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Making modern water: The content, actors, and processes of embedding the Mahaweli Development Project in Sri Lanka (1963–2010)

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ABSTRACT

Existing literature has established a clear connection between large-scale water projects and modernist development, but further exploration is needed to empirically demonstrate how this connection materializes in specific cases. Focusing on one of the world's largest and most ambitious water projects carried out in Sri Lanka, we demonstrate how the hydrosocial paradigm of 'modern water' created conceptual and practical linkages between mega water projects and modernist development. Drawing on policy transfer and mobility literature, we articulate how the co-constitution of modern water and development enabled the global flow of modernist water ideals. We highlight the content, actors, and processes that drive this flow, demonstrating the embedding of modern water within Sri Lanka's hydrosocial landscape. We also draw attention to how contemporary water policies remain shaped by mid-20th century water-development projects, both ideologically and materially. This shows the endurance of modern water, even as the restoration of alternative water management systems becomes central to policy discussions in Sri Lanka. Our findings add insights into the spatio-temporal patterns of modern water, enhancing existing scholarship on policy transfer, mobility, and mega water-development projects.

1. Introduction

The history of large-scale water projects is tied to the hegemonic institutionalisation of modernist development (Mehta, 2013; Scott, 2009). For more than a century, large dams have been constructed not just for irrigation and hydropower, but as projects of nation-state building (Menga, 2015; Mitchell, 2002; Rusca et al., 2019; Witharana, 2022). These projects remain contested, as diverse social groups point to the socio-cultural, ecological, and economic costs of altering the flow of rivers (D'Souza, 2006a; Dukpa et al., 2019; Fung & Lamb, 2023; Huber & Joshi, 2015). Yet, they continue to proceed – from large-scale transfer projects in the Amazon to hydro-power projects in the Himalayas – despite often infringing Indigenous rights (Booth, 2017) and leading to large scale displacement (Mehta, 2013). Existing literature has pointed out the link between large-scale water projects and modernist development (Bakker, 1999; Birkenholtz, 2023; Boelens, 2022; Hommes & Boelens, 2018); this article contributes further by elucidating the specific processes through which this link occurs and how these processes

have enabled the enduring hegemony of mega water-development ideals.

We explain the evolution and impact of this path-determining linkage by conducting a historically-grounded analysis of the design and implementation of the Mahaweli Development Project (MDP) in Sri Lanka. Developed between 1963 and 2010, the MDP remains one of the most ambitious large-scale water transfer projects globally, and the largest water management and development project carried out in Sri Lanka. The MDP altered the landscape of 55% of the country's ecological 'dry zone', impacting the majority of its population. The project consists of 11 reservoir complexes built along the Mahaweli River, diverting its waters through a network of canals to several large tanks for storage. These tanks form 13 irrigation systems (A-M), within which water is distributed to smaller tanks in irrigation blocks, before being sent out to individual irrigation plots (conditionally owned by farming families). This structure furthered colonial alterations to Sri Lanka's hydraulic infrastructure, overriding many of the historic Tank Cascade Systems throughout the dry zone.

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The MDP is an important case to study not just for its material scale and impact, but also for its enduring influence on hydrosocial relations,¹ water management policy options, and Sri Lanka's current and future development aspirations. Focusing on the unfolding hydrosocial relations that underpin the MDP helps to reveal and explain the co-constitutive relation between modern water, development ideals, and Sri Lanka's hydrologic landscape. To explain this approach, we draw on literature relating to policy transfer, hydrosocial studies, and critical development. We develop a framework for understanding how the content of modern water (as a policy ideal) travelled to and was embedded in Sri Lanka via a complex network of actors and transfer processes operating within international development circuits. This framework helps to illustrate the conduits through which modern water travelled globally, as well as the embeddedness of modern water in places such as Sri Lanka.

Contributing these insights in relation to the MDP, we divide our analysis into three sections. In the first section, we examine the processes behind its formation and design, which was heavily inspired by the U.S. Tennessee Valley Authority. We argue that the spread of the TVA model was facilitated by the conceptual embedding of the modern water paradigm (Linton, 2010; Linton & Budds, 2014; Schmidt, 2017), its geo-political transmission through the international development industry, and its materialization in large-scale engineered solutions. Next, we focus on the MDP's implementation, showing that it not only reflects but reproduces modern water by reshaping landscapes, establishing infrastructure, and instituting governance frameworks. Finally, we explore how the MDP's entrenched infrastructure and governance frameworks continue to generate a lasting influence on subsequent water management initiatives, limiting current policy options and constraining Sri Lanka's hydrosocial landscape.

2. Modern water as a travelling ideal

To make sense of the complex history and enduring impact of the MDP, we draw on two interconnected bodies of literature: approaches to policy transfer and mobility with a particular focus on water, and conceptualizations of modern water as a global hegemonic paradigm. These frameworks are crucial for understanding how the international development industry facilitated the transfer of large-scale water management models and how these models became embedded in local governance structures.

2.1. Travelling water policy ideas, ideals, and templates

Contemporary policy-making processes frequently extend beyond jurisdictional boundaries, both 'horizontally' (between national and local political entities) and 'vertically' (between hierarchically scaled institutions and domains) (Dolowitz & Marsh, 2012). Work to understand the travel of policies has included two main approaches: *policy transfer*, which focuses on how policy ideas and practices are adopted and adapted across different contexts, aiming to enhance policy learning and implementation, and *policy mobility*, which examines how policies evolve, mutate, and take on new forms as they move through different socio-spatial contexts (Haupt, 2023). Here we identify four key theoretical tenets of these approaches: (1) policy transfer processes, (2) outcome-oriented policy content, (3) the role of key actors, and (4) contextuality/embeddedness. We identify these four themes because they elucidate the evolution of the MDP as a long-running mega water project, adding nuance to the history of international development networks.

First, policy transfer approaches have focused on policy optimization processes, which help effective policies diffuse (first and fastest) across

jurisdictional spaces. Typically applied at the international level, policy transfer explains how and why certain water policies proliferate across countries with factors such as timing, geographic proximity, and biophysical conditions playing key roles (Malano et al., 1999; Michaels & de Loë, 2010). The emphasis is often placed on identifying 'effective' policy designs that are generic enough to be transferable across different contexts, while minimizing the importance of features specific to time and place (Benson & Jordan, 2011). Policy transfer approaches reflect a rationalist approach to policymaking, assuming that the 'ideal' policy can be constructed from objective analyses of past successes and failures, and then implemented in diverse jurisdictions with small contextual modifications (Borrelli et al., 2021; Irfan et al., 2021). We demonstrate in our analysis that the political and institutional conduits that enable such rationalist transfer processes have origins in the emergence of international development networks of expertise, and their influence on water-related development projects.

In contrast, policy mobility approaches emphasize the path-dependent movement of policies, which are deeply embedded in networks of institutions, politics, discourses, and power relations (Cochrane & Ward, 2012; Radaelli, 2000). Often applied at the city or subnational level, policy mobility focuses on how policies are reshaped and adapted as they travel through urban and local governance contexts (Haupt, 2023). These movements are influenced by a range of 'invisible' forces, including social practices, power dynamics, and institutional structures, which guide the transformation of policies as they are reinterpreted across different spaces (Mollinga, 2014). Policies are thus understood as "the outcome of overlapping and interconnecting sets of social, political, and economic relations stretching across space" (Cochrane & Ward, 2012, p. 7). They are simultaneously 'fixed and mobile,' travelling through relational and territorial pathways (Cochrane & Ward, 2012, p. 7). We build on this perspective by addressing how specific water knowledges and management ideals, shaped by historical and path-dependent factors, consolidate dominant and mobile frameworks for implementing water projects through international development networks.

Second, policy transfer and policy mobility approaches differ in their emphasis on policy content. Policy transfer focuses on outcome-oriented development, aiming to replicate policies proven effective in other contexts, such as specific water technologies, blueprints, or management algorithms (Ashby & Falgout, 1996; Hwang et al., 2014; Pereira et al., 2002). In contrast, scholars applying a policy mobility lens emphasize the discursive foundations of policy development and implementation. In the water sector, for instance, governance approaches are viewed as collections of principles, ideals, and discourses that circulate across jurisdictions but adapt to local contexts (Perera, 2012). While addressing both global and local challenges, policy mobility focuses more on how ideas evolve and are reinterpreted as they move between contexts, rather than replicating established solutions (Haupt, 2023). These flows of ideas may manifest in practical approaches – such as the World Bank's promotion of water privatization policies globally (Goldman, 2007) – but the emphasis remains on the politics of idea circulation and the relationships among actors in policy networks. Our analysis highlights the significance of geopolitical relationships and histories in enabling modernist water ideals to flow across borders and shape hydrosocial landscapes across generations, not just within a single policy cycle.

A third focus is the significance of actors in policy travel. While policy transfer studies often emphasize the roles of rational actors (such as expert policymakers), policy mobility approaches place key actors within institutional and path-dependent contexts, highlighting how various forces shape and constrain policy movement. Policy mobility explores how policy actors, both individually and in coalitions, engage in an argumentative struggle to reshape and reinterpret policy meanings as they move across contexts, including the subtle reworking of ideas often described as 'policy translation' (Mukhtarov, 2013). Mukhtarov (2014) also notes the inclusion of non-expert actors and unorganized citizens in this process, recognizing their role in shaping the travel of

¹ Hydrosocial relations are those through "which water and society make and remake each other over space and time" (Linton & Budds, 2014, p. 170).

ideas. While our analysis largely focuses on those in powerful decision-making roles, it also highlights the significance of citizen contestation in influencing water policies and plans.

Finally, policy mobility literature highlights contextuality and *embeddedness*. Critical studies have focused on how seemingly abstractable, static, or objective ideas are embedded in a complex world of discourses, social norms, power-relations, and institutional pathways. Because of this embeddedness, policies arrive in places not as replicas of policies from elsewhere but as policies-in-transformation (Peck & Theodore, 2010; Yates & Harris, 2018). Indeed:

A policy ‘model’ ... can only exist as a model once it has enrolled an ‘audience’ of interlocutors and would-be emulators; this field of reception itself represents ... an active zone of adaptation and transformation, not to say joint constitution (Theodore & Peck, 2012, p. 23).

Policies and their practical applications are therefore always contextual, as there are particular social, discursive, and political processes that influence their constitution, travel, and implementation. In our analysis we draw on this framework to explain the geographically contingent (but not biophysically constrained) ways in which mega water projects evolve in-place. In particular, we contribute to the literature on policy mobility (which has largely focused on the present moment²) by highlighting the importance of historical continuities, genealogies, and institutional legacies that inform current approaches (Almandoz, 1999; Vidyarthi, 2010).

2.2. Modern water: A hegemonic concept for (mega-) development

Modern water refers to a particular mode of knowing and representing water that currently dominates the modern hydrological discourse. This concept is underpinned by modernist assumptions, such as society-nature dualisms and the vision of nature as divisible and manageable (Liao & Schmidt, 2023). It abstracts water from the social, historical, and local conditions in which it exists, reducing it to a singular, common, and abstract identity represented simplistically as ‘H₂O’. This reduction allows water to be depicted as merely circulating within the hydrologic cycle, a depiction that removes its complex variability and ties to specific locales (Linton, 2014). From an ontological perspective, modern water reconceives water as a discrete, manageable resource, separate from its ecological and cultural contexts, making it suitable for scientific manipulation and control (Flaminio, 2021; Götz & Middleton, 2020; Yates et al., 2017). Epistemologically, it promotes a knowledge system that elevates technical measurement and management over indigenous or traditional water understandings, supporting the development of hydrological expertise grounded in universal scientific principles rather than localized knowledge (Linton, 2014).

This knowledge system is also *material* – manifesting through the deployment of hydraulic infrastructure and technologies that embody and reinforce principles of modern water. As Pfaffenberger (1988, 1992) argues, water infrastructures like dams and canals are not neutral tools; they carry embedded social scripts that reflect the choices of dominant social groups. These choices become solidified in physical artefacts, which come to represent specific power relations and governance frameworks (Millington, 2018; Mollinga & Veldwisch, 2016). Infrastructures embody the political and social ideologies of their creators, shaping not only the physical landscape but also the governance of water resources. At the same time, infrastructures possess a temporal fragility – constantly subject to decay, maintenance, and repair – that reflects the precariousness of the socio-political configurations they support (Barnes, 2017; Gupta, 2021; Ramakrishnan et al., 2021). This ongoing need for maintenance underlines how infrastructure, while appearing

stable, must be continually upheld, both physically and politically, to sustain its influence.

Relatedly, Shah and Boelens (2021) highlight how hydraulic infrastructure is imbued with a moral dimension that frames certain modes of water control as inherently just or necessary. Through what they term the ‘moralization of hydraulics’, hydraulic technologies reinforce the normative ideals of water management, presenting large-scale infrastructure like dams as not just technical solutions, but as morally justified interventions. These infrastructures naturalize the dominance of certain groups’ interests while diminishing the legitimacy of alternative, often indigenous, water management systems. This moralization works to entrench modern water’s technocratic principles, embedding its logic in both physical infrastructure and governance.

The integration of modern water with material infrastructure thus highlights its dual power: not only discursively through policies and institutions but also materially, as these technologies become inscribed with political meanings (Menga & Swyngedouw, 2018; Swyngedouw, 2015). As these infrastructures become embedded in different geographies, they serve not only as mechanisms of water control but also as carriers of the socio-political ideas that shaped their creation (Hommes et al., 2022; Millington, 2021). Hydraulic technologies such as dams, levees, and irrigation systems act as material conduits for modern water’s principles, spreading its logic of abstraction and control across diverse contexts (Crow-Miller et al., 2017). By reshaping landscapes to fit standardized models, these infrastructures diminish the local variability of water systems, enforcing a technocratic worldview that marginalizes indigenous and ecological knowledge (Jackson & Head, 2020; Laborde & Jackson, 2022).

Linton (2010) has traced how modern water, as a concept, emerged in industrialized countries before internationalizing in three particular ways.³ First, epistemological internationalization occurred through global institutions and professional associations, such as the International Association of Scientific Hydrology and International Union of Geodesy and Geophysics (Dooge, 1999; Linton, 2010). Second, modern water became discursively embedded through hydro-nationalism, as reshaping rivers became a symbol of national strength and economic development. Hydro-nationalism both fueled and was shaped by modern water, as countries like the United States (Worster, 1992), Spain (Swyngedouw, 1999, 2015), the Soviet Union (Duke, 2006), Canada (Desbiens, 2004), China (Pietz, 2002), Tajikistan (Menga, 2015), and Germany (Blackbourn, 2007) pursued large-scale projects that embedded modern water into their hydraulic landscapes. Third, the post-World War II international development industry provided the practical basis and institutional networks through which modern water infiltrated water projects across the globe. American hydrological models in particular – along with their hydrologic and engineering expertise – were disseminated through international development networks in the twentieth century (Ekbladh, 2002; Khagram, 2004; Scott, 1998, 2009; Woodhouse & Muller, 2017). The Tennessee Valley Authority (TVA) model has been particularly implicated as an American template that flowed through development networks to re-shape hydrologic landscapes in diverse contexts (Ekbladh, 2002; Scott, 2009). A

² Presenting ‘fast policy’ as a product of intensified global connections; see Craggs and Neate (2017); Harris and Moore (2013); Jacobs and Lees (2013).

³ While Linton focuses on the post-World War I internationalization of modern water expertise, we acknowledge that in Sri Lanka, modern water’s roots are tied to colonial histories. Critical geographers have shown that British colonizers throughout South Asia sought to control water flows through embankments, canals, and dams, culminating in TVA-inspired Multi-purpose River Valley projects (D’Souza, 2006a; Ramesh, 2021). Although these studies do not explicitly frame their analyses through modern water, they reveal how colonial water expertise, such as ‘irrigation sciences’ (D’Souza, 2006b; Ranjan, 2024; Tozzi et al., 2022), reduced water to a technical matter, aligning with Linton’s concept. Thus, while a detailed historiography of modern water in Sri Lanka pre-MDP is beyond our scope, it’s clear that its foundations were laid long before the TVA and MDP.

growing body of literature has demonstrated the impact of these processes in their analyses of contemporary mega water projects (Ahlers et al., 2014; Fernside, 2017; Hausermann, 2018; Hommes & Boelens, 2018; Huber & Joshi, 2015; Mehta, 2013; Quealy & Paranage, 2024).

However, it is necessary to recognize that not all water systems have been fully subsumed by this framework. As Schmidt (2017) argues, despite modern water's dominance, certain forms of water and traditional relationships to it remain outside direct modernist control. These alternative water management systems persist, though they must now adapt to the technocratic frameworks established by state-driven hydraulic projects. Similarly, Scott's (1998) notion of *metis* – local, practical knowledge that remains illegible to centralized authority – provides valuable insight into how such systems continue to function, even as their autonomy has been curtailed. Rather than being erased, these traditional practices are reshaped and redefined within the overarching logic of state-led hydrological management, allowing them to coexist within the constraints of the modern water paradigm.

Building on studies that examine the co-constitutive relationship between modern water and modernist development, our research demonstrates how these relationships materialized within the MDP framework. We trace the policy pathways behind the MDP's creation and illustrate how modern water's principles resonated with U.S. hydro-technological expertise, the growing international development industry, and Sri Lanka's state-building agendas. Our analysis shows how the MDP, underpinned by modern water, became a template for infrastructure development, reshaping Sri Lanka's hydrological landscape and marginalizing pre-existing water management systems. While traditional systems persist, they now operate within the MDP's modernist framework, adapting to (and co-evolving with) the overarching logic of modern water. Finally, we explore how the MDP, as a tangible embodiment of modern water, continues to limit the exploration of alternative water management strategies and the revitalization of traditional practices.

3. The MDP in context

3.1. Sri Lanka's historic hydrosocial context and the impact of the MDP

Sri Lanka is typically divided into three climatic zones (Fig. 1) based on average annual rainfall: the 'wet zone', the 'intermediate zone', and the 'dry zone'. The dry zone – constituting about 75 percent of the island – is the agricultural heartland of Sri Lanka and has spawned many irrigation-centred hydraulic societies.

Given the scarcity of water in the dry zone, ancient Sri Lankans constructed over 20,000 village tanks fed by the rivers throughout the island (Dharmasena, 1994). These tank systems were central to life in the north-central part of the island, with their expansion continuing until British colonization (1769–1948) (Abeywardana et al., 2019; de Silva, 2022). Informed by Enlightenment principles of resource management, British colonists renovated some village tanks while demolishing others, attempting to reorganize and re-link the tanks according to scientific water management practices (Abeywardana et al., 2018; Kekulandala et al., 2021).⁴ An administrative body, now known as the Irrigation Department, was established to manage large and medium-scale tanks and their associated irrigation systems, while another entity called the Department of Agrarian Services was created to administer smaller irrigation systems. These administrative bodies also

⁴ For example, British colonists introduced structured designs such as replacing traditional sluices with modern stone or concrete structures and constructing new canals to regulate water flow more efficiently. These changes were part of a broader effort to standardize water management, exemplified by the restoration of large tanks like Kala Wewa and Yodha Ela, which were upgraded with durable materials and redesigned for greater storage capacity and control.

initiated training programs, sending local farmers abroad to receive training in scientific water management and agricultural practices.

After gaining independence from the British, the MDP was Sri Lanka's first systematic attempt to reorganize the dry zone's waterscape (Wickramasekera, 1985; Zubair, 2005). The project, executed over a 50-year period, involved constructing 11 reservoir-complexes along the Mahaweli River (see Fig. 1) to divert water through various channels. This water is then channelled through a network of canals to large storage tanks. The surrounding area, known as an Irrigation System, can be irrigated using this stored water. The MDP encompasses 13 major irrigation systems, named alphabetically from A to M. Water from the large tanks is distributed to smaller tanks within these systems, termed Irrigation Blocks, before being directed to individual irrigation plots owned conditionally by farming families, who are the end users.

3.2. Researching the MDP

This analysis builds on qualitative research conducted between 2017 and 2021, drawing from three primary sources: (1) a review of archival and grey literature on the MDP's design, (2) in-depth semi-structured interviews with current and retired MDP officers, and (3) grounded fieldwork in System H.

To understand the MDP's design and evolution, we focused on key archival materials, particularly the Mahaweli Master Plan, the blueprint for irrigation and hydropower development. Supplementary documents, including Mission Reports, Needs Assessments, Program Budgets, Implementation Strategies, and Feasibility Reports from international organizations, provided additional insight into the MDP's design and implementation. Minutes from World Bank and Aid Group Ceylon meetings, along with correspondence between international organizations and the Sri Lankan government, further illuminated the transfer of funds, technology, and expertise.

We conducted 20 key informant interviews with current and former MDP officers, resident project managers, civil servants, and specialist support officers. These interviews revealed critical insights into the negotiations with international consultants during the 1978 IBRD mission and highlighted the political dynamics driving the policy transfer processes that shaped the MDP. The interviews also provided a high-level overview of the project's implementation, underscoring the influence of the modern water paradigm.

Fieldwork was conducted in System H, the first fully developed irrigation system under the MDP (1974–1980). This included 25 semi-structured interviews with farmers, along with informal discussions and transect walks, offering insights into the operational realities of irrigation and water governance. Special attention was given to first-generation farmers resettled under the MDP, contrasting pre-MDP life in the dry zone with the transformations imposed by the hydraulic grid. These interviews, conducted in *Sinhalese*, were recorded, transcribed, translated into English, and thematically coded for analysis.

4. The MDP and the embedding of a modernizing water-development framework in Sri Lanka

4.1. Designing the MDP: Planning modern water

Following independence from Britain in 1948, the government of Sri Lanka (then Ceylon) sought to re-develop the country's dry zone; repopulating it with people and re-vitalizing its irrigation-based agricultural heritage (Bandarage, 2023; Paranage & Yang, 2020; Shanmugaratnam, 1985). To that end, the government requested technical assistance from the United Nations Development Program (UNDP) and the Food and Agricultural Organization (FAO) to survey the dry zone with hopes of identifying development potentialities. The government also requested the involvement of the International Bank for Reconstruction and Development (IBRD), and the International Monetary Fund (IMF) – as a result of which the president of the IBRD pledged in

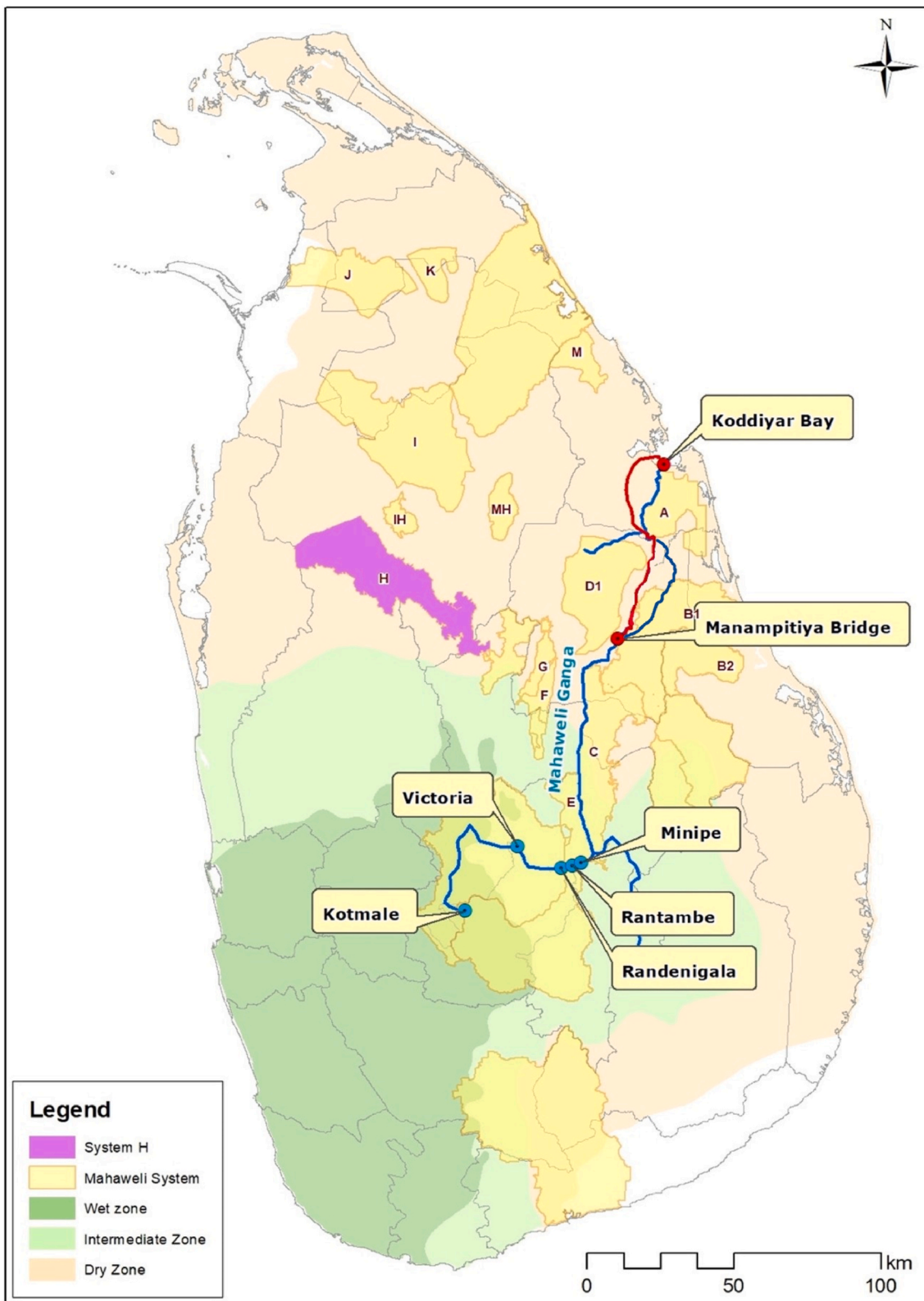


Fig. 1. Locating the MDP's reservoir-complexes and agricultural systems within Sri Lanka's climate zones. The blue line represents the Mahaweli river, while the red line represents how its original trajectory was diverted to facilitate farming. (For interpretation of the references to colour in this figure legend, the reader is referred to the Web version of this article.)

1953 to "... follow with interest any action taken [by the Sri Lankan government], and to discuss how the Bank can best help in the future development of Ceylon ..." (IBRD, 1953, p. vii). The IBRD and the IMF then jointly established a standing committee in Sri Lanka called the 'Aid Ceylon Group' to increase the flow of foreign aid to the country.

In 1963, a combined task force of experts from the UNDP and FAO first undertook a study to determine the feasibility for a large-scale hydraulic development project (the MDP). Their work was carried out at the peak of the "big dam regime of development" during the 1950s–1960s (Khagram, 2004, p. 33; Mehta, 2013).⁵ Bolstered by the locally perceived successes of the Gal Oya Project⁶ in the early 1950s (Uphoff, 1982; Wickramasekera, 1985) and the widespread adoption of 'Multi-Purpose River Valley Development' projects during the Nehruvian post-independence period in neighbouring India (D'Souza, 2006a; Khagram, 2004), the task force set about attempting to design a large TVA-style irrigation and hydropower project in Sri Lanka to make the country self-sufficient in both agriculture and hydroelectricity (Widger & Wickramasinghe, 2020). Comprised of engineers and hydrologists previously employed by the TVA,⁷ the UNDP/FAO task force completed their work within 3 years, drawing up a technical feasibility study, a 'master plan', and a cost-benefits analysis.

The IBRD and IMF, while broadly agreeing with the UNDP/FAO's recommendation for a TVA-style project in Sri Lanka, deployed their own expert mission (the Crofts-Weizmann mission) in 1968 to verify these findings. This mission, in turn, enlisted the Netherlands Engineering Consultants (NEDECO), a firm with close ties to both TVA planners and the IBRD/IMF, to draft a comprehensive implementation strategy. Thus, while the government of Sri Lanka had initially commissioned these studies, the network of influential actors quickly evolved to advocate a TVA-style model as the most appropriate and efficient response to Sri Lanka's irrigation and development needs. Modelling the MDP on the TVA-design was justified by all international organizations involved and by local experts:

The TVA-model would guarantee measurable results, and was easy to design, implement, and monitor. Adopting the TVA-model also meant the installation of the latest and best water infrastructure, backed by the first-class expertise of United States' engineers (interview, Resident Project Officer, 2018)

This description suggests two reasons for the adoption of the TVA-design in Sri Lanka. First, the TVA design, which abstracted irrigation systems and promised results independent of context, was predicated upon the ontology of modern water. This ontology treats water as an abstract, monological, and quantifiable resource, detached from socio-ecological relations and positioned as an "object of calculation ... subject to a particular kind of accounting or manipulation" (Linton, 2010, p. 199). This abstraction is evident in the MDP's Master Plan, which made use of limited datasets by extrapolating from existing records.

For example, the Master Plan incorporated crop water requirement (CWR) estimates from studies conducted in Arizona and Texas. Although this reflects a common practice of utilizing international data to fill local data gaps,⁸ it underscores the broader theme of importing hydrological

⁵ Inspired by the success of the TVA project in the US, the big dam regime of development was exported globally as a model of Western modernization under Truman's 'Point Four' program, which was inaugurated in 1949 (Ekbladh, 2002, 2010).

⁶ Sri Lanka's 'Gal Oya' development project was the country's first pilot of TVA-style management at a relatively small scale. It was dubbed 'Ceylon's Little TVA' by MacFadden (1954).

⁷ The TVA has been highlighted in critical analyses of modernist land and water management previously, including international development. See, for example (Mitchell, 2002; Scott, 2009).

⁸ The FAO guidelines recognize the variability of CWR across different agro-ecological zones, providing a basis for applying CWR values from one region to comparable zones elsewhere.

methodologies under the guise of standardization. While such adaptations were typical and aligned with recognized hydrological frameworks, the transfer of methodologies also subtly facilitated the embedding of a certain hydrological paradigm, rather than being solely focused on data adequacy.

Second, the TVA model was made practically replicable due to advances and flows of knowledge relating to state-of-the-art water infrastructure. Hydrosocial scholars have explored how the discourse of modern water is tied to technical expertise and high-level water infrastructure such as 'multipurpose' dams (Linton, 2014; Schmidt, 2017). We see the connection clearly through the MDP – in this case, US-backed infrastructure⁹ underpinned the material manifestation of modern water within the Sri Lankan context (see Fig. 2). The TVA was therefore both a product of modern water (in being an abstract, quantifiable model for managing water as a resource), and a (re)producer of modern water across contexts – establishing infrastructures that manifested and perpetuated the Modern Water paradigm.

While the MDP was presented as a de-politicized solution to Sri Lanka's irrigation and development 'problems,' there was widespread criticism that its technical feasibility masked intricate politically contested objectives.¹⁰ A Sri Lankan civil servant, liaising with the actors of the international development sector delivered a critique of the political process:

There is an amazing misconception about the nature of the decisions to implement the master plan. Some persons at the highest political, technical, and administrative levels seem to think that if the technical feasibility of the constructing structures such as dams is established, that it is adequate. This is nonsense: while it might be technically possible to build a dam 100 feet high, one should not undertake it if one does not know if it would be worthwhile doing so (Iriyagolle, 1978, p. 8).

The civil servant critic, along with most MDP-engaged interviewees, argued that funding for the MDP was approved primarily for its technical feasibility, with less attention given to its benefits for Sri Lanka's ecology, economy, and society. Our interviewees argued that for international development actors, particularly the IBRD and IMF, the MDP was an opportunity to export U.S. technologies and consultancy services to Sri Lanka via the TVA-style design (since the IBRD only funded the technologies, expertise, and services that were imported from the U.S., see (Tandler, 1975)). For the critical Sri Lankan civil servant, this only served to reproduce geo-political relations of dependency:

We must question the wisdom of committing the economy to such undertakings, especially if they are pressed upon us by 'project selling' foreign interests or national influence peddlers motivated by

⁹ The implementation of the MDP's technical headworks relied heavily on U.S.-based hydro-technological expertise. For example, the Sri Lankan government established the Central Engineering Consultancy Bureau (CECB) in 1973, and many of its engineers received training in the U.S. These engineers were instrumental in the MDP's execution, and the CECB continues to maintain connections with U.S. institutions, thriving as one of Sri Lanka's largest water infrastructure consultancy firms. Additionally, NEDECO, which had strong ties to TVA engineers, was handpicked by the IBRD to draft the strategic implementation schedule for the MDP. Furthermore, while some dams were constructed by UK and German firms, such as Balfour Beatty, Edmund Nuttall, and Costain Group, many of the engineers in these firms were connected to U.S. expertise, having worked closely with American experts during the post-WWII reconstruction effort, which influenced their approach to large-scale infrastructure projects.

¹⁰ Critical development scholars have highlighted the de-politicizing processes through which the identification of development 'problems' is linked to the availability of specific technical 'solutions.' This process reduces perceived development issues to technical problems that can only be solved by the right type of expertise, consequently masking the space for political contestation (see Ferguson, 1994; Li, 2007; Mosse, 2005).



Fig. 2. Examples of the material infrastructure created by the MDP. Top left: A water distribution canal (photographed by the Authors); Top right: The Victoria reservoir. Bottom: The Moragahakanda reservoir – the last major reservoir of the MDP to be completed (Lanka Business Online, 2018).

money or partisan politics. The Mahaweli Project will not become better because a lending institution is prepared to make us its debtors ... International financial institutions also has a duty to *not* help the government of a less developed country along a path to suicide (Iriyagolle, 1978, p. 12)).

The design of the MDP was therefore also reflective of emerging geopolitical relations (including dependency) tied to contemporary international development networks. It draws attention to the perceived objectivity attributed to the processes/contents of policy transfer by international development organizations, while illuminating the de-facto hidden politics that characterize the process/content of such transfers.

This section examined how the MDP was modeled on the TVA, influenced by three interrelated techno-political factors: (1) the perceived depoliticization of the TVA model through its association with modern water, (2) a network of development actors willing to fund the model, and (3) U.S.-backed hydro-technological expertise capable of implementing it in Sri Lanka. Through our analysis, we traced the political and institutional pathways that enabled these ideas to take hold and demonstrated how the modern water discourse provided the conceptual foundation for the global spread of ‘development-as-modernity’ via water-related projects like the MDP.

4.2. Implementing the MDP: Building modern water

While the MDP was first conceptualized in 1963, it was not until 1977 that it captured widespread interest, both in the political and

public realms. In 1977, the reigning Sri Lanka Freedom Party (SLFP) was defeated by its successor, the United National Party (UNP) in a landslide election. Under the new UNP government, the MDP evolved to be the centrepiece of Sri Lanka’s development agenda with its projected goals of achieving agricultural transformation and hydroelectric self-sufficiency (Shanmugaratnam, 1984; Zubair, 2005). Given the importance placed on the MDP as the flagship of the new government’s mandate, the incumbent UNP leadership sought to implement the MDP before the next general election. This meant shortening the project’s original implementation timeline from 30-years down to just 5-years.

Having made this decision, the Sri Lankan government decided to present the completed feasibility report and action plan for the MDP to a number of donor countries in an attempt to secure bi-lateral aid. The government’s strategy was to secure funding from separate donors for each of the 11 high-level reservoir-complexes and accompanying irrigation systems. For example, one multipurpose complex (completed in 1985) was funded by aid granted by the United Kingdom, while another one (completed in 1986) was funded by the government of Germany. To illustrate the rapid financing of the MDP, we refer to the minutes of a 1978 meeting between the World Bank and the Aid Ceylon Group, which state:

The chairman said that the Bank had found itself in a curious position vis-à-vis the government of Sri Lanka. In December the Bank had seen itself as leading the pack, with a little flag, saying “follow us, from here on it is uphill all the way.” Instead, it was outrun by the pack. When he visited Sri Lanka in March, he had found that bilateral

donors had already engaged in substantial and serious negotiations with the government, which the Bank had to run extra fast to catch up with. (Aid Group Ceylon, 1978, p. 10).

Bolstered by development aid, the MDP was implemented rapidly between 1978 and 1995, completely transforming Sri Lanka's water-scape.¹¹ The MDP significantly overhauled Sri Lanka's water infrastructure (demolishing many of the country's historical small tanks in the process) to facilitate water distribution via gravitational pull. However, this simplification of the terrain was not merely a technical necessity for building modern water systems; it reflected a deliberate shift in governance and control over water resources. By erasing small, decentralized tanks – long managed by local communities – the MDP replaced a network of adaptive, place-based water management systems with a uniform, centralized infrastructure that aligned with the technocratic ideals of modern water. In the words of a water engineer who previously worked with the MDP:

The first activity is to identify the area which can be commanded by gravity from the reservoir. Then, the engineers use a predetermined canal-layout as the guide to demarcate the maximum land area that can be commanded by gravity from the water source. Canal traces are laid along straight lines and are connected together using transitional bends. After this, local landscape features such as forest patches in irrigable areas are cleared, and obstructions across the natural stream paths such as small village tanks are demolished in order to make the land clean and to spread water uniformly (interview, Water Engineer, 2018).

The MDP's process of demolition and remodeling significantly altered Sri Lanka's water infrastructure and local water management practices. Historically, Sri Lankan village tanks were interconnected in a cascade system, allowing excess water to flow from upstream reservoirs to downstream ones. This system facilitated water filtration and recycling, prioritizing conservation by managing demand according to available water supply in an environmentally sustainable manner (Geekiyana & Pushpakumara, 2013; Panabokke, 2009). In contrast, the MDP introduced a centralized approach to water control, much like the TVA model, which prioritized the engineering of large-scale infrastructure over local, adaptive practices. Such models abstracted water into a manageable and quantifiable resource, overlooking the broader relational and ecological roles water played in local communities (see Schmidt, 2017). This shift not only erased many existing village tanks but also supplanted traditional hydrosocial systems that had long supported sustainable water management and fostered communal cooperation (Paranage, 2018).

As Barnes (2017) observed in Egypt's irrigation infrastructure, large-scale state-led projects often diminish local control and disrupt the social practices tied to resource management. In the pre-MDP dry zone, for example, farmers engaged in cooperative water management practices, such as rotational night-watches to protect farms from wild elephants, highlighting how water governance was deeply embedded in community life. The MDP's introduction of a centralized, state-controlled water system therefore not only transformed physical infrastructure but also restructured the social organization around water, displacing local agency and traditional knowledge. The result was a loss of deeply rooted hydrosocial relations that had once harmonized resource management with community resilience and ecological adaptation.

This section demonstrated how a TVA-style hydraulic grid (when imposed) simplifies and 'modernizes' both local terrains and hydrosocial

worlds. The simplification demanded by modern water is not merely conceptual but operates through the very artefacts (dams, canals, and irrigation systems) that materialize its vision. As Shah and Boelens (2021) argue, these artefacts naturalize a particular way of governing water, framing it as a resource to be controlled and distributed according to a centralized logic. This shift is not only a policy or ideological move but also one deeply embedded in the physical transformation of the landscape, where technology enforces a particular socio-political order by altering how people interact with water. Therefore, modern water's abstraction is inscribed in the engineered solutions – such as canals that erase local terrains and small tanks – paving the way for technocratic management while erasing alternative systems of water governance that are intimately connected to the local environment and social organization.¹² The MDP's embedding of modernity also extends beyond water – for example, the MDP also introduced scientific agricultural management training programmes (Paranage, 2019), modern fertilizers (Paranage, 2020), and modern 'socially engineered' settlements to redistribute the dry zone's population and to instigate a new paradigm of modernist regional planning (Dissanayake et al., 2016). All of this demonstrates how the modern water paradigm was both conceptually and practically linked to modernity-through-development initiatives.

4.3. Completing the MDP: The legacy of modern water

While the MDP finished most of its implementation by 1995, its influence was far-reaching into the future. Being the largest development and water management project ever undertaken in Sri Lanka, the MDP continues to influence (and be influenced by) subsequent water related initiatives to a large degree (see Quealy & Paranage, 2024).

First, the delayed completion of the Moragahakanda reservoir in 2018 – one of the 11 major infrastructural projects envisioned under the MDP – illustrates how modern water not only persists through its ideological frameworks but also through the material extension and reconfiguration of infrastructure, embedding itself deeper into Sri Lanka's hydrosocial and political landscape. While funding for the Moragahakanda project was secured in the early 1980s through a bilateral aid agreement with Japan, its implementation did not begin in earnest until 2015. The final version of the Moragahakanda project deviated from its original plan in the MDP's Master Plan, not simply concluding the MDP's initial architecture but extending its infrastructural reach. This expansion created an opportunity to further entrench modern water's principles through a new project – the North Central Province (NCP) Canal. This canal, spanning 22 km and designed to channel water from the MDP's last reservoir to northern provinces, exemplifies how modern water operates through the extension of infrastructure. Funded by the Asian Development Bank (ADB) and set for completion in 2024, this project underscores the MDP's lasting impact, demonstrating how *modern water* continues to shape Sri Lanka's hydrosocial landscape through the persistent materialization of its principles.

Second, the MDP's infrastructure and outreach was further consolidated and extended by another combined water and development project funded by the World Bank called the *Dam Safety and Water Resources Planning Project* (DSWRPP). On the one hand, this project sought to renovate the MDP's ageing infrastructure as a result of the safety concerns raised by farmers living downstream of large tanks. On the other hand, the DSWRPP sought to update the original MDP Master Plan, and potentially integrate the MDP's infrastructure into a new national water use Master Plan by applying the best-practice models of contemporary Integrated Water Resources Management discourses. This

¹¹ The UNP government was unable to complete the MDP within 5 years as they originally intended. However, and in large part due to their strong progress with the MDP, the UNP government remained in power until 1994, winning two consecutive general elections.

¹² Additionally, our analysis of the sort of aqua-terraforming demanded by Modern-water based abstractions signals a qualified departure from (historical) studies arguing that biophysical similarities between contexts influences the kind of policy transfer and lesson-learning that is possible (Michaels & de Loë, 2010).

process of integration also involved the creation of a comprehensive hydrometeorological database that would collect and organize hydrological information pertaining to the entire island.

Third, the MDP was also shaped by global neoliberal and participatory water models (Boelens et al., 2019; Dukpa et al., 2019; Goldman, 2007). Influenced by these models, the Sri Lankan government launched the Mahaweli Restructuring and Rehabilitation Project (MRRB) in 1998, restructuring the MDP's water management into a river-basin agency with more participatory practices. The decision also came within the context of the recurrent expenditure on irrigation service delivery being too heavy (Manikkuwahandi et al., 2019), prompting the increased relegation of responsibilities (and thus cost) to farmers. The MRRB introduced the participatory concept of 'bulk water allocation' for pilot testing in Irrigation System H, providing farmers with a bulk quantity of water at the beginning of a cultivation season. While evaluation studies are ambivalent about the success of Bulk Water Management (Wong & Herath, 2014), the practice remains limited to initial pilot projects.

These examples reflect the ongoing influence of modern water and the MDP on many subsequent water projects in Sri Lanka, which have increasingly aligned with neoliberal development logics. Through the MDP, modern water is now firmly embedded in Sri Lanka's hydrological and political landscape, not just in terms of policy and planning, but within the very infrastructures and technological systems that govern water management. This invisible embedding of modern water within the MDP ensures that its legacy continues to dominate water management practices in Sri Lanka, even as alternative approaches, such as the revival of Tank Cascade Systems, seek to challenge it (Quealy & Yates, 2021).

5. Discussion

Previous work in development studies has established connections between modernist development ideals and large-scale water infrastructure projects. Our analysis of the MDP provides new spatio-temporal insights into this body of research by detailing the conceptual and empirical linkages between (1) the ontology and epistemology of modern water, (2) modernist development ideals, (3) the politics of hydro-technological knowledge, (4) the interests of the emerging development industry, and (5) the state-building aspirations of the Sri Lankan government. These connected elements reveal how specific content, actors, and processes enabled irrigation paradigms – such as the TVA model – to travel through policy networks and materialize in diverse settings.

The MDP illustrates how water governance models travel and become entrenched within particular contexts. A key component to the MDP's contextual materialization was the practical application of modern water's abstract notion that water is (inherently) a manageable and quantifiable resource. Modern water is an ontological framework that re-shapes hydrological landscapes in line with the notion that water is a quantifiable resource to be managed with engineered technical infrastructure. In the case of the MDP, however, modern water not only shaped the technical design of water infrastructure, it also influenced governance structures and local water management practices. Modern water therefore had a political-ontological impact beyond just the development of infrastructure. By normalizing modern water as an ontological framework, the MDP's influence extended beyond its initial implementation, as it continues to constrain contemporary water policy options and material water realities. This empirical evidence builds on the work of scholars like Linton (2010) and Schmidt (2017), demonstrating that modern water does more than inform policy – it actively restructures landscapes and governance systems with long-lasting consequences.

The case of the MDP provides further evidence that modern water and the international development industry were co-dependent in their far reaching impact. Modern water required development networks to travel as a concept and form of technical expertise to be implemented in

Sri Lanka. International development similarly required an abstract, universalizable framework such as modern water to facilitate investments, interventions, and mega projects. However, the MDP's material impacts – and their ongoing contest with alternative governance approaches, such as the traditional Tank Cascade System – highlight a political ontological dependency not yet fully explored in the literature on mega water projects. Modern water acts as an ontological framework, shaping infrastructure, regulatory, policy, and material environments in its own image, creating a path dependency that reinforces a modern water paradigm driven by globally circulating policy ideals within development networks. In Sri Lanka, the MDP's material implementation shifted paradigms, though perhaps not as initially intended. Even adopting alternative water governance would require engagement with this new legacy of mega water management entrenched by the MDP.

These findings demonstrate that policy transfer and mobility process are active in their material re-modelling of the world. While policy transfer literature tends to emphasize the replication of successful policies across jurisdictions, our findings demonstrate that complex negotiations and contextual transformations of ideas are simultaneously ontologically dependent and ontologically delimiting. Policy transfer literature has highlighted the contextual adaptation (and mutation) of policy frameworks, yet this work has mostly highlighted the social and political dynamics of adaptation and mutation. We demonstrate that, in the case of the MDP, policy mobility is not just the geographic movement of policy frameworks, but the geographic articulation and remaking of policy ideals. Modern water evolved as it became rooted in diverse socio-political environments of Sri Lanka. Consequently, modern water recirculates as a policy ideal on the basis of the MDP's implementation, giving modern water a new – albeit contested – lease of life in shaping water realities around the world.

Our findings therefore extend the literature on the materiality of modern water. Our analysis of the MDP provides further evidence of how hydraulic systems, such as dams and irrigation grids, materialize the conceptual logic of modern water. These infrastructures naturalize technocratic models of water governance, marginalize traditional or alternative systems, entrench governance paradigms amenable to global policy transfer while limiting alternative policy options, and reinforcing the global spread of modernist development frameworks (Shah & Boelens, 2021; Swyngedouw, 2015). Significantly, however, we demonstrate the political ontological limits of modern water in this context. The challenges and geographical adaptations now embodied in the MDP indicate a shift in the evidence base for modern water as a conceptual foundation for global policy transfer. Modern water may persist as an abstraction, but cases such as the MDP demonstrate its political-ontologically contingent materialization. Modernist development frameworks do not circulate in a vacuum, but through networks of expertise and influence that must now address (or at least acknowledge) the protracted and limited application of modern water as a normative framework for development.

6. Conclusion

Through a longitudinal analysis of Sri Lanka's MDP, this paper contributes new empirical and theoretical insights relevant to the co-constitution of mega water development and modern water. We draw attention to the entrenched influence of modern water within Sri Lanka's hydrosocial and political landscapes, using the case of MDP to demonstrate how large-scale water projects materialize and sustain hegemonic water-management paradigms. The MDP exemplifies the ways in which modern water operates not only as an abstract concept but as a tangible force that restructures both ecological landscapes and socio-political governance. Despite the project's original objectives, the outcomes underscore a complex legacy – one that integrates both the envisioned benefits of infrastructure development and the unintended dependencies on modernist frameworks.

Future research could expand on this analysis by examining the

resilience and adaptability of traditional water management systems, such as Sri Lanka's Tank Cascade Systems. Investigating their capacity to coalesce with, or even counterbalance, the modern water paradigm could yield valuable insights into alternative governance pathways. Comparative studies across regions that have implemented similar large-scale water infrastructure would also be beneficial. These could elucidate how local socio-political factors shape the evolution of imported water governance models and reveal unique regional adaptations or resistances to the modern water framework. Furthermore, longitudinal studies on policy transfer in water governance could deepen our understanding of how hydrological models are adapted and transformed over time within varied ecological contexts. Exploring the dynamics of how these frameworks are redefined in response to local needs and environmental feedback will be critical to fostering more sustainable and inclusive water management practices globally.

CRedit authorship contribution statement

Kavindra Paranage: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Conceptualization. **Julian S. Yates:** Writing – review & editing, Writing – original draft, Supervision, Conceptualization. **Harry M. Quealy:** Writing – review & editing, Writing – original draft, Conceptualization.

Declaration of competing interest

Declarations of interest: none.

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