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Ecosystem-based DRR in urban Sri Lanka: the socio-political dynamics of wetland restoration

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ABSTRACT

Ecosystem-based disaster risk reduction is gaining increasing recognition as a sustainable alternative to engineered methods for mitigating disaster risks. Although implemented worldwide, numerous Ecosystem-based DRR projects largely rely on Western scientific frameworks, frequently neglecting the local knowledge, actions, and perspectives embedded in the socio-economic and cultural contexts of local populations. This study aims to understand how economically disadvantaged urban communities perceive and engage with ecosystem-based DRR, with the case study of 'Kolonnawa,' a flood-prone urban region in Sri Lanka. Using semi-structured interviews and a focus group discussion with informal settlers in wetlands that employed participatory mapping, the research demonstrates that residents possess considerable ecological awareness, particularly regarding the functions of wetlands in mitigating flood risks. However, the study found strong opposition to wetland restoration programmes, stemming from concerns over land loss, disruptions to livelihoods, and potential displacement. The results underscore the gap between community needs and top-down disaster reduction strategies, highlighting the necessity of incorporating local knowledge, empowering community leadership, and addressing socio-political vulnerabilities in the development of effective Ecosystem-based DRR approaches.

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Ecosystems; disaster risks; local people

Introduction

Natural ecosystems offer a diverse range of services critical to disaster risk reduction (DRR) (Estrella & Saalismaa, 2012). Conservation, restoration, and the sustainable use and management of ecosystems have been introduced into the DRR approach titled 'ecosystem-based disaster risk reduction' (ecosystem-based DRR). Ecosystem-based DRR leverages

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the benefits of healthy ecosystems to mitigate natural hazards, reduce people's vulnerabilities, and enhance community resilience in the face of disasters (Renaud et al., 2016). Resilience refers to the ability of local communities to anticipate, endure, and recover from disasters (Zhao et al., 2025).

There are numerous ways in which ecosystems are utilised in DRR. In the context of flood risk reduction, wetlands, riverine ecosystems, lakes, and rivers are protected, conserved, restored, and managed to enhance their ability to retain water in upper catchments and create room for overflow (García, 2011; Hauer et al., 2004). In coastal areas, mangrove ecosystems, coastal dunes, coastal plants, and coral reefs are conserved, protected, restored, and managed to mitigate the peak levels of storm surges, reduce flow speed, address rising sea levels, prevent saltwater intrusion, and reduce coastal erosion (Suwandhahannadi et al., 2024). Mountainous forests are conserved, protected, and restored as part of ecosystem-based DRR to mitigate landslide hazards (Sandholz et al., 2018; Sudmeier-Rieux et al., 2021).

Most of these ecosystem-based DRR interventions have traditionally been implemented in rural or semi-urban areas, with relatively less attention given to urban environments (Janzen et al., 2025). Nonetheless, there is increasing attention now being paid to urban environments, aiming to enhance resilience, reduce vulnerabilities, and create sustainable solutions for urban DRR by utilising natural ecosystems within urban landscapes (Dhyani et al., 2018; Lahoti et al., 2019). Healthy urban ecosystems can mitigate urban floods by providing space for water to run, increasing permeable spaces to absorb water from large rainfall events, enhancing biodiversity, and reducing pollution while also contributing to livelihoods (income-generating activities upon which residents depend for economic security) (Keenan-Jones et al., 2025; Liu & Zhang, 2025; Rotimi et al., 2025). Ecosystems also buffer urban communities from hazards and aid post-disaster recovery by providing access to safe drinking water and food (Berke & Glavovic, 2012). For these reasons, ecosystem-based DRR is increasingly recognised as an effective and sustainable urban DRR approach (UNDRR, 2020).

Research on urban ecosystem-based DRR primarily examines how ecosystems can mitigate the impacts of natural hazards and reduce people's exposure (Nguyen et al., 2019; Yin et al., 2022), while also assessing the costs and benefits of urban ecosystem-based DRR and its contributions to urban recreation, beautification, and well-being (Dhakal & Chevalier, 2017; Meerow & Newell, 2017; Schubert et al., 2017). An emerging body of research also addresses the lack of policies supporting urban ecosystem-based DRR (Dabral et al., 2025). However, this body of work has paid comparatively less attention to how ecosystem-based DRR interacts with existing socioeconomic vulnerabilities in urban informal and low-income communities.

The few studies on ecosystem-based DRR and socio-economic vulnerabilities underscore the importance of considering the specific vulnerabilities of urban poor communities, who often settle in hazard-prone areas and have limited access to resources and adequate infrastructure (Gurtner & King, 2021). A slight change in their immediate surroundings can lead to significant changes in their daily lives, as some urban dwellers, particularly those experiencing poverty, rely on ecosystems for food, water, and livelihoods (Gurtner & King, 2021; Healey et al., 2022). Overlooking these local realities can cause disruption in their lives and the failure of ecosystem-based DRR approaches (Hill et al., 2025). Thus, the formulation of effective urban ecosystem-based DRR strategies requires

integrating local communities' perspectives, knowledge, and actions (Dhyani et al., 2018; Lansakara et al., 2024).

In this context, it has become clear that predominant ecosystem-based DRR frameworks grounded solely in Western scientific paradigms risk overlooking critical social, cultural, and political dimensions of disaster risks (Dabral et al., 2025). This research examines urban ecosystem-based DRR by explicitly accounting for the socio-cultural and political dynamics shaping urban communities. This approach moves beyond conventional Western scientific paradigms, ecosystem-based DRR frameworks that prioritise ecological functions in isolation (Hill et al., 2025). Instead, it emphasises the importance of community-based knowledge, participatory governance, and local agency in shaping ecosystem-based DRR strategies,that challenges top-down and externally driven approaches.

The research concentrates on the Kolonnawa Divisional Secretariat Division of Sri Lanka, a densely populated and highly urbanised region characterised by households with low to middle incomes that confront significant socio-economic difficulties (Samaraweera, 2024). Numerous residents suffer from housing instability, precarious livelihoods, restricted access to healthcare and public services, and reliance on informal jobs that are particularly susceptible to economic and environmental shocks such as flooding (Nagamuthu, 2023). These vulnerabilities stem from larger socio-political dynamics, including unequal urban growth, historical marginalisation, and limited access to official land and housing systems. Cultural and social factors, such as strong kinship bonds, attachment to place, and community solidarity, further influence how residents perceive risks and react to disaster management efforts, often deterring them from relocating despite hazardous living conditions (Fernando & Jayasinghe, 2023). Additionally, gender disparities, vulnerabilities related to age, political underrepresentation, and entrenched social hierarchies disproportionately impact women, the elderly, and other marginalised groups, resulting in complex vulnerabilities that are essential for understanding urban disaster risk (Samaraweera, 2024).

Cernea's Impoverishment Risks and Reconstruction model provides a useful lens to elucidate the socio-economic dangers linked to displacement and resettlement, especially for vulnerable and marginalised communities (Cernea, 2000). The model posits that development or disaster-related initiatives can create various forms of impoverishment if social and economic realities are not considered (Cernea, 2004). Cernea identifies a variety of interconnected risks associated with displacement, such as landlessness, joblessness, homelessness, marginalisation, food insecurity, heightened morbidity, loss of access to common property resources, and social disintegration (Cernea, 2000). Furthermore, the framework stresses that these risks are interlinked processes that can exacerbate existing inequalities and social vulnerabilities. Simultaneously, the model underscores the significance of reconstruction through restoring livelihoods, promoting social inclusion, facilitating community participation, and ensuring equitable governance to diminish long-term impoverishment and vulnerability (Cernea, 2004).

The study thus employs a vulnerability-informed conceptual framework that views disaster risk as a socially constructed phenomenon through interconnected socio-economic, political, and cultural factors rather than merely the result of natural hazards (Kelman et al., 2017). In urban wetland settings like Kolonnawa, residing in hazard-prone areas is often influenced by poverty, reliance on livelihoods, housing uncertainty, and exclusion

from formal land markets (Dlamini et al., 2025). Within this framework, Cernea's IRR model provides a crucial perspective for comprehending how ecosystem-based DRR interventions, including wetland restoration and relocation efforts, may inadvertently reproduce or exacerbate existing vulnerabilities. Utilising the IRR framework allows the study to transcend the notion of ecosystem-based DRR as merely ecological or technical; rather, it situates it within broader discussions on social justice, governance, and structural inequity. Acknowledging the vital role of urban poor communities in ecosystem-based DRR, this case study thus aims to comprehend how at-risk urban residents perceive, negotiate, and engage with ecosystem-based DRR amid their everyday socio-economic and cultural realities.

The context of the study

Geography, climate, and population and socio-demographics

Sri Lanka is an island nation in the Indian Ocean, located between latitudes 5°55′ and 9°51′ N and longitudes 79°41′ and 81°53′ E. Covering 65,610 sq. km, it measures 435 km from north to south and 240 km wide, featuring three main elevation zones: coastal belt, plains, and central highlands, with 103 rivers.

The country experiences varied rainfall due to geography and monsoons, divided into wet, dry, and intermediate climate zones, with lowland temperatures averaging around 27°C. Sri Lanka has diverse ecosystems, including forests and marine environments.

Its population stands at 22.04 million, primarily consisting of Sinhalese, Tamils, and Moors, with 1% made up of Burghers, Parsis, and Veddas. Various religions (Buddhism, Christianity, Hinduism, and Islam) and languages (Sinhala, Tamil, and English) are practiced throughout the country.

Flood hazards in Sri Lanka

Sri Lanka experiences several natural hazard-induced disasters annually (Aronsson-Storrier, 2021; Senanayake & Pradhan, 2022). Among these, flooding forms the highest threat to the country (Sivakumar, 2015). The frequent floods in the country can be attributed to its Monsoon climate, tropical cyclones, and extensive river network (Samarasinghe et al., 2022). The Sri Lankan Disaster Management Center indicates that, over the past four decades Sri Lanka has experienced over 8000 flood events, with a notable increase in frequency. The Western Province is the most affected region with 1,781 flood incidents, followed by the Southern Province with 1,119 (Figure 1), where the Kolonnawa Divisional Secretariat Division (DSD) is. In densely populated urban regions, flood risk is intensified not only by physical factors such as impervious surfaces and inadequate drainage systems, but also by socio-economic vulnerabilities including poverty, informal settlements, insecure housing, limited access to resources and services, livelihood precarity, and historical marginalisation. Many residents are compelled to settle in hazard-prone wetland areas due to limited access to affordable land and housing, increasing both their exposure and sensitivity to flooding. These interconnected environmental and socio-economic conditions significantly heighten

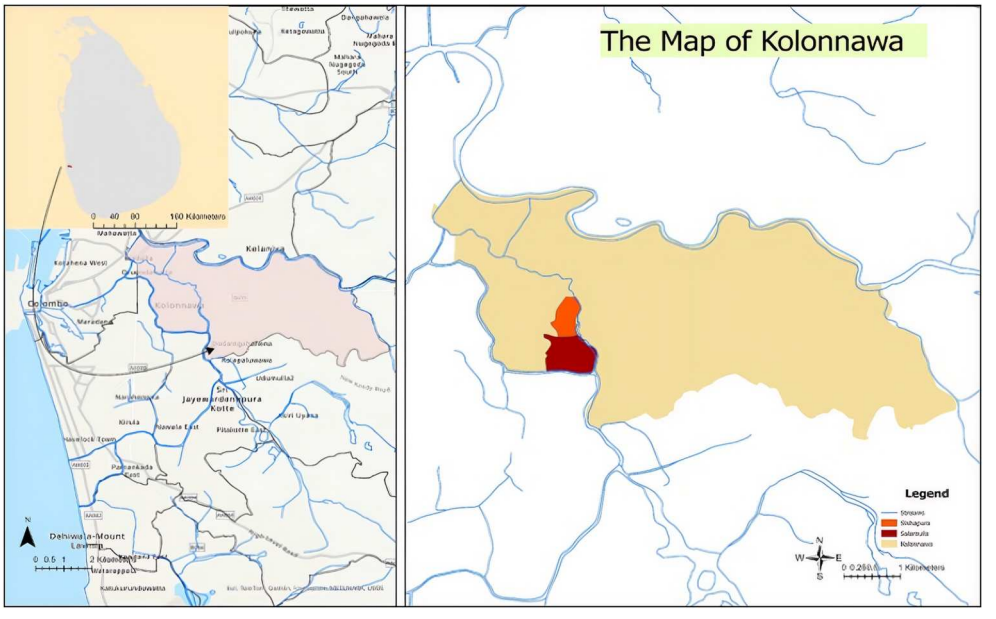

Figure 1. The map of The Kolonnawa Divisional Secretariat Division.

community vulnerability and reduce the capacity of residents to prepare for, respond to, and recover from flood disasters.

Case study: Kolonnawa divisional secretariat division

Kolonnawa represents a critical case where high population density, socio-economic vulnerability, and wetland loss converge. Kolonnawa DSD is in the Western Province on the eastern side of Colombo District (Figure 1). Recognized by the Disaster Management Center as one of the most flood-prone areas in the country (Hewawasam & Matsui, 2023).

The Kolonnawa DSD office reports a population density of 7,183 individuals per square kilometre, far exceeding the national average of 332.76 people per square kilometre. In terms of employment, only 50.81% of the population (101,044) is employed, while 2.4% (4,820) are unemployed, and 47% (92,982) are engaged in informal financial activities (Kolonnawa Divisional Secretariat Division of Sri Lanka).

During the Southwest Monsoon season, heavy rainfall frequently causes the Kelani River, Heen Ela, and Diyawanawa Ela to overflow, making the DSD vulnerable to flooding (Dissanayaka & Sangasumana, 2017). Since 1980, 45 floods have affected Kolonnawa DSD (about one flood per year), with the most severe occurring in August 2010, 1989, and 2016 (Hewawasam & Matsui, 2023). It is estimated that over 81% of the total population (about 155,000 residents) face flooding risk (Manawadu & Wijeratne, 2021).

Historically, a large portion of Kolonnawa comprised wetlands and other natural vegetation, which played a crucial role in floodwater management and ecological equilibrium. Kolonnawa has experienced significant land-use changes due to rapid population growth, leading to the conversion of wetlands and natural vegetation into settlements and infrastructure (Hewawasam & Matsui, 2023; Manawadu & Wijeratne, 2021). This transformation, as shown in Figures 2–4, has compromised the area's ability

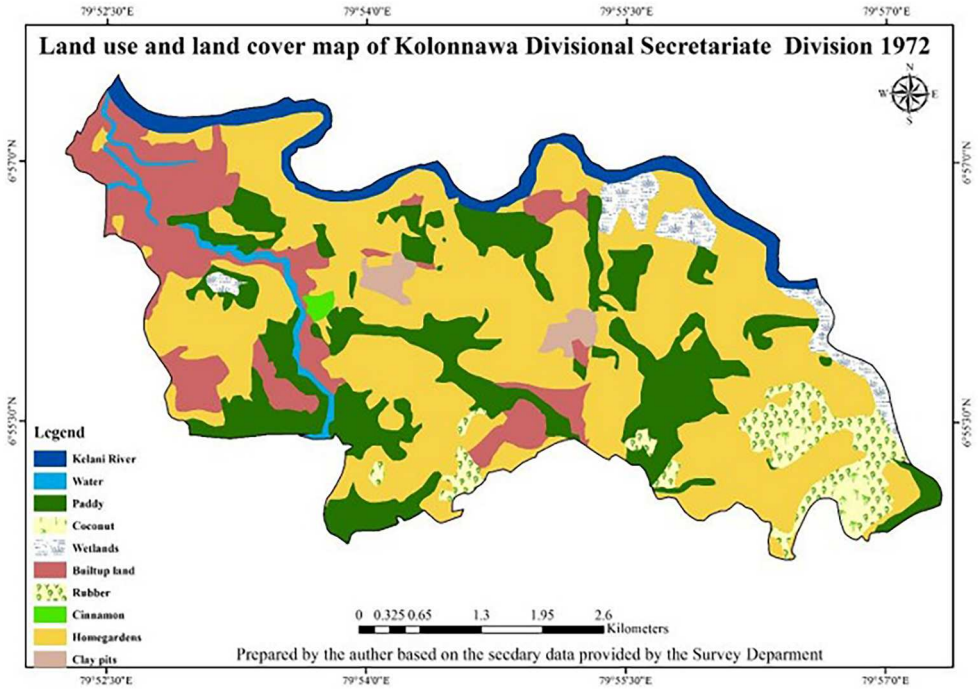

Figure 2. Land use and land cover map of Kolonnawa Divisional Secretariat Division Sri Lanka, 1972.

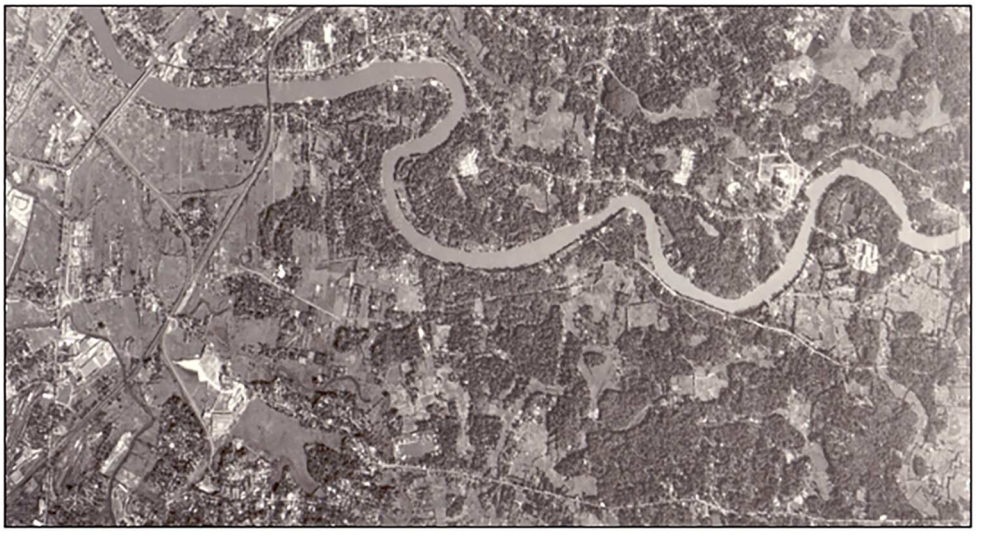

Figure 3. A satellite image of land cover and land use map of Kolonnawa Secretariate Division, 1972.

to manage floodwaters, increasing susceptibility to flooding (Nagamuthu, 2023). The loss of wetlands, which previously served as natural buffers, along with increased runoff from urban surfaces, has intensified flooding risks and their impacts on the community and

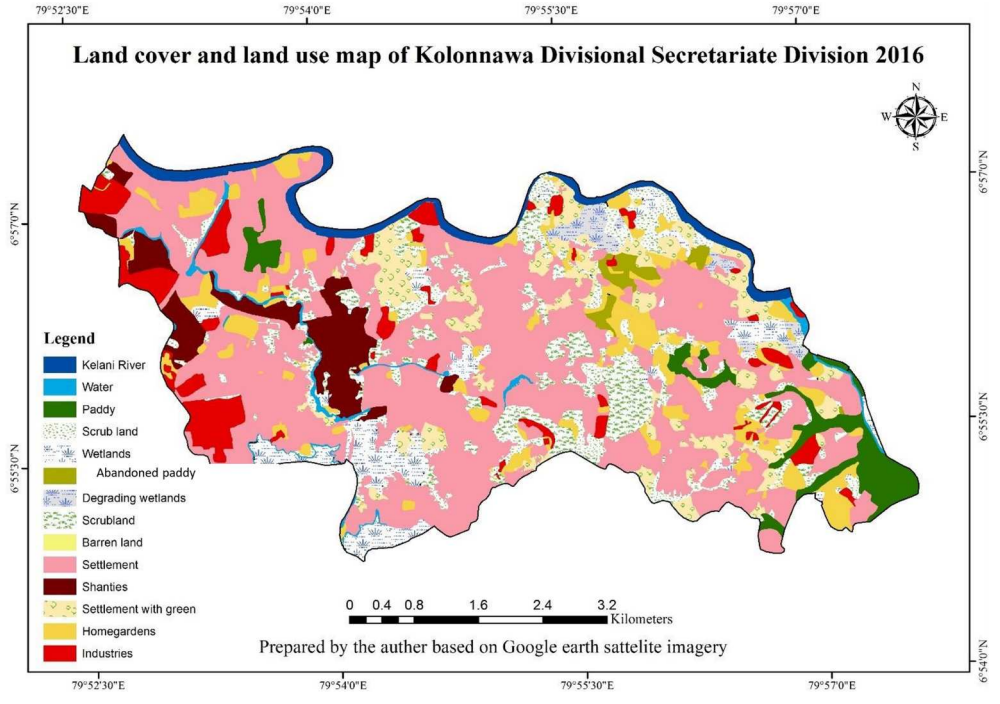

Figure 4. Land cover and land use map of Kolonnawa Secretariate Division, 2016.

environment. In 1972, the area was characterised by extensive wetlands, encompassing half of the land cover (49.22%), alongside substantial proportions of rubber plantations (34.1%), grasslands (9.42%), and built-up lands (13.05%). However, by 1981, there was a slight decrease in wetland coverage and a noticeable expansion of water bodies and paddy fields. This trend continued into 1989, with a dramatic increase in paddy fields, marking 20% of the land cover, while wetlands saw a considerable reduction. In 2008, a significant increase in urbanisation occurred, with settlements occupying most of the area (70.6%), and industrial zones emerged.

Additionally, there was a notable increase in barren lands and scrublands, suggesting urban expansion into previously undeveloped areas. By 2016, settlements further expanded, encompassing over 73% of the land cover, while wetlands and water bodies experienced marginal changes. The temporal analysis underscores a profound shift from natural ecosystems to urbanised landscapes in Kolonnawa DSD, reflecting evolving socio-economic priorities and land development patterns over the decades. Some of the low-lying areas were reclaimed for development purposes, such as housing, public utilities, industries, and warehousing, and some other areas that could not be reclaimed were utilised for the disposal of solid waste. Certain areas were encroached by poor families who were engaged in informal sector activities in the city of Colombo or in and around Kolonnawa town. This has resulted in many squatter settlements coming up in flood-prone low-lying areas of Kolonnawa. About 80% of the flood retention areas have now been filled without proper drainage.

Research methodology

This research is grounded in the epistemological perspective of social constructivism, which acknowledges that the understanding of DRR and ecosystem services is influenced by the specific context and shaped by individuals' lived experiences, cultural backgrounds, and socio-political contexts. By using this viewpoint, the study aimed to uncover how local communities perceive and interact with ecosystem-based DRR in their unique ways. A qualitative case study methodology was utilised to investigate these dynamics in detail and provide in-depth, nuanced insights into participants' knowledge, perceptions, and experiences (Creswell et al., 2007). This methodological approach offered a comprehensive understanding of the socio-cultural and environmental factors that affect community attitudes towards ecosystem-based DRR (Triyanti & Chu, 2018). This approach is consistent with the research of Yin (2003) and Stake (1995), who support the use of case studies to explore intricate social phenomena in real-world settings.

Three main qualitative methods were employed: a total of 45 interviews (Table 1) were conducted using a flexible guide that allowed for probing follow-up inquiries. The interviews delved into participants' experiences with local hazards, DRR practices, ecological understanding, and views on ecosystem-based DRR. Conducted in Sinhala and Tamil, the interviews ensured linguistic inclusiveness and cultural relevance. The length of the interviews varied from 20 to 90 min, depending on the participants' engagement level. Before full implementation, the interview guide was tested with two individuals to ensure its relevance to the research goals.

One Focus group discussion (FGD) with 18 participants (Table 1) was conducted to examine collective perspectives, social interactions, and shared experiences concerning flood risks and ecosystem services. They provided a supportive setting for discussing sensitive issues and validated findings from individual interviews. The discussions commenced with a briefing on the research objectives, ethical considerations, and the

Table 1. The demographic table of research participants.

Gender		Ethnicity		Age (Years)		Duration of residency (Years)	
Gender	Number of respondents	Ethnicity	Number of respondents	Range	Number of respondents	Range	Number of respondents
Key Informant Interview participants							
Female	30	Sinhalese	12	18–30	04	1–10	03
Male	15	Muslims	23	30–40	10	10–20	11
		Tamils	10	40–50	15	20–30	12
				50–60	10	30–40	11
				60–70	04	40–50	05
				70–80	01	50–60	01
				80–90	01	60–70	01
Focus Group participants							
Female	17	Sinhalese	8	18–30	2	1–10	1
Male	1	Muslims	8	30–40	2	10–20	3
		Tamils	2	40–50	4	20–30	5
				50–60	12	30–40	8
				60–70	1	40–50	01
				70–80	0	50–60	00
				80–90	0	60–70	00

Notes: Created by the author.

rights of participants. The FGD involved a two-dimensional participatory mapping activity. Participants collaborated to identify significant spatial features, including areas prone to hazards, existing infrastructure, and potential locations for ecosystem-based interventions. This approach not only illustrated community knowledge but also enabled discussing the possible co-development of locally acceptable DRR strategies (Cadag & Gaillard, 2012). The materials used for mapping included pencils, markers, and large sheets of paper.

In total, there were 45 residents (30 females, 15 males) living in informal settlements on reclaimed wetlands involved in the study. Participants were chosen purposefully to ensure representation across ethnicities (Sinhalese, Tamil, Muslim), age groups, and duration of residency in Kolonnawa. This demographic variety provided a wealth of insights into how different community members perceive and experience flood risk and DRR efforts. Informed consent was secured from all participants. Confidentiality and anonymity were emphasised, particularly given the politically sensitive nature of illegal settlements and DRR interventions. Many participants were initially reluctant due to concerns about political repercussions, but trust-building and clear communication regarding privacy protections significantly enhanced participation rates.

A thematic analysis was conducted to analyze the data collected from interviews with local participants and FGD. Thematic Analysis was chosen for this research due to its flexibility and ability to interpret qualitative data effectively. First, the recordings of semi-structured interviews were listened to familiarise themselves with the dataset (Clarke & Braun, 2017). After listening to the interviews and becoming familiar with the audio recordings, the lead author began the actual transcription. After transcribing, codes were generated (a word or a short phrase) to summarise noticeable and essential data based on the research objectives (Clarke & Braun, 2017). This research employed a multi-level coding approach, applying codes to individual words and larger segments of interview transcripts. After generating codes, themes were created. Codes were clustered into themes to understand ecosystem-based DRR practices and community participation comprehensively. Then, the generated themes were reviewed to ensure their accuracy and representation of the dataset.

Results

Three themes emerged from the Kolonnawa case study. (1) Knowledge and awareness of the role of wetlands in flood risk reduction, (2) Attitudes toward implementing wetland-based DRR in Kolonnawa, and (3) Setting conditions for supporting Ecosystem-based DRR. The IRR framework guided the analysis of participants' experiences by highlighting how concerns about displacement, loss of livelihood, homelessness, and the breakdown of social networks mirrored wider processes of poverty and vulnerability linked to ecosystem-based DRR interventions.

Theme 1: knowledge and awareness of the role of wetlands in flood risk reduction

The interviews and FGD revealed that the majority (43 out of 45) of participants recognised the critical function of wetlands in mitigating flood risk hazards. Participants

demonstrated both awareness and substantial knowledge regarding the underlying processes and characteristics of wetlands that contribute to flood attenuation. They articulated how wetlands serve as natural sponges, effectively absorbing excess water, retaining it, and gradually releasing it into the Kelani River. Additionally, the participants identified wetland elements such as specific plant species that play a vital role in enhancing flood resilience through their unique adaptations and physiological functions:

> Wetlands play a crucial role in reducing the impact of floods. They absorb excess water by acting as natural sponges, storing it, and slowly releasing it into the river. This process reduces the risk of flooding and helps prevent damage to homes and businesses. (Participant 12, 12 January 2023)

Residents recognised the extensive benefits of wetlands, with many emphasising their crucial role in enhancing biodiversity. They noted that wetlands serve as breeding grounds, feeding areas, and shelters for various wildlife, thereby playing a crucial role in biodiversity conservation. Participants also described the recreational opportunities provided by these ecosystems and the significant sense of well-being they derive from them. They reminisced about their various activities, including fishing, birdwatching, and swimming in the wetlands.

Furthermore, research participants shared valuable insights into the wetlands' critical role in sustaining their communities. They underscored the vital function of wetlands in water purification, recounting their historical reliance on the Kelani River for daily necessities, particularly for bathing and sourcing clean water. They highlighted how these rich ecosystems offer indispensable resources for their daily lives. For example, they mentioned pan gas and dams as sources of food and materials for weaving mats.

During the interviews, 42 out of 45 participants in semi-structured interviews and FGDs identified the link between ecosystem degradation and intensifying flood risks. Participants explained that wetland filling and building over the filled wetlands amplify flood risks by reducing the space for floodwater storage, increasing runoff, and reducing water retention.

> Human activities, such as the destruction of wetlands and the construction of settlements in these areas, have significantly amplified the occurrence of floods. I understand that we are responsible for this because we have made our home here for a long time. (Participant 18, 6 January 2023)

The research participants explained the factors that led to the filling and encroachment on wetlands for settlement, despite their awareness of the potential impact they were causing. One among many reasons included widespread poverty and homelessness that had left them with no choice but to fill the wetland and settle there. Another critical factor highlighted during the interviews was the support of national and local politicians, as well as drug dealers, in illegal wetland filling. Participants explained that politicians distribute illegally filled wetlands for settlement, expecting votes in return. Simultaneously, drug dealers aid encroachment, expecting support for drug trafficking.

Theme 2: attitudes towards implementing wetland-based DRR in Kolonnawa

This theme reflects community perceptions regarding the implementation of wetland-based DRR in Kolonnawa. Although there is a strong awareness of how wetlands can

help mitigate flood risks and an acknowledgment that wetland degradation worsens flood severity, participants showed significant reluctance to endorse the current methods of wetland-based DRR initiatives.

Out of the 45 individuals interviewed, 40 voiced concerns about land acquisition and the potential disruption of current settlements. These worries influenced how participants assessed wetland-based DRR, with perceived socio-economic risks often overshadowing the expected benefits of flood reduction. Specifically, those dependent on local job opportunities were particularly anxious that these initiatives could compromise their means of livelihood. This apprehension was particularly evident among female-headed households, where women with low literacy levels relied on nearby informal employment options:

> We do not want to provide this space for wetland restoration and relocate to another area. Job opportunities are plentiful here, unlike areas with limited employment options. Choosing wetland restoration could force all of us to relocate and threaten our livelihoods. (Participant 29, 16 December 2022)

Participants also highlighted the significance of neighbourhood stability in shaping their views on wetland-based DRR. Many characterised their communities as safe and cohesive environments that were built over time through strong social connections, shared cultural practices, and collective initiatives like neighbourhood watch programmes. Residents from Sinhalese, Muslim, and Tamil backgrounds underscored that these ties were integral to their sense of security and everyday resilience. Thus, proposed interventions that could disrupt settlement patterns were seen as threats not just to their physical homes but to the social fabric. For these participants, leaving a familiar and trusted neighbourhood – even for flood risk reduction – was regarded as a major loss.

Fears regarding housing insecurity further contributed to the resistance toward wetland-based DRR. Several participants linked land acquisition to the possibility of homelessness, drawing upon past experiences of housing instability. These recollections fuelled a strong desire to safeguard their current living situations, resulting in reluctance to support initiatives perceived as potentially leading to forced displacement: 'No, we do not want wetland restoration to be implemented. If we agree to leave, we will be homeless. We were once homeless, and we do not wish to be in that situation again' (Participant 36, 16 January 2023).

Alongside concerns about livelihoods and housing, participants conveyed frustration with the existing DRR decision-making processes. Many believed that politicians and DRR practitioners held excessive control over planning, favouring technical or strategic goals over local needs. This sense of exclusion bred mistrust toward official DRR initiatives, including those focused on ecosystem-based approaches, and diminished willingness to participate. Participants stressed that the genuine involvement of local communities in decision-making is crucial for fostering confidence and support for DRR efforts.

A frequently mentioned example reflecting this mistrust was the construction of a floodgate across the Kelani River in the Saalamulla Grama Niladhari Division. While the floodgate was aimed at reducing flooding by redirecting excess water to Diyawannawa Lake, participants noted that flooding had intensified since its installation. Many observed that floodwaters now accumulate more quickly after relatively brief rainfalls, reinforcing the belief that externally developed DRR measures do not appropriately consider local hydrological conditions.

Previous experiences with relocation initiatives also influenced community attitudes toward wetland-based DRR. Participants referred to negative outcomes from past relocation efforts, which fuelled scepticism about the state's ability to implement socially acceptable solutions. While participants did not fundamentally oppose ecosystem-based flood risk reduction, these experiences heightened concerns regarding the socio-economic and cultural impacts of land-based initiatives. Consequently, their support for wetland-based DRR was contingent upon how these initiatives are designed, governed, and executed, rather than a complete rejection of ecological approaches themselves.

Theme 3: setting conditions for supporting ecosystem-based DRR

Theme 2 noted that local participants lack interest in implementing ecosystem-based DRR. It described the fears rooted in the potential loss of jobs, neighbourhood rights, reverting to homelessness, and inadequate relocation policies, which led to significant opposition to ecosystem-based DRR. However, a third theme emerging was research participants' willingness to engage in ecosystem-based DRR under specific conditions. These conditions mainly revolved around reforming local DRR policies and approaches, empowering local people to make DRR decisions, and integrating their knowledge and experience into DRR initiatives.

Participants emphasised the urgency of updating local strategies that are currently seen as ineffective. They noted that accessing DRR aid often relies on political connections, resulting in inequities where individuals without such ties struggle to receive support. The importance of establishing transparent and fair procedures for aid distribution was underscored, promoting an inclusive system that addresses the needs of all community members. This approach aims to empower individuals, foster resilience, and ensure equitable access to resources during times of crisis.

All research participants emphasised the need to decentralise decision-making power in DRR to encourage support for local ecosystem-based initiatives. They highlighted their role as primary beneficiaries and the importance of integrated governance, asserting their right to participate in decisions that directly affect their lives. Inclusion in DRR decision-making would enhance support and promote active participation in environmental conservation efforts. Participants stressed the significance of local leadership in ecosystem-based DRR, with two expressing willingness to serve as regional leaders if implemented 'If the existing DRR process could be changed, and our inputs included in decisions, People would then happily participate in and help DRR' (Participant 7, 4 January 2023).

Participants consistently highlighted the essential role of local leadership in ecosystem-based DRR. Due to their in-depth knowledge of the community's environment and specific challenges, many pointed out that local leaders are ideally suited to enforce sustainable and context-relevant solutions: 'Local leaders understand our land, our people, and what is effective here. Outsiders might miss critical aspects' (Participant 18, 1 January 2023).

Others supported this view, saying that local leadership fosters greater community trust and involvement in the initiatives. They also emphasised that local leaders are better equipped to integrate indigenous wisdom and cultural practices, which external parties often neglect. Overall, participants believed that local leadership enhances community empowerment and boosts the long-term resilience of both individuals and ecosystems.

In addition to advocating for policy changes, decentralising decision-making power, and enabling local leadership, participants advocated the importance of local knowledge.

Participants, for example, cited the floodgate failure incident, claiming that the floodgates were constructed without considering recent environmental and geographical changes. Participants pointed out that the filling of wetlands has increased the height of the Kelani River Basin, where most of the wetland has been filled, compared to the elevation of the Kalu River Basin, where the wetland is only partially filled. Participants argued that the natural water flow of the region had been disrupted due to the artificial elevation changes resulting from the wetland filling, and this elevation change had not been considered during the floodgate construction.

Participants expressed frustration over the lack of local knowledge integration in DRR strategies. They emphasised the importance of incorporating their lived experiences, which provide a deeper understanding of environmental conditions and risks often overlooked by external experts. They argued that their insights could offer innovative, culturally appropriate approaches to risk management. They called for collaborative frameworks that combine local knowledge with scientific expertise to enhance the effectiveness of DRR initiatives and build resilient communities.

> DRR practitioners must gain awareness of evolving flood characteristics and land changes before building a floodgate. Human-induced wetland filling has significantly altered the landscape; however, existing approaches often neglect these transformations. Understanding these changes is crucial for devising effective strategies that could potentially involve water diversion between the two sides of the river. (Participant 18, 18 January 2023)

Local participants also mentioned the importance of proper DRR information dissemination and noted that they are always the last to receive information about decisions regarding DRR. The following statement shows a sense of feeling overlooked and marginalised, consistently being informed last and treated as a lower priority.

During the FGD, a 2D participatory mapping exercise was conducted to explore possible actions in different geographical areas of their community (Figure 5). The ecosystem-based DRR approach planned for river deepening focused on mapped locations to reduce

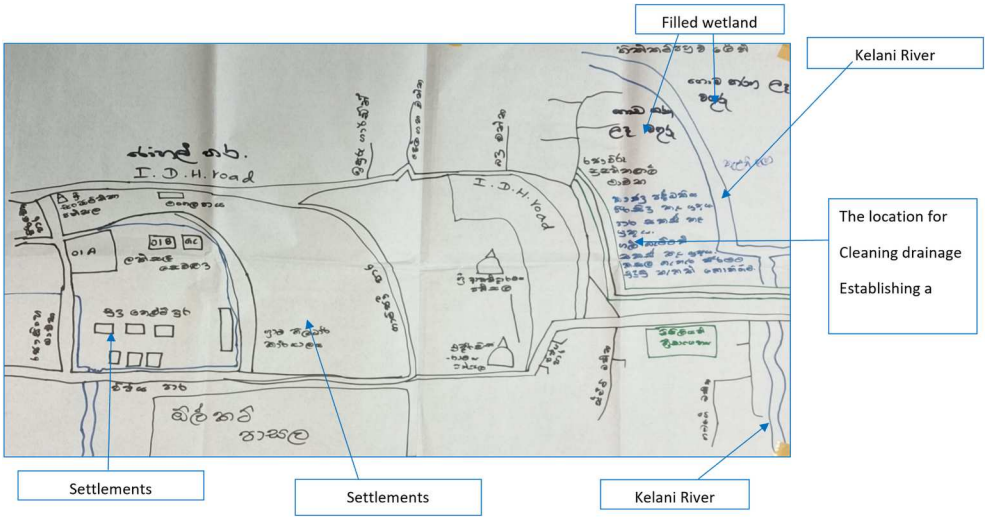

Figure 5. The 2 dimensional participatory map.

local floods by clearing accumulated mud, allowing more floodwater retention. Participants highlighted the importance of riverbank restoration, wetland cleaning, and conserving natural resources for effective flood reduction. They emphasised integrating ecosystem-based approaches with engineering methods, such as flood walls and barriers, to enhance effectiveness. Residents identified specific areas on the map for both approaches, suggesting that untouched wetlands and riverbanks need ecosystem-based solutions, while degraded wetlands require engineering interventions. Notably, the proposed ecosystem-based DRR methods were straightforward and did not require land acquisition.

Discussion

The study's results showed that local urban residents possess a complex understanding of the role of ecosystems, particularly wetlands, in reducing flood risk. Participants identified specific processes such as rainwater retention, absorption, and runoff management. This highlights a considerable level of ecological literacy, which stands in contrast to common assertions in the literature on DRR and ecosystem approaches (Cutter, 2012). Many of these sources emphasise a prevailing belief in the disconnection between urban residents and their adjacent natural ecosystems, along with a limited practical understanding of the role that wetlands play in mitigating flood risks (Douglas et al., 2008). Contemporary research emphasises that local ecological knowledge can enhance the effectiveness of ecosystem-based DRR strategies (Healey et al., 2022; Kelman & Stojanov, 2023). The Kolonnawa case demonstrates that ecological literacy alone is insufficient to guarantee community support for interventions, as social, economic, and political realities critically shape residents' responses.

When analysed through Cernea's Impoverishment Risks and Reconstruction Model (Cernea, 2000), the narratives of participants prominently highlighted issues related to livelihood insecurity and the possibility of unemployment. In urban wetland areas like Kolonnawa, livelihoods are intricately tied to location, social connections, and access to informal economic opportunities. Consequently, ecosystem-based DRR strategies that involve relocation or land acquisition were perceived not just as environmental initiatives, but also as potential risks to economic survival and long-term social stability.

Participants expressed strong opposition to ecosystem-based DRR strategies focused on wetland conservation and restoration. Their concerns centred around potential job loss, displacement, and disruptions to social networks. The proposed land acquisition for restoration was seen as a significant threat to livelihoods, especially in communities already facing discrimination and limited employment opportunities. This unease was amplified by histories of homelessness, leading to fears of relocating to unfamiliar areas with scarce job prospects. For numerous participants, moving was not seen as a means of gaining safety but rather as a possible pathway to deeper impoverishment and social exclusion. Consequently, environmental initiatives from governmental agencies were often perceived as threats rather than opportunities for DRR. These findings align with the literature on disaster-induced displacement, which documents how relocation disrupts social identity, informal support networks, and community cohesion, particularly in marginalised populations (Amaratunga & Haigh, 2011; Cernea, 2000; Fernando & Jayasinghe, 2023; Fernando et al., 2024; Haslam et al., 2024; Jayasuriya & McCawley, 2008, 2010; Oliver-Smith, 2013; Pinter et al., 2019; De Sherbinin et al., 2011).

Interpreted through Cernea's Impoverishment Risks and Reconstruction (IRR) framework (Cernea, 2000), participants' concerns reflect multiple impoverishment risks associated with ecosystem-based DRR interventions, including landlessness, joblessness, homelessness, and social disarticulation. These risks help explain why wetland restoration is perceived not as risk reduction, but as a potential pathway to further marginalisation. This demonstrates that resistance to ecosystem-based DRR is rooted less in ecological misunderstanding and more in historically and politically produced socio-economic insecurity.

The results also emphasise how ecosystem-based DRR measures can connect with current experiences of housing instability and displacement. Within the IRR framework, lack of housing and land ownership are crucial risks that arise when at-risk populations lose access to shelter, informal housing, or community-rooted living environments. In Kolonnawa, these threats were especially prominent due to the participants' backgrounds of poverty, insecure housing situations, and limited access to formal land ownership.

In Kolonnawa, vulnerability is influenced not only by susceptibility to flooding but also by persistent socio-economic disparities, poverty, insecure housing, informal job markets, restricted access to formal land ownership, and experiences of displacement and homelessness. A significant number of residents have moved into wetland regions due to the lack of affordable housing and stable job prospects elsewhere, making these areas both environmentally risky and socially crucial for their survival. The IRR framework helps examine how the suggested wetland restoration and relocation efforts might inadvertently exacerbate existing vulnerabilities by jeopardising residents' access to shelter, job prospects, and community support systems. For participants, wetland restoration was viewed not merely as a strategy for flood mitigation, but as a potential route leading to renewed impoverishment and exclusion.

The results indicate that vulnerability in Kolonnawa arises not just from environmental flooding but also from wider structural inequalities that influence living conditions and locations. The experiences shared by participants highlight enduring socio-economic marginalisation, such as poverty, unstable livelihoods, lack of secure housing, and exclusion from official planning and land systems. The IRR framework assists in contextualising these experiences within the larger dynamics of impoverishment and social vulnerability related to displacement and urban environmental initiatives.

The Kolonnawa case illustrates how disaster risk is produced through structural socio-economic conditions rather than individual choice. The wetlands in Kolonnawa serve as both an ecological defense against flooding and a source of shelter and livelihood for residents facing secondary homelessness (Fernando et al., 2024; Jayasuriya & McCawley, 2010). This situation highlights the intricate relationship between environmental management and socioeconomic vulnerability. The DRR literature increasingly acknowledges that ecological interventions can inadvertently impact local livelihoods if informal settlements are ignored (Haslam et al., 2024).

In this context, Cernea's Impoverishment Risks and Reconstruction model (Cernea, 2000) provides a useful framework for formulating ecosystem-based interventions, particularly those involving relocation or land acquisition. Ecosystem-based DRR should adopt strategies with directions (a) from fear of losing land to land-based resettlement; (b) from joblessness to reemployment; (c) from homelessness to house provision/reconstruction; (d) from risk of further marginalisation to social inclusion; (e) from fragile

livelihoods to livelihoods opportunities; (f) from loss of access to resources to provision of community services and assets; and (g) from risk of social dislocation to maintaining communities ties and networks. The case of Kolonnawa, therefore, highlights the importance of recognising ecosystems not only as natural infrastructure for flood risk reduction but also as lived spaces that shape livelihoods, social identity, vulnerability, and power relations. It further demonstrates that ecological solutions cannot be separated from questions of social justice and must be designed alongside socially equitable policies that protect livelihoods, housing security, and community cohesion.

The incorporation of local knowledge and community-driven actions is essential for effectively accounting for socio-economic vulnerabilities, addressing historical grievances, and overcoming the mistrust associated with top-down governance approaches (Parpiani et al., 2025). By integrating local insights and fostering community participation, vulnerabilities across social, economic, cultural, and environmental dimensions will be more effectively identified and mitigated (Palmeiro-Silva et al., 2025). This approach not only strengthens social cohesion and builds trust among populations most at risk but also enhances the practicality, acceptance, and resilience of interventions (De Silva & Kawasaki, 2018).

This challenges the prevailing top-down DRR frameworks that predominantly utilise externally generated knowledge while marginalising local expertise (Mercer et al., 2010). Acknowledging community members as knowledge holders repositions DRR as a collaborative process, moving away from a purely technocratic imposition (Klein et al., 2019). However, it is important to note that despite this paradigm shift, many existing frameworks still heavily rely on external knowledge sources, thereby limiting the potential for effective local engagement and implementation (Parpiani et al., 2025).

Participants raised concerns about wetland restoration focused on relocation but did not completely dismiss ecosystem-based DRR. Their views emphasised the significance of DRR strategies that tackle both environmental risk mitigation and socio-economic vulnerability. In this context, the IRR framework offers valuable lens for crafting ecosystem-based DRR initiatives that enhance livelihoods, housing stability, social inclusion, and community resilience while minimising the chances of further displacement and impoverishment.

Participants advocated for a blended approach that combines ecosystem-based and structural interventions. They recommended measures such as conserving intact wetlands, restoring riverbanks, and deepening rivers to enhance floodwater retention. These solutions are low-cost, minimally disruptive, and precisely targeted, demonstrating a keen awareness of spatial variations in risk and practical feasibility. The findings serve as a caution against overly idealising ecosystem-based DRR as a standalone solution. While these natural interventions are indeed valuable, they can be implemented alongside engineering measures and explicitly address socio-economic vulnerabilities, including housing insecurity, employment precarity, and social cohesion.

Another aspect that is prominently highlighted in the narratives of participants is the disruption of social connections and community support systems. According to the IRR framework, social disarticulation refers to the deterioration of social networks, kinship bonds, and types of collective assistance that uphold daily life and resilience (Cernea, 2000). In Kolonnawa, these informal social structures are essential for helping residents manage flooding risk and response, economic difficulties, and housing instability.

Participants advocated for locally sensitive approaches that minimise displacement, strengthen local livelihoods, and involve communities directly in planning and decision-

making processes. These findings suggest that policymakers should move beyond purely technical or ecological approaches and adopt integrated DRR strategies that combine ecosystem restoration with socially equitable housing policies, livelihood protection mechanisms, and participatory governance structures that recognise the everyday realities of vulnerable urban populations (Nishanthi & Dissanayaka, 2021). These findings underscore the necessity for DRR strategies that integrate ecological insights with socio-economic and cultural considerations. They emphasise the importance of actively involving local knowledge and adopting context-sensitive participatory approaches. This research highlights the importance of community viewpoints in crafting DRR strategies that are tailored to the local context and socially aware, by illustrating how residents in Kolonnawa recognised flood hazards, assessed suggested wetland solutions, and proposed alternatives that are practical for their community.

Conclusion

This research challenges common beliefs in ecosystem-based DRR by highlighting that urban informal settlers possess valuable knowledge about ecosystems, especially wetlands, for flood risk reduction. In Kolonnawa, Sri Lanka, residents show a deep understanding of their environment gained from experience and history. However, they displayed resistance to wetland restoration geared to reduce disaster risk. Such resistance arises from socio-economic vulnerabilities, fears of displacement, and distrust in government, perceived as top-down and disruptive to social cohesion, reflecting broader issues of political marginalisation and housing insecurity.

Nevertheless, residents proposed feasible, low-cost ecosystem-based DRR measures that align with local expertise and minimise displacement. Their preference for and implementation of ecological restoration, together with engineering solutions, shows a practical approach to flood risk management. For urban ecosystem-based DRR to succeed, it must consider the complex socio-political realities of the communities involved. This involves decentralising decision-making and empowering local populations to participate in processes that impact their lives. Incorporating local knowledge is essential, as community members often have valuable insights into their specific challenges and resources.

Interventions in Kolonnawa and Sri Lanka at large should be socially equitable and environmentally sustainable, ensuring a fair distribution of benefits, especially for marginalised groups that are disproportionately affected by disasters. Building trust through open communication, collaborative planning, and transparency is crucial. Inclusivity fosters a sense of ownership in the community, making nature-based risk reduction strategies more effective. When communities feel valued, the solutions developed will be more resilient and better equipped to address urban challenges.

Disclosure statement

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