Road Development Authority, Board of Investments etc.,)	30%
	Academic/Research Institute (e.g. University of Sri Jayawardenapura, University of Wayamba etc.)	19%
	Consultant	17%
	Non-governmental organization (NGO) (e.g. Environmental Foundation Limited, Field Ornithology Group of Sri Lanka, Centre for Environmental Justice etc. UNDP, IUCN,)	14%
	Local Government Department (e.g. Municipal Councils)	4%
	Student	4%
	Other (e.g. Private Sector)	12%
Direct involvement in wetland-based activities	Yes	68%
	No	22%
	Unaware	10%
Familiarity with the WMS	Familiar and involved in implementation	37%
	Familiar but not involved in implementation	46%
	Unfamiliar and have not heard of it	17%

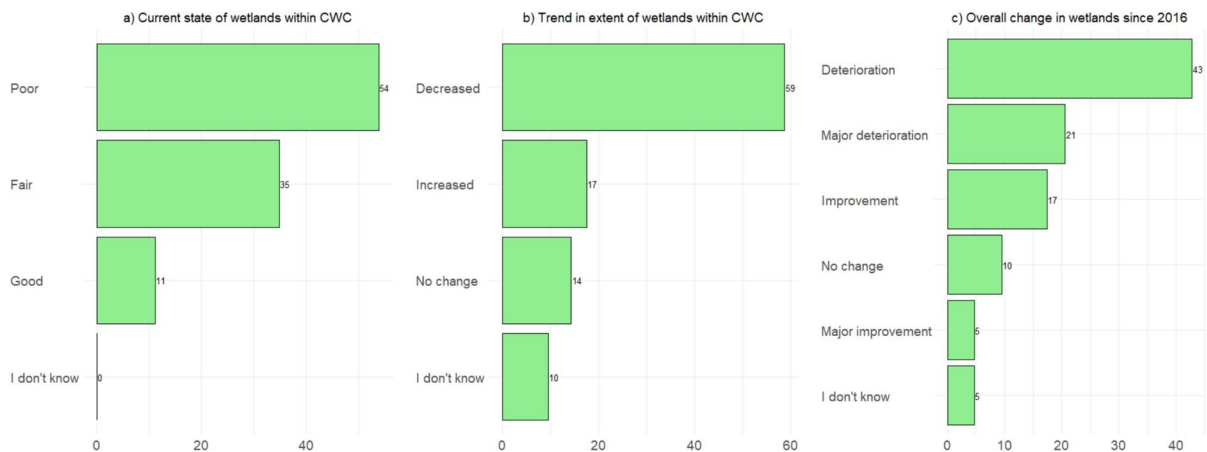


Fig. 2 Perceptions on the **a** current state of wetlands, **b** trend in the extent of wetlands and **c** overall change in wetlands since in 2016. The x-axis in all three graphs correspond to percentage of responses

objectives of CWMS and initiatives outlined in the CWMS. This categorization process allowed for a structured assessment of how implemented activities aligned with the strategic framework. Prior to this data collection, a preliminary review of the CWMS was conducted to evaluate its alignment with or divergence from existing national policies that provide strategic direction for wetland management in the country.

Results from both the stakeholder data collection and perception survey are presented primarily through descriptive graphs and visual representations. These simple, clear visualization methods were selected deliberately to enhance accessibility and facilitate straightforward interpretation by diverse audiences, including policymakers, practitioners, and the scientific community. This approach prioritizes clarity and immediate comprehension while maintaining analytical rigor, allowing stakeholders to readily identify patterns, trends, and key findings to inform decisions.

Results and discussion

Perception survey

A total of 63 persons (57% male and 43% female) participated in the online perception survey (Table 1). Many respondents represented national institutions (cumulatively 34%), followed by representatives

from academic or research institutes. More than 75% of respondents were aged between 30 and 65, while just 6% were over 65 and 18% fell in the 20 to 29 age range. A considerable percentage of respondents were either independent consultants (17%) or did not belong to a specific organization (termed as ‘Other’—12%). Nearly two thirds of the respondents were directly involved in wetland-based activities and the rest were either only indirectly involved or were not aware of their role in wetland management. Over 80% of respondents were familiar with the CWMS, and out of them, only 37% had direct involvement in its implementation while the rest were aware but not directly involved in implementation.

Current state, changes, and drivers of change of wetlands in CWC

Survey responses revealed varied perceptions of CWC wetland status and trends (Fig. 2). Most respondents (54%) rated the current state of CWC wetlands as poor, while 35% considered conditions fair and only 11% good (Fig. 2a). Nearly 60% indicated wetland extent has decreased since 2016, compared to 17% reporting an increase (Fig. 2b) and 14% reporting no change (Fig. 2b). Regarding overall wetland health changes since 2016 (considering water, soil, landform, biodiversity, natural processes, ecosystem benefits), 64% reported deterioration (Fig. 2c), with only 22% noting improvement and 10% reporting

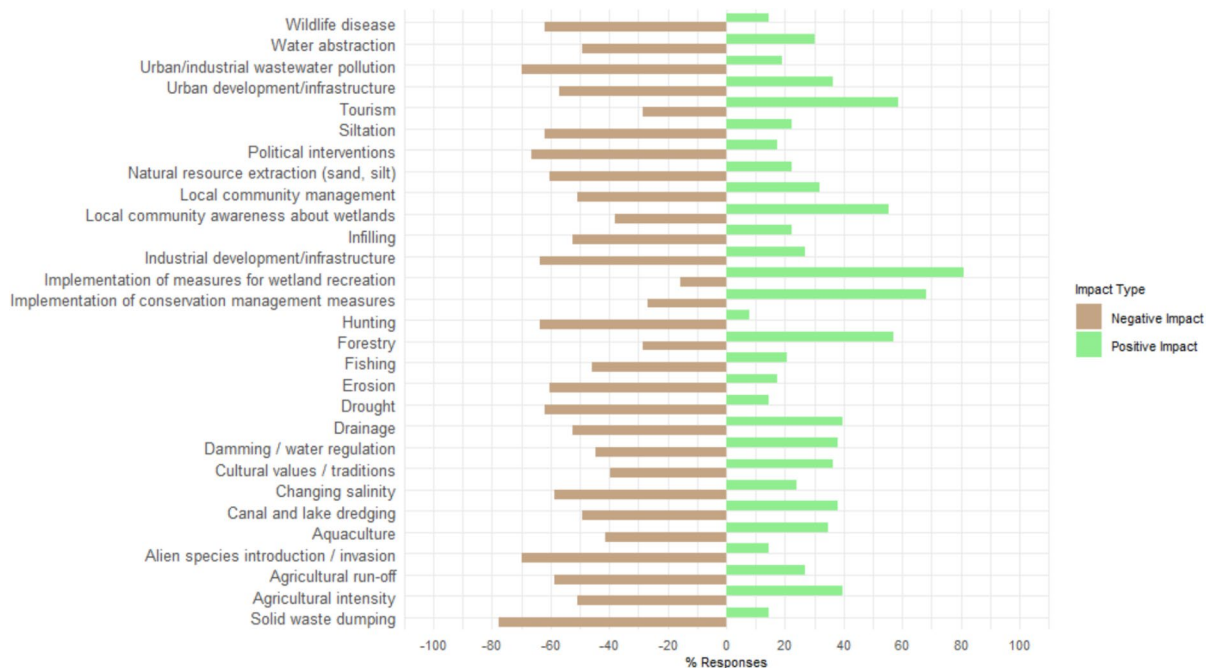


Fig. 3 Drivers of wetland change within the CWC

no change. While these responses are subjective, based on the level of knowledge of the respondents, what they perceive as “good” wetland health and whether they genuinely compared it against the 2016 baseline conditions—it is evident that majority of the people are of the belief that wetlands in CWC are deteriorating.

When asked about drivers affecting wetland health since 2016, negative impacts outweighed positive ones (Fig. 3). Pollution emerged as the primary threat, with solid waste dumping (78%) and urban/industrial pollution (70%) leading to deterioration. Urban areas with high population density are pollution hotspots (Liang et al. 2019; Grimm et al. 2008). In the Western Province where CWC is located, daily per capita waste generation is 0.58 kg, with 3500 tonnes of litter accumulated daily, which is five to seven times higher than in less urbanized provinces (Basnayake and Visvanathan 2014). This stems from commercially driven consumption patterns and poor waste management at individual and institutional levels. Despite most municipal waste being organic, many Colombo households don’t segregate waste; a Kottawa area (Fig. 1) survey observed 50% of households don’t separate waste and

only 26% compost organic matter (Warunasinghe and Yapa 2016). Increasing production of persistent, low-density plastics threatens ecological and human health (MacLeod et al. 2021; Chamas et al. 2020). Country wide studies assessing plastic accumulation in coastal areas, especially beaches near cities, have revealed an average of 4.1 large (i.e. over 25 mm) debris items and 158.0 small (i.e. 5–25 mm) pieces per square meter, surpassing levels reported in several other countries (Jang et al. 2018). Waste presents an acute problem severely impacting CWC ecology and communities dependent on wetland ecosystem services.

The spread of invasive alien species (IAS) was identified by 70% of respondents as a key driver changing wetland conditions, unsurprising as Sri Lanka’s wetlands have long been affected by IAS (IUCN 2004). Aquatic species like water hyacinth (*Eichhornia crassipes*) and *Salvinia* spp., and terrestrial species like pond apple (*Annona glabra*) commonly occur in CWC habitats. Invasive aquatic species alter hydrology by modifying water flows and reduce accessibility to wetland resources by impeding boat travel (Howard and Harley, 1998). Surface mats reduce flow rates, causing siltation that converts open

water bodies into shallow marshes. Nearly 60% of respondents recognized siltation's negative impacts, though this could also result from urban sediment runoff and inappropriate dredging. Despite generally negative influences, IAS can mitigate anthropogenic threats and enhance ecological functioning. Water hyacinth serves in phytoremediation by removing organic and inorganic pollutants including heavy metals (Amalina et al. 2022). Similarly, while pond apple forms mono-carpet converting marshes to terrestrial habitats, it is observed to store significant organic carbon. For instance, Kolonnawa and Thalawathugoda wetlands (Fig. 1) within CWC that are dominated by pond apple show high organic carbon in soil sediments (504–550 tonnes per hectare) (Dayathilake et al. 2021).

Urban and industrial development and resource extraction were considered to be significant (60%) driving wetland deterioration. These findings align with global trends where land-use change has had the largest negative impact on nature since the 1970s, with direct resource exploitation being the second largest driver of ecosystem degradation (IPBES 2019; Convention on Wetlands 2021a). Over half of respondents agreed that water abstraction, drainage, and agricultural runoff cause wetland degradation. While CWC as an urban wetland complex lacks large-scale agriculture, 87% of its extent supports subsistence rice farms and home gardens for food crops and livestock (GoSL 2016). Globally, agricultural development is a primary cause of wetland loss due to numerous associated threats (Convention on Wetlands 2021b). Water regulation activities, pollution from nutrients and chemicals, ecosystem modification, and unsustainable cultivation practices affect more than 50% of global Ramsar wetland sites (Convention on Wetlands 2021b). Thus, public perceptions of drivers causing negative change in CWC correspond with observations from ecosystems in other regions.

The respondents identified wetland recreation promotion as having the most positive impact, with over 80% viewing it favorably. Nearly 70% believed implementing wetland management measures helps maintain or improve wetland health. Urban forestry and tourism (60%) were also recognized as important drivers of good wetland management, likely due to their recreational elements. This recognition stems from growing awareness of wetlands' role in

enhancing wellbeing through ecosystem services that make cities more livable. A 2016 rapid assessment of wetland ecosystem services (RAWES) identified thermal cooling, air quality regulation, and noise/visual buffering as highly valued CWC ecosystem services (McInnes and Everard 2017). Over 50% of respondents determined that local community awareness positively influences wetland conditions. These observations align with other studies, including a citizen science survey on global wetland state that identified community awareness, conservation measures, cultural values/traditions, and tourism as the most frequently reported positive drivers of wetland ecology (McInnes et al. 2020).

Interestingly, traditionally negative drivers such as pollution and urban development received some positive ratings, reflecting divergent stakeholder perspectives shaped by contextual realities rather than mere survey limitations. This apparent contradiction stems from several factors: the persistent notion that wetlands are wastelands suitable for waste absorption; the prevalence of small land parcels that make it difficult to comply with prescribed building regulations, leading residents to conveniently discharge wastewater into wetlands; inadequate municipal waste management services despite strong community expectations that such services should be provided; and weak monitoring and enforcement that allows non-compliance to persist. Some respondents may therefore view waste dumping as solving immediate disposal challenges in the absence of better alternatives, or value industrial development for economic benefits, despite long-term ecological harm. These conflicting perceptions underscore a fundamental governance challenge where immediate socio-economic pressures such as spatial constraints, service delivery failures, and economic needs, consistently override long-term conservation considerations, emphasizing the need for enhanced awareness programs coupled with improved services, realistic regulatory frameworks, and strengthened enforcement mechanisms to shift attitudes toward sustainable wetland values.

Level of implementation of the Colombo wetland management strategy (CWMS)

The CWMS includes initiatives aligned with five strategic objectives: recognize, prevent, restore,

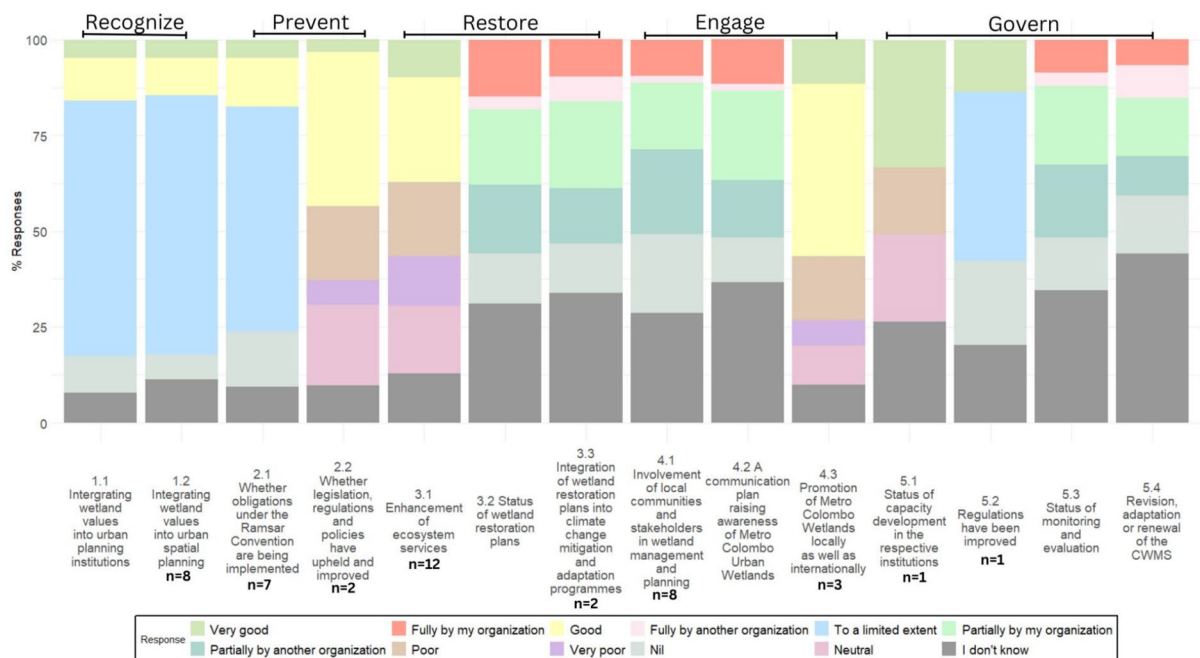


Fig. 4 Percentage responses expressing the level of implementation of initiatives defined under the main strategic objectives in the CWMS. The number (n) at the bottom of the a-axis bar labels correspond to the number of activities as presented in Fig. 2

engage, and govern (Fig. 4). Respondents showed varying levels of agreement regarding their implementation. Under *Recognize*, integrating wetland values into urban planning required agencies to be aware of the CWMS, understand wetland benefits, and have trained staff capable of aligning wetlands with institutional goals and thereby, meant to guide future decision-making (GoSL 2016). Nearly 70% of respondents felt this integration has occurred only to a limited extent since 2016. Around 10% at each end of the spectrum saw it as nearly complete or entirely absent. These results resonate with studies that have assessed the progress of other similar plans such as the national biodiversity strategic action plans (NBSAPs) (Santos et al. 2023). Lack of adequate recognition of habitat and biodiversity loss as a cross-cutting problem undermines integration of wetlands in policymaking and implementation across different sectors and levels (Candel and Biesbroek 2016).

The initiatives under *Prevent* were intended to prevent any further degradation or loss of wetlands because of urban development and in instances where this cannot be avoided, to mitigate any impacts arising from development. This is primarily related

to the principles adopted under Resolution XI.11 of the Convention on Wetlands on the 'Principles for the planning and management of urban and peri-urban wetlands' (Convention on Wetlands 2012). Prevention involves proactive regulation, planning, and design to protect wetland area and function. This includes exploring alternative sites, opting for a 'no-project' decision when risks are too high, and managing waste effectively (GoSL 2016). Although 40% respondents thought that there is an improvement in the interpretation, application and compliance of existing wetland-related legislation, regulations and policies since 2016, a similar percentage of respondents (19–21%) either disagreed or thought there has been no change in upholding Ramsar obligations.

The *Restore* objective focuses on enhancing ecosystem services by integrating cross-sectoral benefits, advancing wetland restoration plans, and linking restoration with climate change strategies. Views on ecosystem service improvement were mixed: 37% felt services had improved (very good or good), while 32% reported degradation (poor or very poor). When linking this with the survey observations perceiving a decline in CWC extent

and state, it suggests that some individuals may not recognize a clear connection between the condition of wetlands and the ecosystem services they provide. Regarding restoration plans, 56% said plans were developed fully or partially by their institution or others, but only 10% said their agency had fully developed such plans. Overlap in responses made this hard to assess clearly. Meanwhile, 13% said no plans exist, and 31–34% were unaware of their status or integration into climate strategies. Despite over half mentioning that restoration plans exist, this wasn't reflected in government reports (see Sect. 3.1). Although not directly relevant to the CWC, as it does not include coastal wetlands, Sri Lanka took a significant step toward science-based wetland restoration by publishing the National Guidelines for the Restoration of Mangrove Ecosystems in 2021. Training restoration scientists and practitioners, along with developing a strategy for selecting and managing restoration areas appropriately remain vital elements of effective restoration (Erwin, 2008).

The CWMS stresses identifying and engaging communities through inclusive, participatory approaches, involving government, NGOs, the private sector, and local communities (GoSL 2016). Under Engage, 51% of respondents felt community involvement in wetland management has improved, either through their own agency or others, since 2016. The CWMS also highlights the importance of an effective communication plan that encompasses curated messages to fit diverse target audiences and using a range of media to convey important messages. Cumulatively, half of the respondents (49%) thought either a communication plan raising awareness on CWC does not exist, or they were not aware of it. This is noteworthy as it may partly explain the level of outcomes under the first strategic objective, Recognize, which largely depends on increased awareness of wetland values. Still, 45% believed promotion of the CWC has increased locally and internationally, likely influenced by the 2018 Ramsar Wetland City accreditation and World Wetlands Day events that have been organized with significant media publicity.

Improving wetland conservation and wise-use requires improved institutional capacity and robust governance structures. Under *Govern*, the first initiative focuses on building capacity to address weak inter-agency cooperation, overlapping

mandates, and inefficient resource use. About 33% of respondents felt their capacity improved since 2016, while 18% saw a decline and 23% reported no change. Meanwhile, 44% noted some progress in enforcing existing laws, though 22% saw no progress. On monitoring and evaluation (M&E), 52% said a plan has been partially or fully developed through either their own organization or by another organization, yet stakeholder feedback did not confirm this. On the initiative to review and update CWMS, a total of 41% of respondents felt that it has been partially or fully reviewed, adapted and renewed since 2016 but it is worth noting that 44% stated their uncertainty regarding this. The sub-committee established under the NWSC was tasked with developing an M&E plan for the CWMS, complete with clear targets and indicators. As a result, the absence of this body is likely to have affected the development of a targeted M&E plan for the CWMS. Similarly, for Initiative 5.4, specific details obtained from the state agencies were lacking to substantiate the claim that the CWMS has been reviewed fully or partially by an organization.

Adoption and implementation of CWMS

The CWMS was developed in 2016 as an initiative towards achieving capacity enhancement for flood and drainage management in wetland management activities. It embraced the policy and strategy document that was first published in 2006. When comparing the two policies, institutions and governance related documents from 2006 and 2016, the policy direction of the national wetland policy and strategy (2006) highlights a wetland management and conservation framework that includes zoning and classifying wetlands based on significance, integrating wetland management into land use plans, prioritizing restoration of degraded wetlands, implementing participatory processes for wise-use and conservation, encouraging civil society participation, and developing sustainable financing mechanisms from local and foreign sources targeting all wetlands in the country (Table 2). The policy outlines the institutional framework for implementation which includes strengthening the NWSC, establishing wetland management committees (WMCs) and wetland facilitating committees (WFCs) at local administrative levels,

Table 2 Key objectives of the national wetland policy and strategy (2006) and the Colombo wetland management strategy (2016)

National wetland policy and strategy (2006)	Colombo wetland management strategy (CWMS) (2016)
• Reconstitute National Wetland Steering Committee to provide policy guidance and facilitate institutional coordination at the national level • Establish Wetland Management Committees (WMCs) for each sensitive wetland or group of wetlands • Ensure WMCs prepare and implement Basic Wetland Programmes for respective wetlands using land use zoning strategies • Ensure assistance of Working Groups (WGs) already formed under the NWSC with regard to identified subjects such as zoning, mapping, land use, preparation of management plan etc., • Establish Wetland Facilitating Committees (WFCs) at Divisional, District, Provincial levels as required • Ensure restoration, rehabilitation and regeneration of essential components of wetlands • Ensure WMCs mobilize the civil society in managing individual wetlands • Draft a new law exclusively for wetland management • Enhance research and development by maintaining a centralized database and developing multidisciplinary research programmes	1. Recognize • Integrate wetland values into urban planning institutions • Integrate wetland values into urban spatial planning 2. Prevent • Implement the obligations under the Convention on Wetlands • Uphold existing legislation and policies 3. Restore • Enhancing wetland ecosystem services for cross-sectoral benefits • Develop a systematic benefits-based wetland restoration plan • Restore wetlands as essential elements in climate change mitigation and adaptation programmes 4. Engage • Engaging with local communities and stakeholders • Implementing a communications plan • Promoting Colombo's wetlands 5. Govern • Developing institutional capacities • Resolve implications for existing regulations • Implementing a monitoring and evaluation plan • Reviewing, adapting and renewing

especially for sensitive wetlands. However, not all wetlands within the CWC have been classified as sensitive, resulting in uneven implementation of management structures. Despite policy requirements for WMC and WFCs to oversee wetland areas, only a single WMC for the Thalangama wetland has been established within the CWC. Despite the 2018 moratorium on infilling that designated additional wetlands as sensitive, corresponding WMCs for these newly recognized areas have yet to be formed. This governance gap extends to other agency-led wetland projects and programs, which similarly operate without dedicated management committees.

The CWMS builds upon the 2006 policy and strategy while enhancing key components to address gaps and emerging challenges for the CWC. The 2016 strategy aimed to improve institutional coordination to tackle drivers of wetland degradation, promote restoration initiatives, deepen community engagement, and strengthen governance through legislative reforms and the establishment of a dedicated sub-committee to improve CWC management. Thus, CWMS can be considered as a targeted refinement of the original policy, specifically intended for management of the CWC by identifying priority areas requiring additional attention and

providing clearer implementation guidance to enable more focused and effective management actions.

The subsequent analysis maps how the implemented projects correspond to each of the five strategic objectives. The wetland-based activities reported by different organizations, mainly representing government, NGO and academia in the current study, were identified to directly or indirectly contribute to 9 initiatives (out of 14) covering all five strategic objectives (Fig. 5). The initiative 1.2 under the objective *Recognize* specifically considers the redrafting and issuance of the Guidelines for Western Province Wetlands Zoning & Relevant Regulations for Application in Urban Development Plan Preparation (2006) as the most important activity that is required to integrate wetland values into urban spatial planning. The above guidelines identify key wetland zones (Wetland Protection Zone, Wetland Nature Conservation Zone, Wetland Agriculture Zone, Special Paddy Cultivation Zone, Low-lying Potential Development Zone) with specific instructions on permitted uses and approved development specifications within each of the zones (e.g. minimum plot size for building construction, maximum area where filling is permitted, maximum permitted ground floor area of an individual building,

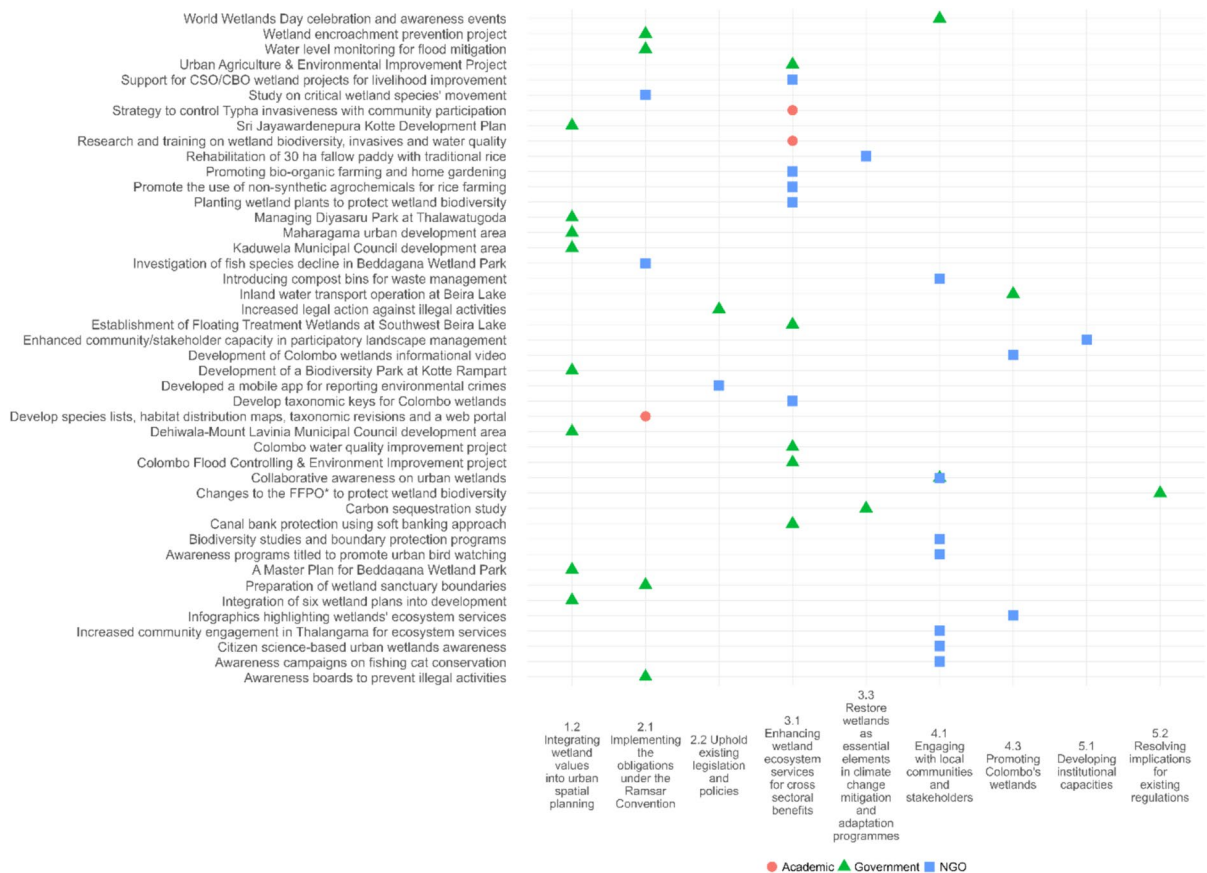


Fig. 5 Wetland conservation and management related activities initiated by different organizations. Initiative number codes relate to 1) Recognize, 2) Prevent, 3) Restore, 4) Engage and 5) Govern in accordance with the CWMS

maximum permitted building height etc.). The UDA spearheaded the revision of wetland guidelines through collaborative stakeholder consultations, resulting in some classification changes. The updated 2018 guidelines contain the same authorized activities and approved construction parameters but eliminated the previous "Low-lying Potential Development Zone" category, which now applies only to wetland areas not falling under the five primary zoning classifications. Importantly, the revised guidelines emphasize a precautionary approach when identifying and demarcating wetland zones, specifically noting that many wetlands within the CWC should be classified as either "Wetland Nature Conservation Zone" or "Wetland Agriculture Zone." This shift reflects a stronger conservation orientation in the regulatory framework governing these ecologically valuable areas within CWC.

The initiative 1.2 aims to further ensure that wetlands and their value as vital urban green infrastructure are deeply integrated into urban spatial planning, with an emphasis on preserving and enhancing their benefits, rather than assuming their worth lies in potential conversion for infrastructural development. In this context, all government-led actions such as developing urban management plans for areas like Kotte, Kaduwela and Maharagama (Fig. 1), as well as improving the management of wetland parks like Beddagana, Diyasar and Kotte Rampart (Fig. 1), and demarcating boundaries of several wetlands to be declared as protected areas serve as key programs. The expanding network of wetland parks and associated walking paths in Colombo, developed and managed by key agencies such as the SLLDC and UDA, offer valuable recreational opportunities to promote the wellbeing of

the urban population while simultaneously deterring illegal encroachment and waste dumping through increased public presence in these ecological spaces. Despite regulations on construction in wetland habitats, and the improvement of blue-green spaces, nearly 50% of the survey participants believed that wetland loss and degradation since 2016 has increased.

Initiatives under *Prevent*, especially 2.1 on implementing Convention on Wetlands obligations, focus on valuable ecosystem services and potential ecological changes from wetland modification. Colombo received Ramsar Wetland City Accreditation in 2018, with subsequent protection strengthened through Cabinet Paper No. CP/18/1817/803/028 that imposed a moratorium on wetland destruction and designated all Colombo's wetlands as sanctuaries. The DWC identified high-risk CWC sites and installed awareness boards to deter illegal activities. Knowledge enhancement on ecosystem services was advanced through academic and NGO studies on species populations, trends, and key species movement such as of the vulnerable fishing cat. State agencies' flood control and stormwater retention assessments improved scientific understanding of wetland functions, supporting conservation prioritization. Initiative 2.2, focused on upholding legislation to prevent wetland loss, was supported by increased enforcement and an NGO-developed mobile application for reporting environmental crimes.

Initiative 3.1 under *Restore* emphasizes managing existing wetlands and restoring lost ones as green infrastructure with cross-sectoral benefits. Nearly 25% of agency activities map to 3.1, focusing on minimizing wetland loss and restoring ecological character. State agencies led projects promoting sustainable urban agriculture, enhancing flood control dedicated initiatives like canal bank restoration, and improving water quality with floating treatment wetlands in Southwest Beira Lake. NGOs and academic institutions contributed by raising awareness about invasive alien species, promoting organic chemicals in agriculture (e.g. paddy fields and urban home gardens), and restoring abandoned paddy fields with traditional rice varieties. One government-led activity assessing carbon sequestration potential aligned with Initiative 3.3 on wetlands as essential

elements in climate change mitigation and adaptation programs.

Programs around engaging with the communities and wider stakeholders as part of Initiative 4.1 (under *Engage*) are evidently led by the NGOs. Many of these activities were centered around increasing awareness of the public on the importance of CWC wetlands for habitat provision and maintaining critical biodiversity. Additionally, some NGOs collaborated with state agencies to conduct wetland awareness programs, while another employed innovative approaches, such as citizen science to promote urban birdwatching and inspire wetland conservation within local communities. State agencies reported organizing World Wetlands Day events aligned with annual themes to raise awareness, foster cross-learning, and honor local wetlands champions. Initiative 4.2 aimed to communicate CWMS purpose and objectives to diverse audiences and involve them in implementation. While respondents reported no dedicated communication plan, they highlighted programs promoting CWC and its ecosystem services through infographics and videos, aligning with Initiative 4.3. Communication, awareness, and public participation are essential for sensitizing communities to wetland importance and changing perceptions (Macharia et al. 2010; Wong 2010; Rutter et al. 2022). Research in Kenya demonstrates how wetland biodiversity education empowers communities to develop sustainable income through eco-tourism and enables collective action for wetland conservation by regulating irrigation water use (Macharia et al. 2010).

Reported activities supporting the initiatives under *Govern* were limited. One NGO reported conducting programs to build community and stakeholder capacity in participatory landscape management, aligned with Initiative 5.1 on developing institutional capacities. Nevertheless, other crucial capacity strengthening initiatives were not reported. Advancing regulatory capacity through legal enforcement, building adaptive capacity to review and adjust decisions as new information emerges, and enhancing integrative capacity by incorporating diverse actors with varying backgrounds, interests, and perspectives are critical for effective environmental governance (Cvitanovic et al. 2015; Van der Molen 2018). One of the main recommendations under 5.1 was to legally establish a CWMS sub-committee within the larger NWSC, which comprises representatives

of wetland management agencies (GoSL 2016). The responsibilities of this sub-committee were to include defining clear institutional responsibilities and co-developing an implementation plan to deliver the objectives of the WMS. However, to date, there has been no progress in establishing the CWMS sub-committee within the NWSC. The operation of NWSC itself has been strained and sporadic. NWSC was established in 1990, the same year Sri Lanka ratified the Convention on Wetlands, with Cabinet approval. It was chaired by the CEA, who was responsible for overseeing the coordination of wetland planning and conservation efforts (IUCN 2004). In 1995, the Cabinet elevated the role by appointing the Secretary of the Ministry of Environment as the Chair of NWSC to strengthen its authority (IUCN 2004). Nevertheless, the NWSC has struggled to function continuously, mainly due to frequent changes in government representatives (IUCN 2004), which highlights the need for an improved mechanism to manage the CWC. Further under the stakeholder information collection, State agencies mentioned ongoing amendments to existing legislation, such as the Flora and Fauna Protection Ordinance, as part of efforts to strengthen natural resource governance under Initiative 5.2.

While national-level initiatives such as Ramsar accreditation, Cabinet-imposed moratoriums, and legislative amendments provide essential policy frameworks for wetland protection, their effectiveness ultimately depends on localized implementation and community engagement. The persistent threats of solid waste dumping and continued industrial encroachment, despite strengthened regulations, underscore a critical disconnect between top-down policy directives and ground-level enforcement capacity. Community empowerment emerges as a vital bridge in this gap, as demonstrated by NGO-led initiatives that employ citizen science, participatory landscape management, and wetland awareness programs to foster local stewardship. Research from Kenya illustrates this principle: when communities are educated about wetland biodiversity, they develop sustainable livelihoods through eco-tourism and collectively regulate resource use such as irrigation water management (Macharia et al. 2010). Without mechanisms to translate national conservation mandates into locally-owned action through capacity building and participatory governance, even

well-intentioned policies risk remaining symbolic rather than transformative.

Recommendations

The observations above indicate that while several positive wetland initiatives have been conducted by diverse organizations, there still remains a need for enhanced governance efforts to reinforce the management of the CWC through inclusive, collaborative actions. The absence of explicit references to the strategy document in project documentation suggests that stakeholders perceived it as an institutional rather than a nationally mandated framework. Formal launch and adoption by the statutory institution responsible for environmental governance (i.e. Ministry of Environment) would have enhanced its legitimacy and ensured broader recognition and application across implementing organizations. Consequently, one of the main reasons for the negative public perception on the state of CWC can be arising from this lack of collaboration and policy coherence between institutions leading to wetland resource use conflicts. The national wetland policy and strategy (2006) and the CWMS (2016) provide the foundation to overcome this, as they offer the guiding principles, conservation strategies and specific initiatives to resolve issues relating to the management and wise-use of wetlands.

Integrating the strategies within the National Wetland Policy and Strategy with the objectives and initiatives proposed under the CWMS could yield an efficient management framework dedicated for the CWC. The Colombo wetland management framework (CWMF), co-developed as part of the Darwin Initiative funded 'Increasing the resilience of biodiversity and livelihoods in Colombo's wetlands' project, consists of four hierarchical levels, each reporting to the level above it (Jirasinha et al., 2025). The NWSC, already established within the Ministry of Environment, will serve as the governing body responsible for overseeing all wetlands across the country (Fig. 6). The second level involves establishing the Colombo Wetland Strategy Committee, a dedicated body under the NWSC, as proposed in the CWMS. This sub-committee will comprise of wider stakeholder and community representatives and will be responsible for overseeing and leading activities related to all wetlands within

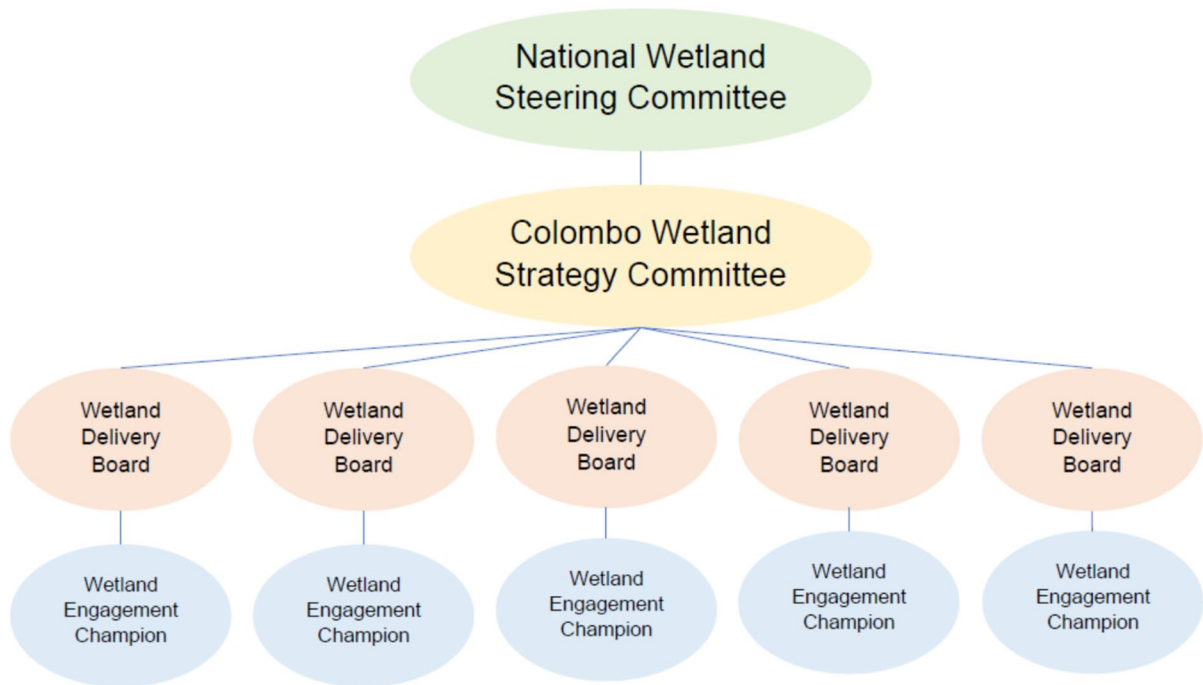


Fig. 6 Proposed Colombo Wetland Management Framework with a dedicated wetland delivery board and a wetland engagement champion for each of the 46 wetlands within the CWC

the CWC. The main goal is to ensure wetland values are integrated across sectors; to have knowledge of all projects within the CWC and to foster multi-agency collaboration. This committee will also act as the body to mobilize resources through multiple funding mechanisms, seek alternative income generation opportunities and coordinate CWC specific wetland awareness raising and promotion.

The third level will consist of a Wetland Delivery Board established for each specific wetland or for specific projects to be delivered within the wetland within CWC. The board will be comprised of multi-national agency, local government, civil society and community representatives from the CWC and will be led by the key government agency or private owner representative that has landowner responsibility for the wetland. The main role is to provide a platform for community engagement and consultation where specific wetland-based activities can be discussed, reviewed and refined. The last level is made up of Wetland Engagement Champions where these roles for each wetland area are identified within the lead agency of the delivery board. These staff members will act as champions for engaging

with local wetland communities and building trust and a strong rapport. They will utilize participatory approaches to work with communities to identify localized wetland solutions for income generation and livelihood support and recognize opportunities where communities will act as guardians by participating in wetland management and monitoring activities.

The proposed Colombo Wetland Management Framework does not envisage additional roles within institutions but rather expand the role of the current staff members for strengthened engagement with other stakeholders and wetland communities. However, in light of resource constraints, particularly following the economic crisis that has weakened the Sri Lanka's labor market due to the emigration of skilled workers and professionals in recent years (Harischandra 2024), it is crucial to allocate roles and responsibilities cautiously to avoid overburdening staff. The framework is envisaged to increase the efficiency of wetland conservation initiatives and significantly reduce single agency cost as multi-agency collaboration can lead to resource use efficiency, development of innovative solutions, and collective sourcing of finances. Improved engagement

with the communities can yield multiple benefits as they recognize the value of wetlands and engage in best practices to promote wetland conservation, restoration and wise-use.

Critical to this governance framework is the establishment of a robust monitoring and evaluation system that integrates both stakeholder perceptions and empirical ecological data. We strongly recommend prioritizing the development of a comprehensive geospatial monitoring program using advanced remote sensing and GIS technologies to systematically track changes in wetland extent, ecological condition, and threat dynamics. Such quantitative assessments, coupled with regular biodiversity surveys, are essential for validating management effectiveness, informing adaptive decision-making, and ensuring accountability within the proposed CWMF structure.

Conclusion

This study indicates that despite increased conservation efforts in recent years, the majority of survey respondents perceive a decline in the extent and condition of the CWC. In light of the heightened focus and investment by state agencies in CWC management, there is a critical need for quantitative studies to assess trends in wetland loss and validate these perceptions as these can deviate from the reality. The survey respondents identified solid waste pollution and IAS invasion as the most critical drivers leading to poor wetland ecosystem health. Wetland recreational opportunities, wetland management measures, tourism and enhanced awareness were identified as drivers of positive change.

Connecting these observations to the effectiveness of CWMS implementation, it is evident that a number of initiatives have been implemented under the five strategic goals but may not have resulted in the desired conservation outcomes. These activities include updates to zoning guidelines, Ramsar Wetland City accreditation, the declaration of new protected areas, creation of wetland recreational parks, the prohibition of wetland filling and increased public awareness on wetland values. However, despite these advancements, many initiatives still require greater

effort and improved coordination to fully realize the intended outcomes of the CWMS. Except for the initiatives under *Prevent*, all other objectives need strengthened activities to ensure wetlands within the CWC are protected and managed sustainably. There is an urgent need for wetland values to be recognized by all stakeholders, along with enhanced institutional cooperation. Results indicate that dedicated efforts are required to develop targeted restoration plans and to mainstream the critical role wetlands play in carbon storage and building resilience against the impacts of climate change. State agencies should also improve community engagement to co-develop wetland-sensitive solutions that balance conservation with infrastructure and livelihood development needs. A well-structured communication plan, highlighting the short and long-term benefits of conservation, could be valuable to advance community participation. Survey results indicated limited progress in upholding and improving existing regulations with a significant portion of respondents indicating that progress has been minimal but direct stakeholder information provided indicated that there are ongoing initiatives to strengthen legislation and deter illegal activities.

One of the most significant gaps identified was the lack of a functioning WMS sub-committee within the NWSC. Establishing this sub-committee could provide essential direction and facilitate the effective implementation of initiatives, particularly those focused on horizontal integration and collaboration among government institutions. The Colombo Wetland Management Framework, which includes a dedicated body under the NWSC, is proposed to enhance cross-sectoral synergies, foster multi-agency collaboration, and promote community engagement, offering a pathway for the long-term sustainability of the CWC.

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Declarations

Competing interests The authors declare no competing interests.

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