Assembling modern water: The hydrosocial politics of water and development in the Mahaweli Development Project, Sri Lanka

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Abstract

This dissertation focuses on the Mahaweli Development Project (MDP) – an irrigation-centred Mega Water Project carried out between 1960 and 2010 in Sri Lanka. Implemented across 50-years, the MDP is the largest water-related project undertaken in the history of Sri Lanka, and it is one of the largest water-related development projects found globally. The project has involved constructing 12 reservoirs along the Mahaweli River (the drainage basin of which covers one fifth of the country's land area) to divert its waters along different channels for irrigation and hydropower purposes. In this dissertation, I offer the first comprehensive political-ecological account of the design, development, evolution, implementation, and consequences of the MDP. In doing so, I explore how the MDP's water policies, water-related regulations, water-control institutions, and water infrastructure are shaped by multi-scalar politics, power relations, discourses, knowledge paradigms, and epistemologies.

The dissertation unpacks how techno-political actors, discourses, and institutions interact over time in the evolution of water governance in the form of the MDP; what kind of knowledge systems are mobilized and reproduced within the MDP; and, what kind of hydrosocial landscapes are produced by the MDP, why, and with what characteristics (in terms of social organisation, ownership, distribution, and access to natural resources). Exploring these themes, the dissertation is informed by hydrosocial perspectives on water. Drawing on historical records and reports, interviews with government officials, project managers, and farmers, and focus groups with farmers working in different irrigation sub-systems, the dissertation and explores the different vantage points, knowledges, and contested understanding of water management entailed in the MDP. The water policies, regulations, institutions, and infrastructure found in the MDP are a product of these assemblages, contestations, and politics.

In unpacking these issues, the dissertation contributes to contemporary discussions at the intersection of critical development studies (particularly focusing on the role and contested nature of mega water projects), policy transfer/mobility, and water governance. The dissertation demonstrates how (often-abstract) international water knowledge and expertise circulated the globe – as part of a newly emerging international development discourse and knowledge network – to be implemented in the MDP as a 'Modern water' project. Yet water was also understood in the specific political and geographic climate of 1960s Sri Lanka at the time the of MDP design and subsequently in implementation. While particular ideas and

abstractions about water circulated the globe through multi-national networks, these ideas came to root and were implemented recursively and relationally (intersecting with water perspectives of local residents and farmers, for example) in the specific geo-political climate of Sri Lanka. The dissertation therefore also examines the post-implementation outcomes of the MDP in such contexts, including the contemporary realities faced by farmers and other water users, uncovering the complex and often unintended outcomes generated by the project. The MDP therefore represents a hydrosocial assemblage of global and local epistemologies and water realities, a close examination of which yields contributions to the literature on water governance, development, and policy transfer.

Declaration

This thesis is an original work of my research and contains no material which has been accepted for the award of any other degree or diploma at any university or equivalent institution and that, to the best of my knowledge and belief, this thesis contains no material previously published or written by another person, except where due reference is made in the text of the thesis.

Publications during enrolment

While the following publications emerged from the work presented in this dissertation, none have been reproduced *verbatim* here:

1. Paranage, K. (2019). The Mahaweli Development Project and the ‘rendering technical’ of agrarian development in Sri Lanka. *Heliyon*, *5*(6), e01811.
2. Paranage, K. (2018). Constructing the ‘legalities’ of encroachments in dam, canal, and stream reservations in the north-central province of Sri Lanka. *Development Studies Research*, *5*(1), 59-68.
3. Paranage, K. (2018). Understanding the relationship between water infrastructure and socio-political configurations: a case study from Sri Lanka. *Water*, *10*(10), 1402.
4. Paranage, K. (2018). The consequences of restricting rights to land: understanding the impact of state-land tenure policies in Sri Lanka. *Sustainability: Science, Practice and Policy*, *14*(1), 46-54.

List of Contents

List of Figures

List of Tables

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CHAPTER 1

Introduction

1.1 The Mahaweli Development Project

This dissertation is centred on the *Mahaweli Development Project* (MDP): the largest multipurpose national development programme in the history of Sri Lanka, and one of the largest water-related development projects found anywhere in the world (see Figure 1.1.). The project constructed 12 reservoirs along the Mahaweli River (the longest river in Sri Lanka at 335 kilometres, with its drainage basin covering one-fifth of the country's total land area) to divert its waters along different channels. The diverted waters are used in two ways: (1) to irrigate new areas in the country and (2) to generate hydroelectricity via the construction of turbines and power-generation plants.

Figure 1.1. [Top] an aerial photograph of the Victoria reservoir – one of the 12 main reservoir complexes constructed under the MDP. [Bottom left] a computer-generated map outlining the altered trajectory of the Mahaweli River under the MDP, with some of the key reservoir complexes outlined in coloured dots. [Bottom right] an aerial photograph of the Mahaweli River (Ministry of Mahaweli Development & Environment, 2001)

The construction of the 12 key reservoirs – 8 devoted to irrigation and 4 devoted to hydropower generation – was scheduled to be carried out in 3 main phases, with each phase containing 3 sub-projects (see Table 1.1.).

Table 1-1. Outline of the MDP's implementation phases and the key reservoirs to be constructed

Implementation Phases	Main Focus	Territory benefitted and/or amount of power generated	Reservoir(s) constructed
Phase 1 – Project 1	Irrigation	Irrigation systems D, G and H (total irrigable area of 186,700 acres benefitted)	Polgolla reservoir
Phase 1 – Project 2	Irrigation and Hydro-power generation	Irrigation systems C and E (87,400 acres benefitted) / 120 Megawatts in 4 power plants.	Victoria reservoir
Phase 1 – Project 3	Irrigation	Irrigation systems H, I and J (54,200 acres benefitted)	Moragahakanda reservoir
Phase 2 – Project 1	Irrigation (mainly)	Irrigation system B (124,900 acres benefitted)	Maduru Oya reservoir
Phase 2 – Project 2	Irrigation (mainly)	Irrigation systems B and C (114,000 acres benefitted)	Taldena reservoir
Phase 2 – Project 3	Irrigation (mainly)	Irrigation system A (98,000 acres benefitted)	Kandakadu reservoir
Phase 3 – Project 1	Hydro-power generation (mainly)	120 Megawatts in 4 power plants.	Kotmale reservoir Kaluganga reservoir
Phase 3 – Project 2	Hydro-power generation (mainly)	120 Megawatts in 4 power plants.	Randenigala reservoir Rotalawela reservoir
Phase 3 – Project 3	Hydro-power generation (mainly)	120 Megawatts in 4 power plants.	Rantambe reservoir Malwathu Oya reservoir

In this dissertation, I offer arguably the first comprehensive political-ecological account of the design, development, evolution, implementation, and consequences of the MDP. Through asking the overarching question: *How, why and with what effects did the MDP evolve as a mega water project?* I explore how the project's water policies, water-related regulations, water-control institutions, and water infrastructures are shaped by multi-scalar politics, power relations, discourses, knowledge paradigms, and epistemologies.

As I shall also demonstrate later in this chapter, a political ecological framework helps us understand the complex post-implementation outcomes of the MDP as they manifest in the contemporary realities encountered by farmers living in a post-project landscape. Many studies have demonstrated that the post-MDP landscape is beset with a wide array of problems: rampaging elephants, malaria-transmitting mosquitos, kidney diseases caused by pesticides, cholera outbreaks, suicide, unemployment, poverty, and agricultural waste being but a few. While conventional research seeks to separate these problems into discrete

categories, a political ecological framework helps us see the seemingly invisible connections among these problems and to provide specific lessons that can potentially improve future policies concerning water management in Sri Lanka and elsewhere in the world.

1.1.1 The Irrigation component: systems, blocks, and units

The master plan for the MDP proposed the irrigation of almost 400,000 hectares (1,000 Sq. km.) using the waters from the Mahaweli River. The water infrastructure for the irrigation component of the MDP were laid out partially on top of existing irrigation-related water infrastructure, and partially in expanses of dry land not previously irrigated. The new expanse of irrigated fields was divided into 13 sub-areas called *Systems,* alphabetically named from System A through to System M (see Figure 1.2.). Each of these 13 irrigation systems were further divided into several smaller units called *Blocks*. There is no set number of Blocks per system, as each system in the overall design varied in size. Certain large systems in the MDP (e.g., System H or System B) could contain as many as 10 blocks, while smaller systems (e.g., System C or System D) might have between 2-5 blocks apiece.

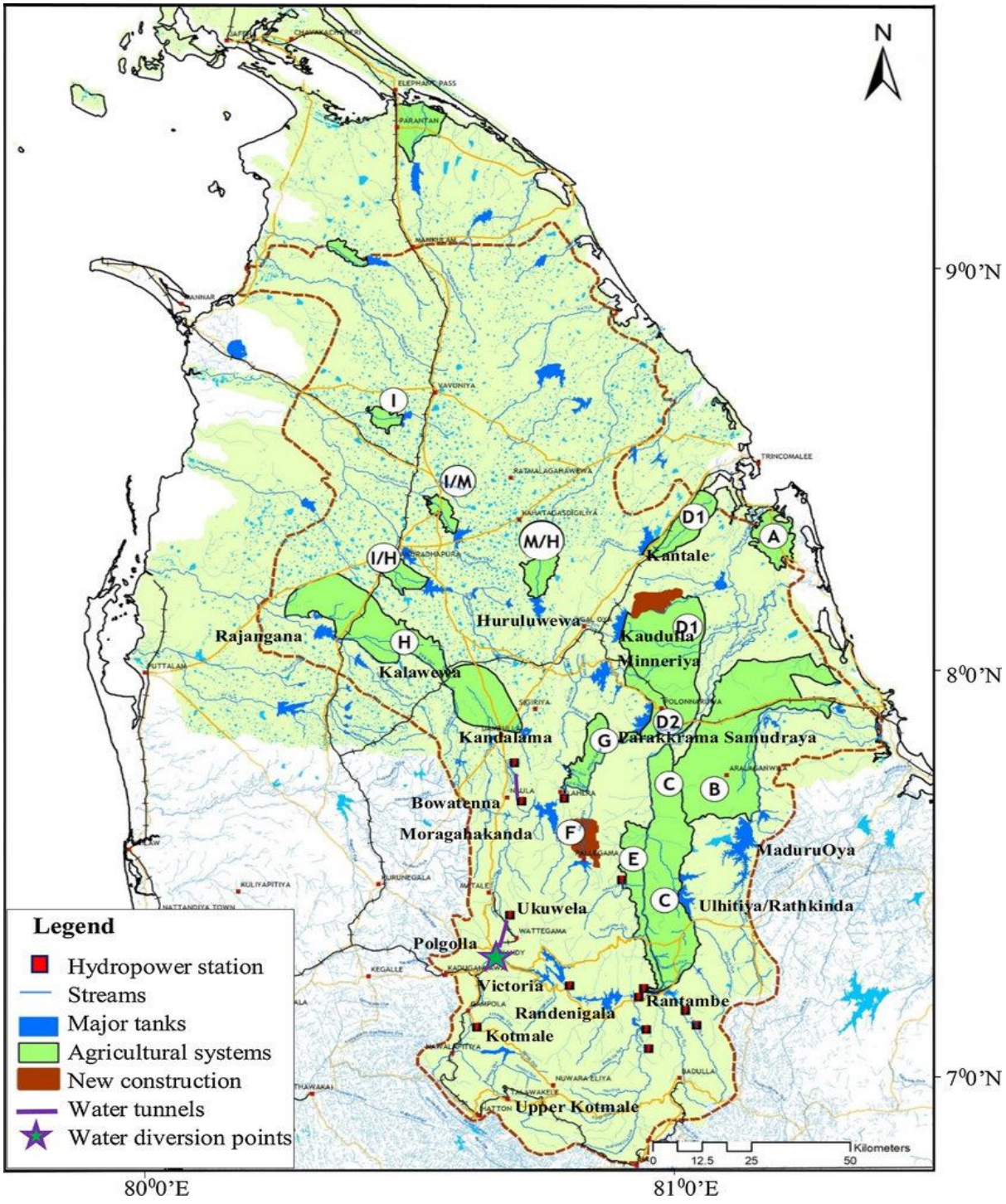


Figure 1.2. The 13 irrigation systems of the MDP (systems A – M) (Ministry of Mahaweli Development & Environment, 2001)

Blocks, however, were not the smallest units in the irrigation systems. Each block was comprised of several *Units* that were smaller still in size. These units were the true building blocks of the irrigation system. Each block contained on average between 10-20 units, depending on the size of the block and of the overall system (larger irrigation 'systems'

did not only have a higher number of ‘blocks’, but each block within these larger systems also contained more ‘units’). Each unit comprised of several farming plots, with each plot being owned by one household, or farming family. These farmers were the ultimate consumers of the water and, as such, the farming plot was the ultimate stop for the diverted waters from the Mahaweli River.

1.1.2 The hydro-electrical component

The hydropower sector established by the MDP involves far fewer complexities than the irrigation sector. The hydropower complex is centred around 4 of the 12 main reservoirs that redirect water from the Mahaweli river. After diverting the flow of water, these reservoirs then transmit it through an underground tunnel at very high pressures. The pressure generated by the water streams, would in turn, be used to generate hydroelectricity via the use of turbines.

While continuing to generate around 500 megawatts (annually), the electricity produced from the MDP’s hydropower complex accounts for less than 5 percent of Sri Lanka’s national requirements. This means that the project’s hydropower component is relatively insignificant when compared to its irrigation component (which spans over 1,000 sq. kms and affects the livelihood of over a million people). Given the difference in overall significance; I will be limiting my analysis of the MDP to its irrigation components while leaving the space for subsequent research to be undertaken on the hydro-electrical aspects.

1.2 The project area and its inhabitants

It is not an easy task to describe the area and people affected by the MDP since its influence extends over the entire country. Approximately 65,000 km^2 in size, Sri Lanka contains five topographical regions that include 17 agro-ecological zones (see Figure 1.3.).

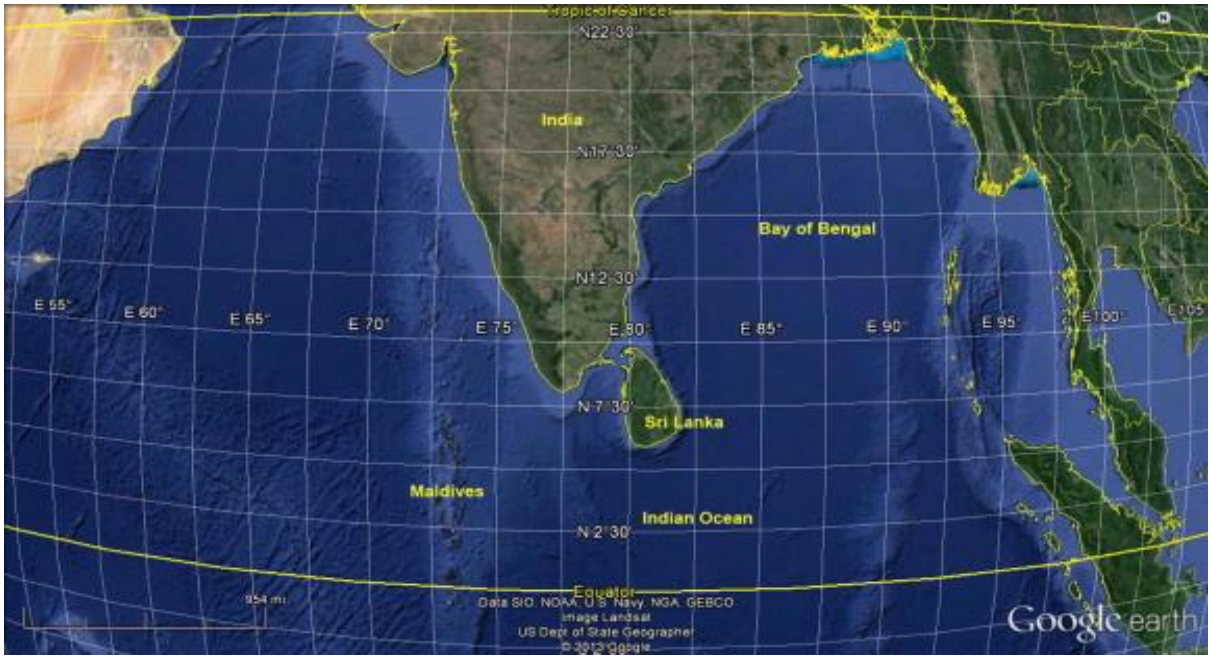


Figure 1.3. Location of Sri Lanka in South Asia (downloaded from Google Earth)

Sri Lanka's documented history spans over 3,000 years, with evidence of prehistoric human settlements dating back from over 100,000 years. Sri Lanka's location as an important trading centre made it well known throughout the world. The country's trade in luxuries and spices attracted traders of many nations, creating Sri Lanka's diverse population. Sri Lanka has been colonized by many settlers of European origins: the Portuguese, the Dutch, and the British. The coastal regions of Sri Lanka were first occupied by the Portuguese in 1505, whose arrival in Sri Lanka was largely accidental. The Portuguese occupancy of the coastal regions was subsequently taken over by the Dutch in 1658. The Dutch possession, in turn, was taken over by the British in 1796. The British were later able to extend their control over the whole island, colonising it from 1815 to 1948. Sri Lanka achieved political independence in February 1948, becoming a republic.

Sri Lanka's constitution specifies it as a republic and a unitary state governed by an executive-presidential system. Sri Lanka has had a long history of international relations, being a founding member of the South Asian Association for Regional Cooperation (SAARC), and holding memberships in the United Nations, the Commonwealth of Nations, the G77, and the Non-Aligned Movement. Sri Lanka rates high on the Human Development Index (HDI), with its HDI rating and per capita income the highest among South Asian nations (Ekayanake, 1987).

1.2.1 Sri Lanka's ethnic and religious composition

The dominant ethnic group of Sri Lanka are the *Sinhalese*, who make up 74.9 percent of the population (Azmi, 2007). Sri Lankan Tamils, who live mainly in the northern and eastern parts of the island, form the largest ethnic minority. The Muslims, who descend from the Arabic merchants that settled in Sri Lanka, form the third largest ethnic group, and are clustered in the southern parts of the island. Smaller minorities include the Malays who descend from Austronesian settlers, the Burghers who descend from European colonists (from Portugal, the Netherlands, and the UK), and the ethnic Chinese migrants who arrived in Sri Lanka in the 18th century.

The dominant religious group of Sri Lanka are the *Theravada Buddhists*, who make up over 70 percent of the population (Azmi, 2007). Minority religions in Sri Lanka include Christianity, Hinduism, and Islam. The dominant language of Sri Lanka is *Sinhala*, which is predominantly spoken by the Sinhalese ethnic group. In summary, Sri Lanka is primarily occupied by members of the Sinhalese ethnic group, who follow Theravada Buddhist doctrines and speak Sinhala (see Figure 1.4.). Ethnic, religious, and linguistic homogeneity is also a feature of the parts of Sri Lanka where the MDP was implemented.

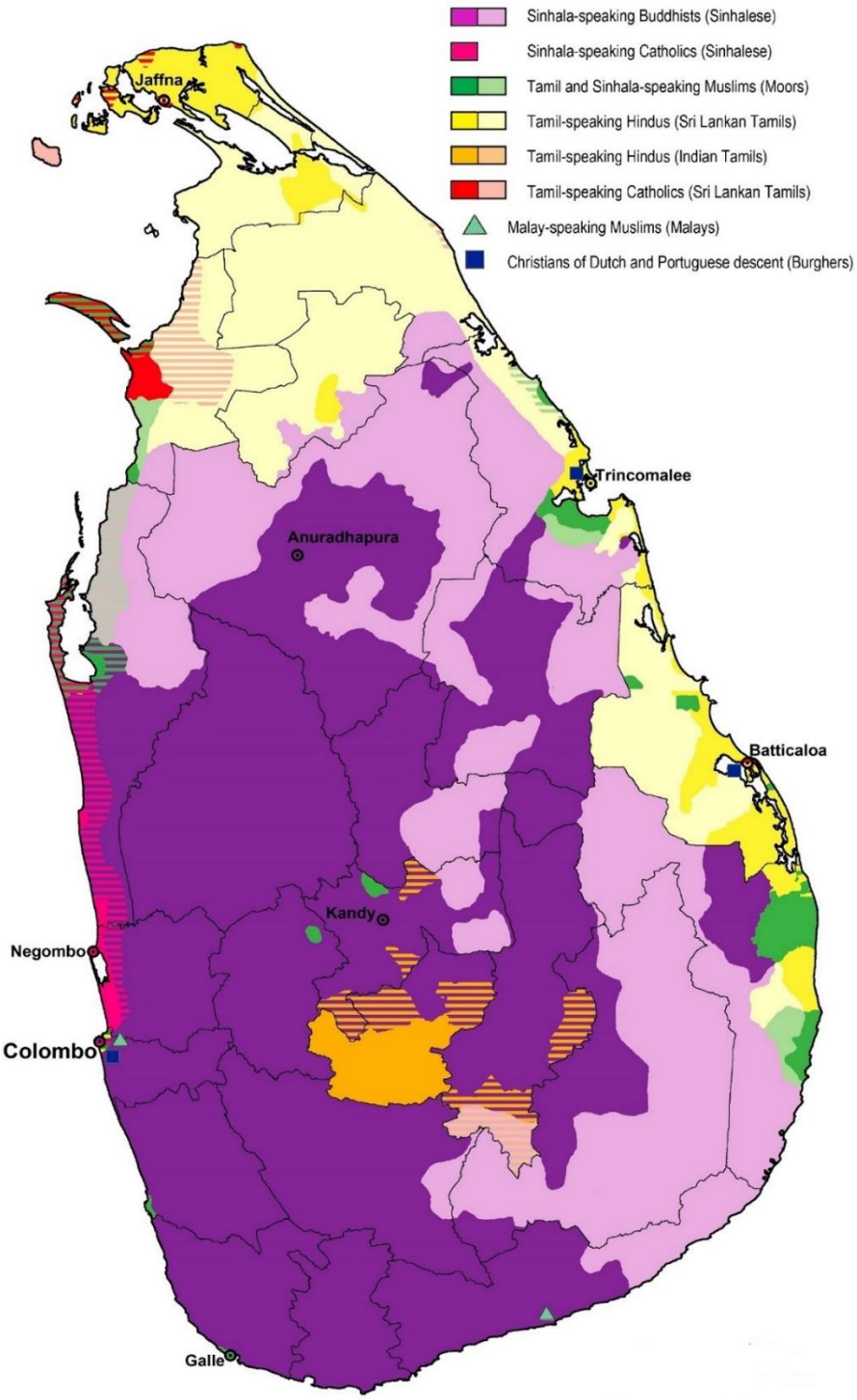


Figure 1.4. Ethnic, religious, and linguistic composition of Sri Lanka (Deegalle, 2004)

1.2.2 The Mahaweli River and the ecological 'dry zone' of Sri Lanka

Twice the length of Sri Lanka's other rivers, the Mahaweli River rises in the high-rainfall area of the central highlands. It flows predominantly north through the lowlands that surround the various Mahaweli irrigation systems and exits into a large natural harbour in the

east. Rainfall in the northern lowlands falls during the northeast monsoon (December through February) and can be irregular, whereas the high-rainfall southwest region enjoys rainfall during both the northeast monsoon and the southwest monsoon (May through September). While rainfall is abundant in the southwest region, water is scarce throughout the northern lowlands – leading to the north eastern parts of Sri Lanka being called the 'dry zone' (see Figure. 1.5.). It is in this dry zone that the majority of the MDP's irrigation systems are found.

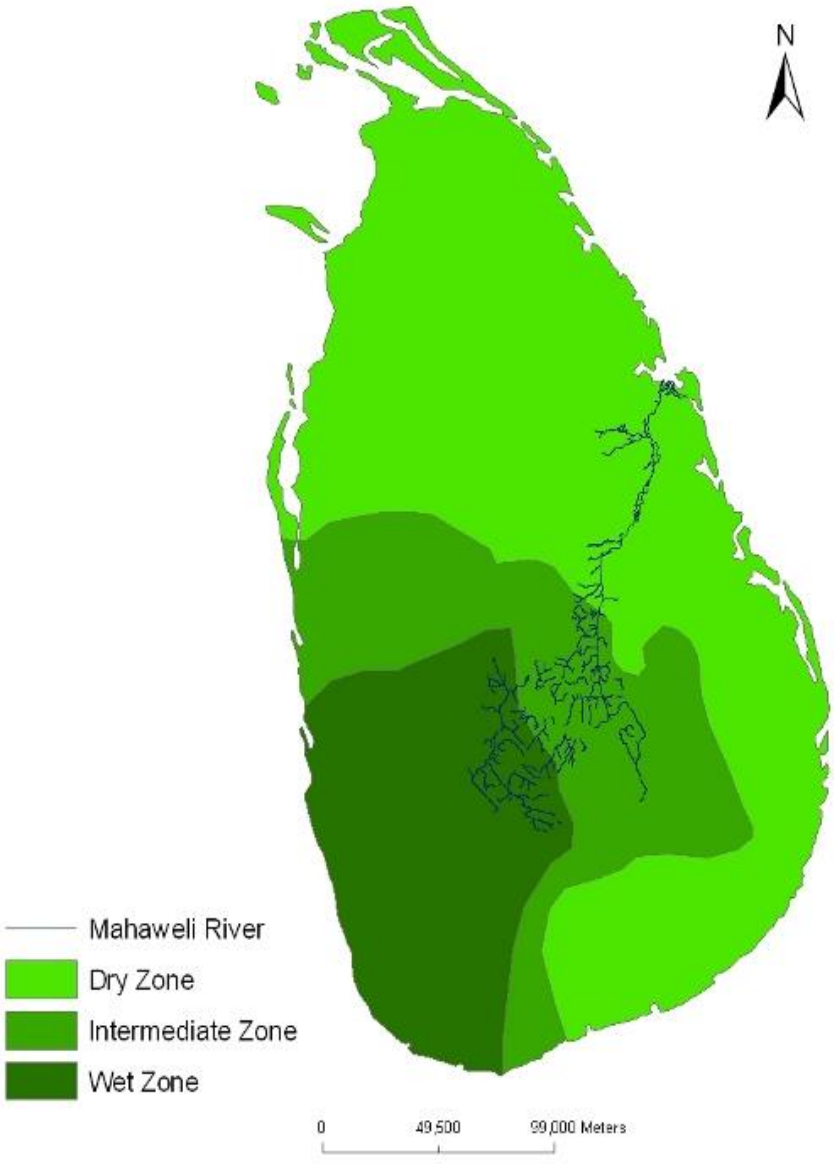


Figure 1.5. The different climate zones of Sri Lanka. One of the key goals of the MDP was to irrigate the so-termed 'dry zone' of the island (Ministry of Mahaweli Development & Environment, 2001)

Incoming migrants to Sri Lanka first settled in the northern lowlands prior to the beginning of the Christian era. During the first millennium, Sinhalese kings unified the population and built what archaeologists and historians consider to be some of the world's most extraordinary irrigation works and cities[1]. Decline came during the 12th century, after which reforestation reclaimed much of the land. Reasons for this decline vary, but include a combination of disease, warfare and irrigation decline because of salinity and water logging. When the Mahaweli Project began, the so-called dry zone of the country, though covering roughly 75 percent of the country, contained only about 25 percent of the population (Manthrithilake & Liyanagama, 2012).

The dry zone population lived primarily in scattered villages. Most villagers grew both rain-fed and irrigated crops, with water provided by small tanks (explored further in Chapter 5). As Leach notes in his classic study of a northern lowland village in Sri Lanka, it was the available supply of water that 'sets a limit to the area of land that may be cultivated and hence to the size of the population that may survive through subsistence agriculture' (Leach, 2011, p. 17). Water also featured prominently in cultural symbolism, being referred to variously as 'the Purifier', 'the Life Giver', 'a Symbol of Transfer, and 'the Destroyer of Evil'. Chapter 5 of this dissertation contains an extended discussion on the cultural and symbolic value of water among Sri Lanka's farmers.

In the north-eastern area that was to be incorporated within the MDP's irrigation System B, the majority of the population were Tamil-speaking Hindu and Muslim villagers who had been later immigrants into Sri Lanka, in addition to a small minority of an indigenous population group known as the *Veddah*. What became System C was comprised of forests, while what became System H contained mainly Sinhalese villages and a few Hindu and Muslim villages. Throughout, villagers were predominantly farmers cultivating irrigated rice for consumption and rain-fed upland (*chena*) crops such as legumes, cucurbits, chillies, and tobacco.

1.3 The design and implementation of the MDP: 1960-2010

In 1961 the government of Sri Lanka asked for aid from the special fund of the United Nations to survey the Mahaweli River Basin in the North and Central Provinces of the country. The request was accepted by the governing board of the special fund in June 1964. A plan of action was drawn up and signed on the 12th of October 1964 on behalf of the

[1] I revisit these historical irrigation works in my analytical chapters: Chapter 4, 5, and 6.

government of Sri Lanka, the United Nations special fund and the Food and Agriculture Organization as executing agencies. Further finances for the project came from the World Bank in the early 1970s, and the project began implementation in 1975.

The implementation of the MDP was shaped by a moving political backdrop. Soon after the implementation of the MDP commenced, there was a change in government, with the right-leaning United National Party (UNP) coming into power. The incoming UNP government and the newly elected executive president of Sri Lanka attempted to accelerate the project implementation timeline by inviting international donors to finance the construction of major headworks (see Figure 1.6.), deepening the involvement of multinational organizations such as the World Bank than would otherwise have been the case. The World Bank not only provided the majority of funds necessary for the MDP's implementation, but also played the role of coordinator of development assistance for the MDP, a role that leveraged more bilateral aid for the project.

Figure 1.6. A photograph taken during the construction of a major reservoir for the MDP (Ministry of Mahaweli Development & Environment, 2001)

The implementation of the MDP was severely affected by the start of a civil war between the Sri Lankan government and a terrorist organization known as the Liberation Tigers of Tamil Eelam (LTTE) who were demanding a federal state for Sri Lanka's Tamil-speaking Hindu minority. The war between the government and the LTTE had several major impacts on the project. First, although the Sri Lankan government initially intended to use the MDP to achieve some degree of ethnic integration within Sri Lanka by resettling Tamil and Muslim families within the ecological dry zone (which was historically dominated by Sinhalese settlements), these plans were scrapped as ethnic tensions heightened during the civil war. Instead, the government gave priority to families already living in the areas within which the MDP was being implemented. Second, the ongoing civil war significantly delayed the implementation timelines of various MDP project components, with state resources being divested away from the project to fund the war. Thus, the civil war in Sri Lanka effectively delayed the MDP's implementation by almost 30-years (the project only being completed by 2010).

In addition to the civil war, the implementation of the MDP was further delayed by the insurgency of a Sinhalese militant political faction called the *Janatha Vimukthi Peramuna* (JVP). Although currently a legitimate political party, the JVP rebelled in both 1971 and during the 1980s. In the 1980s they targeted the MDP, including settlers who were UNP members, as representative of the government in power. Especially active in System H of the MDP, the JVP killed local government officials as well as settlers. As told by Thayer Scudder, an American Social Anthropologist who visited the MDP's system H in 1979 as a consultant:

> *In 1985 we were interviewing beside a major road in System H when several security vehicles went by. In response to our queries, we were told that a JVP landmine had detonated under a jeep, killing five security personnel. Wanting to assess the validity of rumours that security force retaliation targeted anyone in the immediate vicinity of an attack, including Mahaweli settlers, we visited the site the next day after travelling through several roadblocks. Tragically, the rumours were correct. An elderly settler living beside the road where the landmine exploded told us how the security forces came to his house at night, piled up his furnishings in one room and torched the house. In the vicinity, I counted over 20 settler homes that were similarly burned … We were also told that the security forces further retaliated by killing youths at nearby crossroads to terrorize the settler population, so we drove to one of the sites mentioned. The victims had been decapitated, necklaced with tyres, and burned with gasoline. When we arrived, only ashes, the metal reinforcing*

> *of the tyres, pelvic bones and vertebrae remained. I counted the number of victims by counting the pelvic bones. Five people had been burned. Subsequently I was told by reliable sources that the total number killed in retaliation was 70 people, although I had no way of confirming that figure (Scudder, 2012, p. 159).*

In addition to creating a sense of insecurity throughout the area, JVP actions also had an adverse effect on participatory institutions since settler leaders were especially at risk.

This, briefly, is an account of the implementation of the MDP, and how the project timeline was extended across 50 years, from 1960-2010. In the analytical chapters of this dissertation, I will refer to various aspects of political changes that backgrounded the implementation of the MDP. For instance, in Chapter 4 of this dissertation I will examine the World Bank's extensive involvement in the design and implementation of the MDP, and the implications this had on the project itself and on the lives of its direct beneficiaries.

1.4 The MDP: 'mega water' and 'mega development'

The MDP remains both one of the leading mega water projects ever to be designed and implemented, and one of the largest development projects carried out in the world. This means that the unfolding of the MDP can be contextualized within both hydrological and development discourses.

From a hydrological point of view, the MDP is an interesting case of hydro-technological transfer (geared toward agricultural expansion), from the Global North to the Global South[2]. As such, the MDP can be located at the vanguard of what Sanjeev Khagram calls the 'big dam regime' (Khagram, 2004) – where mega water projects that controlled water through large dams were beginning to take hold of the popular imagination. In his work, Khagram charts the upward trajectory of mega dam[3] development to demonstrate how the dam construction intensified during the 1960s – coinciding with the design and implementation of the MDP (see Figure. 1.7.).

[2] Investigating the history of technological transfer from the Global North to the Global South, Jessica Teisch notes that pre-1960 transfers of hydro-technology were limited to constructing canals for transport (e.g., the construction of the Panama Canal by the United States). An exception to this is in India, where the British colonial regime renovated existing canal systems in Mumbai and Punjab (Teisch, 2011). I shall refer to Teisch's analysis more in Chapter 2.

[3] Mega dams (also big dams and large dams) refer to the multi-purpose gravity (or arch-gravity) dams that were first designed in the United States at the turn of the 20th century.

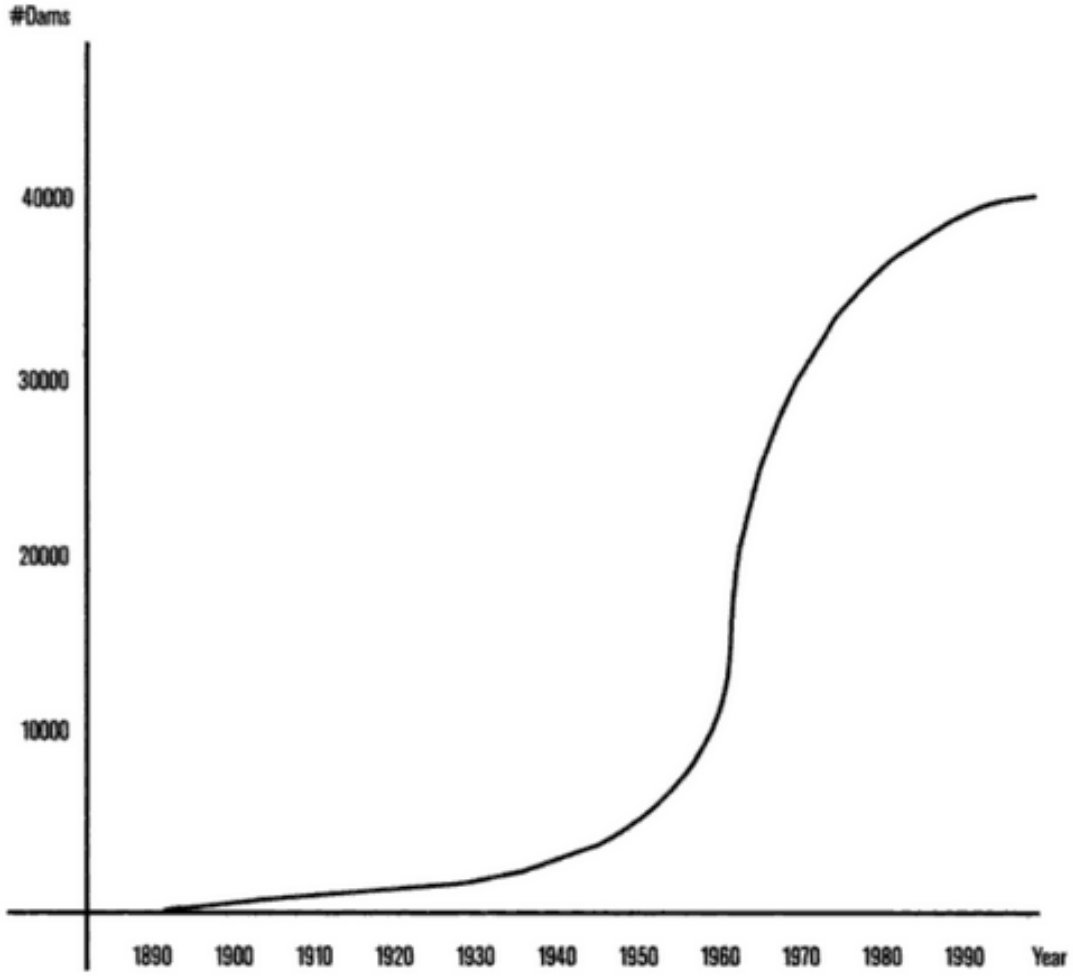


Figure 1.7. Illustrating the increasing prominence of mega dams in the 1960s and 1970s (Khagram, 2004, p. 18).

Beginning in the 1930s and 1940s, the construction of big dams proliferated around the world, with thousands of dams being constructed in China, the United States, India, Japan, Brazil, South Africa, Mexico, and Spain (Khagram, 2004). Further, transnationally allied supporters of big dam projects became increasingly connected during these early years, with a global professional association called the *International Commission on Large Dams* (ICOLD) being established in 1929 to facilitate the transfer of knowledge about dam building around the world. Being designed and implemented during the early years of this 'big-dam' era influenced the MDP in many ways – the nature and extent of this influence will be a central theme running through the pages of this dissertation.

From the perspective of post-World War II development thought, the MDP is among the world's first set of large-scale development projects, imbuing it with the politics of a growing international development industry. The project, during its design and implementation, was the cornerstone of Sri Lanka's development agenda, to which initially 30 percent of national capital development funds were allocated. Such was the importance attributed to the MDP, that the UNP government (that led the implementation of the MDP) created a national ministry to manage the project, which later came to be called the *Ministry of Mahaweli Development and the Environment*.

As I show in this dissertation, analysing how the MDP unfolds in the context of the 'big dam regime' on the one hand, and the national and international development paradigms on the other has many advantages. First, analysing how the politics of hydrological and development paradigms influenced the MDP help us to better unpack and understand the often-complex outcomes produced by the project. Second, conducting an autopsy of a mega project that was simultaneously influenced by emerging networks of hydro-technological knowledge and development expertise, contributes to the critical literature at the intersection of water governance and international development. Finally, exploring this dual identity of the MDP helps us draw previously unexplored connections that exist between the world of water and the world of development.

1.5 The MDP today: the blurring of a vision

Notwithstanding guarantees of success and optimistic predictions regarding the performance and capability of the MDP, the project has increasingly come under criticism for its failure to achieve intended irrigation targets, and for its overall underperformance (Withanachchi, Köpke, Withanachchi, Pathiranage, & Ploeger, 2014). Further, many studies have demonstrated that farming in the MDP has met with a number of unexpected challenges, including a rise in encroachments, farmer remonstrations, and conflicts between farmers and project officers in the field who are responsible for the management of project infrastructure (Dilini, Lyanage-Hansen, Attygalle, & Nandalal, 2014; Manthrithilake & Liyanagama, 2012; Paranage, 2018a, 2018b; Withanachchi et al., 2014).

As a result of the settlements created through the MDP, the population of Sri Lanka's dry zone increased by about 1 million people within a very short time, generating rising unemployment (Gunatilake & Gopalakrishnan, 1999). Certain land ownership practices within the MDP are reported to have negatively affected the economic and social wellbeing

of the second and third generations of settlers (Azmi, 2007; Paranage, 2018a). The irrigation practices have generated many environmental issues such as pest problems (Aravinna, Priyantha, Pitawala, & Yatigammana, 2017), water pollution and soil degradation, and economic problems such as inadequate labour supply. Furthermore, the MDP has also created many public health concerns: from malaria outbreaks to chronic kidney diseases of uncertain origin. Cases of water-borne gastroenteritis and other diarrhoeal infections have also been extensively reported within the MDP's systems, as was an outbreak of cholera from 1974-76 (Morimoto, 2013). On the other hand, some reports suggest that settlers in some irrigation systems of the MDP regularly encounter displaced herds of elephants – encounters that have caused both human and animal fatalities.

Most alarmingly, some studies have reported that the MDP settlements have the highest levels of suicide in Sri Lanka. Some studies have found suicide to be the leading cause of mortality within the MDP's systems, causing 70 percent of hospital-reported deaths during 1980-1990, with a suicide rate of 43.7 per 100,000 people (Schrijvers, 1993). In a 1998 paper, Van der Hoek and colleagues reported on a detailed study of insecticide poisoning, the drinking of insecticide being the main means for committing suicide. Based on records from two hospitals in System H, more than 50 percent of deaths were the result of insecticide poisoning (Van Der Hoek, Konradsen, Athukorala, & Wanigadewa, 1998). Media reports at times have linked the high rates of suicides to the various socio-economic problems pervading the MDP's systems, although no systematic research has been undertaken to explore any potential connections.

While there are numerous studies identifying a variety of problems associated with the MDP, these studies often address specific problems as unconnected entities. Indeed, if we shift our perspective to look at the larger picture, we are encountered with a seemingly endless inventory of issues that appear largely unconnected. What do failing crops have in common with cholera or chronic kidney diseases? How do these illnesses relate to the increase of malaria-transmitting mosquitoes and displaced elephants? What do unemployment, pesticide, diarrhoea, and suicide have in common?

1.6 An overview of the argument and methods used

Although the various problems that have been associated with the MDP have generated a significant amount of local and international research, the solutions put forward by the researchers and policymakers are both field-specific and technical. While generating

useful results, these studies fall short of addressing some basic questions about the MDP – why did the project result in so many negative consequences not envisioned by planners? Could there be some previously unseen links among these seemingly discrete problems? The problems encountered in the MDP, although certainly unique to the project in many ways, also parallel the many profound social, economic, and environmental problems experienced by planners of mega water projects in other parts of the world (a point which I shall revisit in Chapter 2). To understand how and why the MDP generates such effects, I start my investigation with an expansive research question:

How, why and with what effects did the MDP evolve as a mega water project?

I utilize a political ecological framework to structure my analysis. My approach involves framing the design, development, and the outcomes of the MDP politically, while simultaneously exploring how politics and materiality of water in Sri Lanka converge over the lifetime of the project. In contrast to the existing studies that attempt to understand (and solve) the MDP's problems through a depoliticized language of overall progress, I look at the MDP as a site of political contestation. In doing so, I explore the struggles and conflicts over water that occur within the MDP's irrigation systems, the number of interrelated contestations that occur over various socio-cultural issues, as well as the various knowledge frameworks and ontological meanings that are brought to bear on irrigation-related decision making. Crucially, by avoiding apolitical and technical frameworks to water management and development, I avoid neglecting the existence of multiple hydrosocial territories and diverse water cultures and societies.

Another advantage of using a political ecological approach is its ability to draw connections across various bodies of work such as water, development, and policy transfer. As I will show in Chapters 4, 5, and 6, drawing theoretical connections between different bodies of literature enables me to better understand how the seemingly unintelligible empirical problems relate to each other. Such an approach is especially valuable given the multiple identities held by the MDP as a mega water project, and as a mega development project. At many points in my dissertation, linking the politics of water governance with the politics of development allows me to shine a light on certain aspects of problems that remain undetected in the face of field-specific technical analyses.

Methodologically, I engage in qualitative fieldwork, mainly carried out in irrigation Systems B and H of the MDP. I conduct a number of semi-structured interviews with farmers

of both irrigation systems as well as with the planners and implementors of the MDP – journeying between the water worlds experienced by the farmers, and the bureaucracies of project administration. A significant component of my methodology is also based in documentary analysis, which I use primarily to understand how the design of the MDP was influenced from similar projects carried out in other parts of the world. Finally, I involve myself in observing many aspects of the water world that is the MDP: from studying the workings of bi-model computer programmes, through to examining how water and its management is treated by people at different ranks and at different scales. A detailed discussion of my research design and methodology is undertaken in Chapter 3.

1.7 Structure of the remainder of the dissertation

In elaborating the argument outlined above, my dissertation proceeds as follows. In Chapter 2, I locate the MDP within the broader context of mega water and mega development. I examine three key bodies of literature that have relevance to understanding mega water projects: water governance (including large dams and irrigation), development, and policy transfer. Taking this as a starting point, I note how these 'mainstream' approaches offer only a partial analysis of multifaceted projects like the MDP, due their depoliticized nature that depends on a conceptual separation between water and society. Later in Chapter 2, I introduce a 'hydrosocial approach' as a theoretical alternative to understanding complex water projects. Finally, I suggest ways of expanding the conceptual parameters of the hydrosocial approach, beyond how it is currently deployed, by using it to analyse the MDP.

In Chapter 3, I discuss my research design, methodology, and analytical framework. I re-introduce my central research problem and key research questions, explain the epistemological framings of my research, discuss my reasons for selecting a case study design and for focusing on the Mahaweli Development Project as a single case, and elaborate on the methods of data collection and analysis at each stage of the research journey. Finally, I conclude with a note on some of the specific challenges I encountered in the field.

I have structured my analytical chapters to deal with three distinct phases of the project cycle: the design (Chapter 4), the implementation (Chapter 5), and the outcomes (Chapter 6). Chapter 4 focuses on how international flows of knowledge and expertise around water travelled across the world to influence the design of the MDP. In this chapter, I show how the MDP's design was inspired by emerging global networks associated with large-scale hydro-technological expertise on the one hand, and by the politics of a growing international

development paradigm on the other. More specifically, I show how hydrologists and engineers from the United States, development experts from the World Bank, and members of the Sri Lankan government together created a hydrosocial network that transferred a particular 'vision' of water from the United States to Sri Lanka, through a variety of policy channels.

Continuing this narrative, Chapter 5 focuses on how this vision of water was contested on the ground by farmers and other water users upon being implemented. In this chapter, I first look at how water was understood in the specific political and geographic climate of 1960s Sri Lanka at the time of the MDP's design and implementation. Subsequent to that, I demonstrate how the farmers, grounded in their cultural and symbolic understandings of water, contested the technical expertise of the MDP's planners - leading to a different version of the project being implemented on the ground rather than what was originally conceived. I conclude by showing that the MDP represents a hydrosocial assemblage of global and local epistemologies, a close examination of which can yield contributions to the literature on water governance, development, and policy transfer.

Chapter 6 focuses on the post-implementation outcomes of the MDP, and the contemporary realities faced by the farmers and other water users as a result of the hybrid hydrosocial landscape created by the MDP. It considers the insights noted in the previous two analytical chapters – (1) that water policies of the MDP are shaped through an interplay of backgrounding contextual factors, and (2) that the MDP is being implemented in a landscape that is already engaged with water in many dimensions, including social and cultural, and applies these insights to understand the complex and often unintended outcomes generated by the project.

Finally, in Chapter 7, I conclude that the key to making sense of the seemingly discrete, unconnected, and unanticipated outcomes of the MDP is to analyse the project from a political ecological perspective grounded in a hydrosocial approach. I demonstrate how looking at water and its governance as a contextually defined phenomenon and understanding how human and non-human actors are brought together *through water* to form assemblages and hybrids can help connect the seemingly unconnected outcomes. I also conclude that hydrosocial approaches also need to be inclusive of substantive fields such as development and policy transfer on the one hand, and the role of power and politics on the other, in order to accurately capture the full range of effects generated by a mega water project such as the MDP.

CHAPTER 2

Literature Review

2.1 The structure of the literature review

The MDP as a mega project has multiple identities. First, it is a mega water project that completely reorganizes the flows of water in the dry zone of Sri Lanka. Second, it is a development project that has the functional agenda of achieving development within Sri Lanka, by reaching agricultural self-sufficiency, creating employment, and generating economic growth. Third, it is a vehicle through which hydro-technological designs and plans were transferred from the Global North to the Global South. Unravelling the complexities of the MDP therefore means positioning the project in relation to existing literature on water governance, development, and policy transfer.

I begin the chapter by contextualizing the MDP, and its related problems, within the broader scholarship on the socio-environmental effects of mega water projects (section 2.2.). The chapter then examines the scholarship on water management (in section 2.3.), development (in section 2.4.), and policy mobility (in section 2.5.) to obtain key insights into the project from various disciplinary standpoints. To tie these bodies of literature together into an analytical approach for examining the MDP, I end the chapter by outlining the analytical value of hydrosocial perspectives, which helps to unpack the unplanned social and environmental outcomes caused by mega water projects (section 2.6.). A hydrosocial approach highlights an ontological disconnect that is deeply entrenched in mainstream water governance, development, and policy transfer literature: that water, in mega water projects, is seen as a self-contained and abstract unit that stands alone, separate from social relations. I note that planners of mega water projects, whether they be experts at dealing with water, development, or policy, tend to disconnect ‘water’ from the ‘people’ while constructing water as a resource for the people. Hydrosocial approaches, conversely, seek to identify water as imagined within socio-political networks. In other words, water is always understood *in relation to* people, cultures, symbols, politics, and the environment – it is the relations that exist between people and water that define the essence of what water is at any given instance. Hydrosocial approaches therefore indicate that the definition of water is political and opens a

space within which alternate framings and understandings of water can be discussed. This, in turn, provides us with the freedom to analyse the politics of (1) how water is framed within mega water projects, (2) how particular framings about water travel across geographies through various policy channels, (3) how different ways of framing water come into contact with each other, and (4) the outcomes that are produced when this happens in actual practice.

2.2 Contextualizing the MDP within wider literature on mega projects

The many problems that are associated with the MDP (as discussed in Chapter 1), although unique to the project in many ways, also parallel the many profound social, economic, and environmental problems experienced by planners of mega water projects in other parts of the world. Large-scale water infrastructure development has often been recognized as generating wide-ranging social and environmental impacts, particularly since the burdens and benefits are unequally dispersed (Duarte Abadía, Boelens, & du Pré, 2019; Dukpa, Joshi, & Boelens, 2019; Fox et al., 2017; J. P. Hidalgo-Bastidas, Boelens, & Isch, 2018; Huber, 2019; Teräväinen, 2019; Warner, Jomantas, Jones, Ansari, & de Vries, 2019). Generally, mega water projects supply water to industrial growth sectors, irrigation schemes, and urban spaces, although the earliest examples of mega water projects involved constructing canals for transport (Teisch, 2011). Many scholars have noted that mega water projects tend to transform hydrological regimes and permanently remake the ways in which local communities engage with water (Boelens, 2008). For instance, Fainguelernt describes how the Belo Monte hydropower dam constructed in the Brazilian Amazon "disrespects Brazil's environmental legislation and the rights of indigenous populations who are considered 'hindrances' to economic development" (Fainguelernt, 2016, p. 241). Further, people affected by mega water projects have mostly been left on their own, facing many negative impacts without receiving any benefits (François Molle & Floch, 2008).

Over the past few decades, mega water projects have been the subject of mounting media attention, increasing academic analysis, and growing public criticism; all condemning the ways in which they produce negative environmental and social impacts. Mega water projects have also been described as modernist symbols of hydrology and engineering, as well as examples of top-down water governance (Iyer, 2003). Mehta (Mehta, 2001a, 2007; Mehta, Veldwisch, & Franco, 2012), Swyngedouw (Swyngedouw, 2007), and Hommes and Boelens (Hommes, Boelens, & Maat, 2016) have explained how this dominant techno-centric regime's limited focus on a small number of issues such as 'water scarcity' actively

legitimizes heavy supply-side investments. Ironically, rather than resolving water scarcity, the regime often ends up producing them, by promoting the growth of water use sectors that demand high levels of water (Birkenholtz, 2010, 2016).

Although widespread critique on mega dams led to funding agencies temporarily withdrawing their support from such projects, mega water (particularly mega hydropower) projects have recently made a worldwide comeback (Boelens, Shah, & Bruins, 2019). Amid increasing awareness about climate-change, hydropower dams have been repackaged as offering solutions for a greener economy (Del Bene, Scheidel, & Temper, 2018). For example, the World Energy Council figures for 2015 state that 76 percent of all renewable electricity comes from hydropower plants (Boelens et al., 2019). As Hommes et al. (Hommes et al., 2016) argue, dam development has been reinvented and reframed in the strongly depoliticized language of overall progress, sustainable, clean development and efficient, rational water management.

Given this resurgence of interest in mega water projects and especially mega dam interventions, unpacking the problems associated with mega water projects such as the MDP; especially the unravelling of political agendas concealed within the overtly depoliticized language of such projects, is of contemporary value. The ensuing sections of this review will explore both the mainstream and critical literature on three principal research areas associated with mega water projects: water, development, and policy. This exploration is undertaken to understand how scholars from each of these fields have platformed their understanding of why mega water projects cause more problems than they solve.

2.3 Defining and governing water in mega water projects

Mainstream approaches to governing water in mega projects often fall under the (so-called) state hydraulic paradigm, or the ‘municipal hydraulic paradigm’ (Bakker, 2005, 2012), also known as the ‘hydraulic mission’ (Molle, Mollinga, & Wester, 2009). This paradigm underpins most mega water projects carried out before the 1980s (including the MDP) and was characterized by the belief that there is an abundance of water that can meet the growing needs of a modernizing society through hydraulic technologies (Bakker, 2010).

The state hydraulic paradigm had two main tenets. First, it promoted the state/public ownership of water resources, citing the large-scale investments that were needed to construct the infrastructure. Further, water was considered essential to a nation’s development and to provide a dignified living standard for its citizens (Bakker, 2010, p. 34), justifying state-control

in the provision of water. However, over time, control of the water infrastructure was gradually taken away from the state into the hands of the private sector, as a result of the perceived weaknesses in supply-side water management (Kooy & Bakker, 2008), including failure to take into account environmental concerns, (Boelens, Hoogesteger, Swyngedouw, Vos, & Wester, 2016a) and the failure to provide universal access to water in developing countries (Reid, 2013).

Second – and particularly important for this dissertation – the state hydraulic paradigm is also characterized by its articulation of water as a scientific fact and an economic resource. As such, it is commonly assumed in mega projects that (1) water, as a scientific fact, can and should be considered apart from its social and ecological relations, and (2) water, as an economic resource, can and should be considered as catering to various human needs. The perception of water both as a scientific fact and a natural resource has specifically characterized the water governance styles of mega irrigation projects such as the MDP, which are motivated by agendas of achieving economic development. Contemporary irrigation projects, for example, use a variety of hydro-technological and hydro-economic models to help make governance decisions (Matthews, Stephens, Hess, Middleton, & Graves, 2002). Such models combine economic concepts and performance indicators with the modelling of hydrologic systems and their infrastructure to make real-time governance decisions (Chartzoulakis & Bertaki, 2015). Water allocation decisions are now increasingly made by proliferating computer programmes such as the *Vista Decision Support System*, the *Open Flows Water GEMS Programme*, the *Alkalinity Calculator*, and the *Moisture EC Programme* (Hess, 1996). The tendency to computerize water governance in mega water projects demonstrates the extent to which the idea of water as a scientific fact and an economic resource has gripped the imagination of project planners.

While water governance in mega projects is still heavily influenced by the state hydraulic paradigm, the 1980s saw an emergence of a different (more critical) approach – one that critiques the state hydraulic paradigm as the social and environmental costs of mega projects became more visible. This body of work:

1. Critiques the state hydraulic paradigm's understanding of water as a 'scientific fact' and an 'economic resource'.
2. Critiques the 'apolitical' understanding of water governance, instead looking at how specific institutional histories, power relations, and discourses affect water governance and policy.

First, this emerging body of work complicates the understanding of water as an apolitical scientific fact and an economic resource (Boelens et al., 2016a; Boelens & Vos,

2014; Kondolf & Pinto, 2017; Linton, 2008; Linton & Budds, 2014; Swyngedouw, 2004a, 2004b; Yates & Harris, 2018; Yates, Harris, & Wilson, 2017). For example, the fact that the Dublin principles[4], on which present water governance rests, defined water as an economic good in the fourth principle, have invoked an intense debate on what water is. Protesters against water privatization and commercialization around the globe have argued that water should be a right, rather than a commodity (Bakker, 2005; Shiva, 2002). Academics have put forward that water, since essential to all life, is ill-suited to the application of market principles (Dilworth, 2007; Shiva, 2002). This has spurred a debate on what a right to water entails, both practically and theoretically (Bakker, 2012; Collard, Harris, Heynen, & Mehta, 2018; Harris, Rodina, & Morinville, 2015; Mirosa & Harris, 2012; Yates & Harris, 2018). Regarding these different ways of trying to pin down the definition of water, Linton has pointed out, however, that water cannot simply be understood in terms of one single identity (Linton, 2010, p. 49). Water is 'uncooperative' (Lankford, Bakker, Zeitoun, & Conway, 2013) and has been more difficult to commercialize than some would have anticipated (Linton, 2008, 2010). Water has thus begun to be thought about in a different way – as not just a resource, but as an object with ecological, cultural, and political dimensions to it (Linton, 2010, p. 7).

Second, the critical literature challenges the 'apolitical' understanding of water governance. Boelens (Boelens et al., 2019) in particular explains how water governance in mega water projects appears to aspire to a universal water rationality, while at the same time subjugating non-hegemonic understandings of water. Modern water policies promise the acceleration of 'progress' through planned development initiatives and attempts to control nature through technology, money, and 'good governance' by rationally managing water users. Modern water policies further assume that any flaws and shortcomings (including cultural differences), will disappear as people realize the effectiveness of rational, modern expertise in meeting water development needs. To borrow from the Foucauldian theorization of the knowledge-power nexus, mega water projects exercise power that continuously generate new water knowledge. In turn, authoritative water knowledge continues to strengthen modernist hydro-political configurations. As Foucault stated, power and knowledge depend on each other: power cannot be exercised without knowledge, and knowledge necessarily engenders power (Foucault & Gordon, 1980, p. 52). In modernist

[4] The Dublin Statement on Water and Sustainable Development (also known as the Dublin Principles) was a gathering of water-related experts at the International Conference on Water and the Environment (ICWE). This conference was held in Ireland in January 1992.

hydrological sciences, water governance and mega-hydraulic policymaking produce lasting, unambiguous results, distinguishing acceptable types of water knowledge and rights from unacceptable ones.

As the critical approaches to understanding and governing water highlights, the way water is understood and governed in mega water projects is not universal, immutable, or apolitical – despite giving this impression. The conceptualization and governance of water in mega water projects therefore needs to be stripped of its mask of objectivity and be rendered political – if one seeks to understand the real breadth and depth of effects generated by these projects.

2.4 Envisioning development in mega water projects

The rise of mega water projects is closely interlinked with the rise of the development industry. The *Tennessee Valley Authority Project* (TVA), considered to be among the first mega water projects, was deemed by Scott to be the 'granddaddy of development projects', demonstrating the extent to which philosophies of water management were underpinned by visions of development (Scott, 1998). Mega water projects can be identified as being influenced in particular, by the modernization theories of development, wherein societies are seen as transitioning from pre-modern to modern (Bernsteint, 1971), and their status assessed according to statistics of economic growth (Ram & Ural, 2014).

Measures for gross domestic product (GDP), GDP per capita and annual GDP growth rates came to be available for most countries by the late 1950s, and immediately became the key metrics by which 'development' was judged. British orientalist Bernard Lewis's 1955 maxim that 'first it should be noted that our subject matter is growth, and not distribution' reveals the importance ascribed to economic growth that underlies the entirety of development-related thinking (Garcia, Millet, & Tonnelier, 2015). Paul Baran, a leading development economist on the political left, wrote in 1957 about the 'political economy of growth' while defining growth as an increase in the per capita production of material goods (Ranis, Stewart, & Ramirez, 2000). Similarly, W.W. Rostow, who had widespread popularity among the public, introduced his 'non-Communist manifesto' as a description of the stages of economic growth – assuming that economic growth singlehandedly defined the whole of society (Rostow, 1990). All these authors, of course, dealt with much more than just economic growth, but their emphasis on growth in national income per capita reflected the spirit of the times.

These dominant perceptions of development have actively facilitated the rapid growth of mega water projects in countries of the Global South. First, modernization theories of development positioned countries like the United States at the top of the development ladder: as an ideal for the less developed countries to strive for. This meant that countries of the Global South (including Sri Lanka) often sought to achieve US-style 'development' by importing water management technologies and governance models from programmes like the TVA (Bertoncin, Pase, Quatrida, & Turrini, 2019; Scott, 1998). Second, the United States actively exported their water technologies and governance models into the Global South as part of the country's foreign policy, known as the 'Truman Doctrine'. Given that the Truman Doctrine also had the political motive of containing Soviet geopolitical expansion during the Cold War, the United States took a special interest in distributing its development policies to non-aligned countries like Sri Lanka, India, and Pakistan (Stone, 2017). Third, development statistics play an important role in evaluating the outcomes of mega irrigation projects: water, land, and human labour are all translated into 'quantifiable agricultural inputs' and assessed on their economic productivity. Bakker notes that planners correlate the agricultural output with the quantity of water that is input into the project – making water, literally, a lubricant for agricultural intensification (Bakker, 2012). Thus, mega water projects continue to be influenced by a particular narrative of development: one that equates development with the quantifiable economic growth of a country.

This way of linking water, development, and economic growth in mega water projects had many detractors in the field of critical development studies. For example, James Ferguson in 1990 notes how development projects carried out in the Global South make patently political decisions about the allocation of resources, while making them appear as technical solutions to technical problems (Ferguson, 1990, 2015). Similar cases of concealing structural inequalities are abundant in mega water projects geared towards improving access to water (whether for irrigation, sanitation, or drinking purposes). In Indonesia, discourses of water-related hygiene were utilized to establish the supremacy of colonists over the natives, while also justifying racially segregated water supply systems (Kooy & Bakker, 2008). In Australia, public health practices together with blatantly racist policies of population management served to delineate and characterize 'white' behavior and identities (Bashford, 2006). These examples are not limited to colonial contexts. In France, the identity of the French middle class was fashioned through the use of sophisticated hygiene-related devices (e.g., the private boudoir), which warranted increased investment towards networked water supply systems within the city (Goubert, 1989).

Once the hidden politics framing the development narratives are exposed, this then leads to a second question: what kind of effects are likely to be produced by mega water projects that are shaped by modernist development agendas? A growing body of work attempts to answer this question by drawing on case studies conducted in various countries (Boelens et al., 2016a; Duarte Abadía et al., 2019; Dukpa et al., 2019; Fox et al., 2017; J. Hidalgo-Bastidas & Boelens, 2019; Hommes et al., 2016; Teräväinen, 2019). These case studies demonstrate how mega water projects inspired by modernist development agendas divide 'nature' and 'society' by portraying nature as the savage Other; to justify water extraction and territorial transformation. Further, these projects when implemented, tend to completely erase the diversity of governance and knowledge forms held by the people on the ground - terraforming entire waterscapes. Chapter 5 and 6 in this dissertation will draw from this body of literature in particular.

2.5 Policy transfer and mega water projects

The travel of policy ideas in the water sector has been widely discussed in the literature (Bozeman, 2000; Castro, 2008; David P. Dolowitz & Marsh, 2000; David Peter Dolowitz, Plugaru, & Saurugger, 2019; Goldman, 2007). The travel of policy ideas is an important part of the creation of mega water projects like the MDP for several reasons. For one, the designs, plans, and hydro-technologies that are implemented in mega water projects are often imported from developed countries (Clarke, 2012; Hidalgo-Bastidas & Boelens, 2019; Meehan, 2013; Minoia, 2012). For another, global funding organizations such as the World Bank, the International Monetary Fund, and the Asian Development Bank, promote certain policy ideas – or 'policy repertoires' – to developing countries that are interested in implementing mega water projects within their borders to achieve development (Yates & Harris, 2018).

The most quoted definition of policy transfer is by Dolowitz and Marsh (2000, p.5) who see it as a process by which: "knowledge about policies, administrative arrangements, institutions and ideas in one political setting (past or present) is used in the development of policies, administrative arrangements, institutions and ideas in another political setting". A common minimalist definition of diffusion views it as a process through which policy choices in one country affect those made in a second country (Simmons & Elkins, 2004, p. 171). Despite broadly agreeing on how policy transfer is defined, there is much terminological and conceptual diversity among scholars studying the phenomenon. Policy transfer has been

variously labelled as: 'imitation and emulation' (Arias & Guillén, 1998), 'institutional transplantation' (De Jong & Edelenbos, 2007), 'lesson-drawing' (Rose, 1991), and 'institutional transfer' (Jacoby & Schneider, 2001).

As far as explaining the mechanisms by which policies transfer, most literatures (despite their methodological differences) generally identify four major ones: learning, competition, coercion, and mimicry (further explained in table 2.1.).

Table 2-1. Mechanisms of policy transfer

Learning	In most policy transfer literature, learning suggests a 'rational' decision made by local governments to imitate foreign policies – expecting that such replication can produce efficient, economical, and successful policy outcomes when compared with alternatives (Rose, 1991). Learning can lead to total or partial policy transfer and can occur bilaterally, or through transnational problem solving in international policy networks or epistemic communities.
Competition	In policy transfer, competition refers to the fact that money tend to flow towards countries with investor-friendly policies: privatization, deregulation, free-market policies, low inflation, and commercialization. From this perspective, differences between individual countries disappear as unattached capital flow towards states that offer the best returns (Jacoby & Schneider, 2001).
Coercion	Most scholars consider coercion to be an explanation of the ever-increasing similarities among different countries' policies. Coercion may come from powerful states (threatening military interventions) or from international financial organizations (attaching conditions to money lending). Coercion is likely to be essential when understanding policy transfer in the developing world (David Peter Dolowitz et al., 2019).
Mimicry	Mimicry – also known as emulation – indicates the copying of foreign models in terms of their symbolic or normative value, rather than engaging with their technical/rational capacity. In this view, states adopt policy models recommended by 'global leaders' (other prominent countries or international organizations) so that they themselves can be perceived as being advanced, progressive, and morally praiseworthy (David Peter Dolowitz et al., 2019)

The conventional perspectives on policy transfer have frequently been criticized for assuming perfect rationality of actors in executing the transfer and underplaying the power of ideas in policy making. As a result of these criticisms, several alternative approaches have developed within the traditions of interpretive policy analysis and critical geography. Here I discuss two recent approaches that are relevant to the central argument of this dissertation: policy mutation, and policy translation.

Policy mutation is particularly relevant to the water sector. Scholars in this tradition show how water policies constructed in the Global North and disseminated to the Global South often fail to consider the local geographies of host countries (Clarke, 2012; Cochrane

& Ward, 2012). Often, water policies are transferred into developing countries as 'fixed templates' (Yates & Harris, 2018), either as a result of transnational policy repertoires being promoted by global organizations such as the World Bank, the UNDP, or the United Nations Economic Commission for Europe (Gerlak & Mukhtarov, 2013; Goldman, 2007; Mukhtarov, 2014), or as a result of the governments of developing countries attempting to import policies at the national scale to shorten the policy innovation timeline (Michaels & de Loë, 2010; Swainson & de Loe, 2011). The failure to consider the geographic, cultural, social, and even symbolic processes within the host countries lead to water policies failing at implementation or delivering consequences diametrically different to what the planners intended – which is the central problem addressed in this dissertation.

Scholars of policy mutation have attempted to capture such unintended consequences caused by policy transfer by looking at the 'mutation' (Brenner, Peck, & Theodore, 2010) or 'variegation' (Brenner et al., 2010; Yates & Harris, 2018) of policies. The work of these scholars has demonstrated, specifically with reference to neo-liberal policies of water governance, that water policies themselves are constitutively incomplete and experimental. The argument is that water policies tend to mutate when encountering the social, cultural, and geographically unique waterscapes of the host countries. In Chapter 5 of this dissertation, I utilize the concept of policy mutation to explain how the original design of the MDP mutated when being implemented on the ground.

The second critical approach, policy translation, has also been considered in the water sector, specifically in the work of Mukhtarov (Gerlak & Mukhtarov, 2013; Mukhtarov, 2014; Mukhtarov, de Jong, & Pierce, 2017). Policy translation can be defined as the modification of policy ideas when travelling cross-jurisdictionally, resulting in the creation of new meanings and designs. Translation allows us to perceive the 'global' in the 'local', and vice versa, regarding the adoption, implementation, and travel of ideas, enabling simultaneous consideration of ideas, objects and interests (Mukhtarov, 2014). Policy translation implies that the travel of policy ideas is affected by a large number of intermingling variables, and that policy ideas taken in an abstract sense provide little help in evaluating the possible effects of the travel. In Chapter 6 of this dissertation, I both borrow from and contribute to the literature on policy translation by demonstrating how the interaction of various stakeholders affected the policy ideas and design principles of the MDP.

2.6 The MDP as a hydrosocial site of investigation

In this section, I look at the literature grounded in political ecology known as 'hydrosocial research', which is central to the overall theoretical framing of my dissertation. Early hydrosocial research developed through critical geographies of water, conceiving new ways of understanding the coevolution of human and water systems (Bouleau, 2014). As an explicit label, 'hydrosociality' has had a comparatively brief history within the discipline of geography: most of the publications labelled as 'hydrosocial' emerged in special issues of *Environment and Planning D* in 2013 (Budds & Sultana, 2013) and in *Geoforum* in 2014 (Linton & Budds, 2014). There are at least two ways in which hydrosociality is applied as a mode of inquiry: one focuses on the idea of a 'hydrosocial cycle' as an analytical tool, and the other focuses on the idea of a 'hydrosocial territory'.

The first body of work on the 'hydrosocial cycle' critiques the society/nature dualism that underlies modern thinking. Bruno Latour argued that the conceptual apparatus of modernity is what allows water (and other non-human things) to be sorted as Nature (Latour, 1993). This is achieved by first transforming objects into a mixture of social and natural forces, and then purifying said objects by separating them into either Society or Nature. Latour claims, 'we have never been modern' because objects fail to fit into these predetermined categories, instead, traversing between them as hybrids. In line with this perspective, accounts of the hydrosocial cycle attempting to locate water's socionature, shows how water withstands neat classification as either completely social or merely natural by concentrating on its complicated identity.

The idea of the hydrosocial cycle came to the forefront of critical inquiry as a conceptual tool, arguably with the work of Jamie Linton and Jessica Budds (Linton & Budds, 2014). Their ground-breaking paper in Geoforum explored the idea of water and society being 'internally linked' as a relational dialectic. Specifically, the idea of a hydrosocial cycle is directly contrasted with the idea of the 'hydrologic cycle', with the latter appearing in hydrologic textbooks since the early 20th century (see Figures 2.1. and 2.2.). While the hydrological cycle traces the 'natural circulation of water', representing water as a natural scientific fact devoid of social content, the hydrosocial cycle reflects a dialectical relationship between water and society. The internal linkage between water and society was first conceptualized by Linton in 2008. Published in the next year, Budds (2009) identified the limitations of hydrological assessments, drawing on critical geographies of water to describe the hydro-social cycle as a means of extending the production of knowledge beyond technical

experts. Later publications by Linton refines these approaches (Linton, 2010; Linton & Budds, 2014), building a unique conceptualization of hydrosocial research based on an ontological foundation of dialectical socionatural relations.

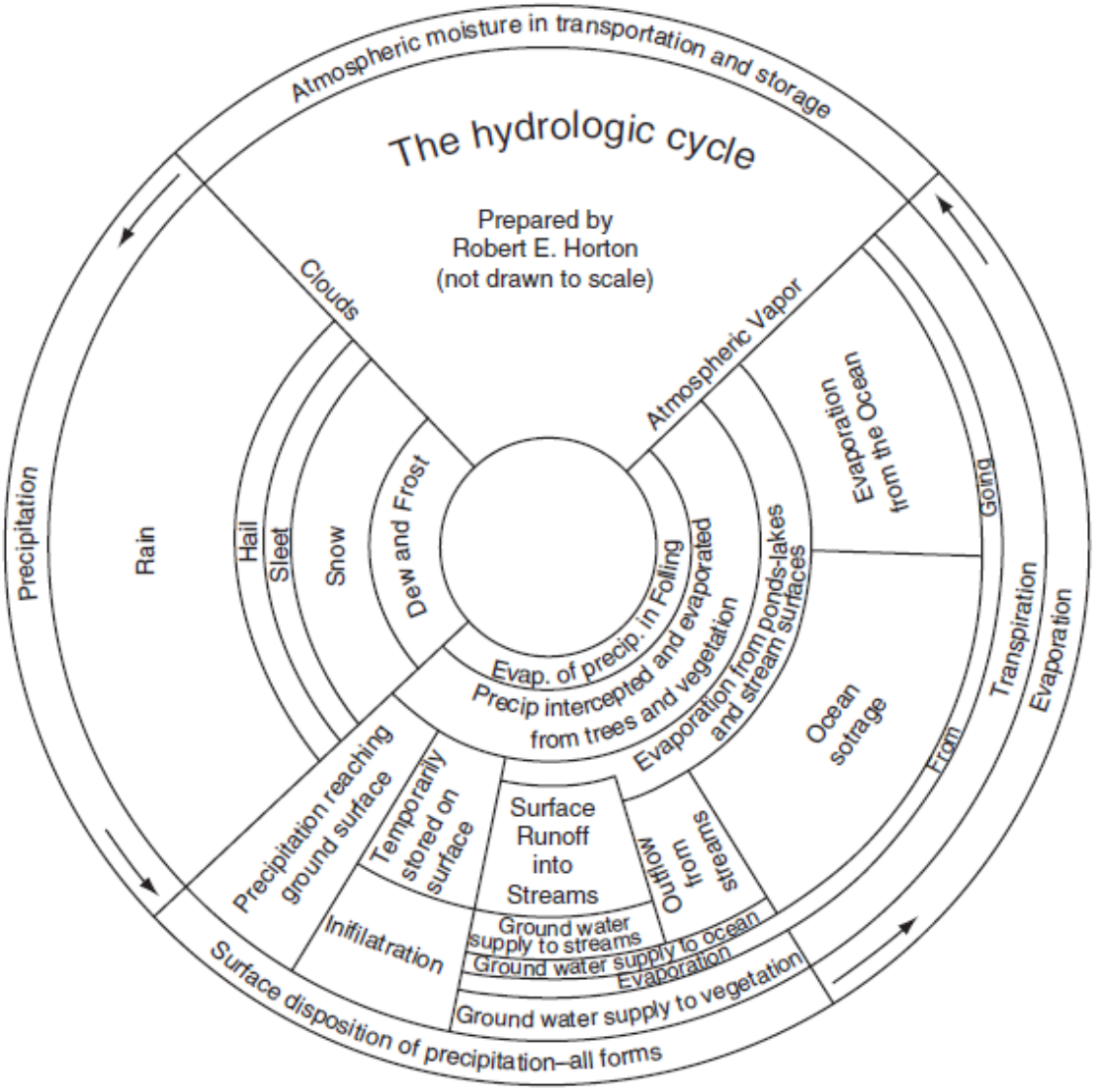


Figure 2.1. The first diagram of the hydrologic cycle as it appears in a paper by Robert Horton read before a meeting of the American Geophysical Union in 1931. Reproduced from (Linton & Budds, 2014)

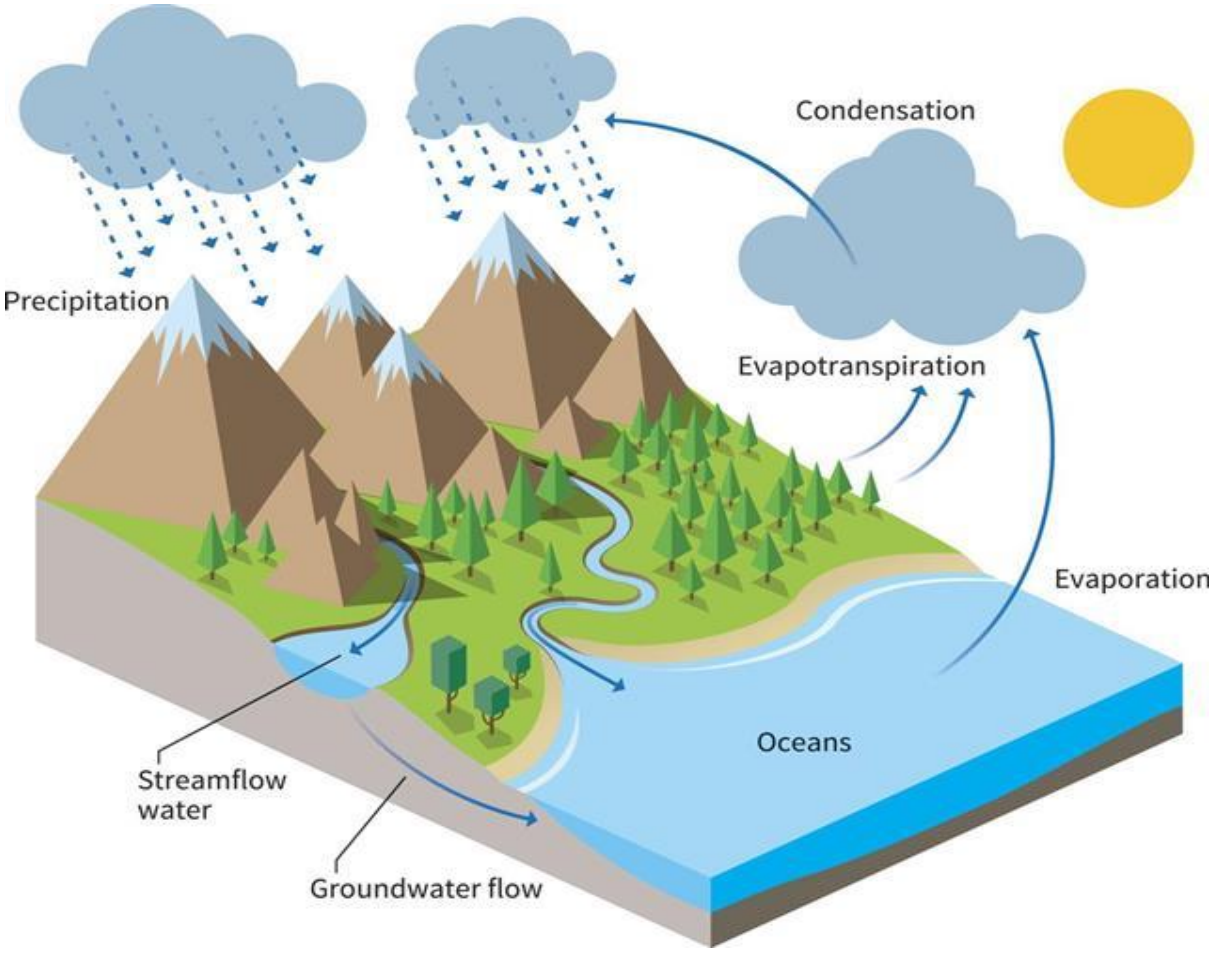


Figure 2.2. A modern rendition of the hydrologic cycle as it appears in contemporary scientific textbooks. Reproduced from (Davie, 2019)

What specifically characterizes this body of work within hydrosocial research is the conceptual model it proposes, and its ontological foundation. On the other hand, a second related school of thought in hydrosocial research focus on the idea of a 'hydrosocial territory'. This approach defines a hydrosocial territory as a spatial configuration of people, institutions, water flows, hydraulic technology, and the biophysical environment that revolve around the control of water (Boelens, Hoogesteger, Swyngedouw, Vos, & Wester, 2016b). This body of work takes the dialectic relational ontology as a starting point to redefine water-territories as a hydrosocial site (Boelens, 2008; Boelens et al., 2019; Hommes et al., 2016). What specifically characterizes this school of thought, however, is its focus on incorporating power and politics into defining hydrosociality. Drawing on Foucauldian notions of power, politics, and governmentality (Foucault & Gordon, 1980), scholars in this tradition make power and politics a central tenant in hydrosocial research.

The peer-reviewed published work that uses the conceptual framing of hydrosocial research in case studies shows a great variety in topics and locations. To give just a few examples: science, policy and politics in water resources management in Chile (Swyngedouw, 1996); the colonial and post-colonial history of 'French' hydraulics in France and North Africa (Pritchard, 2012); control and use of water in the Upper Jordan (Zeitoun, Karim, Talhami, & Dajani, 2013) water and culture in the Andean highlands (Swyngedouw, 1999); definitions of water in the European Water Framework Directive (Melo Zurita et al., 2015); science-policy interactions in the Seine and the Rhône catchments, France (Bouleau, 2014); canal irrigation and contested water control in the Tungabhadra Left Bank Canal, South India (Mollinga, 2014); and urban water governance in Durban, South Africa (Sutherland, Scott, & Hordijk, 2015).

Despite the case studies noted above, hydrosocial analyses has thus far not been applied to dissect the workings of a single mega water project in the manner that I propose in this dissertation. In my work, I take apart and analyse the programmatic components of the MDP: its design, implementation, and outcomes. By looking at each of these three components, I draw connections across a variety of actors, networks, scales, administrative bodies, legal arrangement, and physical structures. My approach most directly overlaps with the work of both Rutgerd Boelens and Lena Hommes who developed the idea of multi-scalar network within hydrosocial theory (Hommes, Boelens, Harris, & Veldwisch, 2019; Hommes et al., 2016). The idea of multi-scalar networks has been used to describe complex systems with a broad range of variables acting in relation to dynamic power relations that assemble nested hierarchies depending on spatial-temporal conditions (Boelens et al., 2019). While I do not directly problematize or discuss the constructions of scale in this dissertation, I nevertheless draw inspiration from and contribute to this line of research by linking actors of different scales and across various geographies to form hydrosocial networks.

2.7 Organizing the theoretical approaches into a conceptual framework

How does one make sense of the different theoretical approaches presented in this chapter to guide an investigation on the MDP? In the subsequent chapters of this dissertation, I present an analysis that borrows and blends together elements from the theoretical strands outlined above.

Looking at water as a socio-natural hybrid, underpinned by a relational-dialectic understanding, forms the theoretical core of this dissertation. I use hydrosociality as the

underlying meta-frame to organize the analytical chapters in this dissertation (Chapters 4, 5, and 6). However, at various points in the dissertation I deploy my hydrosocial analytical framework in combination with the other theoretical and disciplinary avenues discussed earlier in this chapter: the critical literature on water (section 2.3.), development (section 2.4.), and policy mobility (section 2.5.). In Chapter 4, for instance, I trace the provenance of the MDP's design by looking at how international flows of knowledge and expertise around water travelled around the world to be implemented in the MDP (policy mobility) and how certain ways of conceptualising water facilitated such knowledge transfers (hydrosocial analysis). Particularly, I look at how key narratives of development and hydro-technological achievement contributes to framing water as a scientific and economic object, that could be considered independently of its social and political context.

Chapter 5, which looks at the implementation of the MDP, begins by utilizing critical literature on policy mobility to look at how farmers and other water users challenged the 'foreign' design-logic of the MDP as it was being implemented – meaning that the version of the MDP that ended up being implemented significantly varied from its original design. Utilizing a hydrosocial perspective, I then demonstrate that the farmers' resistance to the MDP's design was based on their indigenous water perspectives, hydrosocial networks, and governance patterns. Finally, in Chapter 6, I use a hydrosocial lens to look at how understanding the complex outcomes of the MDP requires stepping away from the human/non-human dichotomy, and the 'water as a resource' mentality maintained in mainstream water and development policy. First, however, I elaborate the study design and methodology through which qualitative data was generated to conduct a hydrosocial analysis.

CHAPTER 3

Methodology

3.1 Research problem and key questions

This thesis starts off from the premise that water is an eminently political resource, disputed through power and authority relationships (Lankford, Bakker, Zeitoun, & Conway, 2013; Mollinga, Meinzen-Dick, & Merrey, 2007; Swyngedouw, 2007). In this regard, water flows are organized and steered (through infrastructure, regulatory mechanisms, rules, conventions, and norms) by means of techno political power relations that involve dominance and subordination, access and exclusion, emancipation, and repression. A variety of interests, power relations, knowledge-paradigms, and discourses compete and converge to control the water flows; thereby producing the geographic, cultural, symbolic landscapes and consequently the hydrosocial cycle (Hommes, Boelens, & Maat, 2016; Linton & Budds, 2014; Swyngedouw, 2004). Construction of hydraulic infrastructure to control access to, and exclusion from, water flows establishes control by one group over another, and reinforces or challenges established power structures (Crow-Miller, 2015; Meehan, 2013).

Situated within this framing, the present study seeks to observe how these hydrosocial processes unfold in the context of one irrigation-related mega water project carried out between 1960 and 2010, in Sri Lanka, called the Mahaweli Development Project (MDP). The MDP is important since it is representative of first-generation mega water projects that were designed and funded by multinational organizations such as the United Nations and the World Bank. First generation mega water projects, such as the MDP, are often considered as early examples of how the Global North (excepting the Soviet Bloc) sought to export technology and ‘development’ to countries of the Global South (Ekbladh, 2002). While much has been written about such first-generation mega water projects from the viewpoints of technological transfer (Cole & Mogab, 1987), policy innovations, and environmental protection and conservation (Bednarek & Hart, 2005); using a hydrosocial lens to understand and unpack the workings of such projects is still a relatively understudied area.

The main objective of this thesis will therefore be to explore the various interests, techno-political power relations, discourses, knowledge paradigms (tempered by social,

cultural, and symbolic influences as well as by geographic and topographic considerations) that underlie the formation of water policies, water-related regulations, water-control institutions and water infrastructure in first-generation mega water projects such as the MDP. Related to this goal is the appreciation that first-generation mega water projects should not be considered a relic of the foregone past, but as an ongoing and evolving enterprise. This is very much the case in the MDP, the implementation of which spans almost 50 years, and continues to shape the geographically largest portion of Sri Lanka's overall waterscape (see Figure 3.1.). Paying attention to the hydrosociality of the MDP has great contemporary value in understanding the inner workings of Sri Lanka's waterscape.

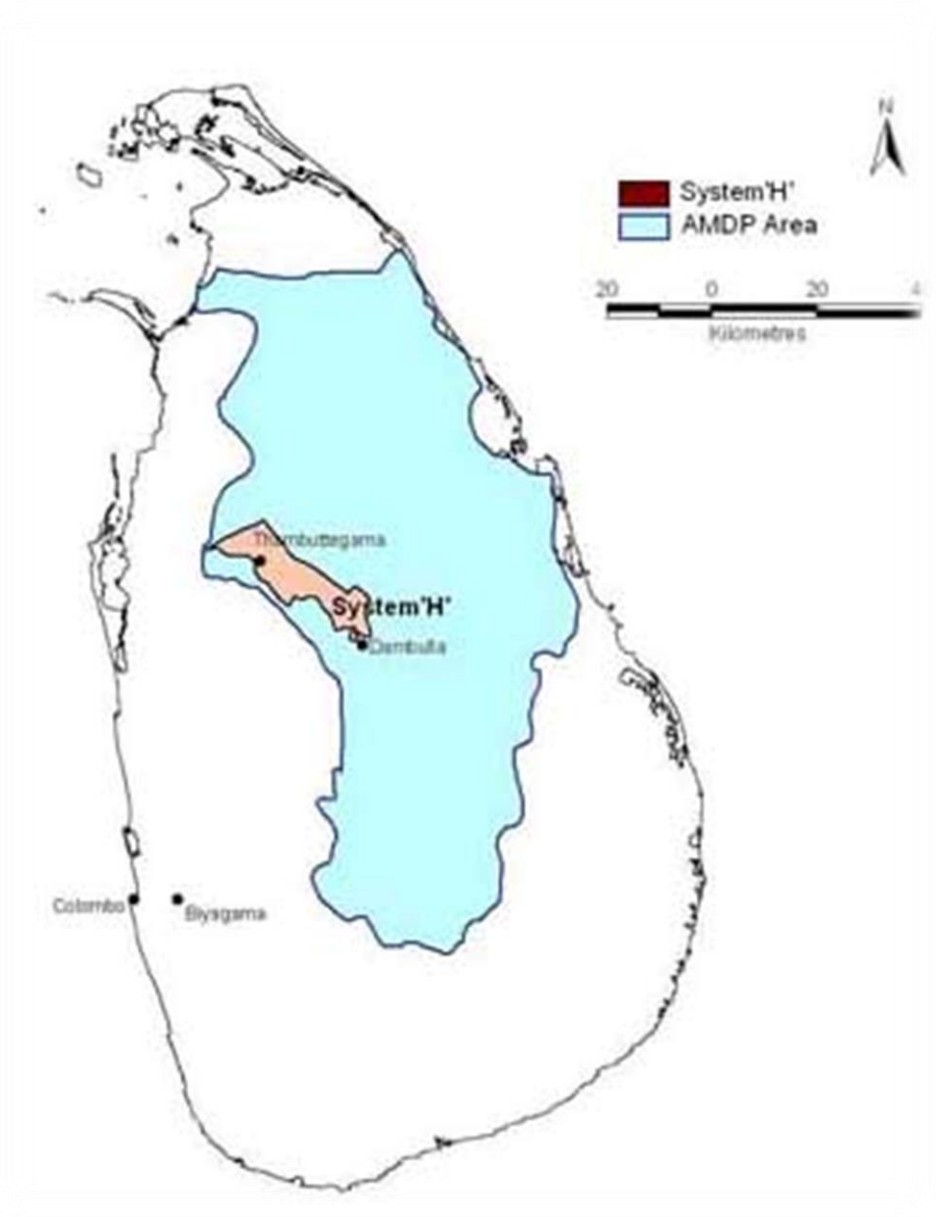


Figure 3.1. The area coloured in blue demarcates the total command area of the **A**MDP – the accelerated Mahaweli Development Program (Dilini, Lyanage-Hansen, Attygalle, & Nandalal, 2014)

The main question that I ask to guide and organize the research is: *How, why and with what effects did the MDP evolve as a mega water project?*

This (composite) research question can be broken down into several specific parts:

1. How do techno-political actors, discourses, and institutions interact overtime to inform the evolution of water governance in the MDP?

2. What kind of hydrosocial landscape is ultimately produced as a result of the MDP, and why? What characterizes the hydrosocial territory that is produced through the MDP (in terms of social organisation, ownership, distribution, and access to natural resources)?
3. Why did the project generate so many negative consequences not envisioned by the planners?

3.2 Epistemological framing of the study

This section discusses the epistemological framing of the present study that informs the choice of study design and data collection methods employed. Much of the mainstream literature on water management, regulation, and governance is underwritten by a positivist/realist epistemology that assumes water to be an entity (or resource) that exists independently of people. Realist epistemologies also presupposes the existence of an optimal way of managing water that is discoverable with the right theory or policy initiative.

This thesis, on the other hand, subscribes to a more complex epistemological position known as relational dialectics. Relational dialectics seeks to make sense of how actual things and states of affairs come to be, how they endure, and how they are transformed. It provides a way of understanding the flow of history as well as the flow of water and reveals how these two flows are closely related. While the idea of dialectics is often considered to have been brought into modern thought by the eighteenth-century German philosopher Georg Wilhelm Friedrich Hegel (1770-1831), the term 'relational dialectic' (emphasis on the *relational* aspect) itself has been employed more prominently in the work of David Harvey.

A relational-dialectical analysis considers how things that are often understood to be separate, independent, or self-sufficient actually produce each other in mutually constitutive processes. This notion has been highly influential in studies of the relationship between water and society (Linton & Budds, 2014; Swyngedouw, 2004), in that dialectical thinking can be used to effectively dissolve the dualism that is ascribed to seemingly separate objects (such as water and society). By dissolving this dualism, relational dialectics considers how each term of the binary is dependent on – and is internally related to – each other. In other words, relational dialectics emphasizes how things do not relate to each other as ready-made, preformed entities; rather, the very existence of things in a dialectical relationship *presupposes* the relationship. As such, by adopting a relational-dialectic approach in this thesis, I conceptually frame 'water' as a thing that only takes form in relation to the entities with which it engages. To quote (Linton, 2008):

> *"… In place behind dams in northern Canada is not merely the liquid H_2O measured in cubic metres that falls through penstocks and turbines to generate hydroelectricity; this water is held in place by state-run power utilities, the human labour that is extracted to produce the dams, penstocks, and turbines; abstract hydrological calculations; water management protocols; discourses linking national identity with the generation of hydroelectricity; networks of transmission wires; consumer expectations; construction consortiums; and political discourses, which together have the effect of fixing it in a particular way … [Therefore] we can say that water itself is constituted by its relations. To be sure, all water – at least in that part of the universe with which we are familiar – exhibits forms of behaviour that are proper to it, and these properties hold in every known instance of its occurrence. When considering water in a relational-dialectical way, however, we recognize these properties while bracketing them in order to concentrate on what might be called its relational substance … In other words, when considered in a relational-dialectic sense, water itself is historical …" (Linton, 2010, p. 15)*

In this thesis, I am not concerned with discovering a right way of water management (through a positivistic/realistic framing). Rather I focus on how the variety of discourses, ideas, meanings, knowledge-systems and interests – held by the actors who are responsible for architecting the water flows – are brought to bear in the 'governance' of water. In other words, I contend that waterscapes (developed through policies, infrastructure, regulations and institutions) are outcomes that are produced through contestations and assemblages between different actors operating from within diverse discourses, perspectives, knowledge-systems, interests, power-networks and scales.

An example of the differences between employing a positivistic/realistic epistemology and employing a relational-dialectic epistemology can be demonstrated with reference to the production and deployment of 'knowledge' in water governance. From a positivist standpoint, water related knowledge is largely 'technical' in nature: mega water projects, for instance, are typically exported as the products of superior engineering knowledge capable of providing objective solutions to the water crises in developing countries. Further, a positive epistemology can easily discern the difference between 'good' governance and 'bad governance' in water since all water problems are framed as objective and technical in nature. However, a relational-dialectic epistemology complicates this picture by demonstrating the existence of different types of knowledge, and showing how the choice of knowledge deployed (in defining water related problems, solutions, as well as the socio

environmental impacts) is predicated on political factors, discourses and power-relations (Boelens, Shah, & Bruins, 2019).

Interestingly, scholars working within the relational-dialectic tradition has also demonstrated that framing a problem as 'technical', can itself be a highly political move in certain contexts (Ferguson, 1990; Li, 2007). According to Boelens:

> *"… In modernism's enlightened science and policymaking, knowledge, empirical perception and intellectual understanding are separated from the ability to creatively imagine human and non-human consequences. In this respect, [water experts] often use depersonalized water planning models that, in fact, dehumanize water development and, as a result, avoid addressing the political roots of the problems of water scarcity and overabundance … water science and policy model-making ivory towers largely combat the generalized Water Crisis by inventing a 'hydro-political dream scheme' – an idealized socio-technical order aligning humans and non-humans, obscuring the day-to-day consequences of these policy models for real flesh-and-blood men and women ... In this vein, the international consultants and academic directors of the new hi-tech Yachay University in Ecuador explain that technology/knowledge development does not need adaptation to local society, but that society must fit to new, external highly modernist knowledge …" (Boelens, 2014a, p. 235)*

3.3 The case-study design

Case study research allows for the study of a phenomenon in depth, assuming that what is seen on the surface is often not a reflection of what is actually occurring; affording an opportunity to thoroughly analyse details that might be lost in another approach (Flyvbjerg, 2006). Topal (2009) describes a case study as an investigation of a phenomenon within its real-life context, reliant on multiple sources of evidence, and including events, individuals, and organisations, all of which are engaged with in this thesis. Bent Flyvbjerg goes so far as to say that "… a scientific discipline without a large number of thoroughly executed case studies is a discipline without systematic production of exemplars, and a discipline without exemplars is an ineffective one …" (Flyvbjerg, 2006, p. 219). He goes on to stress that fields within social sciences can only be strengthened by further case studies, as humanity and its myriad differences and interactions can only begin to be understood when derived from the context-dependent knowledge generated by case studies (Flyvbjerg, 2006, p. 224).

When deciding to use a single case, Topal (2009, p. 47) emphasises the need to decide whether that case fits one of five rationales: critical, unique, representative, revelatory

or longitudinal. I regard the MDP as a single case that possesses three out of the five rationalities outlined above: it is representative, revelatory, and longitudinal.

Firstly, the MDP is representative of the first-generation mega water projects that spread across Europe, Latin America, Africa and Asia after the Second World War. Many scholars argue that these mega water projects all derive design inspiration from the prototypal Tennessee Valley Project implemented in the USA in the late 1930s (Ekbladh, 2002). The water logics and policies that underpin the Tennessee Valley Project have been actively exported as heralds of 'development' since the 1950s (along with the funds to implement them) via policy networks supported by the World Bank and the United Nations (Goldman, 2007). Although many scholars have studied these first-generation mega water projects extensively in terms of technological transfer, policy innovations, and environmental protection and conservation – few have explored the socio-political dynamics that underpin the transfer of the Tennessee Valley prototype to developing countries. In this sense, the MDP can be used as a representative case that stands for many similar projects that all derive design inspiration from the same origin: the Tennessee Valley Project.

Secondly, the MDP is revelatory in that it offers potential to explore the insights from a hydrosocial analysis in a development mega-project, Existing hydrosocial literature that seeks to understand how various political, social and cultural interests have shaped the flow of water have hitherto limited their analytical focus to indigenous water management systems (Boelens, 2014b), urban water systems (Hommes, Boelens, Harris, & Veldwisch, 2019) and nation-wide waterscapes (Swyngedouw, 2007). They have typically fallen short of carrying out an autopsy on (first-generation) mega water projects: to understand how different discourses on water compete and merge within such projects. There is also the fact that first-generation mega water projects such as the MDP are also examples of early development projects and that the architecture of the development industry has helped to transport water logics and policies across continents. In this sense, we can take the case study carried out in the MDP as revelatory in nature, particularly as it helps to shed light on the conjoining of development logics, mega-projects, and contested hydrosocial rationalities.

Lastly, the MDP can also be considered as a longitudinal case, in that the political ecological processes related to water have unfolded across the span of over 50 years (1960-2010). This enables us to understand to understand how contestations over water governance processes have evolved temporally and spatially, both in the project design and over the course of its implementation. Further, recognizing the trajectory of the MDP longitudinally is especially important for understanding the characteristics of the kind of hydrosocial

territory/waterscape that is ultimately produced as a result of the MDP's implementation, i.e., to understand the consequences of the water governance processes established during the project.

3.4 Methods of data collection and analysis

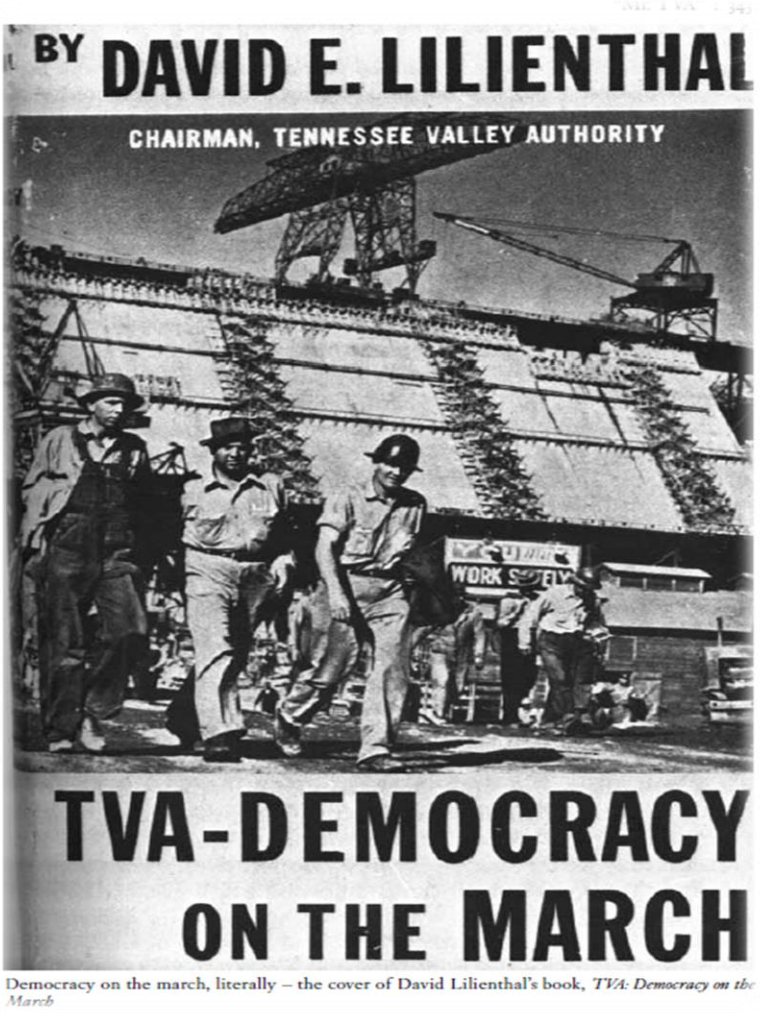
From late 12-hour bus trips to riding on the backs of 1980s Honda motorbikes, from visiting dusty archives, research centres, libraries and pouring through old typewritten manuscripts, to cycling on a pedal-bike along the straight-line water ways, I travelled many different paths through the ever-unfolding labyrinth that is the MDP project – while carrying out multi-sited and multi-class fieldwork. What follows is a discussion of the key data sources (both primary and secondary) that have informed my overall analysis and understanding of the MDP. In the first part of this section, I will introduce the key sources of data and how they inform my overall analysis (in terms of understanding the evolution of the MDP at various stages), while the second part of this section will examine the concrete steps and techniques that I followed during the process of data analysis. It should be noted that data relating to the MDP encompass a timeline of around 50-years; making sense of this data therefore requires us to weave together facts, figures, numbers, perceptions, and (most of all) memories, into a complex, rich and colourful tapestry.

3.4.1 Key sources of data and their contribution to the overall analysis

Stage 1: Understanding the design of the MDP

The starting point for my research was to understand the extent to which the MDP draws design inspiration from the Tennessee Valley Project in the USA. As a first step, I sought to familiarize myself with the design and organizational features of the Tennessee Valley Project itself. This involved understanding the (a) water infrastructure, (b) water and land related regulations, and (c) organizational hierarchies and management structures of the project: a process which required the analysis of congressional hearings, reports and documents relating to TVA (1933-1952), reports on the *Tennessee Valley System Design and Structural Adjustment Measures*, the *Tennessee Valley Authority Act*, and related circulars issued by the federal government. This was followed up by an examination of numerous secondary sources that helped shed light on the socio-political discourses that may have shaped and influenced the Tennessee Valley design. Important among the secondary sources was the project manifesto in the Tennessee Valley authored by David Lilienthal named *TVA:*

Democracy on the March (see Figure 3.2.) which discusses the underlying logic of the Tennessee Valley Project:



Democracy on the march, literally – the cover of David Lilienthal's book, *TVA: Democracy on the March*

Figure 3.2. The cover of David E. Lilienthal's manifesto on the Tennessee Valley Project (Ekbladh, 2002)

This was followed up by an examination of the project documents relating to the MDP (to examine the similarities and difference between the Tennessee Valley Project and the MDP in terms of infrastructure, regulations and the organizational structure), specifically the 3-volume *Mahaweli Master Plan*, of which only a few select hardcopies were available in the libraries of the Mahaweli Planning and Monitoring Unit (PMU).

The second (and arguably the most difficult) step in the research journey was to attempt a re-construction of the de-facto process of policy transfer – i.e. using knowledge of policies, programs, and institutions in one context in the development of policies, programs, and institutions in another see (Aitken, 2010; Bogason, 2009; Dolowitz & Marsh, 2000) –

that happened between the Tennessee Valley Authority (TVA) and the MDP to understand the contextual geo-political dynamics underlying the formal process. As a starting point, I looked at the *Mission Reports*, *Needs Assessments*, *Program Budgets*, *Implementation Strategies*, and *Feasibility Reports* submitted to the Sri Lankan government and donor organizations by (a) a mission from the IBRD (World Bank), (b) teams from the United Nations Development Programme (UNDP) and the Food and Agricultural Organization (FAO), and (c) employees of a Netherlands-based independent consultancy firm operating on behalf of the World Bank. This was followed up by an analysis of the correspondence between team leaders of the consulting missions and ministers of the Sri Lankan government, as well as an analysis of the contracts drawn between the government and the IBRD (which was the main funding body for the MDP).

After realizing who the key players involved in the process of policy transfer were, I looked to obtain an understanding of the contextual geo-political dynamics, power-relationships, and discourses underpinning the process itself. The obvious challenge here was that I was attempting to gain an understanding of a process that happened several decades ago. In this respect, I was fortunate enough to encounter several (now long retired) officers of the MDP, who had negotiated with the international consultants from the original IBRD mission in 1978, on behalf of the Sri Lankan government. The content obtained through these interviews (N = 5), linked with statements made by government ministers in the *Sri Lankan parliamentary Hansard*, and key speeches captured in press, enabled me to reconstruct a rather inclusive understanding of the politics involved in shaping the de-facto policy-transfer processes. Table 3.1 relates the various research objectives to the relevant data sources.

Table 3-1. The contribution of data sources in achieving the research objectives of Stage 1

Research goal	Data sources
1. To understand the extent to which the MDP aligns with and diverges from the TVA model. 2. To understand the *content* of the water management policies that were transferred. 3. To unpack and examine the water-logics, discourses, and rationalities that *underlie the content* of said water policies. 4. To understand the architecture of the policy transfer channels and the key players within it.	*PRIMARY (Documentary)* *Congressional hearings, reports and documents relating to TVA, 1933-1952* **Tennessee Valley Authority/USA** Tennessee Valley System Design and Structural Adjustment Measures **Tennessee Valley Authority/USA** Master Plan of the Mahaweli Development Project **UNDP/FAO** Needs assessment of the MDP **UNDP/FAO**

Research goal	Data sources
5. To understand *context* of the policy transfer – that is, to understand the underlying power-relationships, politics, discourses (both on the part of the policy 'exporting' organization and the policy 'importing' government) that coloured the outcomes of the policies. In other words, did the process of transfer qualitatively affect the policies?	Financial allocation/budget statement of the MDP **UNDP/FAO** Reports developing the master plan carried out between 1968-1979 **The Crofts-Weizmann Mission/IBRD (World Bank)** Reports on drafting an implementation strategy for the MDP **NEDECO/Netherlands-based consultants** Contract – IBRD Articles of Agreement (with the Government of Sri Lanka) 1978 **IBRD/World Bank** Correspondence between Team Leader/NEDECO and the Minister for Mahaweli in 1978 **Archives/Sri Lanka** Extracts from the Parliamentary Hansard of Sri Lanka **Parliament of Sri Lanka** Media/newspaper records **National Archives of Sri Lanka** **Associated Newspapers of Ceylon Limited** Laws/Circulars and Acts that provides the legal and operational backdrop to the MDP: 1. Land Acquisition Act No 9 of 1950 2. Land Betterment Charges Act No 28 of 1980 3. Agrarian Services (Amendment) Act No 4 of 1991 4. Land Development Ordinance No 19 of 1935 5. Mahaweli Authority of Sri Lanka Act No 23 of 1979 6. National Environmental Act No 56 of 1988 7. State Land (Recovery of Possession) Act No 7 of 1979 8. State Lands Ordinance No 8 of 1947 9. State Lands Encroachments Ordinance No. 12 of 1840 *PRIMARY (Non-Documentary)* 10. Key-informant interviews with former executives of the Mahaweli Authority of Sri Lanka [N = 5] *SECONDARY* 11. TVA: Democracy on the March: **David Lilienthal** 12. TVA and the Grassroots: **Philip Selznick**

Stage 2: Understanding the implementation of the MDP

The second stage of the research involved looking at the implementation trajectory of the MDP, a feat that lasted over 30-years, encountering numerous interruptions and setbacks (including the beginning of a devastating civil war that effectively halted project implementation in many key areas). In this stage, I focus both on the general and the specific:

On the one hand, I looked at annual implementation reports and statistical reports (called *Sampath Pethikada* in Sinhalese) published by the PMU to understand the notable developments in terms of construction, resettlement, water issuing, management and the agricultural output for the whole MDP. These provided me with a bird's eye-view of the trajectory of implementation. I also interviewed farmers from two irrigation sub-systems of the MDP (see Figure 3.3), system H and system B (semi-structured interviews N = 20 / focus group discussions N = 4) as well as farmers from an adjacent non-Mahaweli system called *Palugaswewa* (semi-structured interviews N = 9 / focus group discussions N = 1) – see Figure 3.4. I also conducted key informant interviews with (former) resident projects managers and specialist support officers in systems H and B (N=5).

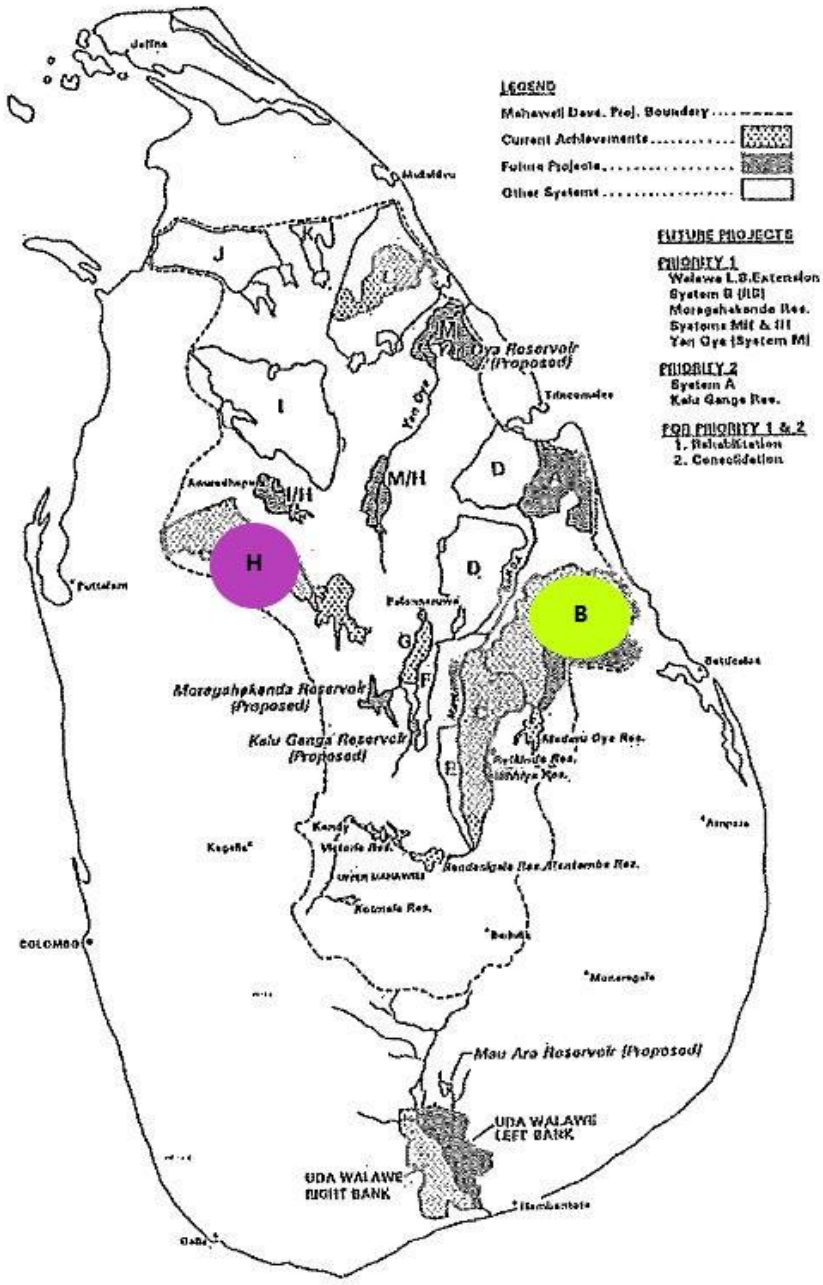


Figure 3.3. Systems H and B of the MDP (Ministry of Mahaweli Development & Environment, 2001)

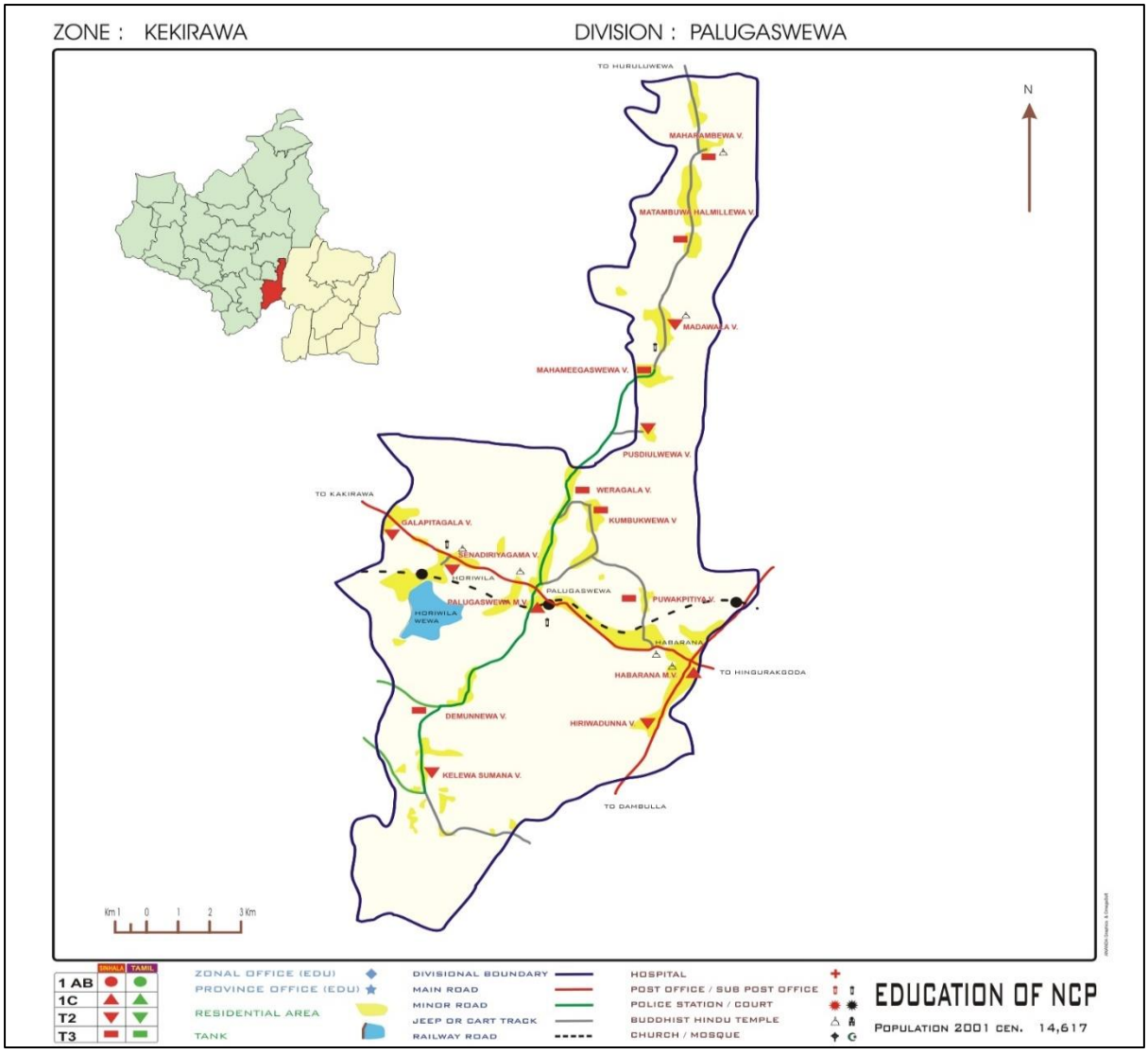


Figure 3.4. Palugaswewa irrigation area adjacent to Mahaweli System H (Ekayanake, 1987)

My field visits and interview material enabled me to understand how the implementation trajectory of the MDP has affected (and was affected by) farmers in these areas; in a contextual and place-specific way. Through my fieldwork, I sought to understand the local customs, beliefs and discourses about water and its management; and how these ideas meld together, shape and are shaped by the broader discourses and water logics of the MDP. I sought to understand how the broad water logics and rationalities of the MDP (supported by a variety of global discourses) meld together with place-specific discourses and values, and if the water management plans for the MDP were qualitatively affected (variegated) because of it. Put differently, my attempt at this stage was to unpack the uneven spatial implications of cross-contextual flows of policy, influence, and discourses pertaining

to mega water projects. Table 3.2 shows the relationship between research objectives and data sources for this stage of the research.

Table 3-2. The contribution of data sources in achieving the research objectives of Stage 2

Research goal	Data sources
1. To understand how the implementation process of the MDP unfolded and evolved over space and time. 2. To understand the various local customs, beliefs and discourses about water and its management in the sites visited for fieldwork. 3. To understand how the broad water logics and rationalities of the MDP meld together with place-specific discourses and if the water management plans for the MDP were qualitatively affected (variegated) because of it. 4. To unpack the uneven spatial implications of cross-contextual flows of policy, influence, and discourses pertaining to the MDP.	*PRIMARY (Documentary)* Implementation Reports of the MDP systems: 1980-2010 **Planning and Monitoring Unit/MDP** Statistical reports 1990-2010 of the MDP systems (*Sampath Pethikada*) **Planning and Monitoring Unit/MDP** *PRIMARY (Non-Documentary)* 1. Key-informant interviews with (former) resident projects managers and specialist support officers in systems H and B [N = 5]. 2. Interviews with farmers of MDP – irrigation sub-system H [N = 10] 3. Focus group discussions with farmers of MDP – irrigation sub-system H [N = 2] 4. Interviews with farmers of MDP – irrigation sub-system B [N = 10] 5. Focus group discussions with farmers of MDP – irrigation sub-system B [N = 2] 6. Interviews with farmers of the Palugaswewa irrigation system [N = 9] 7. Focus group discussions with farmers of the Palugaswewa irrigation system [N = 1]

Stage 3: Understanding the outcomes of the MDP

The final stage of my research journey sought to understand the hydrosocial landscape ultimately produced by the MDP: in terms of social organisation, ownership, distribution, and access to natural resources etc. This stage of the research, like the previous stage, required alternating between the general and the specific. I looked at the overall characteristics of the hydrosocial landscape left behind by the MDP by analysing the cropping intensities, amounts of water issued, overall agricultural productivity, changes in market values for crops and agricultural inputs, and cultivating patterns in the project command areas. I also focused on the qualitative aspects of the farmers' experiences to learn whether their perceptions, motivations and attitudes towards farming have transformed over time, and within generations. This aspect of the research attempted to understand the agrarian way or type of life that has emerged in the Mahaweli areas due to engagement with the project imposed hydraulic grid. This question is essential for understanding water

management through a hydrosocial lens – I was concerned not only with how culture, politics, discourses, and power relations affect water and its management, but also to understand how the rearrangement of the hydraulic grid as a result of the MDP could affect people's identities, cultural reference frames, and political economic relationships.

Finally, observation too, played a key role in this final stage of the research. One of the key observations I made during my fieldwork was how the water management system operated in the MDP. By visiting the water management secretariat for several days on end (and with the help of its patient technical administrative staff), I learned how a bi-model computer system operated to help make water related allocations between MDP's systems. I learned that a macro-model computer system has been designed to use historical streamflow data and the demand for irrigation and hydropower to evaluate policy options, while a supporting micro-model system helped assess water stresses, demands and diversion of flows within the complex system of tanks and irrigation areas. I took part in observing how a panel of high-ranking civil servants made policy decisions related to water allocation based on the inputs of these systems. Finally, I also observed how micro-level decision making occurred at regional levels, system levels and at the unit levels. I noticed how water and its management was treated by people at different ranks and at different scales: from high-ranking civil servants driving their government designated BMW cars, to farmers who depended on water for their income, livelihood, and survival. The relationship between research objectives and data sources for this stage is shown below in Table 3.3.

Table 3-3. The contribution of data sources in achieving the research objectives of Stage 3

Research goal	Data sources
1. To understand the hydrosocial landscape ultimately produced by the MDP. 2. To understand whether the farmers' perceptions, motivations and attitudes towards farming have transformed over time and within generations. 3. To understand how re-composition of large-scale hydraulic grid could affect people's identities, cultural reference frames and political economic relationships.	*PRIMARY (Documentary)* Datasets on (a) cropping intensities, (b) water issue, (c) land use, (d) market values for paddy, other field crops, and agrarian inputs, and (e) cultivating patterns in MDP command areas. **Planning and Monitoring Unit/MDP** *PRIMARY (Non-Documentary)* **Field observations:** This includes (a) observing the water infrastructure at the field-level, (b) participating in decision-making meetings pertaining to water management [at micro, meso and macro scales], and (c) developing an understanding for the way water is managed in the MDP from the source to the end point. *See also: Primary (non-documentary) sources listed in table 3.2.*

3.4.2 Steps, methods, and techniques followed in the process of data analysis

The research process concluded with the accumulation of an extensive set of data, from interviews, maps, statistics, diagrams, and observations recorded in a field diary. In analysing data, therefore, the first step was to sort out the datasets into different categories of materials: 1) textual, consisting of documentary data such as reports, laws, circulars, transcriptions of interviews etc., and 2) contextual, consisting of observation-based data, maps, photographs etc. While both inform the findings and overall analysis of the study, different methods were used in analysing each category.

Analysing textual data

Textual data, which included full transcriptions of the interviews and focus group discussions, comprised the bulk of my source materials. I further divided this text-based data into two types: digital text materials and hard-copy text materials. Digital textual material was inputted into the qualitative data analysis computer software: NVivo. Interview transcripts and digital documentary sources already available in PDF or MS Word file formats were uploaded directly into NVivo, while many hard-copy documents underwent a hard to soft-copy conversion process using an open-source optical character recognition (OCR) algorithm prior to being uploaded. However, this still left me with several source-documents that could not be converted into a soft-copy format; either because they were in Sinhalese, or because they were typewritten. In the case of this latter set of documents, I followed the same process of analysis that I followed in the documents uploaded into NVivo, albeit manually, using cue cards, notepads, and copious quantities of coloured post-it notes.

The first step in analysing the textual data was to run a preliminary content analysis using the ‘word frequency’ and ‘word cloud’ options used by NVivo (see Figure 3.5.). These options enabled me to identify textual patterns of concurrence or collocation. Some of the keywords I used included ‘development’, ‘water’, ‘Tennessee Valley Authority’, ‘river basin’ and ‘irrigation’. One example of the utility of this sort of analysis is that it enabled me to understand the most common lexical choice made by respondents in representing a topic. For instance, one observation I made was that higher-level project managers tended to use the word ‘development’ more often than farmers when talking about the MDP, indicating that these respondents tended to frame water management through the discourse of development. Thus, word frequency analysis and word clouds tended to have a socio-linguistic value that went beyond typical theme or node-based analysis.

Figure 3.5. Sample word cloud generated by NVivo

Secondly, I started the process of thematic coding through a systematic and comprehensive reading of all inputted text files. Each node is a receptacle for coded information such as information on a particular category or theme. As the analysis developed and overarching themes and patterns emerged, the nodes were also integrated into a hierarchy consisting of ‘parent’ nodes and ‘sub-nodes’. The larger ‘parent’ nodes near the apex of the hierarchy were often well-developed arguments that directly contributed to formulating an answer to a research question. Further, I created two basic folders to collect the ‘nodes’: (a) one folder containing more thematic and analytic nodes (e.g., the way ‘water’ is conceptualized and understood: for instance, water as a ‘resource’ might be an analytic node) and (b) another folder containing nodes on specific subject-based issues (e.g., nodes on ‘agriculture’, ‘water management’ or ‘land-use’).

Thirdly, I also looked for ‘context’ in understanding the thematic node-based information using the framework of Critical Discourse Analysis (CDA). CDA as an analytical approach is very important, especially since this research carries a heavy focus on understanding the types of interests, ideas, and discourses that underpin and shape the surface-level matter. In order to capture the contextual sphere of influence I constructed and deployed a series of analytic questions:

1. Who is making a claim, or presenting evidence?
2. What is being constructed as a 'truth' or as a 'norm?
3. Which kinds of statements are considered as acceptable within the boundaries of a conversation or document? What sort of claims can an author make?
4. How are the key ideas, actors and subjects positioned within the text?
5. What actions and entities are enabled and/or disallowed?

Analysing contextual data

Contextual data refers to the non-text-based input I received from field, such as photographs, that nevertheless significantly informed my overall understanding of the research field. The line dividing contextual and textual data is admittedly thin (and by some measures, may be called arbitrary) but the two forms have been distinguished from one another here since the analytical steps and techniques followed were different for each.

I was able to traverse sections of the scheme by foot or bicycle and observe the hydraulic infrastructure and their placement in relation to farms, as well as the way the farms and settlements themselves were organized. I was also able to observe and take notes on several pivotal meetings that happened at various levels that determined the seasonal water distribution agenda for the MDP. Regarding the latter, I was able to participate at three different levels of meetings. The first and the highest-level of meetings were held at the National Water Secretariat of Sri Lanka and was attended by high-ranking representatives from the MDP, the Ceylon Electricity Board (CEB), and the National Irrigation Department. These officials made the water distribution timetables for the overall MDP, taking into account competing hydro-electric and irrigation needs, and with the help of a two-tier (micro and macro-scale) algorithm-based software: The *Vista Decision Support System*®. The second meeting that I observed was at the system-level: the annual meeting between the regional project manager and field staff in System H to determine a system-level water distribution and cultivation timetable. The third (and the final) level of meetings that I attended were the seasonal *Kanna* meetings held by farmers at the premises of local farmer organizations. At all levels of meetings, it was illuminating to observe the interplay of dialogues and discourses (limited to an extent through the formal and informal rules governing the meeting) that ultimately resulted in the production of concrete and tangible decisions in relation to water management and farming – decisions that would result in

multitudes of social, economic and environmental consequences for the farmers as well as the wider population who were (directly or indirectly) in some way part of System H.

Finally, it should be noted that, in keeping with the ethical standards of the research (as approved by the Monash University Human Research Ethics Committee – MUHREC) and information sheet provided to the participants, all personal identifiers of the informants have been excluded from the transcripts, save broad references to the title of the positions that they held, but without reference to the location or the time period.

3.5 A note on reflexivity and challenges encountered in the field

I started my research with the aim of understanding the underlying techno-political power relations, knowledge paradigms, discourses, interests, and politics that underpin Sri Lanka's largest water management and development project: the MDP. Since I needed a conceptual starting point, I (somewhat naively) attempted to organize my methodology around several key stakeholder groups: politicians, development officers, and farmers. This was motivated by my readings into the literature on development projects; especially since previous research outline that contestations around power, knowledge and discourses are typically carried out between engineers and bureaucrats and water user groups (or beneficiaries).

Once I started the fieldwork however, it soon became apparent that this narrow conceptualization of hydrosociality excludes more insights that it illuminates. For one, some of the original stakeholder groups that I envisioned being useful (politicians and officers working in UN/Sri Lanka) either denied me appointments or had almost no in-depth information that would be useful for a hydrosocial analysis. On the other hand, a small group of farmers in a farming system adjacent to the MDP (and employing unique irrigation practices based on a millennia-old cascade of tanks) were enormously helpful to my analysis – even though they technically fell outside the scope of being MDP's direct beneficiaries. This shift in my understanding of which stakeholder groups are important to shed light on the hydrosociality of the MDP speaks volumes to the complexity of human-natural systems. Put simply, understanding true hydrosociality called me to 'think outside the box'; to stop thinking in terms of pre-given categories of 'water' and 'society'; of 'humans' and 'nature'. Once I truly appreciated that water is an element that constitutes human relations (and humans) to the same degree that it constitutes natural phenomena – it opened the space to think of many non-hegemonic alternative ways of conceptualizing how water and society co-

constitute each other. To this extent, I began to see the MDP not as an enterprise where human discourses, politics, and power relations cause water to be 'managed' in a certain way. Rather, I began to understand the MDP as a complex and unique organism consisting of humans, canals, discourses, symbols, cultural values, bureaucracies, politics, tanks, dams, and knowledges; all of which is held together *through* water. In a lot of ways, it is a world in itself, where getting to know its operational logics and dynamics makes you change and re-evaluate your ideas on who and what can be important to a hydrosocial analysis.

Figure 3.6. **(**Left) A focus group discussion with local farmers, (Right) Talking to farmers on a field

On a personal note, returning to Sri Lanka to collect data on the MDP posed several dilemmas for me. What constitutes the 'field' versus 'home' is a problematic distinction, as returning to my country of origin to do fieldwork was by no means returning 'home'. The field sites were all rural, quite different from the capital city of Colombo, where I was born and had mostly grown-up in. The socio-economic context was also quite different. I could certainly relate better to the research participants than a non-Sri Lankan would, but I (and most research participants) was acutely aware of my class privilege: I was from Colombo, from an educated background, could read and write in English, and was pursuing a doctoral degree in Australia. This made me, simultaneously, an insider, outsider, both, and neither. The ambivalences, frictions, and instabilities caused by my subjective position became important points of reflection; where the contradictions in my positionality and status had to be continually re-negotiated as I undertook fieldwork.

Further, my positionality had to be negotiated differently in relation to different stakeholder groups. For example, the key informants I interviewed in educated and policy circles, most of whom held advanced degrees in the social sciences, hydrology or in

engineering, were able to converse with me in the ‘academic’ or ‘operational’ languages of the development industry; and (as a result) perceived me as an ‘insider’. However, interviewees of this group who were currently working for the MDP (despite seeing me as an ‘insider’) were often suspicious of me, perceiving my research as an attempt to undermine the project (despite my best efforts to persuade them otherwise). This tension was obvious in the many rejections of meetings, disregarding of granted appointments, guarded responses, and rushed interviews that I encountered. On the other hand, those retired from service were often more relaxed, reflexive, and generally more willing to have an open dialogue about the relative strengths and weaknesses of the MDP.

Farming families, in contrast, very much perceived me as an ‘outsider’ despite me being a native Sri Lankan. I could not phrase my queries in the same way I did for the key informants, and this posed novel challenges. Despite this, most farming families were incredibly willing to talk and warmly welcomed me into their homes. The hospitality shown, even by the poorest farmer, demonstrated the sincere generosity that people exhibited towards a guest. It also, sadly, made me even more aware of the deference with which they treated me, as it was unlikely that an ordinary neighbour would receive the same treatment. On the other hand, refusing hospitality is deemed offensive to the host, so I had to constantly rework my positionality through the everyday acts of eating and sitting (I often sat on the floor or on a short chair). In summary, doing research about the MDP with different stakeholder groups was, for me, a complex and insightful experience, that brought to light the dynamics of insider-outsider politics of representation, as well as the axes of social differentiation beyond sharing a common nationality or ethnicity.

CHAPTER 4

Assembling Modern Water: Hydrosociality, Development, and the Mahaweli Project

4.1 Hydrosociality and First-Generation Mega Water Projects

This chapter looks at how international flows of knowledge and expertise around water travelled around the world to be implemented in first-generation mega water projects such as the MDP. I use 'first-generation mega water projects' to refer to the structured programs that were implemented in the 1950s and 1960s, on the basis of exporting water-related technologies and policymaking strategies from the Global North to the Global South, through multi-national networks and funding bodies such as the World Bank (Boelens, Shah, & Bruins, 2019). These technological and policy-related transfers were ostensibly done for altruistic purposes: to help improve and develop 'underdeveloped areas' (Gaddis, 1974; Merrill, 2006). In the words of Harry S. Truman, in his inaugural address in 1949:

> *We must embark on a bold new program for making the benefits of our scientific advances and industrial progress available for the improvement and growth of underdeveloped areas … I believe that we should make available to peace-loving peoples the benefits of our store of technical knowledge in order to help them realize their aspirations for a better life. And, in cooperation with other nations, we should foster capital investment in areas needing development (Esteva, Babones, & Babcicky, 2013, p. 6)*

Truman's speech (now widely known as the Four-points Doctrine) ushered in a contemporary era of development by establishing a development 'constitution' that enabled global institutions such as the World Bank to help create channels and networks to transfer the technological and policy innovations of the United States to countries of the Global South. This emerging era gave rise to what is now known as the 'development industry': a massive enterprise involving networks of international organisations, government departments, big international charities and social movements; all working to fight against the causes of poverty and inequality (Powell & Seddon, 1997). In many ways, first-generation mega water projects, such as the MDP, are the very cornerstone of the development industry;

they were the first 'development projects' that sought to export technological and policy innovations to the Global South.

Therefore, the MDP, being a first-generation mega water project – is located at the intersection of two related spheres of global influence and politics. On the one hand, being a *water* project, the MDP lies at the centre of emerging global networks associated with large scale hydro-technological expertise. On the other hand, being a *development project*, the MDP is also shaped by the politics of a growing international development paradigm. My purpose in this chapter is to focus on how the MDP (being both a water project and a development project) created unique links, networks, and assemblages between these two global paradigms of hydro-technological expertise and the development industry.

Further (and as elaborated in Chapters 2 and 3), I utilize hydrosocial approaches to add another dimension to my analysis. Starting off from the central insights of hydrosociality (that every actor, or group of actors, 'imagines' water and its management in different ways informed by their subjective positions), I demonstrate how each stakeholder group (including hydro-technological experts, development professionals and members of the Sri Lankan government) involved in the creation of the MDP were influenced by the politics that transpired within their own sphere of influence in interpreting questions around water. In other words, I demonstrate how a shared 'imagination' of what water is, and how it should be managed, has been an important element in organizing hydro-technological experts, development experts and members of the Sri Lankan government into novel networks.

The contents of this chapter are divided into four main sections. Section 4.2 demonstrates that the MDP has been clearly inspired by a similar mega water project carried out in the USA, the Tennessee Valley Project. Section 4.3 looks at *how and why* the Tennessee Valley water model acted as a design inspiration for the MDP, particularly via a set of institutions and stakeholders both internal and external to Sri Lanka. I demonstrate that looking at how and why the Tennessee Valley water model was adopted in Sri Lanka (especially in hydrosocial terms) enables us to illuminate the interactions that happen between large scale hydro-technological networks, the development industry, and the Sri Lankan government. Next, section 4.4 considers how adopting the Tennessee Valley model has characterized the MDP, in terms of shaping its water infrastructure, regulatory mechanisms and overall approach to water governance, while section 4.5 concludes this chapter by illuminating the contributions this analysis of the MDP makes to the literature on water governance, mega water projects, development, and policy mobility.

4.2 The MDP as a case of development 'transfer' of first-generation Mega Water Projects: design inspirations from the Tennessee Valley Authority

In 1961 the Sirimavo Bandaranayake government of Ceylon (as Sri Lanka was then known) requested assistance from the Special Fund of the United Nations to survey the Mahaweli Ganga Basin and the Dry Zone areas. Accordingly, a study was first carried out in 1963 by the United Nations Development Programme (UNDP) and the Food and Agricultural Organization (FAO) to determine the feasibility for a large-scale hydraulic project (the MDP). The UNDP/FAO completed its task in 3 years, drawing up: (1) a feasibility study for the MDP, (2) a Master Plan divided into 3 phases of implementation, and (3) a financial statement in a collection of 18 volumes. The Sri Lankan government then requested financial (development assistance) from the World Bank (specifically, the International Bank for Reconstruction and Development, or the IBRD), and – as a response to this request – a mission of international development experts were sent by the World Bank to further develop the Master Plan, including its construction and infrastructural design components. This second mission by World Bank experts was called the *Crofts-Weizmann* mission, and was sent out in 1968. The mission was directed by Mr. *P. G. Fialkovsky* as Project Manager and Mr. *R. S. Cooke* as Co-Manager. The *Crofts-Weizmann* mission recommended the use of an independent consultancy firm based in Netherlands (called NEDECO) to develop a concrete implementation strategy for the project, and these consultants submitted their reports to the government in 1975.

Interestingly, although the MDP's original design can be seen as the combined product of at least four separate institutions and agencies, (the UNDP, the FAO, the IBRD and the Netherlands based consultancy firm), the ultimate design of the MDP can be seen as a very close replication and adaptation of the design of the Tennessee Valley Project in the United States: more generally known as the Tennessee Valley Authority (TVA) which is the name of the federally owned corporation that administers the project. Design-wise, the water infrastructure of the MDP clearly resembles that of the TVA (see Figures 4.1. and 4.2.). As can be seen, both systems use straight-lined gravity-based network designs to transport water from its source (the river basin) to the end point (agricultural fields). In both projects, the water originates at large multi-purpose dams and reservoir complexes; and is progressively distributed over a large irrigable space over a straight-line network of canals ending at single-unit farms at the end of the line.

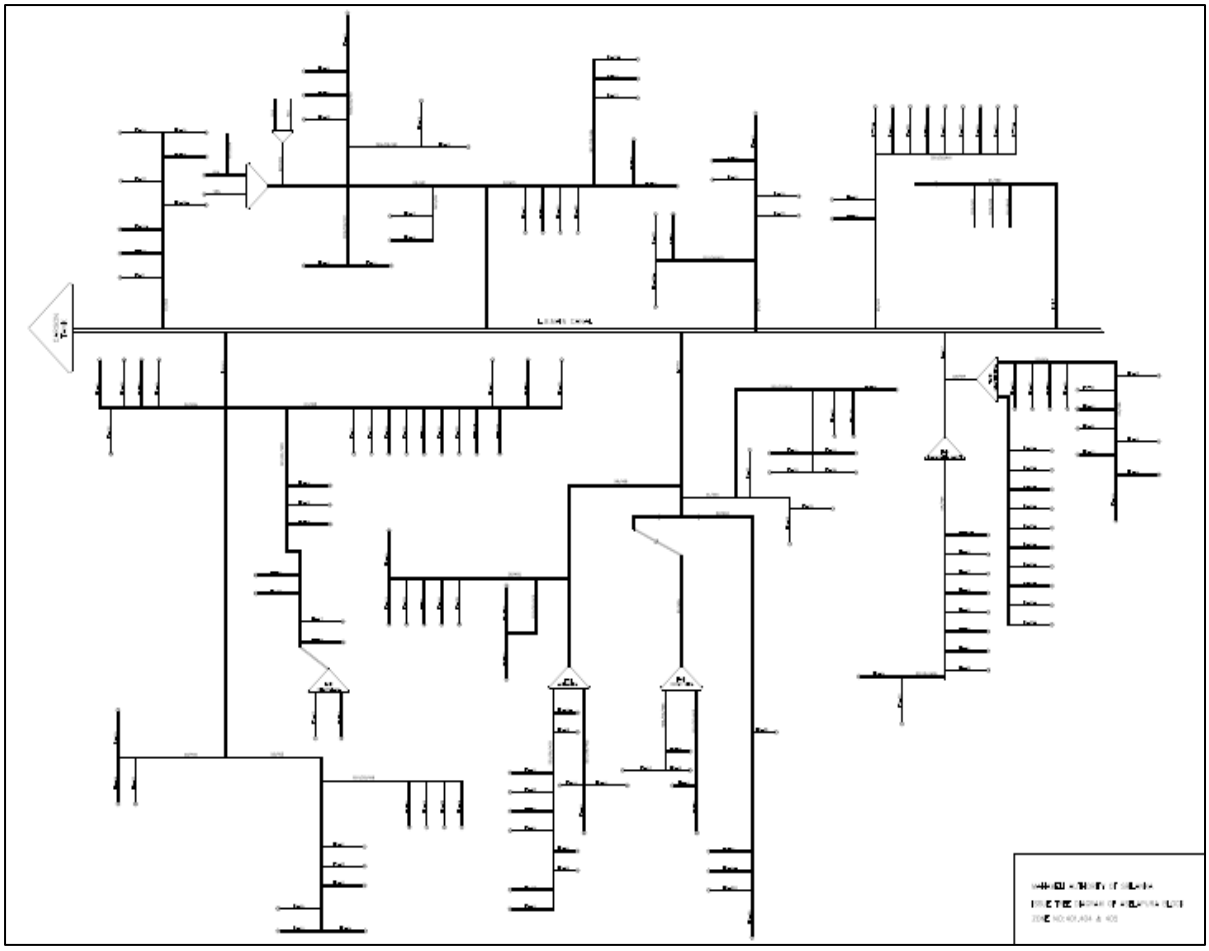


Figure 4.1. A cross-section of the water infrastructure in the Tennessee Valley Agrarian Fields (Ekbladh, 2002)

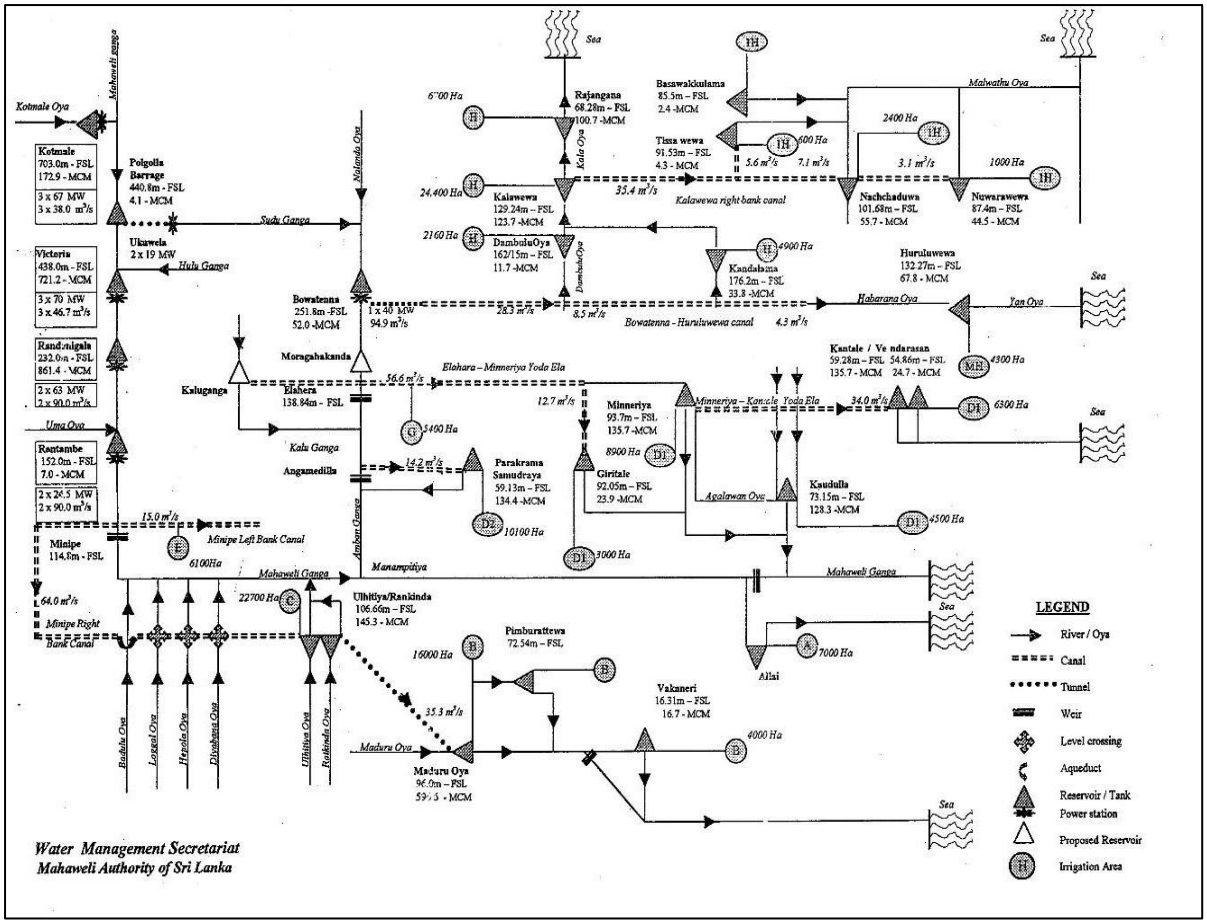


Figure 4.2. A cross-section of the water infrastructural layout in the MDP (image obtained from the Water Management Secretariat – the Mahaweli Authority of Sri Lanka).

There are numerous explicit references to the TVA project in the 18 volume financial statements, as well as in the implementation strategy outlined by the Netherlands based consultants. The TVA has been referenced in relation to the cropping intensities that can be expected after the MDP has been implemented (i.e., the number of times per year that a field can be cultivated). Further, explicit appraisals are drawn (in the financial statements) between the existing agricultural landscape in Sri Lanka and the TVA: in terms of cultivation outputs, primary and alternative field crop types, cropping patterns and settlement patterns. There are also more general and diffused references to the TVA in the way that the cost-benefit analysis is framed. Volume 16 of the financial statement, for instance, gives a yearly breakdown of the agricultural productivity in the TVA system, and proposes that the Total Factor Productivity (TFP) measurements that were used to evaluate the agricultural productivity in the TVA should also be used for an evaluation of the MDP.

Furthermore, the personnel who were involved with the MDP in terms of design had been trained in relation to the example provided by the TVA's irrigation system. In the words of one local expert who helped co-author the Master Plan for the MDP:

> *Most of the experts who took part in the Crofts-Weizmann mission [by the World Bank/IBRD], including the Project Manager, Mr P. G. Fialkovsky, the Co-manager, Mr. R. S. Cooke, and even the late H. de S. Manamperi who led the negotiations on the construction aspects were at one point working for the Tennessee Valley programme. So were some of the consultants employed by NEDECO [the Dutch consultancy firm]*
>
> [INTERVIEW – JUNE 2018]

Even the local experts who represented Sri Lanka's Ministry of Irrigation in negotiating the designs for the MDP were influenced by the TVA. This is because more than a decade before the plans for the MDP were drawn up, Sri Lanka's first (post-independence) prime minister commissioned a large dam to be built in the south-eastern parts of Sri Lanka, called the *Gal Oya* dam. The engineering expertise for this project came from a group of TVA engineers travelling to Sri Lanka. As part of their efforts, they also helped train the Sri Lankan irrigation engineers in water management. Thus, most (if not all) of the architects of the MDP were influenced by the water management style of the TVA. Before turning to the effects of the TVA's influence on the MDP, I first clarify precisely the mechanisms that facilitated the flow of TVA engineering into the design and implementation of the MDP.

4.3 A hydrosocial explanation for the adoption of the TVA model in the MDP

This section utilizes a hydrosocial lens to explore *why* the TVA water model was preferred for adoption in Sri Lanka, and *how* it travelled from its place of origin (in the United States) to take root in the Sri Lankan context.

4.3.1 Water and money: the TVA model and the appeal of quantified water

In the hydrosocial literature, multiple authors (Boelens, 2014; Boelens et al., 2019; Budds, 2009; Hidalgo-Bastidas, Boelens, & Isch, 2018; Linton, 2010; Linton & Budds, 2014) have noted that water was conceptualized as a 'resource' in the context of industrial modernization. As water became, literally, a lubricant for agricultural intensification (Bakker, 2012), it became increasingly important to be able to secure continuous measurable supplies of water for agricultural purposes. I argue that this was the main appeal of a straight-line,

TVA-style irrigation system (refer to Figures 4.1. and 4.2.), where factors such as the relationship between water supply and agricultural output could be, at least hypothetically, mathematically calculated at an abstract level. Linton (2008) has noted the same advantage in the concept of the 'hydrologic cycle': where water is framed as continuously moving on, above and below the surface of the Earth. The hydrologic cycle encapsulates the concept of water in a very abstract way, and this abstract nature in turn, makes the idea of a hydrologic cycle transferrable across geolocations. This is in sharp contrast to water-related knowledges that are inherently grounded in specific geo-social contexts. Similarly, the irrigation style of the TVA gave the impression of being equally formulaic, which made it easy for policy makers to attempt to adapt the TVA design in many different geolocations, including Sri Lanka.

In the TVA system, several simple formulas based on a few boundary conditions (such as estimations of the amount of water consumed by field crops during their life cycle) would allow a local policy planner to calculate the number of hectares that could be cultivated through a specific issued quantity of water. In the MDP's Master Plan, for instance, cultivable areas in System H are calculated to the nearest 10 acres without allowing room for any uncertainty. This simplicity is attractive to policymakers, as a former resource economist for the MDP notes:

> *"... Policymakers often want an economic assurance that the project they are undertaking is profitable, or at least not a loss. In capital budgeting, this is calculated through a formula for measuring the internal rate of return. They want, at least, to be able to calculate, without significant uncertainty, whether a project is worth investing in. This is why the TVA model was so attractive and was so readily funded. On the one hand, [the model] shows you the numbers on a spreadsheet. On the other hand, it has already been tried, tested and verified in the USA to great effect ..."*
>
> [INTERVIEW – JUNE 2018]

Further, the quantitative focus on measuring water (present in the TVA and adopted in the MDP) also would have made more sense to the international funding organizations that drive the development industry. For instance, the World Bank was the main financial donor for the MDP, and in the 1960s, their policy was to fund self-liquidating projects at the expense of self-financing or welfare projects (Coutard, 1999; Kaika, 2005; Saurí & del

Moral, 2001)[5]. This is because, during this period of the World Bank's history, it faced the challenge of needing to establish its creditworthiness and obtain working capital through bond issues. Thus constrained, the World Bank's policy held that it should not lend for 'non self-liquidating ventures': projects with low rates of return that were unlikely to generate sufficient revenue to enable the loan to be repaid, particularly if the investment generated revenues in 'soft' local currencies (Kapur, Lewis, & Webb, 1997). Given this situation, the World Bank needed some assurance that it would get return on the investment that it made in the MDP. The TVA model was able to provide this assurance, derived in no small part from its ability to measure and quantify water, and translate this quantification into monetary terms. This is a key instance of how the water-logics of hydro-technological experts on the one hand, and the economic-logic of development professionals on the other, enabled the development of a shared perspective on water: thus, promoting the adoption of the TVA model in Sri Lanka.

It is also important to reiterate a point that I made in section 4.2 – that the employees of the World Bank sent to evaluate the Sri Lankan case (the *Crofts-Weizmann* mission and its sub-contractor, the independent consultancy firm based in the Netherlands) were at one point also involved in the design of the original TVA project. This finding points to a considerable overlap between 'hydro-technological experts' and 'development experts': suggesting that hydro-technological architects of the MDP also saw water *through* the interests, values, and knowledge-systems of the development industry. In broader terms, this finding stresses the emergent connections between the global networks associated with hydro-technological expertise and the development industry.

4.3.2 The 'simplicity' of TVA's infrastructural design

TVA-style irrigation is also simpler in terms of the infrastructural design of the water system. As Figures 4.1. and 4.2. illustrate, the TVA is comprised of straight-lined gravity-based network designs to transport water from its source (the river basin) to the end point (agricultural fields). This architecture makes it relatively easy to calculate the input and output of water. This is not the case in more complex water management systems. For example, Sri Lanka itself had a

[5] It should also be noted that the field mission to Sri Lanka was from the IBRD, and not the International Development Association (IDA) established much later. This distinction is important, since the IBRD was more open to funding projects that would repay the Bank on its initial investment (i.e. self-liquidating projects) than the IDA, which was more open to providing 'soft loans' with more focus on poverty reduction.

millennia-old complex water system comprising of a network of tanks (called cascades), where water circulated from small to progressively larger tanks (see Figure 4.3.):

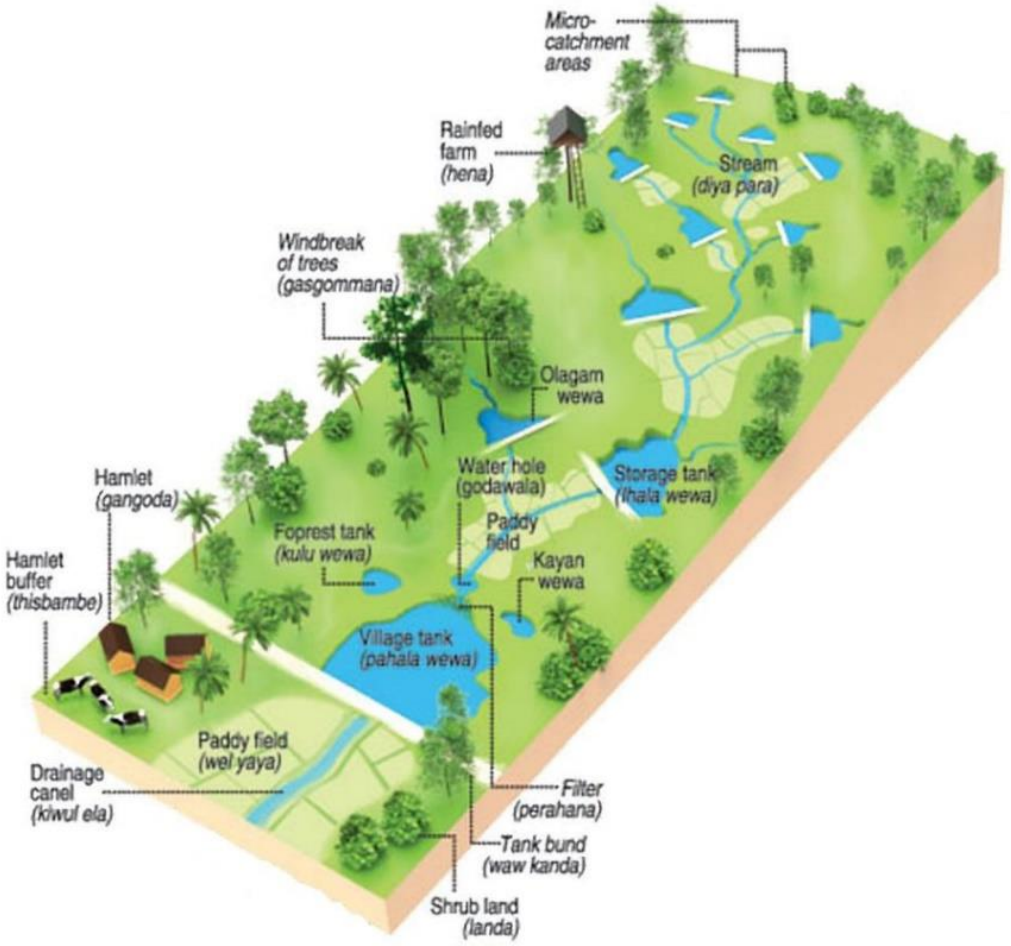


Figure 4.3. This is an image of the layout of the Tank Cascade System that existed in Sri Lanka since at least 1200 BC (Geekiyanage & Pushpakumara, 2013). As can be seen, the circulation of water is mapped to suit the immediate geographic contours of the landscape.

In TVA-style irrigation however, water does not circulate. It starts and ends at a specific destination, partly because it is not easy to maintain formulaic calculations for water use in a cycling system such as the above. In hydrosocial terms therefore, the simple, linear, and controlled nature of the TVA model aligned readily with the 'water as money' perspective described above, leading to its application outside the TVA, in Sri Lanka.

4.3.3 The national development paradigm and the adoption of the TVA

Another set of stakeholders that facilitated the transfer of TVA-style hydrologics to Sri Lanka was the Sri Lankan government itself. Extracts from the parliamentary Hansard reveals that the Sri Lankan government saw a macro-scale development programme centred on water management for irrigation as the solution for Sri Lanka's (perceived) under-development. The following excerpt from Mr. Gamini Dissanayake (the minister for the MDP) reveals that the Sri Lankan government wanted an effective and efficient solution to achieve national development, and had sought answers from the World Bank:

> *At stake here is the survival of society. People are dying. There is famine. There is unemployment. No one would have to starve when we [referring to the MDP] have made a success of an irrigation system of one hundred and thirty thousand acres … I like to mention here a conversation that took place between our President and the World Bank when he was Prime Minister, at which I was present. The World Bank was present. He told the World Bank, 'I have got a huge mandate, a five out of six majority in Parliament. I have committed myself to undertake a programme of development to get this country moving, to accelerate development to find some answer, may be not the perfect answer, for unemployment, for our food crisis, energy crisis. Now I want to get on with the job. Are you going to help me or not? He [the president] said, 'I do not want your advice to tell me that I should not do things. If that is going to be your advice, please leave me alone and leave the country. You can go back as quickly as you came. But if you want to help us, help us, so that we can get the development, that our people want in this country, off the ground as quickly as possible.*
>
> [AN EXTRACT FROM SRI LANKA PARLIAMENT'S *HANSARD* REPORT ON 17 MARCH 1983 DURING THE SECOND READING OF THE APPROPRIATION BILL, 1983]

This quote potentially points to issues of dependency, and to issues of decision making and autonomy. It is important to note that the Sri Lankan government did not specifically request an irrigation-centred project for the country, but rather, looked for a way to accelerate development overall. Thus, it appears that the World Bank and other international agencies (as opposed to the national government) may have opted for an irrigation-centred water project as a wholesale development solution for the crises of unemployment, food, and energy faced by Sri Lankans. This demonstrates the extent to which the newly emerging 'development industry' in the 1960s was influenced by US-centred networks of hydro-technological experts, in that development for Sri Lanka was considered achievable only through remodelling the country's waterscape in the image of the Tennessee Valley.

To sum up, this section looked at the reasons *why* the TVA water model was adopted in Sri Lanka, and *how* it travelled from its place of origin to take root in the Sri Lankan context. I have demonstrated how the TVA water system was constructed as an abstract and quantifiable model ready for use outside the geographic boundary of the Tennessee Valley. The attraction of mega project abstractions was also a driver of, and driven by, the context of international development from the 1960s onwards. Within this context, the Sri Lankan government's concern for its national development paradigm also drove the rapid adoption and implementation of the MDP. Thus, during this period, the MDP emerged as one of the world's first mega water projects that combined the international flows of capital and expertise associated with the modern development constitution, Modernist abstractions of water implemented in practice at a macro-scale, and policy networks, transfers, and mutations that helped to transform Sri Lanka's hydrosocial landscape into a working model of Truman's desire to develop the 'underdeveloped' world.

4.4 What were the implications of adopting the TVA designs in the MDP?

This section looks at how adopting the Tennessee Valley model has characterized the MDP (in terms of shaping its water infrastructure, regulations, and management style). In this section I shall also briefly hint at the (longer-term) implications felt by the water users in the region as a result of the TVA model being adopted in Sri Lanka. A deeper discussion of how these long-term consequences unfolded, and an analysis of their inter-generational effects on water users is provided in Chapter 6.

4.4.1 The 'simplification' of Sri Lanka's hydrosocial terrain

In section 4.3.2, I looked at how Sri Lanka itself had a millennia-old complex water system comprising of a network of tanks (called cascades). This tank cascade system consisted of hundreds of small and moderate-sized tanks[6]. The planners of the MDP went on to remodel this hydrosocial landscape in the image of the TVA, literally 'simplifying' it by demolishing a large number of local tanks. The attitude of the World Bank mission in relation to this infrastructural simplification was heavily critiqued in the Sri Lankan press. One quote from the *Daily News*, a newspaper published by the *Associated Newspapers of Ceylon* can be used to illustrate this:

[6] For a full discussion of the tank cascades, see Chapter 5.

> *The mission from the World Bank has the same attitude to water management as the late J.S. Kennedy [the director of irrigation in Sri Lanka in 1933 under the British rule] who famously said: the suggestion to deliberately destroy a tank may sound like a rank heresy, but as a matter of fact, the village tanks like the village cattle are too numerous for efficiency [italics added for emphasis].*
>
> [FEBRUARY 4, 1978, DAILY NEWS]

In addition to the tanks, many environmental and topographic features that characterized Sri Lankas's dry zone were also cleared through the process of remodelling. This is because, while the straight-line surface irrigation employed in the TVA would have worked well in Tennessee (given that the topography of the Tennessee Valley itself is relatively even and homogenous), it did not work as well in Sri Lanka due to country's high degree of surface unevenness and contours. In the words of a former Chief Irrigation Engineer for System C of the Mahaweli:

> *[The engineers] use basic data sheets to map the downstream target areas, indicating the contours and natural features of the landscape. The first activity is to identify the area which can be commanded by gravity from the reservoir. Then, they 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 – SEPTEMBER 2018]

In Chapter 6, I demonstrate that the attempt to proactively homogenise the landscape (an attempt that was never fully realized even at the surface level, and completely disregarded the movement of subterranean water) has resulted in various irrigation communities in the MDP systems receiving different amounts of water, which has had a major impact on their livelihoods. Figure 4.4. provides a visual representation of the linear, bounded, and abstract infrastructural designs employed by the architects.

Figure 4.4. Photographs of the canal-network in System B and System H of the MDP

4.4.2 Centralized water management and calculating water balances

TVA-style water systems called for centralized water management practices, in an attempt to gain an accurate quantifiable appraisal of the amount of water issued, and to equalize the natural streamflow. In order to calculate water allocations between the MDP's systems, the planners use a bi-model computer system called the Acres Reservoir Simulation Programme (ARSP) (see also Chapter 3). It is a mass balanced mathematical model for simulating the schemes operation (and calculating the allocation of water for each system) over a 40-year timeframe (1971-2010)[7].

With respect to balancing the water requirements for irrigation, the ARSP uses various parameters such as cropping intensities, the total extent of land to be cultivated within each system, and the type of crops to be grown. However, as a computer programme, any

[7] The ARSP programme has also been used to manage Irrigation and Hydropower projects in Kenya, India, Thailand, Ghana, Ethiopia, Newfoundland, Uganda, Nepal, and Panama (Manthrithilake & Liyanagama, 2012), meaning that imagining water in a quantitative, formulaic way is not unique to the MDP, and can be extrapolated to other Mega Water Projects constructed around similar time periods.

simulation created by the ASRP is reliant on many assumptions, most of which correspond to international developmental trends in agriculture rather than Sri Lanka's empirical context. For instance, the feasibility studies prepared by the MDP's planners assume that over time, farmers of the MDP will diversify into other field crops, which will require less water than the originally targeted crop: paddy. Such assumptions of future diversification are based on global agricultural trends (referred to in the Needs Assessment and Master Plan for the MDP) and not on site-specific conditions and contingencies. This is an example of how *global* trends in the development industry render invisible the *local* waterscape.

Further, the MDP's approach to managing water appears to be based on liberal economic principles of consumption, supply, demand, and profit. The opening sentence for the section on water balances in the Mahaweli Action Plan reads:

> *The approach is based on a volumetric water balance between water demand, for both consumptive and non-consumptive uses, and water supply, both from the Mahaweli River Basin and within the stipulated irrigation command areas.*
>
> [PAGE 68, MAHAWELI ACTION PLAN]

This way of balancing water trade-offs provides an indication as to how water was imagined within the ARSP (and by extension, the MDP). In the ARSP, water (measured in cubic millimetres) is one variable in a formula in which the other elements are economic (such as consumption, supply, demand, and profit). Making water a 'variable' in an economic formula illustrates water's status as a quantifiable resource – subject to scientific control and manipulation – in the eyes of the MDP's planners.

One consequence of using the ARSP to manage water in the MDP is that the amount of water that each system receives is calculated in a rigid top-down manner. This centralized water management style is reflected in the regulatory instruments and polices that govern the decision-making processes within the MDP. In fact, the annual water allocation plan for the MDP is determined by a group of high-ranking civil servants (the permanent secretaries for the Mahaweli Project, the Sri Lankan Electricity Board, and the Sri Lankan Water Board) by using the ARSP datasets compiled by employees of the Planning and Monitoring Unit for the MDP. The annual water allocation plan thus drafted and finalized would then be handed down to the regional project manager for each system of the MDP.

4.5 Assembling Modern Water: Hydrosociality, Development and the MDP

This chapter demonstrated that the design of the MDP is influenced by the interplay of politics between a variety of global institutions and the Sri Lankan government. As such, the adoption of the TVA model for use in the MDP is not merely a techno-managerial decision but is also a highly political one: conditioned by specific histories of the emergence of international development networks and expertise in large-scale hydro projects. This section looks at my analysis of how and why the TVA model was adopted in the MDP; and signals its contributions to several bodies of literature: water governance, mega water projects, development, and policy mobility.

First, conventional theories on water governance and development tend to think of exporting efficient water management systems to improve the waterscapes of the Global South as 'progressive' (Bakker, 2013; Saggi, Maskus, & Hoekman, 2004). Such an analysis ignores the political dynamics that permeate the very core of such policy transfer and adoption. For instance, I have demonstrated in my analysis that the MDP's adoption of the TVA model reflects a process of abstraction and simplification for the purpose of more technical and streamlined policymaking (rather than a process geared towards incremental improvement). Further, I have also demonstrated how *global* trends of the development industry render invisible the *local* waterscape, often with negative consequences. Thus, the adoption of the TVA model seems to be rooted in an attempt to make planning and implementation of the MDP easier, not necessarily better. It is only by paying attention to the politics, interests, and particular 'visions of development' (Boelens et al., 2019, p. 417) supporting the process of policy transfer, that one can begin to paint a more complete picture of the emergence of the MDP.

Second, exploring the MDP in terms of equally circulating water logics (propagated by a network of USA-trained engineers and hydrologists) and development narratives (propagated by a network of development experts and institutions) adds a new dimension to existing literature on the international transfer of water-related policies and planning. While that literature has typically focused on proliferating international conduits for transferring models and best practices within contemporary 'good governance' frameworks for water (Goldman, 2007), exploring the MDP in relation to this literature reveals a longer institutional history of transferring water logics across national contexts[8]. For instance, the

[8] Existing literature on the international transfer of water policies concentrate their discussions on: the World Bank's post-1970 'water for all' policy (Goldman, 2007); the Bank's move into the domain of urban domestic water supply (Bakker, 2013); and policy transfer in light of the 'green neo-liberalist' ideological

fact that USA-trained hydrologists served both as internal officers of funding institutions (such as the UNDP, the FAO, and the World Bank) and as independent consultants outside the development industry (the NEDECO) exposes the degree to which USA-centred hydro-technological expertise had permeated the development industry since the latter's very emergence (in the 1960s). Thus, the literature that looks at the development institutions' involvement with the water sector should consider how USA-centric networks of large-scale hydro-technological expertise and the international development industry has relationally and recursively co-evolved from the outset.

Third, the hydrosocial framework adds yet another dimension to my analysis of how and why the TVA policy models circulated the globe, by demonstrating how the shared imagination of water as a *quantifiable and economic resource* created networks among engineers, development experts and the Sri Lankan government, which in turn facilitated the transfer of the TVA-model to Sri Lanka. Critical-development or post-development scholars and researchers on policy mobility who focus on the circulation of water logics and development narratives across geographies have so far not paid attention to hydrosocial aspects in their work. Since ideas about water governance, regulations, management strategies, and water-infrastructure all derive from the way a particular group of people 'understand' water, I conclude that the insights from hydrosocial literature (Boelens et al., 2019; Budds, 2009; Hidalgo-Bastidas et al., 2018; Linton, 2008) needs to be connected with the literature on development (Esteva et al., 2013; Kothari, 2019), and policy mobility (Goldman, 2007; Minkman, van Buuren, & Bekkers, 2018; Prince, 2017; Temenos & McCann, 2012) in order to fully understand the sub-structural workings of first-generation mega water projects such as the MDP.

Finally, first-generation mega water projects such as the MDP can be seen as 'carriers' of the 'modern water paradigm'. In the hydrosocial literature, the works of Jamie Linton and Jessica Budds (Linton, 2010; Linton & Budds, 2014) focus on how the 'scientific' or 'modern' conceptualization of water as 'H_2O' has come into existence. Specifically, this literature notes that the United States became, since the 1936 construction of the Hoover Dam (the world's first so-called super dam), a world leader in the propagation of the 'modern water' paradigm. However, while Linton, Budds and others (Boelens et al., 2019) have

revolution (Bakker, 2010; Castree, 2009). However, findings of this chapter demonstrate that the international transfer of water- and irrigation-related policies have an older history that dates to an era before the World Bank was transformed by its president Robert McNamara.

focused on how the paradigm of 'modern water' emerged in the USA[9], the precise way (the *how* and *why*) in which modern water was disseminated to other geographies (particularly of the Global South) has not received much attention. This chapter helps to fill this gap, revealing that the architecture of the development industry (particularly the policies of the World Bank, which was, and still is, the most influential actor in setting development agendas) has helped circulate the idea of 'modern water' into varying geographical contexts in the Global South, when financing first-generation mega water projects like the MDP. In this sense, the TVA's design can be seen as the 'carrier' of the modern water paradigm, actively promoted by the World Bank into countries of the Global South.

[9] Essentially by institutionalizing the quantification of stocks and flows of water on a national scale, the United States took a major step in making water available for, and amenable to, management by state agencies. These agencies were eventually to succeed in controlling a vast portion of the water flowing in American rivers, thus materializing modern water and consolidating its identity as an abstraction of flow (Linton, 2010).

CHAPTER 5

Hydrosociality of the tank cascades and the creation of hybrid waterscapes within the MDP

5.1 Hydrosociality and policy mutation

In the previous chapter I examined – through the combined insights of hydrosociality, post-development theories, and policy mobility – how international flows of knowledge and expertise around water have come to shape the design of the MDP. In that chapter, I observed how the ethos of the development industry has contributed to the construction of the 'modern water' paradigm, and how the 'modern water' paradigm (embedded within the TVA design) came to characterize the irrigation landscape of Sri Lanka vis-à-vis the MDP. That chapter also articulated how a hydrosocial understanding of water can deepen our knowledge of how water policies travel across geographies: the imagining of water as an economic, quantifiable resource by post-war development institutions was essential to the transfer of TVA-style irrigation models from the USA to the global south.

While Chapter 4 focused on the design of the MDP, this chapter focuses on its implementation. I begin the chapter by presenting a hydrosocial analysis of the kind of human-water relations that existed in Sri Lanka when the MDP was first implemented. Drawing on this analysis, I then demonstrate how farmers in Sri Lanka, grounded in their cultural and symbolic understandings of water, contested the technical expertise of the MDP's planners, leading to a different version of the project being implemented on the ground rather than what was originally conceived. In other words, I demonstrate that the technical and economic water rationalities embedded in the MDP's design were not able to fully override the local human-water relations. Thus, the MDP did not fully reorganize the water flows in Sri Lanka's dry zone as per its original agenda – rather, it created a complex hybrid regulatory landscape where both global and local water perspectives joined together to form intricate assemblages.

5.1.1 Introducing the tank cascade system[10]

Sri Lanka's North Central dry zone, where the MDP was implemented, was originally home to a water harvesting and management system that comprised of a series of human-made tanks, locally called *wewa* (Abeywardana, Schütt, Wagalawatta, & Bebermeier, 2019). The tanks are typically organized in cascades and are connected by canals. Functionally, the tanks are used to store, transfer, and utilize water (see Figure 5.1.). Based on historical sources, the tank cascade system of water management dates back to the 4th century BC – flourishing until its partial abandonment in some provinces during the mid-15th century due to Portuguese and Dutch influences on Sri Lanka's agriculture (Abeywardana, Bebermeier, & Schütt, 2018; Madduma Bandara, 1985). The tank cascades were revitalized by the British colonial rulers in the 18th century, however, and have been an ever-present feature in Sri Lanka's waterscape until the inception of the MDP. Over the span of around two millennia therefore, around 30,000 tanks have been built as part of the tank cascade system in Sri Lanka. Roughly one third of these tanks are currently functional (see Figure 5.1.).

The tank cascades of Sri Lanka appear to be similar in style to another tank-based irrigation system found in the state of Tamil Nadu in South India. The oldest tanks in Tamil Nadu dates back at least to 200 BC, meaning that they were created around the same time as their Sri Lankan counterparts. Further, the tanks in Tamil Nadu appear to be similar to the tank cascades in Sri Lanka in both form and function – in that they cycle excess water from one tank to the next. Despite such similarities between the two systems, and an increasing awareness of the role played by tank cascades in advancing the irrigation practices of Tamil Nadu (Srivastava & Chinnasamy, 2021; Hakeem & Raju, 2009), no attempt seems to have been made in the literature at investigating whether these two systems have had a shared provenance.

While noting the existence of tank cascades in Tamil Nadu enables us to locate Sri Lanka's tank cascade system – both geographically and temporally – within the larger South Asian context, it is beyond the scope of this thesis to undertake an examination of how these two systems might have historically co-evolved. Such a study moreover, although important in its own right, would not have a significant bearing on my analysis of Sri Lanka's pre-MDP hydrosocial relations.

[10] The material presented in the following sections has also been published by the author during his Ph.D. candidature – see Paranage, K. (2018). Understanding the relationship between water infrastructure and socio-political configurations: a case study from Sri Lanka. *Water*, *10*(10), 1402. It is not, however, a *verbatim* reproduction of that manuscript.

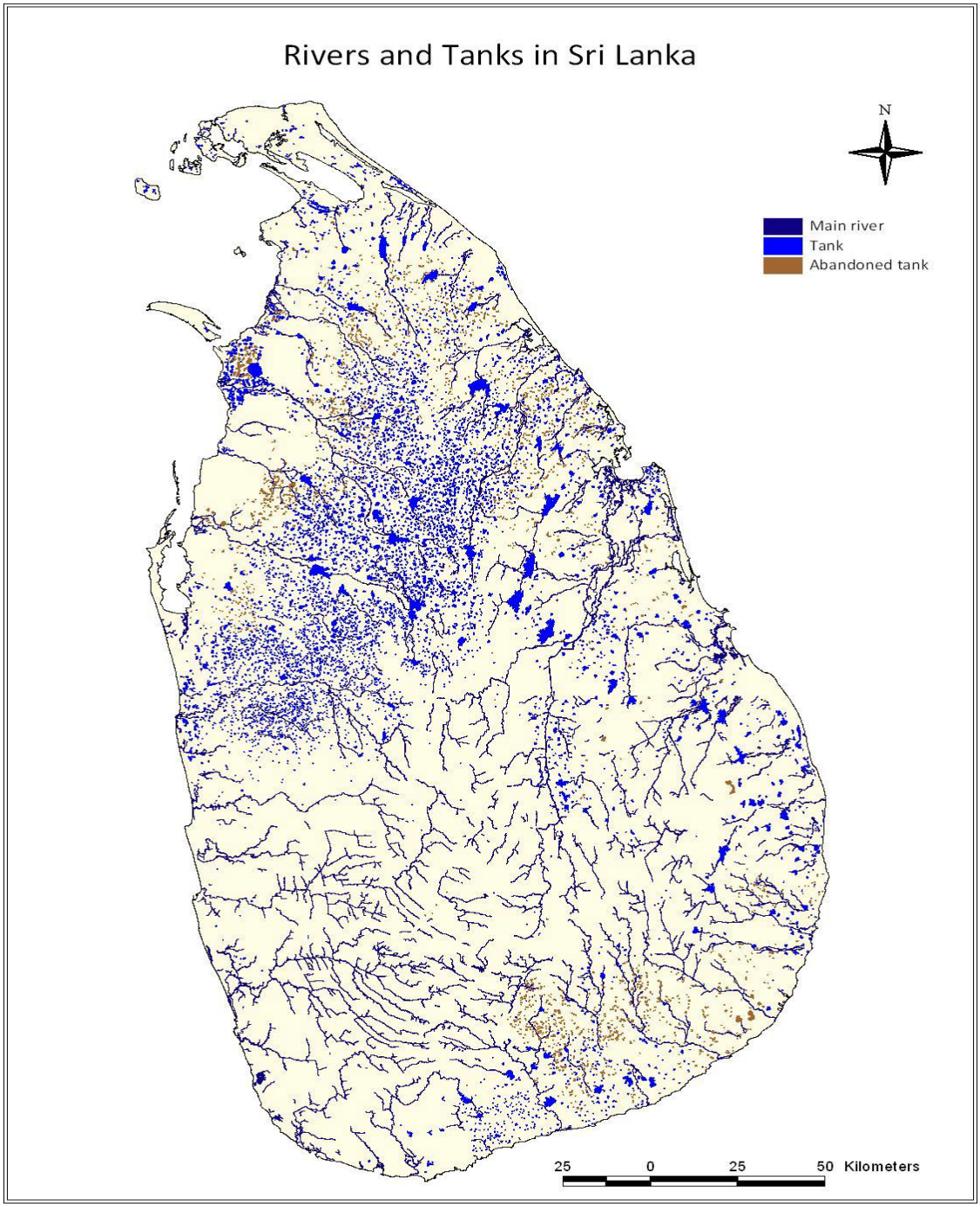


Figure 5.1. A map containing Sri Lanka's streams, rivers and small to mid-sized tanks constructed before the country's colonization by the British in 1815. Approximately 10,000 of these tanks are still functional in some capacity (Abeywardana et al., 2018).

I noted in Chapter 1 that the North Eastern parts of Sri Lanka were an ecological 'dry zone'. This dry zone enjoys less than 1750 mm of rainfall with high rates of evaporation and is plagued by recurrent droughts and desiccating winds. The tank cascade system was the ancient Sri Lankan farmers' response to the droughts, as it is founded on principles of water conservation. By cycling and re-using water through a network of small to large scale tanks, ancient farmers were able to irrigate large expanses of lands using a relatively small amount of water (Geekiyanage & Pushpakumara, 2013).

Being over 2 millennia old, the tank cascade system with its accompanying socio-ecological practices was entrenched in the lives of Sri Lankan farmers. Later in this chapter, I will utilize a hydrosocial analysis to explore the dynamics of the human-water relationships that were built around the tank cascades and how they affected the implementation of the MDP.

5.1.2 Structure of the analysis

For the analysis in this chapter, I draw upon two strands of scholarship. First, I utilize hydrosocial literature to unpack the character of human-water relationships in the dry zone of Sri Lanka as they were influenced by the tank cascade model of water management. The concepts of 'hydrosocial networks' (networks that are intentionally and recursively shaped around water and its use) and 'hydrosocial territories' (spaces produced through the interactions between water, human imagination, social practices and related knowledge systems), in particular, inform my analysis (Boelens, 2014, 2015; Hidalgo-Bastidas, Boelens, & Isch, 2018; Hommes, Boelens, Harris, & Veldwisch, 2019; Hommes, Boelens, & Maat, 2016; Shah, Boelens, & Bruins, 2019). Second, I draw on the body of work focusing on policy translation (Brenner, Peck, & Theodore, 2010b; David P. Dolowitz & Marsh, 2000; Mukhtarov, 2014; Mukhtarov, de Jong, & Pierce, 2017), the travel of ideas (Mukhtarov et al., 2017), and policy mutation (Brenner et al., 2010b; Brenner, Peck, & Theodore, 2010a; Yates & Harris, 2018). This literature has demonstrated (particularly within the domain of water policy) how various water-related discourses intersect to create variegated water policies replete with contradictions, innovations, limits and constraints (Yates & Harris, 2018).

The scholarship on policy translation and mutation has recently been developed by researchers trying to show how water management practices mutate to fit local contexts when applied in specific cultural geographies. As I shall show in this chapter and the next, the idea of policy mutation can successfully be employed to analyse the occurrence of similar transformations within the MDP. On the other hand, *how* and *why* such transformations occur

can only be explained with reference to a hydrosocial analysis. The point, then, is to show how a hydrosocial analysis can complement policy translation/mutation perspectives, thereby contributing to both camps.

The remainder of this chapter is structured into three main sections. Section 5.2. looks at how water was hydrosocially constructed in the pre-MDP waterscape based on tank cascades, and how farmers organized their socio-economic lives around the concept of the old tank cascades. Section 5.3. looks at how the residents of Sri Lanka's dry zone generally, and the farmers of the tank cascade systems more specifically, defended their way of life in face of the ongoing implementation of the MDP, challenging its TVA-inspired infrastructure and management policies. Finally, section 5.4. concludes this chapter by illuminating the contributions this analysis makes to the literature on hydrosociality and policy translation.

5.2 Before the MDP: A hydrosocial analysis of the way of life in Sri Lanka's Dry Zone

In this section, I look at the way the waterscape of Sri Lanka's dry zone was organized prior to the MDP being implemented. This section draws upon the interviews that I conducted with farmers of irrigation System H, most of whom remembered a life farming in the tank cascade system before it was reconfigured by the MDP. I also draw from interviews that I conducted with farmers in *Palugaswewa*: an irrigation system that is adjacent to System H (see also Chapter 3). The Palugaswewa irrigation system is unique in that it still operates in a tank cascade model, adjacent to, but falling outside the boundaries of the MDP. Farmers in Palugaswewa also come from an unbroken lineage of farmers in tank cascades that runs back for at least a century.

In conducting a hydrosocial analysis of the human-water relationships in farmers of the tank cascade systems, I concentrate on three different elements. First, I look at how water was imagined or conceptualized by the farmers in the tank cascade systems. Second, I look at how farmers around the tank cascades organized themselves in a hydrosocial network (Boelens, Hoogesteger, Swyngedouw, Vos, & Wester, 2016) by exploring the kinds of associations that they established with each other and with water. Third, I look at how the body of water forms part of the villagers' and farmers' core identity. Taken together, these three components form part of an overall hydrosocial analysis of Sri Lanka's dry zone before the MDP.

5.2.1 Imagining water in tank cascade systems

The hydrological principle behind tank cascade systems is the cycling of water through a network of small to large tanks. A ‘cascade’ is a connected series of tanks located within a micro- (or meso-) catchment in order to store, convey, and utilize water from a rivulet (Abeywardana et al., 2018). Each of these cascades define a distinctive small watershed or meso-catchment ranging from 13 to 26 km^2, with an average size of 20 km^2 (Abeywardana et al., 2019). The tank cascade system is the basis for organizing irrigation networks within Sri Lanka’s dry zone. Tanks, paddy fields, watersheds, and canals have been integrated and interwoven with the natural environment for over 2 millennia (Geekiyanage & Pushpakumara, 2013). The tank cascade system of water management uses rainwater and small streams as primary water sources. Water is stored in small tanks and is used to cultivate downstream areas. Once used, the water flows down to increasingly larger tanks (see Figure 5.2.).

Figure 5.2. A drone photograph of the tank cascades in the dry zone of Sri Lanka obtained (with permissions) from the archives of the Mahaweli Authority of Sri Lanka

A key characteristic of the way water is imagined or enculturated in the tank cascade system is the central role of water in connecting various discrete elements of an eco-system. In the words of one farmer from the Palugaswewa irrigation system:

> *Water is not a separable part of the environment … it is part of a greater whole. One must consider everything … the earth, the trees, the birds, and the people, [to which] water is in some way connected. [Therefore] to look at water as something to be used only for farming, or even only for drinking, is misguided. [We] use [one or several of] the village tanks for all our needs, be it for farming, drinking, recharging our wells, or feeding the animals. To focus only on cultivation does not keep with traditional principles of the interdependence of all living things.*
>
> [INTERVIEW – OCTOBER 2018]

Frequently, the farmers who were interviewed also referred to the *Theravada Buddhist* doctrine of *Pratītyasamutpāda,* which can be translated as 'dependent arising' (Bhikkhu, 1997). It is important to note that the doctrine of *Pratītyasamutpāda* is very different to that of causality as it is understood in the West. Instead of referring to a direct Newtonian form of causality, the concept of *Pratītyasamutpāda* in Buddhism refers to conditions resulting from a plurality of causes that necessarily co-originate phenomena within and across lifetimes (Paranage 2018b). The concept of a plurality of causes directly underpins the interconnected eco-systems approach utilized by farmers of the tank cascade system.

Relatedly, the evolution of the tank cascade system under the influence of Theravada Buddhism: the dominant religion in Sri Lanka since the second century BC (Withanachchi, Köpke, Withanachchi, Pathiranage, & Ploeger, 2014), meant that Buddhist monks have traditionally played a dominant role in shaping socio-cultural perspectives of water management. Village monks are often consulted on water management decisions and to lead agriculture-related festivities. As a farmer from the Palugaswewa irrigation system puts it:

> *Village priests [Buddhist monks] are very much a part of everyday life. The temple itself owns some land under 'Olagama' [or] 'Paraveni Pangu' [rules of land ownership existing in rural Sri Lanka]. The priests organize 'Pinkam' [a type of group-worship], for the villages to participate in, before the beginning of a cultivation season. Sometimes, a 'Pinkam' might be organized when there is drought.*
>
> [INTERVIEW – OCTOBER 2018]

The nexus between Buddhism, water, and agriculture, together creates a hydrosocial (perhaps even a hydro-cosmological) understanding of water as something that unifies the innumerable elements of the environment. This way of understanding water is widely different to the way hydrologists, engineers, and development experts understood water when planning the MDP. Later in this chapter, I will look at how the two different water worlds collided when implementing the MDP.

5.2.2 Forming hydrosocial networks and territories around tank cascades

The village tank is essential to the social organization in the dry zone of Sri Lanka, with the cascade system being a logical response to the ecological challenges present in the dry zone. Water is the scarcest resource in this environment and its rational use formed the basis of all dominant human activities. In an environmental setting where ground-water resources are relatively limited, it is natural that attention is focussed on storing surface waters. The management of surface water resources in a tank cascade system, once accomplished, organizes the microclimatic, hydrological, ecological, and sociocultural aspects of life.

This way of organizing social lives around the village tank is characteristic of all old (or *purana*) villages in the dry zone (Leach, 2011). Five land use zones in a purana village system are identified by: the tank, the old field, the field blocks, the parkland, and the forest (Leach, 2011). The main axis running through these zones is represented by the ephemeral stream which enters the tank and passes through the paddy fields. The original tank settlement with its necessary appurtenances displayed a fine adjustment of man's activities to nature, providing a stable background for its long-term persistence (see Figure.5.3.). Further, each village is a discrete and highly independent unit that is based on the village tank[11]. Thus, the dry zone of Sri Lanka can be thought of as comprising of small agricultural village-republics (Bebermeier, Meister, Withanachchi, Middelhaufe, & Schütt, 2017), each centred around a single dam or several dams joined together in a cascade.

[11] In most contexts, 'village tank' was synonymous with 'village' (Leach, 2011)

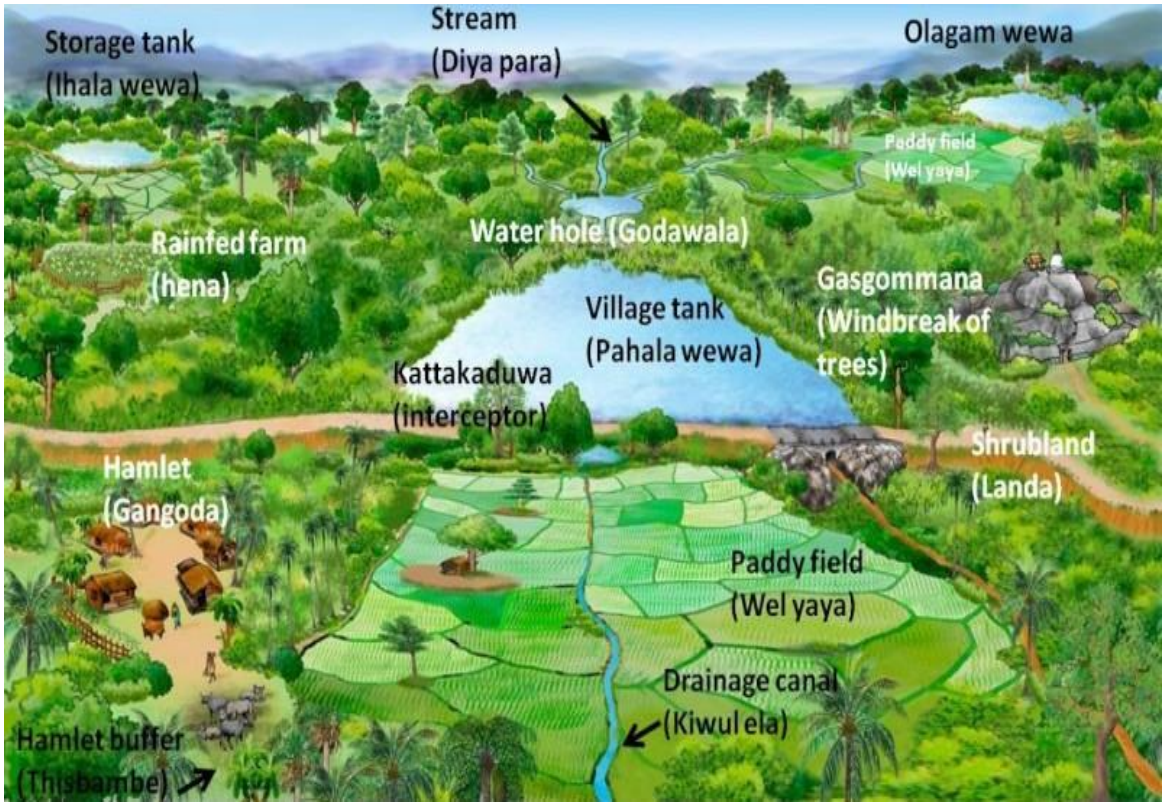


Figure 5.3. Schematic representation of a tank cascade system (the various components of the system are subtitled with their Singhalese names) (Abeywardana et al., 2018)

Although largely independent from each other in terms of cultivation, farmers from different villages often came together to maintain the dams that were linked in a cascade. For example, during a time of unusually heavy rainfall, a breach of the bund of the highest tank in the cascade can lead to a breach in the second tank and so on. In other words, heavy rainfall can progressively collapse the tanks like a set of dominoes. Therefore, the people living in a downstream tank settlement necessarily had a serious interest in the safety of upstream tanks. It was customary for farmers to pool their resources to repair a breached bund, and to collectively partake in tank maintenance.

> *We did it [maintained the tank] collectively with the instruction and leadership of 'Vidane' [village leader] … and all the farmers participated. The tank-bund was divided, and the maintenance and cleaning of each part was assigned to specific farmers. For example: back then, there were lot of cows in the village, and they would eat the grass that grew on the tank bund, causing damage to the bund. Farmers [annually] renovate the damaged parts of the bund, using soil cut from the tank bed. We maintained the tank for a long time like this.*
>
> [INTERVIEW – SEPTEMBER 2018]

In years of low rainfall, farmers have traditionally resorted to what was known as *bethma* or *Irawilla* forms of cultivation. Under these systems only a portion of the old paddy fields is chosen for cultivation on a common proportional ownership basis. In a situation of serious water shortage, a threatened crop could be saved if the tank above is able to release some water. Given the highly localised nature of rainfall in these areas, it is possible for different tanks in the cascade to receive different amounts of water from rainfall.

Other aspects of cultivation in the tank cascade system too, prompted collective social organization among the farmers. For instance, farms owned by individual farmers are arranged in a cluster in the areas downstream of the tank, while the farmers' residences are again arranged in a different cluster further away in a hamlet called a *Gangoda* (literally meaning 'village cluster' in Sinhalese), see Figure 5.3. The farmers have quite a distance to travel from their homes to reach their respective cultivation plots, meaning that they cannot effectively respond to night-time threats posed by wild animals (especially elephants). This required the farmers to coordinate a night-watch on a rotational basis. There is evidence to suggest that such coordination among farmers has also led to the communal regulation of production processes and cultivation (Paranage 2018b). This system of coordination is strengthened by a variety of social norms and values as well as kinship obligations (Paranage 2018b). According to one farmer from the Palugaswewa irrigation system:

> *All the major milestones that come up in seasonal cultivation must be achieved at the same time by all the farmers. Farmers can decide when to harvest their farms, but often all the farms are harvested within days of each other. And all the villagers get together to help each farmer with their harvesting; it is like a festive event. The wife of the farmer [whose lands are being harvested] plays the role of the host, and the women of the village all gather to help her cook and set up lunch for the men working in the field.*
>
> [INTERVIEW – SEPTEMBER 2018]

If a particular farmer cannot tend to or harvest his field due to sickness or some other adverse circumstance, it is standard practice for the other farmers to cultivate and harvest his crop, which is then given to the affected farmer's family.

Finally, it should be noted that the kind of hydrosocial territory that grew around the tank cascade system of water management, and the kinds of hydrosocial networks that were formed around it was only minimally altered during the period of colonial rule. Although the British colonizers attempted to formalize the land tenure system in the dry zone by enacting

the State *Lands Encroachments Ordinance No. 12 of 1840*, the *State Lands Encroachments Ordinance No. 12 of 1840*, the *Land Resumption Ordinance No 4 of 1887*, and the *Land Development Ordinance No 19 of 1935*, this was not systematically implemented on a large scale. Thus, while it is difficult to understand the full extent of changes that colonial rule had on the dry zone, it is safe to assume that it did not substantially alter the character of the small agricultural village republic.

5.2.3 Tank cascades and the Singhalese identity

The village tank was also part of the core villager identity. Since the lives and the livelihood of the villages were immediately tied to the small, localized tank, it became a part of the Singhalese identity. Water was an element that was central to most agrarian rituals in the dry zone villages, as reminisced by one farmer in System H:

> *'Kiriethireema' is an annual ritual based on irrigation, and farmers collectively expect water from the sacred 'Bo' tree and the 'Kaludevatha Bandara' god. There are two types of 'Muttimangallaya' ceremonies (Pot ceremony) performed annually to get the support of … guardian gods. Every seven years, we organise 'Mahadana' … again this ritual is to regenerate the collective sprit of the community. All these rituals are based on irrigation water, and finally those rituals enhance common unity and community spirit among the farmers.*
>
> [INTERVIEW – SEPTEMBER 2018]

Since irrigation and water use was the dominant livelihood form in rural Sri Lanka, water became a symbol that represented the state (Leach, 2011). Sri Lanka has been referred to variously as a 'hydraulic state' and as a 'hydraulic civilization' by a number of anthropologists (Ballestero, 2019; Beatty, 2018; Leach, 2011). In his now seminal study on a rural agricultural village in Sri Lanka, Edmund Leach (2011) noted that the social organization in the country was established on a caste system predicated upon roles related to irrigation and water management. The largest caste group in Sri Lanka was the *Goigama* (cultivator) caste (comprising of around 70 percent of the total Sinhalese population), who were involved with farming. The other castes too, subscribed to a division of labour that was predicated on irrigation and water management or performed attendant duties to the dominant *Goigama* caste. These caste systems were still widespread and functional around the time of MDP's implementation, as was noted in my interviews with first-generation of farmers who had lived through the transformation of their hydrosocial landscape by the MDP in the 1970s.

> *In my time [prior to the implementation of the MDP] there were separate villages for the families [of other castes]. They lived in these villages and provided various services to the 'Goigama' caste such as pottery, blacksmithing. 'Doranawa', 'Mahiellawaand', and 'Kumarakeliya' are some of these villages.*
>
> [INTERVIEW – SEPTEMBER 2018]

Some castes specialized in water management, tank repair, and performing aquatic rituals in the villages. Members of these castes were called the *Vanniharu*, and their services were in great demand throughout the dry zone.

Apart from directly shaping the social and occupation hierarchies of Sri Lanka, water is seen as a symbol for the country itself. A stanza from a poem that is historically common among Sri Lankan villages (and still uttered symbolically at the inaugural swearing-in of the executive presidents and prime ministers of Sri Lanka) is:

Devo Vassathuc Kalena Sassa Sampaththi Hethucha Pitho Bhavatu Lokocha Raja Bhavatu Dhammiko

[Translation]: May there be rain in due seasons. May the crops be bountiful. May the king be righteous, and may the country become prosperous.

To summarize this section, a hydrosocial analysis of the tank cascade system contributes to our understanding of water governance in Sri Lanka before the implementation of the MDP in three important ways. For one, it demonstrates that water in tank cascade systems was imagined as a force that unifies the environment which is very different from the abstract rendition of 'modern water' discussed by Linton and others (Boelens, 2015; Linton, 2008, 2010). Second, it illuminates the principles of social organization among farmers in tanks cascades. I noted how each village was independent in terms of water governance and hydrosocial arrangements, excepting cases where they came together to maintain the integrity of the tanks. I also observed how, within villages, water governance and irrigation planning took on a collective form, resembling the theory of common-pool resources articulated by Elinor Ostrom and her colleagues (Ostrom, 2000, 2002; Varughese & Ostrom, 2001). Third, I looked at how water and the village tank formed part of the village identity, in some cases overlapping with the Singhalese ethnic identity. The remainder of this chapter will look at how the farmers, grounded in their cultural and symbolic understandings of water, contested the technical expertise of the MDP's planners, leading to a different version of the project being implemented on the ground rather than what was originally envisioned.

5.3 Hydrosociality and the mutated implementation of the MDP

This section draws attention to the various ways through which the residents of Sri Lanka's dry zone generally, and the farmers of the tank cascade systems more specifically, defended their way of life in face of the ongoing implementation of the MDP – whilst also challenging its TVA-inspired infrastructure and management policies. This section demonstrates that the foreign hydro-logics of the MDP did not entirely override the local hydrosocial networks, but rather, combined with them to form new hybrid regulatory mechanisms. I provide three examples: the incorporation of local village tanks into the MDP's water infrastructure, the change of policies concerning water commodification and cost-recovery, and the implementation of farmer organizations that were structured differently from the initial designs.

5.3.1 Incorporation of village tanks into the MDP's water infrastructure

An analysis of the newspapers that appeared in 1979 from the *Associated Newspapers of Ceylon Ltd*., tells the story of how the MDP's water infrastructure was transfigured to incorporate the village tanks in irrigation System H. Initially, the MDP's plans involved the demolition of all local village tanks (existing as part of the tank cascade system) to pave the way for new infrastructure. However, as recorded in articles published in the newspapers *Dinamina* and *Silumina*, farmers protested the destruction of the tank cascades.

First, the farmers drew a sharp distinction between the 'foreign' knowledge agenda of the World Bank, and the local knowledge systems of traditional Sri Lankan water users. Farmers argued that local knowledge should be respected above foreign expertise, and that local heritage be preserved. Second, it was asserted by both farmers as well as some politicians of the now defunct *Sri Lanka Equal Society* political party, that the Sri Lankan irrigation sector was not merely another division that contributed to the country's economic growth, but also part of its identity. Third, the farmers argued that the village tanks could be effectively incorporated into the MDP's water infrastructure. They argued that incorporating the village tanks into the MDP's water distribution system would expand the command area of the project[12] by several thousand hectares: serving more farmers. Further, they argued that

[12] The area that can be irrigated using water from the Mahaweli river.

interposing village tanks into the straight-line irrigation system proposed by the MDP would provide wide-ranging ecological benefits by recharging ground water more effectively[13].

The protests gained equal traction among farmers, residents of the dry zone, and politicians. In 1979, the then-leader of the opposition, Mr. M. N. Perera, appealed to President J. R. Jayawardena and the government to alter the plans to the MDP to incorporate the village tanks. The president concurred to this appeal and after consulting with the farmers, issued orders to the Minister for Mahaweli Development to alter the plans for the MDP. The amended MDP infrastructure and policies were rolled out towards the end of that same year.

5.3.2 The drive for free water

In the original (pre-1978) agreements entered by the government of Sri Lanka with the World Bank, it was stipulated that the water cost must be borne by and paid for by the farmers in the MDP's irrigation schemes. The cost was originally set by the World Bank at 40 Sri Lankan rupees (LKR) per acre owned by the farmer which, by the 1978 conversion rates published by the US treasury, would have amounted to a little over 2 US dollars/acre. The recommendations of the Crofts-Weizmann Mission of the World Bank read as follows:

> *Irrigation water is an input for agriculture just as much as seed, fertilizer and agro-chemicals are. It cannot be considered a donation or a dole, especially when supplied from distance places, at enormous public expense, from costly head works and distribution systems. If farmers are to rise above subsistence levels of husbandry and if farming is to be a rewarding as well as a dignified business, costly irrigation water must be paid for as part of the farm budget. Payment is also essential if appropriate levels of water use efficiency are to be achieved. Payment for water is necessary in the interest of both the farmer and the rest of the population who pay for the investment.*
>
> [EXTRACT FROM THE WORLD BANK'S MISSION REPORTS].

[13] This, however, was not the eventual outcome. Without making a case for either the superiority of the TVA system or the efficacy of the Sri Lankan hydraulic model, I will demonstrate, in Chapter 6, that this hybridization of the two systems, without proper investigations being undertaken to observe the working of the cascade system, has led to many adverse ecological and social consequences. Part of the problem was the absence of a systematic architecture to guide the fusion of small village tanks to the MDP. Since different clusters of villages had distinct layouts for organizing small tanks into cascades, the MDP mutated in extemporaneous ways when incorporating the small tanks into its design. As will also be noted in Chapter 6, this lack of uniformity in mutating meant that different systems (and sometimes different areas within the same system) of the MDP received variable amounts of water leading to multiple socio-environmental problems.

This is an intriguing quote that reveals how the World Bank's articulation of water in agriculture is embedded within the economic and technical paradigms of 'modern water'. The focus on water as an 'input' for agriculture points to the perceived marketability of water, while the phrase 'supplied from distance places' implies notions of cost recovery and of water as a 'flow resource' (Bakker, 2010, 2012). The idea that irrigation water must be paid for by the farmers for farming to be a 'rewarding as well as a dignified business' highlights the normative notions of economic development forming part of the World Bank's development agenda (Bernsteint, 1971; Garcia, Millet, & Tonnelier, 2015; Ram & Ural, 2014; Scott, 1998). The notion of water as a limited, economic resource underlies the statement: 'payment of water is necessary in the interest of both the farmer and population who pay for the investment', illustrating ideas of cost recovery and demand management. The commodification of water is dressed as 'logical', closing the discussion to alternative understandings of water.

Although charging the farmers for water use was the initial consensus arrived at between the Sri Lankan government and the World Bank, this was met with open hostility by the farmers who were enculturated into the water governance philosophy of the tank cascades, and who considered water as a part of the environment to be collaboratively managed, not something to be paid for. Faced with the prospect of paying for water, the farmers soon organized themselves as political campaigners, fighting for the right for 'free water' and to stop the perceived victimization of poverty-stricken farmers. At various points, the campaigners also drew on nationalistic discourses, portraying water as part of the 'national identity of the Singhalese' (see section 5.2.3. above). The campaign soon made headlines in the national media, leading to the governing political party falling into disrepute among many sections of the population. Bowing to this pressure, Maithripala Senanayake (a temporarily appointed minister for the Mahaweli) went on record to say:

> *We object to several clauses in the agreement that were not in accordance with the sovereignty of an independent country. We primarily object to the levy of LKR 40 as irrigation costs, and the World Bank has agreed to delete this section from the agreement.*
>
> [EXTRACT FROM THE MONTHLY PUBLICATION 'CEYLON TODAY', VOL. XX NOS. 5-6, MAY-JUNE 1971 – CENTRAL LIBRARY ARCHIVES OF SRI LANKA].

This statement echoes the anti-commodification and anti-cost recovery sentiment widespread among Sri Lankan farmers. However, the minister's statement appears to be a

partial truth at best. In reality, the World Bank strongly objected to the removal of the water fee and the end result was a compromise: instead of openly levying a full 40 LKR fee for water use, the government reduced this to 20 LKR and included in a euphemistically labelled 'land betterment charge'. This was brought into effect in the *Land Betterment Charges Act* No. 28 of 1980.

5.3.3 Creation of farmer organizations

A third example of how the original MDP policies (in relation to its management philosophy) mutated in relation to the hydrosociality of Sri Lanka's pre-MDP dry zone can be found by observing the development of farmer organizations. The MDP was generally characterised by a multi-level centralized approach to the management of water, water-infrastructure, and irrigation (refer to Chapter 1, section 1.1.1). At the top level (system), the resident project manager supervised a team of disciplinary experts dealing with irrigation, agriculture, land, marketing, and community development. At the midmost level (block) there would be the block managers (reporting to the resident project manager), each of them with their own sub-team of professionals. The lowermost level (unit) comprised of unit managers who acted as the main contact between the settlers and MDP for provision of a wide range of services. The efforts of the unit managers were supplemented by field assistants for agriculture, water management, and irrigation labourers. This top-down approach of the MDP left little agency to the resident farmers, according to one project administrator:

> *Although an objective of establishing self-sufficient local organizations was sometimes expressed, the means to achieve this could be characterized only as 'guided democracy'. The planners assumed from the beginning that dry zone farmers are disunited and require a great deal of guidance and training from officials. Hence, there is an emphasis on developing a 'partnership' with the settlers, but not an equal partnership.*
>
> [INTERVIEW – JULY 2018]

However, during the MDP's early years (1980-1990), there was severe dissatisfaction among the farmers about their lack of active involvement in cultivation planning. Many farmers did not abide by the water management timetables assigned by the MDP's central planning committees, and instead, created unauthorized water ways to divert water to their personal fields at non-regulated intervals by damaging the canal network. Moreover, in System H especially, communications between the farmers and the MDP's management

began to deteriorate, with farmers often registering grievances with local politicians. In response, the MDP attempted to create farmer organizations at the lowest level (unit), through assigning leadership roles for farmers. However, this approach proved problematic:

> *There was evidence that 'leaders' were often selected by the authorities rather than farmers; and the groups were often controlled by power groups of influential and affluent farmers. Farmers have always asserted that these so-called farming organizations were mere extensions of the Mahaweli bureaucracy, dominated by the officers in collaboration with powerful farmers who were 'deputized' to act for the officers.*
>
> [INTERVIEW – JULY 2018]

Another problem noted by both farmers and low-level project administrators was that the MDP's approach to creating farmer organizations was based on the block/unit *administrative* model, rather than a hydrosocial one. For farmers in the dry zone who had organized themselves for centuries along the hydrological lines established by the village tanks, this novel form of organization was meaningless. Finally, in the late 1980s, the government of Sri Lanka collaborated with the International Water Management Institute (headquartered in Sri Lanka's capital, Colombo) to come up with the following proposals:

1. Creating farmer organizations based on hydrological lines, by organizing farmers around a hydrologic unit (tank).
2. Giving farmers the authority to appoint leaders within the organization, through a formal voting process.
3. Placing farmers in charge of maintaining the water infrastructure and giving leaders of the farmer organizations the right to fine farmers who damage infrastructure, or do not comply with standard management practices.

Although this new system of organization still differed from the natural organizational patterns of the old tank cascade systems, it did resemble these patterns to an extent. By organizing the farmers along hydrologic lines and not administrative ones, the new farmer organizations somewhat resembled the old 'independent village republic' model that I discussed in section 5.2.2. Further, the number of farmers involved in the farmer organizations was roughly similar to the number of farmers that occupied pre-MDP villages in the dry zone. On the other hand, there were still some noticeable differences such as the appointment of presidents and vice presidents through formalized voting procedures, and the

fact that the MDP only provided the farmer organizations with limited autonomy. However, this model of farmer organizations proved to be relatively stable and enduring, although not without its own problems, as will be discussed in Chapter 6.

5.4 Hydrosociality, policy mutation and the MDP

This chapter employed a hydrosocial analysis to understand how Sri Lanka's pre-MDP waterscape was constructed. This involved looking at how water was imagined in the pre-MDP dry zone of Sri Lanka, and how water itself (in the configuration that it was contained: as small tanks linked in a cascading network) caused the structuring of the dry zone society in certain ways that even contributed to the creation of a 'Sri Lankan identity'. I then linked my hydrosocial analysis of the pre-MDP waterscape to an analysis of how water policies of the MDP mutate (or are recursively adapted by the planners) in relation to various aspects of the pre-MDP dry zone's hydrosociality, thereby creating variegated regulatory arrangements.

As shown in this chapter, linking the conceptual framework of hydrosocial research with a policy translation/mutation perspective can provide a more nuanced and layered understanding of *how* and *why* policies mutate (Åm, 2016; Dolowitz & Marsh, 2000; Dolowitz, Plugaru, & Saurugger, 2019). Policy translation/mutation perspectives criticize conventional assumptions about policy making: that policies are stable instruments and that their core 'content' or 'lessons' can be understood and implemented in different geographical contexts to obtain consistently positive results (Dolowitz & Marsh, 2000). Instead, policy translation/mutation scholars look at how policies themselves are brought into existence and shaped by context specific meanings (Dolowitz & Marsh, 2000; Dolowitz et al., 2019; Minkman, van Buuren, & Bekkers, 2018; Swainson & de Loe, 2011; Yates & Harris, 2018). The language of hydrosociality, in turn, offers a framework that can not only identify how water perspectives are tied to the socio-political contest, but can also frame the interaction between competing water perspectives.

My analysis in this chapter provides empirical examples of how the language of policy translation/mutation and hydrosocial theory can be deployed in combination with each other. As my findings show, the reason for local farmers challenging the MDP's policies and project designs is grounded in their relationship to water. In his work, Jamie Linton has shown that every instance of water is realized *in relation to specific social contexts* (Linton, 2008, 2010; Linton & Budds, 2014). Thus, the contestation between the MDP's planners and

local farmers occur at the level of conceptualizing water – these two groups have different and broadly incompatible *situational* understandings of water, water governance, and irrigation. Put differently, hydrosocial theory presents us with a deeper analysis, at the level of ontology (Yates, Harris, & Wilson, 2017), as to why policies mutate when implemented.

Understanding the mutation of the MDP's design also goes a long way into answering the central empirical question that I introduced at the beginning of this dissertation: why did the MDP result in so many negative consequences not envisioned by its planners? The answer to this question partially lies in the analysis I presented in this chapter – the MDP that was implemented on the ground was substantially different to its original design. This was a result of farmers protesting the imposition of foreign hydro-logics, centralized bureaucracies, and rigid techno-rational systems of water-management that worked against their interests. This is a key part of the puzzle, yet one that is routinely overlooked by almost all accounts of the MDP. In Chapter 6, I will look at how some of the 'unintended outcomes' resulting from the MDP can be traced back to the examples of policy mutation discussed in this chapter.

Finally, this chapter also highlights the necessity of connecting hydrosocial research with a discussion of power and politics. While most literature on the hydrosocial cycle tends to engage with the ontological aspects of connecting water with society: my findings demonstrate the importance of applying a political frame to recognize the contestations among competing water perspectives. For instance, Laeni, van den Brink, Trell and Arts (2020) articulates the difference between 'global' and 'local/contextual' understandings of water in their study of the Mekong delta from a policy translation perspective – but does not critically engage with how different systems of knowledge compete with each other to gain prominence. In contrast, my analysis shows that understanding the (political) struggle between competing water perspectives is vital to explaining policy translation and policy mutation through a hydrosocial framework, especially in mega water projects like the MDP.

CHAPTER 6

Contemporary realities: Living in the post-MDP hydrosocial landscape

6.1 Understanding the post-MDP hydrosocial landscape

So far, I have argued that to understand the international travel of water policies (Chapter 4), and their recursive adaptation in localized contexts (Chapter 5), one must pay attention not only to the content of the policies (in terms of their technical merits and/or governance approach) but also to the contextual factors (such as the politics and socio-materiality of water) that shape them (Boelens, 2014; Budds, 2009; Linton, 2008; Linton & Budds, 2014). Awareness of these backgrounding factors is essential to understanding the design and implementation of complex mega water projects such as the MDP, and how its frameworks evolved over time.

I have also used insights from a hydrosocial perspective to demonstrate how the co-evolution of modern water and international development paradigms was instrumental to transferring water policies from the United States to Sri Lanka: policies that inspired the design of the MDP (Chapter 4). Further, I have demonstrated how US-centred visions of water intersected with localized cultural understandings during the implementation of the MDP, thus creating hybrid regulatory and infrastructural outcomes (Chapter 5). This means that the implemented version of the MDP differed considerably from its original design.

Following from these discussions, this chapter looks at the *complex post-implementation outcomes* of the MDP as they manifest in the contemporary realities encountered by farmers in the post-MDP hydrosocial landscape. I examine five complex and unintended outcomes of implementing the MDP that were revealed through my fieldwork:

1. Section 6.2 looks at how the attempted ‘simplification’ of Sri Lanka’s waterscape has caused a chain of unplanned problems, including animal attacks, cultivation losses, and various health risks.

2. Section 6.3 looks at how attempts at bureaucratically controlling the water schedules has resulted in loss of agricultural engagement among farmers and provided a fertile environment for widespread deviant irrigation practices.
3. Section 6.4 looks at how controlling land and water to achieve agricultural productiveness has prompted the intergenerational creation of encroachments.
4. Section 6.5 looks at how attempts to incorporate village tanks into the MDP's original design has created inequalities in water distribution.
5. Section 6.6 looks at how the attempt at creating hybrid farmer organizations that was an uneasy compromise between the original TVA-style plans and local farmers' demands has created conflicts among farmers.

This chapter focuses specifically on my third research question: Why did the project generate so many negative consequences not envisioned by the planners? Is there a previously unseen link that can connect these problems together? Here I concentrate on finding the connections between seemingly unrelated outcomes, like the common denominator between droughts, crops, and elephants. At the conclusion of this chapter (section 6.7.) I demonstrate that looking at the MDP's outcomes through a relational dialectic lens – that is, by perceiving objects as socio-natural hybrids – is key to understanding how these outcomes are linked together in a complex chain of causation. I will also highlight some specific lessons that can be drawn from observing these complex hydrosocial outcomes.

The analysis in this chapter draws upon the interviews, focus group interviews and field observations conducted in the MDP's irrigation Systems H and B. While the previous chapters took an arm's length and expository approach to writing about the design and implementation of the MDP, this chapter employs a more descriptive and narrative style of writing that better encapsulates the lived experiences of the farmers.

6.2 How simplifying Sri Lanka's waterscape negatively affected farmers' livelihoods and health

In Chapter 4, I noted how the MDP remodelled the complex socio-natural geography of Sri Lanka's dry zone to recreate the image of the Tennessee Valley. This section looks at how initiating such remodelling has led, through intricate causal sequences, to the creation of many socio-ecological problems. I present two examples that demonstrate, for one, how seemingly discrete aspects of the social and natural environment are in fact connected, and for another, how transforming one aspect results in a cascading chain of unintended impacts.

6.2.1 Droughts, crops, and elephants

> *We often get less water than the other farmers [of the next unit]. This has always been the case but in the past ten years, because of the drought, the difference has been more noticeable. I think it is because in our unit, the surface area is very uneven, with hard crystalline rocks jutting out. Whatever water is issued for us tends to dry up quickly and often does not reach the farmers who live further away from the water source.*
>
> [INTERVIEW – SEPTEMBER 2018]

These were the words of a farmer in System H of the MDP. I started my fieldwork in System H, as it was the first irrigation subsystem to be developed under the MDP. The sentiments of my interviewee surprised me somewhat, since I had fallen into the trap of focusing on the official statistics, plans, and maps in the management offices of the MDP, which gave the illusion of homogeneity within the MDP's systems. I was beginning to rethink my own assumptions and approach while talking to a farming couple under a tree, overlooking their MDP-given paddy field.

Figure 6.1. Talking to a farming couple overlooking their MDP-given field. Photograph taken on site by the author with necessary permissions obtained.

Before coming to System H, I had visited the headquarters of the MDP, located in Colombo, trying to understand how this irrigation subsystem was administratively organized (see also Chapter 1). I understood that System H, being one of the largest irrigation subsystems of the MDP, had been sub-divided into three *projects* for manageability: 'Thambuttegama', 'Nochchiyagama', and 'Galnewa'. Each *project* had been further sub-divided into approximately 5 *blocks*, containing about 2,500 farm families apiece. The blocks were again sub-divided into *units*, each containing approximately 100 farming families. Focusing on these administrative boundaries had instilled in me the idea that all of System H was uniform, coherent, and consistent, which was dispelled soon after I entered the field.

Upon my arrival at System H, I travelled – alternately in a van, on a bicycle, and on foot – across most of System H. I was expecting to see a homogenous landscape, but what I encountered was considerably different. Certainly, the paddy fields were there, just as the maps from the MDP's offices laid out. So was the repetitive concrete water infrastructure that guided the flow of water within the System, like the arteries transporting blood within a massive organism. However, the trees, plants, and the vegetation within different parts of System H were extremely diversified. While paddy appeared to dominate the cultivation landscape, different parts of the system were peppered with other types of crops, including chillies, sugarcane, bananas, onions, green gram, maize, ground nuts, finger millet, soya beans, and various other vegetables and fruits. I asked my respondent whether this crop diversification was tied to the water availability, as he had told me that the water was distributed unevenly across the various units. I also asked if crop diversification was the farmers' idea, or part of the official MDP mandate.

> *Yes, our cultivation practices are tied to how much water is available in the unit. Sometimes, we get directives [from the MDP] about cultivating field crops other than paddy, but the farmers do not always follow these directives. Technically speaking, we are not allowed to cultivate crops that are not approved by the project officers, but some farmers do it anyway. Cultivating paddy [in units that receive low amounts of water] is simply not possible in times of drought. It is a very water-intensive crop.*
>
> [INTERVIEW – SEPTEMBER 2018]

I then asked my respondent if planting different types of vegetation within the units had any unplanned consequences. This question got an interesting response.

Yes, there turned out to be quite a few problems when farming different crops. Some farmers in my unit decided to cultivate sugar cane and bananas, and this ended up attracting a lot of wild elephants to the unit. Wild elephants are rampant in Mahaweli areas anyway, ever since the forests were cleared out to create farms.

[INTERVIEW – SEPTEMBER 2018]

I had previously come across herds of elephants scattered throughout System H, where they commonly draw the traffic in this part of Sri Lanka to a standstill by crossing roads. Although the 'elephant problem' in System H was an issue that captured the attention of Sri Lanka's press, there was no concrete attempt to link this problem to the post-MDP land use context.

Figure 6.2. Elephants wandering around the village roads are a common sight in the MDP project areas. Photograph taken by Carol Taylor (reproduced with permission).

In another interview, conducted with a different farmer, I asked my respondent to describe the realities of having to live with the constant threat posed by wandering elephants.

With jungle clearing and settlements moving forward, herds of elephants are boxed in, and have nowhere to go. When the elephants come into the farms, bypassing, or breaking the electric fencing designed to keep them away, they

are chased away by the settlers armed with fireworks and flares. The elephants move away at first as they are not aggressive animals by nature. When the elephants are continuously chased off and have nowhere to go, they turn around and retaliate. At first the charges and attacks are mild but overtime it can get very dangerous. Sometimes, farmers are compelled to use guns, but this is counterproductive … guns in the hands of inexperienced farmers will not kill the elephants but will only maim them. Maimed elephants, maddened by the pain, then go on a rampage and end up killing farmers before being put down by marksmen.

[INTERVIEW – SEPTEMBER 2018]

The above discussion illustrates the nature of the problems encountered by the farmers living in irrigation System H: problems that occur as a result of the complex socio-natural transformations set in motion by the MDP. The first aspect of the problem is that the modification of the dry zone's topography (vis-à-vis clearing forests) to suit the MDP's implementation has displaced large animals such as elephants, forcing them to wander in search of food. The second problem is that not all farms in the MDP get the same amount of water – it appears that different units in System H receive different quantities of water due to surface landscape features (such as crystalline rocks) not being successfully cleaned out during project implementation. This led to farmers in some units to cultivate crops (such as sugar cane and bananas) in times of drought, which in turn attracted herds of displaced elephants. Ironically then, the problem involving droughts, crops, and elephants seem to stem simultaneously out of both *clearing the landscape,* and *not clearing enough*.

6.2.2 Groundwater, mosquitos, and kidney diseases

While System H appeared to suffer from the lack of water at the surface, farmers of System B are faced with the issue of a surplus of water below the surface. In the words of one farmer that I interviewed:

This entire system has very high levels of ground water. On the one hand, these high levels of groundwater cause problems with waterlogging [i.e., the saturation of soil with water] in most of the units and blocks, in the farms, and sometimes along the roads. On the other hand, there are shallow water tables that cause soil salinity problems.

[INTERVIEW – SEPTEMBER 2018]

Waterlogging has many adverse effects on agricultural production. As water and salt levels build up, both wet and dry seasonal crops are lost. Some areas also begin to absorb salts pushed out by irrigation from neighbouring fields. My observations reveal that many farmers have abandoned their farmlands (in whole or in part), and that current land use patterns in System B comprise of patches of productive irrigated fields intercepted by derelict saline lands (see figure 6.3).

Figure 6.3. A paddy field abandoned due to salinity problems. Photograph taken by the author in irrigation system B of the MDP.

The growing unevenness of the cultivation outputs and cropping intensities as a result of this patchy groundwater-scape has also been noted in the statistical reports 1990-2010 of the MDP systems (*Sampath Pethikada*) issued by the MDP's Planning and Monitoring Unit, as well as in the individual reports produced on cultivation patterns and cropping intensities.

Cultivation disparities, however, have not been the only consequences of ignoring the sub-terrain waterscape. Stagnant water tables at the soil surface are the cause of many serious health problems within System B, such as the growth of *Anopheles Culicifacies* (Malaria-transmitting mosquitos) caused by clearing out large tracts of jungle and stagnant water near the soil surface. In fact, data from the anti-Malaria campaign by the Ministry of Health, Sri

Lanka reveal that 26,403 Malaria cases were reported in 1987 alone in System B of the MDP. I was able to interview a former resident project manager in System B, who had to deal with a serious Malaria outbreak during his tenure:

> *Malaria became an epidemic in System B of the Mahaweli project between 1986 and 1988, ten years after its implementation. Many inhabitants became severely ill with Malaria for the first time. Doctors here believe that clearing vast tracts of jungle land for the Mahaweli Project's implementation increased contact between the inhabitants and the Malaria mosquitoes, which otherwise prefers cattle blood. There is also stagnant water at the soil surfaces, increasing the incidence rate of Malaria.*
>
> [INTERVIEW – SEPTEMBER 2018]

While the Malaria outbreak died down after 1990, the problems related to groundwater were far from over. In 2010, a different health concern came into the fore in System B: chronic kidney diseases (CKD) caused by agro chemicals dissolving in shallow water tables closer to the soil. Such chemicals and nitrates lead to a build-up of adverse nutrients in the ground-water aquifers, which are then used as wells for drinking water by resident farmers, causing CKD.

Figure 6.4. A farmer in System B spraying chemical pesticide on his farm. Photograph taken on site by the author with relevant permissions obtained.

Datasets from the Ministry of Health, Sri Lanka report that the prevalence of CKD in System B of the MDP was around 22.9 percent (Morimoto, 2013). However, the data itself does not paint a full picture of the daily realities encountered by the farmers in System B, especially those suffering from CKD. The sufferers, I found, had to be treated on a daily basis by being connected to the dialysis machines kept at the town hospital. For the farmers living in the unit that I was conducting my interviews in, this meant undertaking daily travel to a hospital 20 miles away. To further compound the problems, public transport in that general area was limited to one bus heading to the town hospital at 6am every morning and returning at 8pm (see figure 6.5.).

Figure 6.5. A bus, run by the Sri Lanka Transport Board, picking up passengers from the village bus stop for their daily commute to the town. Photograph taken on site by the author with relevant permissions obtained.

The above discussion of groundwater, mosquitos, and kidney diseases is yet another example of a complex problem occurring as a result of the socio-natural transformations activated by the MDP encountered by farmers, as a direct result of project implementation. First (and like the elephant problem), the clearing of jungle tracts has caused Malaria carrying

mosquito varieties to emerge out of the forests to feed on the settlers. Second, the attempt to homogenize the landscape appears not to have extended to the movement of subterranean water. The problem again appears to be the result of both attempting to homogenize the lands for project implementation, and then inevitably falling short of realizing that objective.

6.3 Centralized control over water and its effects

Overly bureaucratic water management was one of the most common complaints brought up by the farmers I interviewed in both System H and System B of the MDP. Farmers frequently complained to me about the rigidity of the water timetables, and the insensitivity of the project administrators, who preferred to issue instructions rather than solicit the ideas and suggestions of the water users. This section first describes the bureaucratic water management practices implemented by the MDP, and then investigates the resulting problems that have arisen.

6.3.1 Bureaucracy and water control

TVA-style water systems call for centralized water management practices to gain an accurate assessment of the amount of water issued, and to even out the natural streamflow. To calculate water distributions between the MDP's systems, the planners use a bi-model computer system called the Acres Reservoir Simulation Programme (ARSP). It is a mass balanced mathematical model for simulating the scheme's operation (and calculating water allocation for each system) over a 40-year timeframe (1971-2010). With respect to balancing the water requirements for irrigation, the ARSP uses various parameters such as cropping intensities, the total extent of land to be cultivated within each system, and the type of crops to be grown.

This method of using the ARSP to manage water in the MDP meant that the amount of water that each system received was calculated in a rigid top-down manner. This centralized water management style is reflected in the regulatory instruments and polices that govern the decision-making processes within the MDP. In fact, the annual water allocation plan for the MDP is determined by a group of high-ranking civil servants (the permanent secretaries for the Mahaweli Project, the Sri Lankan Electricity Board, and the Sri Lankan Water Board) by using the ARSP datasets compiled by employees of the Planning and Monitoring Unit for the MDP. The annual water allocation plan thus drafted and finalized would then be handed down to the regional project manager for each system of the MDP.

Once the regional project manager receives the ‘water budget’ for their system, they will pass on this budget to the irrigation ‘block’ offices that constitute the system. The managers of the irrigation blocks then proceed to map out a detailed plan for water distribution among the farmers: a water timetable. I discussed this process with a former regional project manager in System H, who painted a picture for me of what went on in the irrigation block offices:

> *In this age of microcomputers, it is a simple task to install a computer in the office of the block manager and train him in its use. Then he could construct trade-off curves based on selected performance measures after examining the complete set of possible optimal solutions for any objective function. With this information he can select the most preferred schedule, making the best trade-off between cost and optimum solution.*
>
> [INTERVIEW – SEPTEMBER 2018]

As this quote demonstrates, the block offices are extensions of the top-down and centralized bureaucracy of the MDP. The block office, after consulting the trade-off curves and performance measures, creates a timetable detailing how much water each unit, and each farm will receive, and on what days. This timetable is printed out and circulated among the farmers (see figure 6.6.).

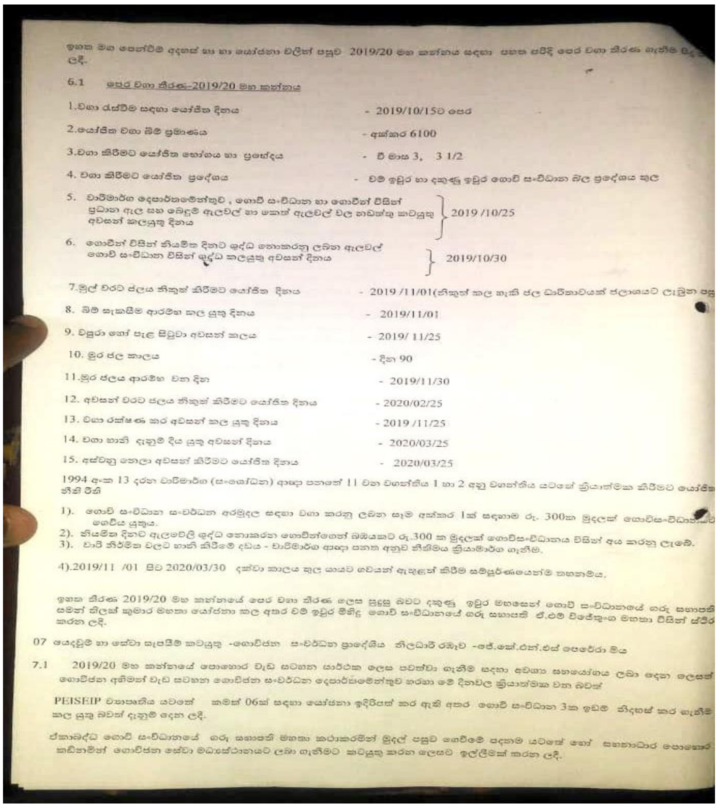


Figure 6.6. A The water timetable issued to farmers. Photograph taken on site by the author with relevant permissions obtained.

While the regional project manager I interviewed freely admitted the bureaucratic role played by the block offices, he did not look at unit managers in the same way. As I mentioned before, a unit is the smallest administrative zone in a MDP operated irrigation system. The unit manager does not create the water budget or the allocation timetable, but rather, hands it down to the farmers. Given this difference, it was clear that my interviewee did not see unit managers the same way as he did the block managers:

> *The unit manager must translate the goals set at the block level into action. In practice we find that the problems which ail the block also affect the unit, only more so. The reason is, this is the lowest level of management and yet the highest point of impact of management on operations in the field. As in the block, though the physical system is primarily a conveyance and distribution system for water, water management cannot stand alone. To make sense it must be functionally integrated at least with input, credit, and marketing. It is the task of the unit manager to be a manager at this interface, not to be a bureaucrat or extension agent.*
>
> [INTERVIEW – SEPTEMBER 2018]

Although it was clear that my interviewee was trying to suggest that unit mangers were not extensions of the MDP bureaucracy, they were still very much part of the 'top-down' style of water management. My observations revealed that the task of the unit manager was to (1) upsell the MDP's management practices to the farmers (to ensure that the farmers comply without protest or lobbying), and to (2) mediate conflicts between farmers over water allocations, but not to seek input from the farmers. The farmers themselves perceived the unit managers as authoritative bureaucrats. According to one farmer:

> *The unit managers are insensitive extensions of the Mahaweli bureaucracy, who use their training and position to serve their own interests and exploit farmers. We hardly even see the unit manager in person. There is a lot of resentment among farmers towards the unit managers, since they are more concerned with looking good in front of their superiors, than visiting the people in their command area.*
>
> [INTERVIEW – SEPTEMBER 2018]

From my interviews with the farmers of both System H and System B, it soon became clear that this perception of unit managers was widely held. In the next section, I will show how the effects of this top down, pseudo-participatory water management style has led to widespread problems among farmers, ranging from disengagement with farming to a rise in deviant irrigation practices.

6.3.2 Water control and farmer disengagement

In this section I look at how centrally controlling water in the MDP systems has led to widespread farmer disengagement. A farmer in System H encapsulated the changes brought about by the MDP:

> *We have no say in what we cultivate or when. Before we were resettled in the Mahaweli areas almost twenty years ago, I and my neighbours used to farm in Sri Lanka's wetland schemes. I come from many generations of farmers. When I was first resettled in the Mahaweli farms I was startled by the difference. Farming here is like a day job. All our responsibilities are timetabled, and we have little else to do other than to sit and wait for the water to come.*
>
> [INTERVIEW – NOVEMBER 2018]

This quote demonstrates how first-generation farmers who were used to different water management styles (including possessing a sense of 'ownership' about water) found it difficult to adapt to a new method that is founded upon very different first-principles (such as rational, centralized water management). This finding exemplifies one of the main themes of this chapter (and thesis): that the techno-hydro logics of the MDP did not match with the experiential, and at times cultural and spiritual, ways of knowing and engaging with water in Sri Lanka – and that this incommensurability led to a number of unplanned consequences, such as farmer disengagement.

Rigidly controlling water and issuing a water budget to the farms has caused disengagement in other ways as well. For instance, controlling water also means that the MDP can also act as a de facto 'cap' on farmer cultivation and on the yield each farmer can produce from their crops. As such, if a farmer were to stick to irrigating their own MDP-given field, they would be economically stagnant within a changing world. This sentiment was expressed in an interview with a farmer:

> *We cannot live life like our ancestors did. Their mindset was if one has enough money to survive, that should be enough. We cannot live like that today. Our ancestors worked just enough to keep their families fed, but today, we need to save money to build houses, give our children a good education, maybe even buy a tractor or a motorbike with some luck. We will only be recognized as someone in the village if we are well-educated and rich. Money is a status symbol now more than ever. Look at the way the world is going. Look at the way this country is going! It is very difficult for an ordinary man to survive by cultivating his Mahaweli-allocated farm without doing several other jobs at the same time.*
>
> [INTERVIEW – NOVEMBER 2018]

My fieldwork in System H further revealed that disengagement with farming due to economic stagnation (caused by bureaucratic control over water) is more prominent among second and third generations of farmers. Their livelihood activities extend over various sectors and over many different geographical spaces. Despite several limitations, some of the second and third generations of the MDP's settlers have managed to procure successful employment outside of farming.

I met *Magilin Nona*[14], the mother of a soldier, in her house in Thambuttegama (in System H). I initially thought that her son might have decided to join the army for reasons of partisanship. However, Magilin Nona proved my assumptions to be wrong:

> *I did not like the idea of my son joining the army at all. Before he died, my husband lost a lot of money gambling. We have one paddy field given to us by the Mahaweli, which my son used to cultivate. Unfortunately, the income from farming this little plot is not enough for us to eat three meals per day. I am now a widow. I cannot afford to put my children through school anymore. I have five children, and the girls are nearing marriageable age. We need to put up some money for their dowries. As I did not have any permanent source of income, I had to approve of my elder son's choice.*
>
> [INTERVIEW – NOVEMBER 2018]

Magilin Nona's narrative and other stories I heard, reveal that having many dependent children makes it difficult for farmers to survive. According to Magilin Nona, it is impossible to pay for daily expenses based on the sole earnings from a single farm. She was also aware that her daughters had reached a marriageable age, and worried about their dowry (i.e. wedding payment given to the groom by the bride's family). She believed her long-term aspirations could not be achieved simply by cultivating their MDP-given plot of land, and therefore gave consent to her son's decision to join the army. Magilin Nona's narrative reveals the impossibility of attaining an adequate income through farming alone, without supplementing this income from other employment.

I conducted another interview with a female trader (Malini) in the Thambuttegama market (see Fig. 6.7). Malini appeared to have carved out a corner for herself in the male dominated marketplace. Although woman do trade in village markets, this is not a very common sight. Woman engaging in occupations such as trade is still frowned upon in Sri Lanka, and especially within the MDP's settlements.

[14] A Sri Lankan-esque pseudonym

Figure 6.7. The Thambuttegama local market that sells vegetables, fruits, and other perishables and some (relatively) niche items such as children's clothes. Photograph taken on site by the author with relevant permissions obtained.

I approached Malini on a market day when there were no other customers around. In response to me asking why she had become a trader, she answered:

> *My husband is developing one farm in Thambuttegama, but this is hardly enough for us. You know the rising cost of living now? Farming on Mahaweli lands does not earn us enough money even to cover our daily expenses. This is why I knit clothes for babies and sell them on the market. It is a hard, but I can make a tidy profit, enough to give my daughter a good education. My daughter is doing well at school.*
>
> [INTERVIEW – NOVEMBER 2018]

Malini's story explains why she entered a traditionally male-dominated space: to provide for her family and to support her children's education. She was aware that her husband's income from the single MDP-farm was insufficient to meet their needs, and her decision to become a trader was motivated by this realization.

The above narratives demonstrate the problems with centralized control of water, and how it is causing farmers to disengage from cultivating. For one, imposing a foreign hydro-logic founded on economic and technical considerations does not sit well with farmers who are used to engaging with water in a different way. For another, controlling water centrally, results in the MDP instilling a cap on the water usage and cultivation extent of farmers – meaning that farmers' upward economic and social mobility is limited. These perspectives contribute to the limited research conducted in Sri Lanka on farmer disengagement in an important way. While existing literature mainly focuses on increasing population pressures in the dry-zone of Sri Lanka (Dissanayake, 2020; Wong & Herath, 2014), this largely overlooks the complex outcomes caused by centralized water control within the MDP.

6.3.3 Water control and deviant cultivation practices[15]

Controlling water in the MDP has also led to farmers engaging in a multitude of deviant irrigation practices, the root of which can be traced back to a loss of cooperation among farmers. In Chapter 5 (section 5.2.2), I noted how the social organization in the dry zone of Sri Lanka was primarily cooperative. Village social structures have had long-standing cooperative traditions such as '*Attam'* (shared labour) '*Shramadana*' (labour donated to the community) and '*bethma*' (water sharing arrangements during periods of drought). However, centralized water control in the MDP meant that each farm had a somewhat independent relationship with the project administration (rather like the relationship between the citizen and the state) which led to the dissolution of such collective norms.

Given that water is centrally controlled by the MDP, the conditions under which the farmers obtain water do not require cooperation. As such, while it is in every famer's interest to get an adequate amount of water for cultivation, whether others get water (or not) could be rather irrelevant — from the production organizational viewpoint of the individual farmer (Paranage 2018b). A limited or rational use of water is not necessarily in the interest of the individual farmer who is well placed, at least from the perspective of the relations within a turnout area. This focus on individuality has led farmers to illegally damage the turnout gates and canal openings to gain more than their allotted share of water (see Figure 6.8 and 6.9). In the words of a unit manager that I interviewed:

[15] The material presented in the following sections has also been published by the author during his Ph.D. candidature – see Paranage, K. (2018). The consequences of restricting rights to land: understanding the impact of state-land tenure policies in Sri Lanka. Sustainability: Science, Practice and Policy, 14(1), 46-54. It is not, however, a *verbatim* reproduction of that manuscript.

We must work overtime to stop farmers from getting more than their allocated amount of water. Farmers sometimes damage the canals and the turnout gates to illegally get more water. More than once, I have woken up from my sleep at midnight to visit the sites and assess damages.

[INTERVIEW – NOVEMBER 2018]

Figure 6.8. Turnout gates which regulate the diversion of water into individual farms. Farmers often break these locks to obtain more water for their fields. Photograph taken on site by the author with relevant permissions obtained.

Figure 6.9. This concrete structure that regulates water distribution in field canals had been destroyed by farmers in an attempt to obtain extra water for their field. Photograph taken on site by the author with relevant permissions obtained.

Unit managers usually take possession of water pumps and issue warnings to those who steal water. For the officials, it is a mixture of being sympathetic towards the offenders and wanting to avoid the difficulties involved in bringing them to court. Farmer organizations[16] in charge of distributary canals are accountable for repairing or paying for the turnout locks.

6.4 Centralized control over land and water, and the intergenerational creation of encroachments

Another feature of the post-MDP hydrosocial landscape is the existence of encroaching families in the MDP's systems. Specifically, farmers are given freehold rights to their lands and farms, but these rights are subject to restrictions. These restrictions, in turn, are a way through which the MDP can manage their behaviour and cultivation practices.

There are two notable examples of such restrictions. First, the lands are granted to the owner, subject to a rule of minimum subdivision, which means that the original receiver of the

[16] See also Chapter 5 for an explanation of farmer organizations within the MDP. I also draw attention to problems with farmer organizations in section 6.6 of this chapter.

grant can pass on his rights to the land (by selling it or under the laws of succession), but only if this action does not entail dividing up rights to the land. The rationale behind this rule is based on economic grounds (predicated on a long legacy of academic and policy research) maintaining that land fragmentation is contrary to sustainable developments in agriculture (De Montis et al., 2019; Gao, Liu, Yu, Yang, & Yin, 2019; Tang, Yun, Liu, & Sang, 2019). Accordingly, this rule preventing subdivision interferes with the usual practices of succession (for instance if the original landowner had more than one offspring) and makes no manifest provisions for any contingencies. Second, grantees are restricted from leasing or renting to nonrelatives. This rule has been established so that the land is not leased to non-farmers (as only farming families qualify to receive land grants in the first place), and thus, the land would only be used for agricultural cultivation.

Fieldwork carried out in both Systems H and B revealed that placing restrictions on rights to the land has created several tenure categories: official, unofficial, and illegal. Table 6.1 identifies the tenure categories that appear in both sample villages with a brief description of each of them.

Table 6-1. List of identifiable tenure categories and subcategories in the sample villages

Encroacher (non-regularized)	This category comprises persons who illegally occupy parts of state lands and may have also constructed housing or other facilities on it. This class of persons is at the highest risk of being evicted.
Tenant in unauthorized subdivision	Tenancy in an unauthorized subdivision can occur if the landowner decides to unofficially (and illegally) subdivide his/her land and lease out part of it to another.
Owner of unauthorized subdivision	The rules against subdivisions prevent landowners from subdividing their lands into smaller parcels. However, in the case of a landowner who has more than one offspring, the land has often been de-facto separated and owned by the siblings, each of whom has constructed homesteads in her or his respective parcels of land.
Tenant on contract (promissory note)	This category comprises tenants who are not relatives of the original owner of the land but to whom the land has been (unofficially) leased. A common practice in the villages is to lease out lands through the use of ‘promissory notes’ (a signed document containing a written promise between the original owner and the lessee) which serves as a lease contract between the parties. The extent to which these documents are legally binding remain ambiguous.
Encroacher (regularized)	This category comprises persons who previously encroached (illegally occupied and/or constructed premises) on state-lands but have been subsequently regularized by the state. They are now ‘legal’ in their occupation.
Approved leaseholder/tenant	This category comprises persons to whom the land has been leased by the original owner. These leases are approved by the state, as the lessee is a relative of the original owner of the land.

Qualified freeholder	This category comprises the original freeholders to whom land has been granted by the state. They 'own' the lands subject to restrictions in subdivisions and leasing.

This wide variety of 'shadow' subcategories has come into existence as an unintended consequence of the MDP's attempt to restrict rights over land. Restrictions against leasing and subletting have led to unauthorized tenancy arrangements being created using promissory notes, while restrictions against subdivisions have caused an outbreak of encroachments. My fieldwork revealed that the majority of encroachments occur during the second and third generations of settlers – a situation that takes place when the original owner of the land passes his rights to one (often the eldest) son/daughter, with this recipient ousting the rest of their siblings (left without any legal claim to the property).

The growth of 'shadow' tenure categories due to attempts to achieve land control has had many social and environmental repercussions. One example of this is when illegal tenants (e.g., non-regularized encroachers) squat in the areas reserved to protect water infrastructure (Figure 6.10.) and dispose their waste into the tanks (Figure 6.11).

Figure 6.10. Temporary structures constructed by encroachers, by clearing out reserved areas of the forest. Photograph taken on site by the author with relevant permissions obtained.

Figure 6.11. A tank bed polluted by domestic and agricultural waste in System H. Photograph taken on site by the author with relevant permissions obtained.

6.5 Problems of hybridity: outcomes of fusing the tank cascades to the MPD infrastructure

I noted earlier in this chapter how artificially remodelling the lands in Sri Lanka to resemble the geography of the TVA was rendered ineffective, given the sheer geographical and eco-system variety in Sri Lanka when compared with the Tennessee Valley. I also looked at how ineffective clearance of Sri Lanka's surface and sub terrain waterscape resulted in different units of the MDP receiving different amounts of water. However, as it turned out, ineffective clearing of the waterscape was not the only reason why different units received different amounts of water. I learnt from my fieldwork that the incorporation of village tanks into the MDP's water infrastructure exacerbated the inequalities in water distribution.

I mentioned in Chapter 5 that an argument was made by the farmers for the incorporation of small village tanks (that were originally part of the tank cascade system) into the MDP's water infrastructure. First, farmers argued that incorporating the village tanks would expand the command area of the MDP by several thousand hectares, thereby serving more farmers. Second, they argued that interposing small village tanks into the MDP's irrigation system would more effectively recharge the groundwater levels in the area, by storing water in numerous small tanks instead of delivering water from source-to-farm.

Taking this into consideration (and bowing to political pressure), the government altered the original designs to accommodate the village tanks. This, however, created unanticipated problems. According to one irrigation engineer that I interviewed:

> *Although these changes might have been made with the best intentions, the consequences were mostly negative. The purpose of the tank cascades was always to provide enough water for farmers to cultivate in the Maha [monsoon] season, by concentrating and utilizing rainfall. The point of the Mahaweli project is in many ways the opposite, in that it tries to increase cropping intensities so that farmers can cultivate throughout the calendar year. The farmers were right in thinking that the water from the Mahaweli river, being stored in small tanks, would recharge ground water levels … the problem is that continuous supplies of water have the effect of overcharging the groundwater tables, leading to widespread water logging.*
>
> [INTERVIEW – SEPTEMBER 2018]

As this example demonstrates, it is difficult to combine two water systems with opposing underlying approaches to water management: one concerned with rainwater conservation, and the other concerned with maximizing crop frequencies. The net effect of incorporating existing village tanks into the MDP's water infrastructure therefore seems to have further imbalanced the groundwater tables, increasing the inequalities of water distribution.

Further, already existing small village tanks were not standard in size – some villages of the dry zone had small tanks, while other areas had medium-sized tanks. Incorporating tanks of varying sizes into the MDP's standardized water management plan therefore caused the whole system to lose its calibration. While attempts were made by irrigation engineers to achieve some sort of uneasy balance when combining the water systems, the outcome was an imperfect water infrastructure, consisting of a hydrological bricolage of old and new tanks.

6.6 Hybrid farmer organizations, politics, and conflict

As I observed in Chapter 5, Sri Lankan farmers have historically formed hydrosocial networks of village tanks. Every village in the dry zone had its own tank, around which a hydrosocial network grew. Each tank (and therefore village) enjoyed significant autonomy from other villages, meaning that each village was a small 'republic' of its own. The social fabric of these republics was organized around the tanks and associated water management practices, meaning that the village, at its core, had the character of a hydrosocial network. A

popular maxim in Sri Lanka is '*gamai, pansalai, wewai, da gabai*', which can be translated as 'one village, one temple, one tank, and one shrine': implying that each village was a discrete (hydrosocially networked) unit, complete with its own temple, priests, fields, and shrine. Religion, water, agriculture, and societies were all interlaced with each other in the village republic (Figure. 6.12).

Figure 6.12. An aerial photograph of 'Isinbassagala Ruwangiri' – a village in Sri Lanka that was unaltered by the development of the MDP – as such, still retaining its original structure. Photograph taken on site by the author with relevant permissions obtained.

Given the historical tendencies of farmers to organize themselves in this manner, it came as no surprise when they resisted the MDP's attempt to reorganize them into artificial farmer organizations. In Chapter 5, I told the story of how the structure of these organizations were constantly negotiated and re-negotiated between the project's planners and farmers, resulting in an uneasy compromise being struck. In the following pages, I will describe the contemporary functioning – or more appropriately, malfunctioning – of these organizations, with reference to my fieldwork carried out in System H.

When entering the field in System H, I asked the head of one of the local farmer organizations in Thambuttegama if I could passively sit in on one of their meetings. The head farmer gave me his permission to attend the meeting, and I made my way to the venue on a Thursday morning. Farmers began to arrive, sometimes individually and sometimes in pairs or small groups. Although there were seats for around 100 people, the total number of attendees were less than 20. I knew that this farmer organization serviced at least 50 farming families and was surprised at this exceptionally low turnout. Later during my fieldwork, I began to piece together an explanation for the low turnouts as I met and talked to more farmers, gradually earning their trust. I present below a quote from one farmer who best explains the scenario:

> *The farmer organizations here are a charade. The organizations are run by the Mahaweli officers, who are more interested in telling us what to do than asking us what the problems are. Yes, we are supposed to vote to elect a president, secretary, and treasurer, but most of us do not even know who they [elected farmers] are, let alone vote at these meetings. There are a few farmers who are on good terms with the unit manager, and these farmers are the only ones and voting at these meetings.*
>
> [INTERVIEW – OCTOBER 2018]

This seemed to be the consensus among most farmers: that as long as enough farmers came to the meetings to give the legal quorum[17], the elections were held. Most of the farmers saw the 'elected' farmer leaders as an elite power group and as little more than extensions of the MDP-bureaucracy, carrying out a pseudo job.

However, the situation was more complicated than a simple power struggle between the power groups (who aligned themselves with the MDP officers) and the remaining farmers. Due to the failed structure of the farmer organizations, it was common for most farmers to register their grievances with local politicians instead of with the MDP's management. These politicians, in turn, would sometimes override the MDP's management and appoint some of their loyalists into top positions withing the farmer organizations. Thus, the so-called independent farmer organizations became partially controlled by the MDP, and partially controlled by local politicians. Indeed, most farmer organizations now appear to be mere vessels to carry out party political agendas.

[17] All farmer organizations in the MDP are considered legal entities under the *Agrarian Services Act of 1971*. The constitution and the management structure for all farmer organizations were provided in the statute itself. All farmer organizations in the MDP therefore had an identical management structure.

6.7 Discussion and conclusions

What do failing crops have in common with chronic kidney diseases? How do these illnesses relate to the increase of malaria spreading mosquitoes and displaced elephants? These are some of the questions that I asked at the beginning of this dissertation, and the same questions that this chapter endeavours to answer.

This chapter offers the first comprehensive political ecological analysis (influenced by hydrosocial theory) that has been conducted on the MDP from a farmer-first perspective. In this chapter, I unpack the complex causal chains – encompassing both human and non-human actants (Latour, 1993) – that produce seemingly unintelligible outcomes. One of the key contributions of this chapter is to demonstrate that some of the problems associated with the MDP stems from altering its original plans to accommodate farmers viewpoints: a fact that has not received adequate attention in either the technical literature, or in critical scholarship on water management. As I noted in Chapter 2, the technical literature on mega water projects typically approaches water governance from a scientific/economic point of view that denies the intrinsic complexity, social construction, and political ordering of local water management practices. On the other hand, critical scholarship on mega water projects – while democratising the space to give voice to local water management practices – creates a conceptual dichotomy between dominant vs subjugated knowledges. This however is somewhat of a simplification since the infrastructure and governance practices of the MDP were already mutated to accommodate local water perspectives. In other words, the MDP was already a hybrid.

Relatedly, it is also important to scrutinize the rather ambiguous role played by the state in the MDP. To say that the state is a dominant actor in the MDP is undeniable. Throughout this dissertation, I have given examples of how the MDP was backed by the Sri Lankan government as a part of its national development agenda. However, while Chapter 4 showed how the Sri Lankan government supported the plans designed by foreign hydrologists and development experts, Chapter 5 showed that it was also willing to back the alternate knowledge-claims made by local farmers. This tension is explicitly noticed in section 6.6. of this chapter on hybrid farmer organizations, politics, and conflict. This section showed that local politicians (who are agents of the state) interfere in farmer organizations against the wishes of the MDP's managers and in favour of neglected farmers, highlighting the ambivalent role played by the state in the MDP.

The complex relationship that exists between the state of a developing country and a mega water/development project such as the MDP has rarely been theorized. While critical literature on water governance has indeed moved away from a narrowly framed understanding of the 'state', this literature primarily looks at scenarios where the state oversees water supply (Bénit-Gbaffou & Oldfield, 2011; Dawson, 2014; Harris, 2020; Oldfield & Greyling, 2015; Watson, 2014). Very rarely does this literature engage with the complex relationships that exist between development experts, the state, and the end-water users. Yet, the importance of understanding the role of the state in mega water projects cannot be understated. A number of contributions to a recent special issue on 'Contested Knowledges: Water Conflicts on Large Dams and Mega- Hydraulic Development' (Boelens, Shah, & Bruins, 2019; Duarte Abadía, Boelens, & du Pré, 2019; Dukpa, Joshi, & Boelens, 2019; Fox & Sneddon, 2019; Hidalgo-Bastidas & Boelens, 2019; Hommes, Boelens, Harris, & Veldwisch, 2019; Teräväinen, 2019) identifies the importance of democratizing water governance, especially by linking grassroot movements with international activist groups via online social networking. The contributions to this special issue demonstrate that now, more than ever, it is easier to challenge the modernist perceptions of mega-hydraulic progress by sharing the life histories of affected water-users with the internet activist community. However, I contend that such attempts at democratizing water governance should also necessarily consider the role played by the state as a key stakeholder accompanying these processes.

Finally, this chapter warns against conventional water management and development approaches that create an ontological split between nature and society. Water, being at the heart of the MDP, is an object which can only be understood in relation to various segments of society (Linton, 2008, 2010; Linton & Budds, 2014). Since there are multiple ways in which different groups of people understand and relate to water, it is recommended that water projects employ a mechanism to foster a dialogue among different water perspectives. This is one of the main empirical lessons to be drawn from my analysis of the MDP: that engaging in a process of co-learning between the different water perspectives is important *at the outset* of a water project. The MDP demonstrates that foreign hydro-logics can never fully override the local water perspectives; the latter will end up mutating the original designs in unplanned ways, causing a number of unpredictable consequences. A planned approach to fostering a dialogue among different water perspectives would be a valuable tool in planning water projects.

When facilitating mutual co-learning, it is important not to appropriate the local worlds within dominant hydro-technological paradigms. Jessica Teisch documents the negative outcomes that emerged when the U.S. state of California attempted to reshape its water infrastructure by drawing inspiration from India's irrigation systems. Although not using the language of hydrosociality, Teisch (2011) nonetheless observes that such negative outcomes ensued because Californian planners overlooked the difficulty of importing India's hydraulic regime (with its own socio-political inequalities) into a democratic society. In the MDP, similarly, we saw how local farmers attempted to stop the old village tanks from being bulldozed by appealing to the MDP's dominant hydro-logic: arguing that incorporating the village tanks into the overall design would extend the project's command area. We saw in this chapter that this was a mistake – incorporating village tanks into the MDP resulted in the entire system losing its calibration. Perhaps this is because the tank cascades in Sri Lanka – similar to its counterparts in Tamil Nadu, as observed by Iyer (2003), Baviskar (2007), and Souza (2006) – are a system that seeks to organize the *demands* of people in relation to water availability, instead of seeking to improve water *supply*. Indeed, we can hypothesize that conjoining two water systems with such incommensurable first principles drastically contributed to creating uneven water levels within the MDP. Either way, it is of profound importance that local knowledge and water perspectives are properly *contextualized* before dialogue is facilitated.

CHAPTER 7

Conclusions

7.1 Summary of argument and contributions

This dissertation analysed the Mahaweli Development Project of Sri Lanka from a political ecological perspective based on hydrosocial approaches. It unpacked how techno-political actors, discourses, and institutions interact over time in the evolution of water governance in the form of the MDP; what kind of knowledge systems are mobilized and reproduced within the MDP; and what kind of hydrosocial landscapes are produced by the MDP, why, and with what characteristics (in terms of social organisation, ownership, distribution, and access to natural resources). Before I highlight the empirical and theoretical contributions of the thesis, I will present a brief response to the three questions that guided the research.

> *How do techno-political actors, discourses, and institutions interact overtime to inform the evolution of water governance in the MDP?*

This question was primarily addressed in Chapters 4 and 5. Chapter 4 noted how transnational actors, discourses, and institutions (i.e., U.S. hydrologists and engineers, the World Bank, and the Sri Lankan government) had interacted to design the MDP as a replica of the TVA. In that chapter, I also drew attention to how the discourse of 'modern water' (embedded within the TVA design) came to characterize the irrigation landscape of Sri Lanka vis-à-vis the MDP. Chapter 5, on the other hand, noted how a mixture of global and local actors as well as local discourses founded on Buddhism had interacted to mutate the original designs of the MDP upon their implementation.

> *What kind of hydrosocial landscape is ultimately produced as a result of the MDP, and why? What characterizes the hydrosocial territory that is produced through the MDP (in terms of social organisation, ownership, distribution, and access to natural resources)?*

This question was primarily addressed in Chapters 5 and 6. Chapter 5 looked at the initial hydrosocial landscape that was created when the MDP was implemented (demonstrating, for instance, that pre-existing village tanks were incorporated into the MDP designs), while Chapter 6 looked at the *post-implementation* hydrosocial landscape experienced contemporarily (sometimes intergenerationally) by farmers. Chapter 6 also drew attention to the many socio-environmental problems that characterized the post-MDP hydrosocial territories – including farmer disengagement, increasing salinity in water, and increasing onset of health issues.

> *Why did the project generate so many negative consequences not envisioned by the planners?*

Answering this question was the primary object of Chapter 6. That chapter demonstrated how reducing a multidimensional entity such as water into a simple economic formula has resulted in a number of cascading consequences that were unanticipated by planners. Further, in that chapter I suggested that looking at the MDP's various outcomes through a relational dialectic lens was key to understanding how seemingly discrete consequences were linked together in a complex chain of causation.

7.1.1 Empirical contributions

Chapter 4: Understanding policy transfer in the MDP

Chapter 4 of this dissertation looked at the transfer of water-related expertise from the United States to Sri Lanka. In this chapter I showed that this policy transfer process was driven primarily by the collective understanding of water (supported by a shared conception of development) held by hydrologists in the United States, development experts in the World Bank, and members of the Sri Lankan government. This finding goes against the conventional accounts framing the policy transfer processes that produced the MDP as rational and progressive, while ignoring the social constructivist dimensions.

In this chapter, I also contribute to the wider literature on international water policy transfer by demonstrating how USA-trained hydrologists served both as internal officers of funding institutions (such as the UNDP, the FAO, and the World Bank) and as independent consultants outside the development industry (the NEDECO). This finding exposes the degree to which USA-centred hydro-technological expertise has permeated the development

industry since the latter's very emergence. Thus, future research that looks at the development institutions' engagement with the water sector should consider how USA-based networks of hydrological expertise and the international development industry have co-evolved since at least the 1960s.

Finally, this chapter highlights the role of mega water projects in transporting the 'modern water paradigm' (Linton, 2010; Linton & Budds, 2014) to countries in the global south. Hydrosocial literature – while drawing attention to how 'modern water' has come into existence with events like the construction of the Hoover Dam, and the formalization of the hydrologic cycle – does not agree on how this understanding of water was disseminated to other geographies. This chapter helps to fill this gap, revealing that policies of the World Bank has helped spread the idea of modern water into varying geographical contexts in the Global South, when financing mega water projects like the MDP.

Chapter 5: Transforming hydrosocial relations and mutating policies in the MDP

Chapter 5 of this dissertation presented a hydrosocial analysis of the kind of human-water relations that existed in Sri Lanka when the MDP was first implemented. The chapter also shows how foreign hydro-logics and water perspectives were not able to completely override local human-water relations, instead producing complex assemblages that mutated the original project designs of the MDP.

The first part of this chapter provides an original commentary on the cultural foundations of the human-water relations in Sri Lanka's dry zone before the MDP was implemented. I show that:

1. Water perspectives held by Sri Lankan farmers were influenced by Buddhist beliefs, specifically by the doctrine of *Pratītyasamutpāda* (dependent arising). Unlike Newtonian forms of direct causality, the doctrine of *Pratītyasamutpāda* lead to an understanding of water as living, interconnected, and unbounded – paying equal attention to various parts of the eco-system without prioritizing human needs.
2. The social organization of Sri Lanka's dry zone was centred around the villagers' relationship to the local water source (village tank). Water and land were co-owned by the villagers, and irrigation was a coordinated operation. This system of coordination among farmers was strengthened by a variety of social norms and values as well as kinship obligations.

3. Each village had its own tank to store water for farming. The tanks belonging to the various villages were, however, linked in the form of a cascade: networked though an intricate system of canals. Rainwater captured by the village tanks at the top of the cascade would be transferred (after being used for agriculture) to tanks further down the line, enabling a method of water cycling. Despite being linked this way, the villages were largely autonomous in planning their cultivation schedules.
4. Water also figured prominently in Sri Lankan cultural symbolism and was tied to its national identity. Water was also an element that was central to most agrarian rituals in the dry zone villages.

While this commentary in itself contributes to an anthropological understanding of water governance in the pre-MDP dry zone in Sri Lanka, my main contributions lie in showing how these local human-water relations contributed to reshaping the designs of the MDP. Particularly, I show that local farmers:

1. Successfully argued for the incorporation of village tanks into the original designs of the MDP, instead of their being demolished.
2. Effectively fought against levying a charge for irrigation water by organizing political campaigns.
3. Renegotiated the organizational structure and management practices within the MDP-implemented farmer organizations.

I show that, as a result of farmers protesting the imposition of foreign hydro-logics, centralized bureaucracies, and rigid techno-rational systems of water-management that worked against their interests, the MDP that was implemented on the ground was substantially different to its original designs. Taking notice of these mutations is vital to understanding the unanticipated consequences generated by the MDP.

Chapter 6: Understanding complex hydrosocial outcomes of the MDP

Chapter 6 of the dissertation engages with the complex post-implementation outcomes of the MDP as they manifest in the contemporary realities encountered by farmers living in the post-MDP hydrosocial landscape. Specifically, this chapter looks at:

1. How reorganizing the dry zone waterscape has caused a chain of unplanned problems including rampaging elephants, cultivation losses, malaria, and chronic kidney diseases.
2. How centrally controlling the water schedules has resulted in, the loss of agricultural engagement, and widespread deviant irrigation practices.
3. How regulating land rights to achieve agricultural productiveness has caused the intergenerational creation of encroachments.
4. How incorporating village tanks into the MDP's original design has caused an unanticipated rise in groundwater levels.
5. How creating farmer organizations has engendered conflict among farmers and politicized the irrigation systems.

Centrally, this chapter demonstrates that the key to fully understanding the unintelligible outcomes of the MDP is to develop a socionatural approach of analysis. For instance, the connection between droughts, crops, and elephants, as well as the connection between salinity, mosquitos, and kidney diseases, is caused by planners narrowly framing water (as a scientific fact and an economic resource) and development (as economic growth). Such an approach excludes the many intricate connections that join the human and the non-human through material-political flows of water. A possible solution would be to use a wider frame of analysis that can better capture the socionatural transformation occurring as a result of the MDP.

Finally, this chapter demonstrates that some of the MDP's unplanned consequences occurred because of the changes drafted to the original plans during implementation. This highlights that establishing a dialogue between the multiple hydrosocial realities at the outset is essential to the planning of any water project.

7.1.2 Theoretical contributions

Contributions to hydrosocial literature

This dissertation provides the first hydrosocial case study of a mega water project that captures the projects' complete trajectory (design, implementation, and post-implementation outcomes). In my analysis of the MDP, I take the ontological premises of hydrosocial research – that every instance of water is defined in relation to someone: a hydrologist, a development planner, or a farmer (Linton, 2008, 2010; Linton & Budds, 2014) – and use it to show how a variety of water perspectives contested and converged over the lifetime of the

project. By doing so, I have demonstrated how the hydrosocial lens offers insight into theoretical discussions on both development and policy mobility, while also contributing to the advancement of hydrosocial theory itself.

Throughout my dissertation, I provide examples to illustrate how hydrosocial theories of water provide an analysis that complements discussions on development and policy in the water sector. In Chapters 4 and 5, I connected hydrosocial theory to development and policy transfer by demonstrating how (1) a model of development as economic growth helped diffuse perspectives of 'modern water' across national contexts, and (2) US-based hydrological networks had permeated the international development industry from the early 1960s. Additionally, in Chapter 4, I linked hydrosocial theory to policy mobility by answering a question often asked in the water policy sector: why do certain water policies take off while others do not? (Gerlak & Mukhtarov, 2013; Mukhtarov, 2014; Mukhtarov, de Jong, & Pierce, 2017). My analysis in that chapter demonstrated that policies configuring water as an abstract, quantifiable entity capable of generating measurable economic growth (in line with the expectations of financing institutions such as the World Bank) was more likely to be transferred across geographies, at least in the first development decade.

Further, my dissertation adds to hydrosocial literature in three different ways. First, I emphasize the need to repoliticize theorizations of the hydrosocial cycle, in line with Boelens's hydrosocial territories approach (Boelens, Hoogesteger, Swyngedouw, Vos, & Wester, 2016; Duarte Abadía, Boelens, & du Pré, 2019; Hidalgo-Bastidas & Boelens, 2019). My analysis of the MDP demonstrates that power and politics are vital to the ontological and epistemological contestations that occur within the MDP. Chapter 5, for instance, demonstrated how local water users have defended their human-water relations by generating enough political power to obtain state-support in changing the plans and designs of the MDP. This finding in particular show how power and politics play an important role in deciding which forms of knowledge are hegemonized and which are subjugated.

Second, I have historized and transnationalized hydrosocial relations that underpin the MDP, by connecting them to development flows. Chapter 4 demonstrates that the MDP as a hydrosocial territory is underpinned by decades of international flows of knowledge, expertise, and investment. As such, I argue that hydrosocial accounts of mega water projects must inherently historicize their study focus, while also looking across scales to understand the relational and constitutive elements of hydrosocial territories. This is especially important in projects like the MDP which – although designed through hydrosocial networks in the 1960s/1970s – continues to impact the contemporary livelihoods of farmers and water users

today. Chapter 6 of this dissertation demonstrated that the effects of the MDP are felt intergenerationally, meaning that the impacts of mega projects can only be understood from a historical and multi-scale analysis.

Third, my dissertation demonstrates how hydrosocial research can be applied to explore the connections between seemingly unrelated, odd, and anomalous outcomes of mega water projects. There is a rich history of studying such 'unintended consequences' of development projects in the critical development literature (Bertoncin, Pase, Quatrida, & Turrini, 2019; Scott, 1998; Ferguson, 1990; Garcia, Millet, & Tonnelier, 2015). Such analyses show how centrally managed development plans misfire (producing numerous unintended consequences) when they impose schematic visions that do violence to inadequately understood complex interdependencies on the ground (Ferguson, 1990; Scott, 1998; Li, 2007). My analysis in Chapter 6 complements these insights by demonstrating that one of the ways in which development plans (in mega water projects) reduce the 'complex interdependencies' on the ground is by simplifying a multidimensional entity such as water into a quantifiable resource. For instance, in that chapter I demonstrate how singularly focusing on water's quantifiability led the MDP's planners to superimpose homogenous irrigation designs on a complex subterranean waterscape – leading to differential water levels within systems. This one (unplanned) outcome, in turn, unleashed a host of related problems, ranging from elephant attacks to disengagement from farming.

Some scholars who work at the intersection of hydrosocial theory and development have already demonstrated how the development industry's treatment of water is partial (Swyngedouw, 2007; Boelens, 2008; Hommes, Boelens, & Maat, 2016; Del Bene, Scheidel, & Temper, 2018). By utilizing the phrase "the dark legend of UnGovernance" Boelens, in particular shows how the development industry seeks to define and control water in exclusively modernist ways – by discounting alternate perceptions of water governance as unscientific, or uninformed (Hommes, Boelens, & Maat, 2016:3). My own analysis adds to this body of work by demonstrating that while development architects do influence and seek control perceptions of water, the process of control is highly disorganized. In Chapters 5 and 6 of this work, I show that development planners do not have a monopoly over defining and controlling water – frequently the communities push back. My findings show that the anomalous consequences of the MDP are often caused by the project attempting to harmonize contesting water perspectives. Chapter 5, in particular, demonstrated that the MDP, as implemented, represented a hydrological bricolage – in its attempt to unite the MDP's original designs with the local tank cascade model. Chapter 6 showed that many of the

MDP's unintended consequences were caused by this attempt to harmonize the MDP with the local tank cascades.

This analysis demonstrates how the hydrosocial approach, as developed in my thesis, can add useful and more nuanced insights to the work on unintended consequences in development. However, as a next step, my thesis also demonstrates how the work on unintended consequences can simultaneously develop hydrosocial approaches. For example, focusing on the unintended consequences of the MDP compels us to examine how different water perspectives coalesce in mega water projects – since most unintended consequences are caused by interactions between a global, western-centric paradigm on the one hand, and local geo-contextual paradigms on the other. Analysing such interactions between different water paradigms raises new questions for hydrosocial theorists: Why do farmers sometimes defend their own traditional practices that might have been discredited by the western-centric paradigm? Why too, do certain actors (such as the state) strategically chose to subscribe to the global hydrosociality in some instances, and to local hydrosocialities at others?

Critical literature at the intersection of hydrosocial and development approaches at times either focus on the emergence of a global water paradigm and the consequential side-lining of older, indigenous forms of water management (Boelens, Hoogesteger, Swyngedouw, Vos, & Wester, 2016a; Linton, 2008); or the revitalization of indigenous paradigms when encountering the novel challenges of the Anthropocene (Linton, 2008; Lynch, 2018). My third contribution to hydrosocial research, therefore, is to draw attention to the ways in which global and local water perspectives intersect with each other, and the attendant consequences of such a fusion.

Contributions to policy and development

This dissertation contributes to existing theories of policy transfer (Evans, 2009; Goldman, 2007), policy translation (Gerlak & Mukhtarov, 2013; Mukhtarov, 2014; Mukhtarov et al., 2017), and policy mutation (Yates & Harris, 2018) as they are applied in the water sector. I noted in Chapter 2 how widely applied theories of policy transfer primarily engage only with the content of the policies – considering the lessons embedded in the policies as immutable. In contrast to this approach, my analysis of the MDP demonstrates that ideas and perspectives of water are contested by local water users, leading to the 'content' of the policies being subjected to re-evaluation and mutation.

My findings in this sense build on scholarship in policy translation that look at how policy ideas are modified when they travel across jurisdictions, creating new meanings. Policy translation suggests that the travel of policy ideas is affected by multiple factors, and policy ideas taken in abstract sense provide little help in judging possible outcomes of the travel. While this approach better encapsulates how policy ideas are translated from global to the local, it tends to accept the process of translation rather uncritically, placing too little emphasis on the contestation and negotiation of ideas in the water sector (Laeni, van den Brink, Trell, & Arts, 2020). Chapter 5 of my dissertation demonstrates how a hydrosocial approach can better illuminate the front-end epistemological contestation occurring during the design and implementation of mega water projects. Explicitly or not, the design and planning of all mega water projects involves conflicts between social groups and disputes among different knowledge regimes, and this reality needs to be foregrounded in policy analysis in the water sector.

My findings also advance the work of scholars who focus on policy mutation and variegation in the water sector (Brenner, Peck, & Theodore, 2010; Yates & Harris, 2018; Yates, Harris, & Wilson, 2017). While this body of work deals most directly with how policy ideas mutate when encountering the social, cultural, and geographically unique waterscapes of the host countries, it suffers from two limitations. For one, this approach has thus far been limited to analysing neo-liberal water policies – focusing on the polymorphing character of neo-liberalism as a concept. For another, policy mutation/variegation literature, particularly the work of Brenner, Peck, and Theodore (2010) does not delve into a deep analysis on *how* and *why* policies mutate, instead opting to frame their discussion from a policy-first viewpoint. The hydrosocial approach applied in this dissertation, on the other hand, deals with water perspectives and meanings from a farmer-first perspective, thereby offering a more nuanced explanation of how policy mutation occurs, and the consequences of such mutations.

Finally, this dissertation also stresses the importance of critical development approaches in democratizing mega water projects (Del Bene, Scheidel, & Temper, 2018; Yates, 2014). It does so by revealing how international development institutions and local governments work together to promote top-down, supply-side water management in mega irrigation projects to achieve rapid economic growth. Chapter 6 of this dissertation shows how this narrow epistemic focus leads to unanticipated negative outcomes that defeat the developmental expectations of the planners; and cautions against side-lining alternative cultural understandings of water governance.

7.1.3 Future directions

The MDP has finished, although its effects are ongoing. The preceding pages have striven to shed some light on the various seemingly disconnected outcomes of the MDP, thereby providing a better understanding of the contemporary realties experienced by the projects' user-base.

As a research topic, political ecological analyses of mega water projects like the MDP avoids presenting neat, all-encompassing solutions. I end this dissertation, then, not with some suggestions on how to pursue concrete water solutions for mega water projects, but with some thoughts on further opening research avenues. First, more scholarship is certainly required to develop a historical dimension within hydrosocial research, one that fully encompasses multi-scale and relational forms of analysis. Second, although this dissertation examines the importance of establishing a dialogue among global and local hydrosocial perspectives – what might this look like in plans and practice? As these multiple hydrosocialities begin to be asserted in the problem space of mega water projects, more research needs to be undertaken to develop concrete methods of cooperation between them. Some examples of possible methods are found in Canada, where the En'owkin Centre, and the Coastal Stewardship Network has promoted whole systems approaches that nurtures voluntary cooperation between various hydrologic environments (Yates, Harris, & Wilson, 2017). These approaches provide a starting point in developing tools, approaches, and governance frameworks that might be adapted for use in mega water projects like the MDP.

Third, given the practical constraints of conducting this research, I have been unable to incorporate questions of gender as part of my political ecological analysis. Differentiating women's experiences from that of men is, however, very important when understanding the unanticipated outcomes of mega projects. One example of this is presented in Chapter 6, where I briefly looked at the experiences of a female trader in the Thambuttegama marketplace (irrigation system H). That example showed that Sri Lanka's socio-cultural norms prevent women from engaging in occupations such as trading or farming. The example also showed that women were increasingly breaking such socio-cultural constraints to help their family's livelihood, especially given the economic limits imposed by the MDP's agricultural policies. Thus, it is clear that incorporating the thoughts and actions of women (as active participants in their own right) into future research of the MDP would offer significant insights to improve both water governance and development planning in mega water projects.

Finally, I have also steered my analysis away from questions of ethnicity – particularly from considering the (potential) hydrosocialities of minority ethnic groups such as the Tamil population. As noted in Chapter 1 (section 1.6.), the MDP systems were occupied almost entirely by the Sinhalese ethnic group. The main reason for this was that the MDP was implemented in regions that were (historically) occupied exclusively by the Sinhalese. Even though the implementation of the project created new settlements and livelihoods, the Sri Lankan government continued to allocate them to Sinhalese farmers. The prioritization of the Sinhalese when populating the MDP areas can be attributed to two main reasons: (1) Clientelism on the part of politicians who sought to secure the votes of the majority ethnic group (the Sinhalese), and (2) the ever-increasing ethnic tensions between the Sinhalese and the Tamils, which would ultimately lead to a protracted civil war. While the limited presence of Tamil populations within the MDP and the equally limited historical engagement of Tamils with farming and irrigation in Sri Lanka[18] led me to exclude them from my analysis, undertaking a close analysis of Tamil hydrosociality would be necessary to build a more complete political ecology of the MDP.

Despite these limitations, I hope my work has contributed towards unpacking the less-addressed complexities of mega water projects, demonstrating the utility of connecting hydrosocial theory to the study of development and policy mobility. I also hope that this work prompts the kinds of dialogues among hydrosocialities that I have highlighted, and which I hope will become of increasing interest across environmental governance realms.

[18] See, for instance the work of (Abeywardana, Bebermeier, & Schütt, 2018; Madduma Bandara, 1985).

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