

# Understanding Water Management through Cultural and Historical Lenses: A Case Study of the Toledo Plantation, Suriname



*BSc. Thesis by Jona Wong Chung*

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# Understanding Water Management through Cultural and Historical Lenses: A Case Study of the Toledo Plantation, Suriname

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## Abstract

This thesis investigates the cultural and historical processes that have shaped the water management system of the Toledo Plantation in Suriname. Combining field-based mapping, GPS data collection, and comparative analysis with historical plantation maps, the study examines how present-day water systems reflect both colonial-era engineering and subsequent local adaptations.

Fieldwork involved walking transect lines, recording GPS coordinates of canals, planting beds, and notable structures, and documenting the only remaining physical artifact of water control, the remains of a sluice located near the plantation's entrance. The mapped canal network revealed a hierarchical system consistent with 18th–19th century sugar plantations, with primary canals connecting to boundary creeks, secondary canals servicing rectangular planting beds, and water control structures strategically placed for regulating flow.

While the physical design bears the hallmarks of colonial planning, with its long narrow planting beds and polder layout, its persistence into the present owes much to community-driven maintenance and adaptation. Certain canals remain functional due to local agricultural use, while others have been intentionally left to overgrow. These practices reflect traditional ecological knowledge and the continuing cultural relevance of water management in the area.

The comparative analysis with historical plantation layouts suggests that Toledo likely conformed to the standard rectangular arrangement of sugar estates, optimized for cane cultivation and efficient water transport. The findings not only reconstruct elements of the plantation's historical layout but also highlight how landscapes function as living archives, preserving both technical designs and the human stories that shaped them.

The study concludes that Toledo's water system is a hybrid legacy, shaped by colonial polder engineering, local adaptation, and environmental change. It emphasizes the importance of interdisciplinary approaches, combining technical precision with historical and cultural interpretation, to fully understand and preserve heritage landscapes. Recommendations are offered for academic research, heritage management, and community engagement to ensure that Toledo's history remains accessible, relevant, and respected.

## Chapter 1 – Introduction

### 1.1 Background

Water management in Suriname is shaped by a complex combination of environmental conditions, historical developments, and cultural practices. Among the many plantation sites in the country, the Toledo Plantation, located just south of Paramaribo, offers a unique case for examining how these factors intersect and how past water management systems can reveal the historical layout of the landscape.



Figure 1: General overview of plantations, including Toledo, by J.H. Moseberg, ca. 1800.

The history of Suriname's plantations is rooted in a blend of Indigenous, African, Indian, Javanese, and European knowledge systems. Each of these cultural groups contributed distinct agricultural and water management techniques adapted to the local climate, soil, and hydrology. Indigenous peoples developed agroforestry methods and water regulation strategies suitable for tropical ecosystems. Enslaved Africans introduced flood-resistant cultivation techniques and soil improvement practices rooted in their native agricultural traditions. Indian and Javanese contract labourers brought expertise in irrigated rice cultivation, while European colonial powers implemented large-scale drainage and irrigation networks.

Some of these Indigenous practices were actively discouraged or reshaped by colonial authorities, leading to what scholars describe as the “purification” of traditional methods (Ramdayal et al., 2021).

Over time, water management systems on plantations like Toledo evolved in response to shifts in political power, like the abolition of slavery. Not only that but also to economic structures, like the growing sugar industry and the more streamlined trading routes. Environmental conditions played a large role as well, with the Dutch having to adapt to the new environment and working on new ways to enhance efficiency on the plantations. The abolition of slavery marked a significant turning point; while the colonial plantation structure was built for large export out of the country and farming to make an economic excess, the new labour force with the abolition of slavery could not keep up. This led to a change in agriculture activity, to more local subsistence-based farming. In recent years, global attention to sustainable development and heritage conservation has renewed interest in understanding how these historical and cultural legacies influence present-day water management. More importantly, analyzing current water infrastructure offers insights not only to present practices but also to the possible historical layout and functioning of the plantation.

### *1.11 Toledo*

Plantation Toledo, originally known as Roobank, is among the oldest recorded plantations in Suriname, with mentions dating back to 1721. It began as a coffee estate but faced economic challenges that forced land sales and eventually led to a transition into sugar production during the 19th century. In an attempt to boost profitability, British investor O’Ferral merged Toledo with the neighboring Nieuwrust. Even with modernization efforts, including the installation of a steam engine, Toledo remained one of the least productive sugar plantations in the colony by the mid-1800s, possibly due to the lack of size of the plantation (Van Stipriaan, 1993).

Ownership shifted several times throughout its history. In 1775, the plantation was in the hands of Isaac Monsanto, who later passed it on to his son, David Monsanto, in 1781. After the abolition of slavery, the plantation’s trajectory changed dramatically when descendants of the formerly enslaved Weegman family gained control. In 1914, Catharina Weegman (born 1834) secured legal ownership, and her descendants would remain its stewards for generations. Her grandson, Frederik Willem Weegman, known locally as Ba Fedi, cemented the family’s lasting

connection to the land, planting various different crops and remaining to live and spend time on the plantation. He married Bertha Mathilda Deekman, herself a granddaughter of the famed resistance leader Kapitein Broos.

The Weegman family practiced small-scale agriculture on Toledo, growing cassava, plantains, and pineapples, with the plantation's waterways serving as essential transport routes. Oral histories offer only sparse details of the slavery era; Johanna Weegman, the mother of Frederik, was born just after emancipation, and rarely spoke to her grandchildren about that period.

As time went on, limited access to education pushed many younger family members to leave. When Frederik's health began to decline, the family relocated to Paramaribo, dismantling their house to transport it with them. Tragedy struck when the barge carrying the house overturned, destroying both the structure and its contents.

Although they no longer live on Toledo, the Weegman family has retained ownership. Today, the plantation stands not as an active agricultural enterprise but as a deeply personal site of memory, heritage, and identity for its descendants (Sarijoen, 2025).

## 1.2 Problem Statement

While much has been written about the technical and ecological dimensions of water management in Suriname (Ehrenburg & Meyer, 2015; Van Stipriaan, 1993), less attention has been paid to its cultural and historical significance, and how current water systems can be used as evidence for historical land use and layout. The dominant narrative often attributes the efficiency of colonial plantations primarily to European engineering and water management strategies. However, the validity of this claim remains underexplored, and the role of non-European knowledge systems, as well as the interpretative value of surviving infrastructure, is often overlooked.

The Toledo Plantation, like many smaller sites, has been largely overlooked in academic research. Most studies focus on large-scale infrastructure or plantations located closer to Paramaribo, leaving smaller plantations underrepresented in scholarly discourse. This lack of attention is especially problematic given the unique blend of influences that shaped Toledo's water management practices. Without a nuanced understanding of these influences, and without examining how current infrastructure reflects historical design,

opportunities to integrate cultural heritage into contemporary water governance may be missed.

The origin of knowledge sometimes seems insignificant, however, when the acquisition of knowledge is largely attributed to one group, the other groups are overlooked and can feel disassociated with this knowledge. In this case, by overlooking the influence of water management practices other than the colonial system, the development of new management practices is limited, and the groups who contributed to the actual success of a plantation aren't taken seriously (Alatas, 2024).

### 1.3 Research Objectives and Questions

#### General Objective

To investigate how cultural and historical factors have shaped water management practices on the Toledo Plantation in Suriname.

#### Internal Objective

To deepen academic understanding of the relationship between cultural influences, historical land-use practices, and water management by analyzing archival sources, oral histories, and field-based evidence from the Toledo Plantation.

#### External Objective

To generate insights that can inform heritage preservation and support local communities and organizations in recognizing and valuing traditional water management practices as part of Suriname's cultural landscape and sustainable land-use strategies.

#### Specific Objectives:

- To examine the role of historical water management in shaping current landscape on the Toledo Plantation.
- To explore the influence of traditional knowledge and cultural heritage on water management strategies.
- To assess how water management practices can inform an understanding of the plantation's historical layout.

**General Research Question: What are the cultural and historical influences that have shaped the water management practices on the Toledo Plantation in Suriname?**

**Specific Research Questions:**

- 1. How has the historical water management influenced the landscape on the Toledo Plantation over time?**
- 2. What role did traditional knowledge and cultural heritage play in the water management on the Toledo Plantation?**
- 3. What can the water management on the Toledo tell us about the assumed historical layout?**

#### **1.4 Significance of the Study**

This study contributes to both academic scholarship and practical water governance in Suriname. Academically, it fills a gap in plantation studies by integrating historical and cultural narratives into the analysis of water management systems. While technical assessments provide critical insights into system performance, they do not capture the lived experiences, traditional knowledge, and historical contexts that underpin these systems. A lot of the old plantations are privately owned.

Practically, the research provides insights that could inform heritage conservation and sustainable development policies. By acknowledging the role of cultural heritage alongside technical expertise, the study supports more inclusive and context-sensitive approaches to water governance. This has the potential to enhance community engagement, preserve valuable traditions, and improve long-term sustainability outcomes.

### **Chapter 2 – Literature Review**

#### **2.1 Historical Overview of Water Management in Suriname**

Water management in Suriname has historically been shaped by its unique coastal geography, heavy seasonal rainfall, and low-lying terrain. Most Latin-American plantations were situated on higher grounds. Therefore, to accommodate the low coastal plains of Suriname, the colonial development required extensive drainage systems to convert wetlands into productive plantation land (Ehrenburg & Meyer, 2015). These systems typically included drains/canals, sluices, and dikes, designed to both prevent flooding and excess water, while also enabling irrigation in the dry periods.

In the plantation belt surrounding Paramaribo, European settlers drew upon both European engineering principles and local environmental knowledge. Early designs were influenced by Dutch polder systems, adapted to tropical conditions. However, the practical realities of maintaining these systems often relied on enslaved labourers and, later, indentured workers who brought their own water management traditions. These plantations weren't only making use of labourers; the plantations were specifically designed around the use of them. (Hauser, 2017). With the dominating Dutch influence on the water management on most these plantations, a diversion from this path was bound to happen. Escape agriculture became extremely popular after the gradual abolishment of slavery (Maat et al., 2023). Maroon communities used this escape agriculture, which entails a lot of crop diversity. This crop diversity stands in direct opposition to the mono-cultures of the large-scale profit based colonial farming which was present on most plantations.

Suriname's plantation economy was embedded in a low-lying coastal landscape that demanded intensive hydrological engineering for any form of commercial agriculture. The environment was both an opportunity and a challenge: fertile alluvial soils lay behind narrow coastal ridges, but they were subject to tidal flooding, seasonal inundation, and saltwater intrusion (Maat, 2024). To transform these wetlands into productive farmland, planters constructed polder-like systems, combining primary drainage canals, lateral field drains, and embankments, which allowed them to regulate water flow and protect crops from excess water while maintaining soil moisture during drier periods.

### *2.11 The Colonial Sugar Plantation Layout*

Dutch plantations in Suriname were designed to function within the constraints of the climate while meeting the demands of large-scale agriculture. A little bit like the houses along the canals in Amsterdam, most estates took the form of long, narrow strips of land with limited front along a river or creek, ensuring vital transport access while stretching deep into the interior (Stipriaan, 1993).

Historical maps and plantation plans from Suriname and the wider Caribbean show that sugar plantations followed a relatively standardised spatial model, though adapted to local conditions. A typical Surinamese sugar plantation began with a boundary creek or river front, which served as the main transport route to Paramaribo and the Atlantic export network. From this extended a primary canal, broad enough for small boats, running inland, often in a straight line for several kilometres (Ryzewski & Cherry, 2015).

Secondary canals branched off perpendicularly from the main canal, dividing the estate into rectangular or trapezoidal field blocks. Within each block, a system of tertiary furrow bed-and-drain channels created elongated planting beds, typically oriented so that excess water could drain quickly into the nearest secondary canal. The bed width and spacing varied by crop type - sugar cane beds, for example, were generally narrower and more closely spaced than those for coffee or cotton (Armstrong & Kelly, 2000).

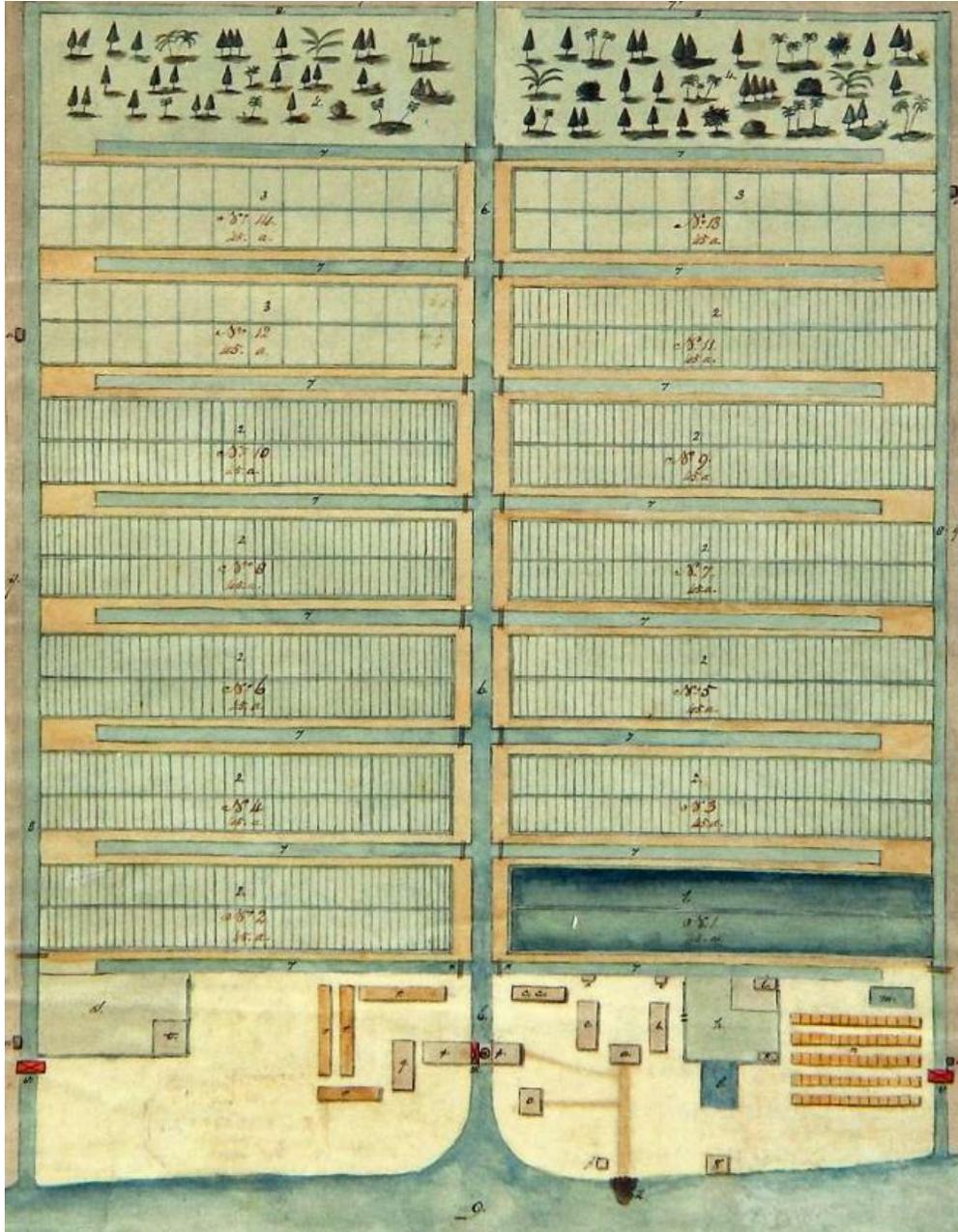


Figure 2: Old map of a sugar plantation (Tropen museum H-3550) (Ehrenburg en Meyer, 2015)

At key junctions, especially where canals met the boundary creek or river, sluices controlled the inflow and outflow of water. In tidal zones, these were often koker sluices, these sluices would be able to open at the bottom with wooden gates that would be either, opened at low tide to release excess water, or closed to prevent saltwater intrusion at high tide. Dykes lined vulnerable sections, especially near the river front, to prevent overtopping during storm surges (Maat, 2024).



Figure 3: Sluis in the Commewijne district (Roy Tjin)

The industrial core of the plantation, including the mill, boiling house, curing house, and storage facilities, was usually situated near the river or creek front for ease of loading sugar onto boats. The manager's residence, overseers' houses, and workshops clustered nearby, while enslaved labourers' quarters were often arranged in rows perpendicular to the main canal, within walking distance of both fields and processing facilities (Armstrong & Kelly, 2000; Brown, 2021). Plantation complexes also included workshops, stables, kitchens, and basic medical facilities, with a stark contrast between the large, well-built planter's

residence and the cramped wooden barracks that housed enslaved labourers. (Stipriaan, 1993).

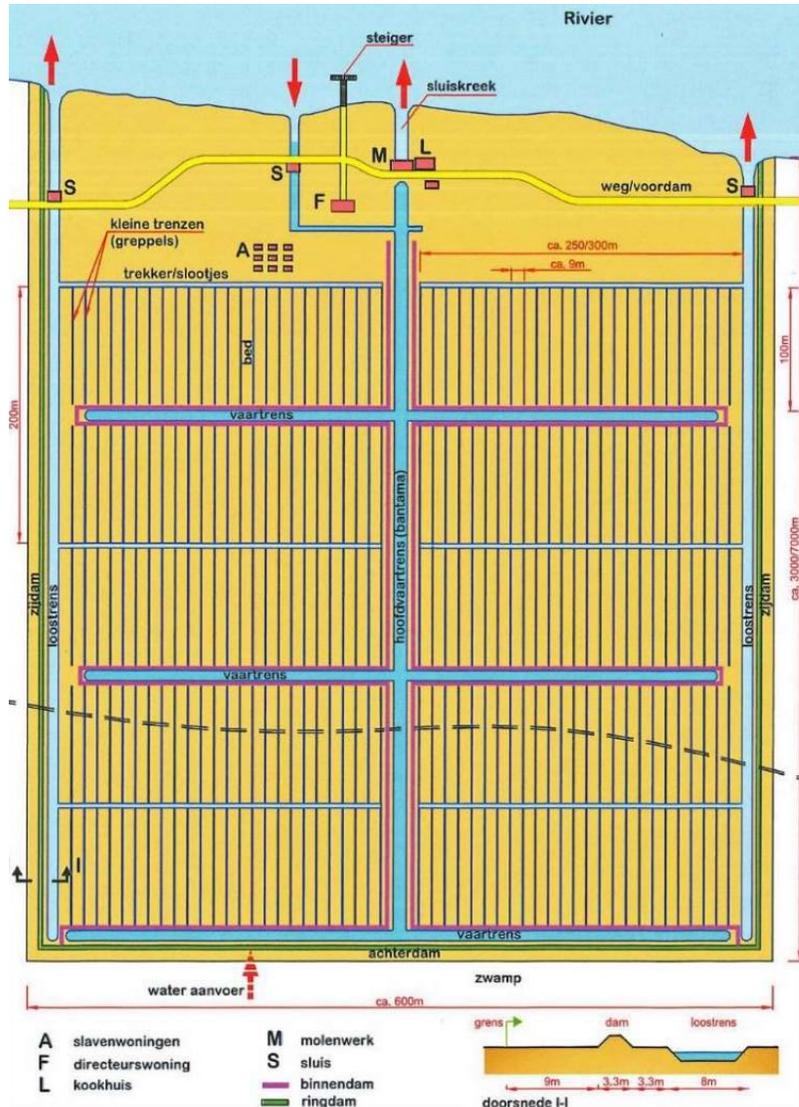


Figure 4: Schematic map of a sugar plantation (drawing Ehrenburg/Sunecon) (Ehrenburg and Meyer, 2015)

The mill was situated at the front of the plantation and benefited from a wide primary canal. The wider the canal, the more hydraulic power could be accumulated to process the tons of sugarcane that needed to be milled down on the plantation (Ehrenburg & Meyer, 2015).

This physical arrangement was not only functional but also disciplinary, one of the key aspects of colonial plantation management. The straight lines of canals and beds created clear sightlines, enabling overseers to monitor labour across large areas (Hauser, 2017). Canals doubled as transport routes for both goods and workers, with boat traffic reducing the need for overland haulage in muddy conditions. As a result, the water management system was both an agricultural tool and a mechanism of labour control.

### *2.12 The polder system*

The plantations in Suriname relied on a polder system, borrowed from Dutch water management traditions and adapted to the coastal swamps. A polder is basically low land surrounded by dikes, with a system of canals and sluices to keep it dry enough for crops.

On the plantations, dikes kept out the river water, while a network of ditches and canals drained the excess rain and groundwater. At low tide, sluices were opened to let the water out into the river, and at high tide they were shut to prevent flooding. This tidal drainage was the only way to manage water, since pumps were not yet available.

The canals also doubled as transport routes. Barges moved sugar, timber, and supplies between the fields and the river, making water the backbone of the whole system. But keeping the polders working took constant effort. Ditches silted up, dikes eroded, and wooden sluices wore down quickly. Enslaved Africans did the hard, daily work of digging, clearing, and repairing; without them, the polder system would have collapsed.

Culturally, the polder showed the Dutch way of thinking about land: controlling and ordering nature through engineering. In Suriname, that meant reshaping the swampy coast into a geometric plantation grid, but it was only sustainable through the forced labor that kept it running.

### *2.13 Adaptations in Suriname*

While the Dutch colonial engineers who were deployed by the Dutch West India Company (Harley et al., 1987), drew heavily on hydraulic principles from the Netherlands, Suriname's tropical conditions demanded modifications. Bed-and-drain dimensions were adjusted for heavier rainfall; sluices were sometimes fitted with additional barriers against floating debris. Over time, these layouts

became hybrid systems, a synthesis of European engineering and local environmental knowledge. According to Maat (2024), this adaptability was key to the long-term survival of the plantation water infrastructure, parts of which remain visible today, including at the Toledo Plantation.

## 2.2 Cultural Knowledge and Agricultural Practices

Suriname's agricultural systems are the product of centuries of cultural convergence, where multiple knowledge traditions met, overlapped, and evolved in response to the challenges of the coastal lowlands. Indigenous peoples of the Guianas developed sophisticated, place-based strategies for farming in seasonally flooded and nutrient-poor environments. These included raised fields, which elevated crops above floodwaters, and flood-adapted cultivation timed to hydrological cycles. They also practiced complex agroforestry systems, such as intercropping annuals with perennials such as fruit and palm species and creating landscapes that provided food, materials, and ecological stability. Such systems, found widely in the Amazon, represent a fusion of biodiversity conservation and production, maintaining soil fertility and hydrological regulation over long time scales (Miller & Nair, 2005).

African communities, forcibly brought to Suriname through the transatlantic slave trade, contributed agricultural methods honed in equally challenging tropical environments. This includes creating elevated planting spots in saturated soils and intercropping to reduce pest pressure and optimize land use, and the application of organic matter to enrich poor soils. Similar techniques are central to sustainable wetland farming in parts of Africa today, and their endurance in Suriname suggests both practicality and cultural resilience. These strategies, suited to flood-prone terrain, complemented Indigenous approaches and offered plantation owners additional models for managing water and soil (Comptour et al., 2018).

Indian and Javanese indentured labourers, arriving in the late 19th and early 20th centuries, brought with them paddy rice cultivation systems precisely attuned to monsoonal hydrology. In Suriname, these methods were adapted to local rainfall and riverine flooding patterns, integrating with existing drainage channels where possible. Over time, rice became one of the most important crops in Suriname, further embedding Indian and Javanese water-management logic into the plantation landscape.

Importantly, these practices did not remain isolated. Plantation agriculture became a site of agricultural hybridization, where owners selectively adopted

aspects of local and imported systems and retaining those that improved yields or reduced labour while rejecting or modifying others to fit colonial ideals of order and “modern” farming. In Miller and Nair’s, 2015, page 162 analysis of Indigenous systems emphasizes that such hybridization often stripped practices of their broader cultural and ecological context, while Comptour’s, 2018, page 18 stresses that transplanted African wetland systems, once removed from community-based management, could lose some of their sustainability benefits.

This complex interplay created layered agricultural systems that persist in modified forms today. At sites like the Toledo Plantation, the spatial organization of planting beds and canals is not only a remnant of colonial engineering but also a physical record of centuries of adaptive experimentation. The raised fields, bed-and-drain configurations, visible in the modern landscape suggest that Toledo’s water management is as much a legacy of Indigenous, African, and Indian/Javanese knowledge as it is of European design.

### 2.3 Colonialism and Post-Colonial Transition

During the colonial period, Suriname’s plantations were primarily oriented toward export crops such as sugar, coffee, and cotton. Water management strategies were designed to maximize production efficiency and safeguard valuable crops from seasonal flooding, with extensive canal networks, sluices, and embankments forming the backbone of plantation infrastructure (Van Stipriaan, 1993). These systems required coordinated labour for upkeep, often enforced through slavery and, later, indentured labour.

The abolition of slavery in 1863, followed by a ten-year transition period of state-controlled labour, brought profound changes to the plantation economy. Many estates struggled to maintain profitability as labour became more costly and less coerced. Some plantations collapsed entirely, while others diversified or shifted toward less labour-intensive crops. Formerly enslaved people, when able to leave the estates, established their own smallholdings, often in marginal lands, and reoriented production toward subsistence or local markets (Yarak & Emmer, 1999).

This economic and social restructuring altered the demands placed on water management systems. Large-scale colonial infrastructure, such as primary canals and sluice gates, often fell into disrepair due to the absence of organized labour for maintenance. In their place, smaller-scale, locally managed systems emerged. These relied more heavily on traditional ecological knowledge, adapting

existing colonial layouts to suit mixed-crop farming, rice paddies, and seasonal flood control (Yarak & Emmer, 1999).

Over generations, these post-emancipation systems evolved to reflect changing agricultural priorities, technological availability, and much more recently, ecological pressures. While much of the colonial infrastructure remains visible, its function today is often integrated with locally developed adaptations, creating hybrid landscapes that embody both historical and contemporary approaches to water management.

#### 2.4 Heritage and Sustainable Development

In recent years, there has been a growing recognition that cultural heritage is not only of historical value but also offers practical lessons for sustainable water management. Historical infrastructure can provide insights into long-term environmental adaptation, while traditional knowledge can guide context-specific strategies today (Dai & Hein, 2023).

The Toledo Plantation offers a valuable case because it embodies overlapping Indigenous, African, and European influences that have interacted for centuries. Preserving and studying such systems can strengthen local identity, inform sustainable development, and inspire heritage-based management models that integrate social, cultural, and ecological considerations.

#### 2.5 Identified Research Gap

Although studies have examined the technical aspects of water management in Suriname, few have explored the intersection of history, culture, and hydrological infrastructure at smaller, under-researched plantations. Moreover, little attention has been paid to how current water management can serve as evidence for reconstructing the historical layout of plantations. This gap is particularly important for heritage conservation, as the physical remnants of water systems can provide unique insights into how plantations were designed, managed, and adapted over time.

The present study addresses this gap by examining the Toledo Plantation as a case study, integrating archival research, oral histories, and spatial analysis to

better understand the cultural and historical influences that shape its current water management systems.

## Chapter 3 – Methodology

### 3.1 Research Design

This research adopts a case study approach, focusing on the Toledo Plantation as a representative site for exploring the intersection of cultural heritage and water management in Suriname. The case study method is appropriate because it allows for an in-depth examination of a single location in its historical, cultural, and environmental context. By concentrating on one plantation, it becomes possible to investigate both technical and cultural factors influencing water management and to link these directly to site-specific historical narratives.

The research design combines qualitative field methods, spatial analysis, and comparative historical interpretation. Field observations and measurements provide the foundational data. Spatial analysis, through the creation of a detailed plantation map, translates field findings into a format that can be compared with historical layouts. Comparative analysis with other colonial sugar plantations then situates Toledo's water management within a broader regional and historical framework.

This layered approach, from field data collection to spatial representation to historical comparison, ensures that the study does not rely solely on one type of evidence. Instead, it triangulates between observed reality, mapped data, and documented historical patterns. And with all this, also a small part of cultural remembrance.

## 3.2 Research Process Overview

The methodology was structured into three main phases:

1. **Field Data Collection** – Conducted over a five-day period, focusing on identifying and documenting water-related features such as canals, creeks, and planting beds.
2. **Data Processing and Mapping** – GPS coordinates and field notes were processed to create a detailed digital map of the plantation's water infrastructure.
3. **Comparative Historical Analysis** – The generated map was compared to known layouts of colonial sugar plantations to interpret historical influences and potential functions of the identified features.

Each phase builds upon the forgoing. Fieldwork provided the raw data, mapping organized it into an analyzable structure, and comparison situated Toledo's features within a wider historical context.

## 3.3 Fieldwork Methods

### 3.3.1 Site Survey and Transects

The field survey was designed to capture a comprehensive picture of the plantation's current water systems. The team employed transect walks, systematic paths taken across the plantation, to ensure that all accessible areas were covered. Transects were chosen to cross major visible features while also extending into less obvious areas, where smaller or overgrown structures might remain.

This method ensured that the fieldwork did not simply focus on the most prominent or accessible canals, but also on secondary and tertiary features that could hold important historical clues. By moving systematically across the site, observations could be compared between transects, reducing the likelihood of overlooking significant features.

### 3.3.2 Identification of Water Infrastructure

During transect walks, all visible water-related infrastructure was identified and recorded. This included canals, creeks, planting beds, junctions, and other landscape features that could relate to past or present water management. Particular attention was given to points where water channels intersected, shifted direction, or showed signs of modification.

The aim was not only to catalogue existing infrastructure but also to note features that might indicate historical usage; for example, unusually straight channels suggesting deliberate construction, or changes in bank slope indicating maintenance or re-excavation at some point in the past.

### 3.3.3 GPS Data Collection

GPS devices were used to record the coordinates of significant features. This geospatial data was essential for producing an accurate map of the plantation's water systems.

Data collection focused on:

- Primary, secondary, and tertiary canals
- Planting beds with visible boundaries or drainage lines
- Distinct landscape anomalies, such as depressions or embankments, that could indicate historical water management functions

Care was taken to ensure that GPS points were recorded at consistent intervals along linear features, allowing for accurate reconstruction of their shape and alignment in the mapping phase. Limitations, such as occasional GPS signal loss under dense vegetation, were noted and later cross-checked with satellite imagery where possible.

### 3.3.4 Feature Classification

Once identified, water features were classified into functional categories. The classification system used four main types:

1. Primary Canals – Main channels likely used for both drainage and transportation of goods.
2. Secondary Canals – Feeding into or branching from primary canals, distributing water across plantation sections.
3. Tertiary Channels – Small-scale drainage features, often associated with specific planting beds.
4. Transport Canals – Specifically aligned and sized to accommodate the movement of goods by boat.

Classification was based on dimensions, alignment, and position within the overall network. For example, a broad, straight channel leading toward the plantation's boundary would be more likely classified as a primary or transport canal than a secondary or tertiary feature.

### 3.3.5 Physical Measurements

Measurements were taken for selected examples of each feature type. Width and depth were the primary dimensions recorded, as these can help indicate original purpose and current state of maintenance.

- Wider, deeper canals may indicate a transport or main drainage function.
- Narrower, shallower channels are more consistent with tertiary or drainage systems.

Measurements were taken using measuring tapes and depth poles where possible. Variability in dimensions was also recorded, as changes in width or depth along a canal's length could suggest different stages of construction or maintenance.

### 3.3.6 Observational Notes and Photographs

Field notes captured contextual information that might not be visible in measurements alone. This included:

- Evidence of erosion or sedimentation
- Vegetation types growing along canal banks
- Remnants of potential sluices or water gates
- Soil texture and moisture conditions in surrounding areas

Photographs were taken systematically to document each feature's appearance. Images were linked to GPS coordinates so they could be referenced during the mapping and interpretation stages.

### 3.4 Data Processing and Mapping

After fieldwork, GPS data was sorted and unnecessary was removed. After that the data was imported into GIS software to create a digital representation of Toledo's water management systems. Field notes and photographs were linked to specific locations on the map, providing both spatial and descriptive context.

The mapping process involved:

1. Digitizing linear features from GPS tracks to recreate the shape and direction of canals and beds.
2. Overlaying the data on satellite imagery to check alignment with visible landscape features.
3. Labelling and categorizing features according to the field classification scheme.

The resulting map allowed for a clear visualization of the plantation's layout. It revealed spatial patterns, such as alignment of planting beds, spacing between secondary canals, and the relationship between water features and plantation boundaries, that were not as evident during fieldwork.

### 3.5 Comparative Historical Analysis

With the digital map completed, the next step was to compare Toledo's current water system layout with known historical layouts of colonial sugar plantations in Suriname. The aim was to identify similarities and differences that could shed light on the plantation's original design and how it has evolved.

Historical sources used for comparison included:

- Archival plantation maps from the colonial period
- Historical engineering plans for sugar plantations
- Scholarly analyses of plantation water management in Suriname

The comparison focused on:

- Orientation: Whether canals and beds align with cardinal directions or follow natural contours.
- Spacing: Distances between planting beds and canal networks.
- Hierarchy: Presence of a clear primary-to-tertiary canal structure.
- Transport Integration: Evidence that canals were designed to connect with regional waterways.

This comparative analysis helped address all three specific research questions by linking the observed features at Toledo to broader historical trends.

### 3.6 Operationalization of Key Concepts

- Historical Water Management: Any physical water infrastructure that dates back to or retains the form of colonial-era designs, even if modified over time.
- Current Water Systems: The functioning network of water features observed today, regardless of origin.
- Traditional Knowledge and Cultural Heritage: Practices, adaptations, and understandings of water management transmitted across generations and embedded within community narratives.

### 3.7 Data Analysis

Data analysis occurred in three stages:

1. **Descriptive Analysis:** Summarizing field measurements, classifications, and observations.
2. **Spatial Analysis:** Using GIS to examine relationships between features and their distribution.
3. **Comparative Interpretation:** Drawing conclusions from the alignment or divergence between Toledo's systems and those of documented colonial plantations.

### 3.8 Validity and Reliability

Reliability was strengthened through consistent application of measurement and classification procedures. GPS accuracy was cross-verified with satellite imagery.

Validity was enhanced by triangulating between field data, spatial mapping, and historical sources. Limitations include the inability to access certain overgrown or waterlogged areas, which hinder our unbiased pathing through the landscape. Certain rough areas would diverge us from our desired path and could have provided us valuable data. With access to aerial drone imagery, it could have provided a broader perspective on the water systems further into the plantations. By looking at the canopy cover of the plantation certain open areas and lines through the landscape could be identified to give us a further understanding of the historical land use, but with the absence of this, a lot more assumptions had to have been made.

### 3.9 Ethical Considerations

The Toledo Plantation is both an ecological and cultural heritage site. Fieldwork respected the integrity of the site, avoiding any destructive sampling. Engagement with local contacts ensured awareness of cultural sensitivities, and no data was shared without consideration of community interests. We had permission of the landowners to conduct our research and were even funded by them. No disrespect has been brought to their land and their believes.

## Chapter 4 - Results

### 4.1 Introduction to Findings

The fieldwork at the Toledo Plantation resulted in a detailed record of existing water management features, their condition, and their spatial arrangement. These findings were documented through GPS mapping, transect surveys, physical measurements, and photographic evidence. Together, they form the basis for interpreting how current water systems may reflect historical plantation layouts and functions.

The field observations revealed three main categories of results:

1. The identification and classification of canals, planting beds, and drainage lines.
2. The discovery and documentation of the currently only remaining physical water management structure, likely the remains of a sluice.
3. Spatial patterns in the mapped water infrastructure that bear similarities to historical sugar plantation layouts.

The sections below present these findings in detail, supported by photographs and historical comparisons.

## 4.2 Overview of the Water Network

The water network at Toledo Plantation consists of a mix of well-defined canals, faintly visible planting bed drainage lines, and isolated depressions that may have been part of older water routes, and dikes surrounding the plantation indicating the Dutch polder system. The most prominent features are the primary canals, which are the largest and most continuous elements of the network. Secondary and tertiary canals are present but are more irregular in their preservation, often overgrown or partially filled. Near the river border, most of the landscape is undefinable. Due to frequent flooding and abandonment of the polder system, a lot of land directly next to the river has been washed away and most of the identifiable landscape structure is gone. The back of the plantation is mostly absorbed by a natural Podosiri (Acai) swamp.

The plantation's boundary creeks to the north and south serve as natural hydrological limits. The southern creek is particularly significant because it hosts the only remaining identifiable water management artifact: the remnants of a sluice structure.

## 4.3 Primary Canals

Primary canals are the main arteries of the water management system. They are broad, relatively straight, and align closely with the long axis of the plantation.

Several of these canals still carry water, suggesting they remain connected to drainage or seasonal flooding processes. Others, particularly toward the plantation's interior, have reduced water flow and are partly choked with vegetation. The relatively straight alignment of these canals suggests intentional engineering, likely serving both drainage and transportation purposes during the plantation's operational period.

## 4.4 Secondary and Tertiary Canals

Secondary canals branch from the primary network, channelling water toward planting areas., These vary in width and are generally shallower than the primary

canals. In some cases their course can be clearly traced; in others, they are only partially visible, disappearing into dense vegetation before re-emerging further along.

These tertiary canals or “furrows”, often no more than a meter wide, run parallel to planting beds where visible. These features are critical for reconstructing the plantation’s agricultural organization because their spacing and orientation reflect planting patterns and are integral to the drainage system.

#### 4.5 Planting Beds and Field Layout

One of the most revealing aspects of the site is the persistence of planting bed structures. In certain areas, the raised beds remain clearly visible, with defined drainage channels separating them. This preservation allows for a partial reconstruction of the plantation’s cropping layout.

##### *4.51 Northern border planting beds*



**Figure 5: Visible planting beds next to the northern border creek.**

The orientation of these beds suggests a design similar to documented colonial sugar plantation layouts, with long, narrow plots designed for efficient water distribution and drainage. These beds near the northern border creek will be referred to as the northern border planting beds, these beds are orientated going from east to west, parallel to the creek flowing to the river and therefore perpendicular to the Suriname River itself.

In some parts of the plantation, the bed alignment becomes irregular, indicating either later re-use of land for different crops or a gradual breakdown of the original system. Figure 4.1 was taken next to the north border creek. This area was the most regular in terms of layout.

North	Width (m)	Length (m)	Furrow width (m)
Planting bed 1	6.5	50	0.8
Planting bed 2	6.3	50	0.7
Planting bed 3	6.6	50	1
Average	6.5	50	0.8

#### *4.52 Southern border planting beds*

South	Width (m)	Length (m)	Furrow width (m)
Planting bed 1	6.8	50	0.8
Planting bed 2	7	50	0.8
Planting bed 3	7	50	0.7
Average	7	50	0.8

The planting beds bordering the southern border creek, have similar dimensions to the northern border creek. The only difference is that the orientation of these planting beds is going from north to south. They lie perpendicular to the primary canal, and parallel to the river. Since this area was a lot more waterlogged than the northern border creek, a clear beginning and end point could not be found.

#### 4.6 The Sluice Remains: Only Surviving Water Management Structure

Perhaps the most significant discovery during fieldwork was the identification of structural remains consistent with a sluice. Located along a canal near the plantation entrance, this feature is positioned in a way that would have allowed it to control water flow between the plantation's internal canals and the southern boundary creek. It connects the waterflow from the Suriname River through the southern boundary creek to the plantation.

Two perspectives of the sluice's remains were documented: a top-down view showing the structural footprint, and a frontal view revealing the preserved profile of the construction. The surviving material suggests an earth-and-wood composite construction, typical of plantation sluices in Suriname, and seen as such in figure 3.



Figure 6: Top view of sluice remains “southern boundary creek”



Figure 7: Frontal view of sluce remains "southern boundary creek"

These remains provide the clearest physical link between Toledo's present water network and the engineered systems of the plantation era. Their location at a hydrologically strategic point strongly supports their interpretation as a sluce used for regulating water levels.

#### 4.7 Relationship Between Sluce and Plantation Layout

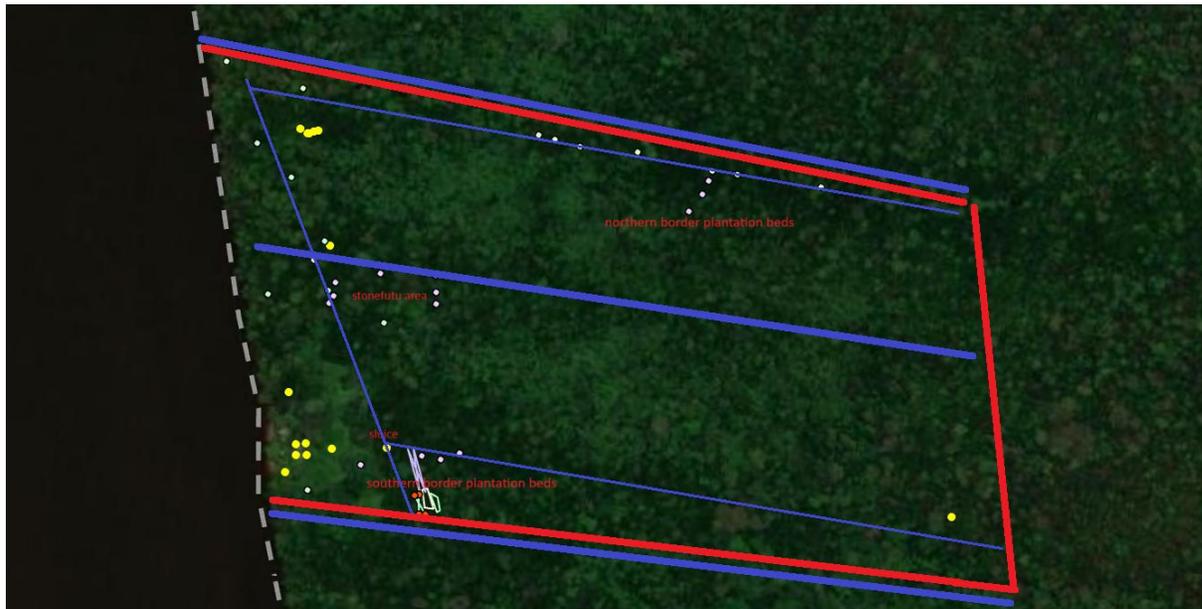
The sluce's location near the entrance, combined with its connection to a broad canal, suggests it was part of a controlled water intake and outflow system. In colonial sugar plantations, such sluices were used to:

- Prevent excessive flooding during high river stages.
- Allow flushing of the canal system to prevent stagnation.
- Regulate irrigation levels during dry periods.

The sluice would have been critical for maintaining optimal soil moisture and protecting crops from waterlogging. Its placement and size suggest it could have influenced the functioning of both the primary and secondary canal networks.

#### 4.8 map of the Toledo plantation.

The modern-day map of Toledo was created and compared with two historical maps of sugar plantations in Suriname and the descriptions of comparable plantations



Besides all the measurements we did of the creek, a certain activity area was found a bit south of the primary canal. Stone pillars were found in the ground, which we referred to as “stonofutu”. Which according to Ms White were used to support buildings and structures in the wet grounds of the low-lying Toledo plantation.

Key similarities include:

1. Hierarchical Canal Structure – Both Toledo and historical maps show a clear progression from primary to secondary and tertiary canals.
2. Rectangular Plot Design – Historical plantations often used rectangular or trapezoidal planting plots separated by canals; Toledo’s preserved planting beds align with this pattern in several areas.

3. Boundary Integration – Historical layouts integrated boundary creeks as water sources and outlets. On Toledo, the south boundary creek for example connects to the plantation with the one remaining sluice.
4. Transport Connectivity – Broad primary canals in both cases connect directly to external waterways, indicating a dual role in drainage and transport.

Differences include irregularities in Toledo's current bed spacing and canal orientation in certain areas, like the ones near the southern border creek. This is likely reflecting post-colonial land use changes and the natural degradation of the system over time.

#### 4.9 Evidence of System Modification Over Time

Several observations indicate that Toledo's water management system has undergone modifications since its initial construction:

- Some primary canals have inconsistent widths, suggesting later re-excavation or partial infilling.
- The presence of planting beds in some areas but not others imply shifts in cultivated zones and shifts in types of crops.
- The sluice remains appear weathered and partially collapsed, indicating long-term abandonment and the absence of recent maintenance.
- Vegetation encroachment is most severe in tertiary channels, suggesting these have not been in active use for decades.

#### 4.10 Spatial Patterns from Mapping

The GPS-based map of Toledo shows:

- Higher canal density on one side of the plantation, possibly due to soil type differences.
- Regular spacing of planting beds in preserved areas, matching the intervals found in historical sugar plantations.
- Alignment of primary canals parallel to the main plantation axis, supporting the idea of planned engineering rather than organic development.

These patterns reinforce the interpretation that much of the visible water system is a remnant of the original plantation-era design.

#### 4.11 Link to Research Questions

The findings directly address the three specific research questions:

1. How has historical water management influenced the water systems found currently on the Toledo Plantation?
  - The hierarchical canal structure and integration of boundary creeks reflect enduring elements of colonial water management design.
2. What role did traditional knowledge and cultural heritage play in the water management on the Toledo Plantation?
  - While physical evidence is primarily linked to colonial systems, the continued visibility and adaptation of these features suggest knowledge transfer and local maintenance traditions.
3. What can the water management on the Toledo tell us about the assumed historical layout?
  - The alignment of canals, presence of planting beds, and sluice remains align closely with historical plantation maps, indicating that Toledo's current layout preserves key elements of its original design.

## 4.12 Summary

The Toledo Plantation retains significant elements of its historical water management system, including primary canals, preserved planting beds, and the remains of a sluice structure. These features, when mapped and compared to historical layouts, reveal a strong continuity between past and present configurations. At the same time, evidence of modification and degradation points to a long history of adaptation, abandonment, and environmental change.

The results presented here establish a clear foundation for the discussion in the next chapter, which will interpret these findings within the broader historical and cultural context of Surinamese plantation water management.

## Chapter 5 – Discussion

### 5.1 Introduction

The findings from this research, when considered alongside the historical and theoretical context outlined in Chapter 2, reveal a complex interplay between environmental conditions, cultural heritage, and technological adaptation in shaping the water management system of the Toledo Plantation. The discussion here draws on these findings and places them within broader debates on heritage-based management, colonial and post-colonial agricultural transformation, and the anthropological implications of preserving and interpreting plantation landscapes. This chapter aims to bridge empirical observation and theoretical reflection, showing how Toledo embodies both the legacy of colonial water management and the resilience of locally adapted systems. It further considers how these systems have been influenced by the interactions of multiple cultural traditions over the centuries, and how they can inform contemporary approaches to sustainable development.

### 5.2 Linking Historical Layouts to Present-Day Features

One of the central findings of this research is the persistence of structural patterns in Toledo's water management system that closely align with the standardized layouts described in the literature on colonial sugar plantations (Chapter 2.1). The mapping results (Chapter 4) confirm the presence of primary and secondary canals, bed-and-drain formations, and remnants of sluice infrastructure. These align with descriptions by Armstrong and Kelly (2000) and Stipriaan (1993), where plantations were organized into long, narrow strips of

land extending inland from a river frontage, subdivided into rectangular or trapezoidal field blocks serviced by an integrated network of waterways.

This continuity suggests that even after the decline of large-scale sugar production and the shifts brought about by emancipation, the spatial logic of the plantation remained influential. While some of the infrastructure has degraded or has been repurposed, its imprint continues to shape the hydrology of the area. In this sense, Toledo is not merely a site of heritage in a symbolic sense, but an active hydrological system whose layout still controls water flow, and drainage. The water that still flows through Toledo, is still sometimes bound by the hydrological infrastructure that was put there many years ago.

The persistence of these layouts also raises questions about the nature of technological transfer and adaptation. While much of the hydraulic design was initially informed by Dutch polder engineering, it has undergone transformations to suit the tropical climate, local hydrological cycles, and the capacities of smaller-scale farming communities.

### 5.3 Cultural Layering and Hybrid Systems

From a cultural anthropological perspective, Toledo can be seen as an example, a landscape where successive layers of cultural influence are carved upon the physical environment. The historical overview in Chapter 2.2 highlighted how Indigenous, African, Indian, Javanese, and European traditions each contributed distinctive agricultural and hydrological practices. In the current field evidence, this layering is visible in the blending of structural elements typical of colonial sugar estates with modifications that are more characteristic of smallholder, subsistence-oriented systems.

For example, the use of raised planting beds visible in certain sections of Toledo can be linked to both Indigenous flood-adapted agriculture and African mounding techniques. Similarly, the subdivision of fields into smaller, more irregular plots in the post-emancipation era reflects a shift toward diversified cropping patterns, which is consistent with Maroon escape agriculture as described by Maat et al. (2023). These features are not simply the result of environmental necessity, but are culturally embedded responses to both ecological constraints and the socio-economic realities of post-plantation life.

This mix of knowledges complicates simplistic narratives of technological superiority or linear progress. Instead, it suggests a dynamic process of selection, adaptation, and integration, where knowledge systems from multiple origins are evaluated in practice and retained when they prove effective in the local context. Water management at Toledo cannot be fully understood through technical analysis alone; it also requires an appreciation of how cultural values, labour organization, and historical memory influence the maintenance and modification of infrastructure.

#### 5.4 Heritage as a Living System

An important implication of these findings is that heritage in the context of water management should not be looked at solely as a static preservation of artifacts or layouts. Rather, Toledo's system demonstrates how heritage can be a living, functional framework that continues to shape and be shaped by contemporary use. This aligns with the perspective of UNESCO on integrating heritage into sustainable water management, which argue that historical systems offer valuable models for resilience in the face of modern challenges (Mager, 2024).

In the Toledo context, the surviving canals and sluice structures are not only historical markers but also potential assets for sustainable land and water use today. Their continued functionality, however, depends on active maintenance and adaptation. This raises questions about governance, community engagement, and the role of heritage in local identity. As discussed in Chapter 2.4, preserving such systems requires balancing respect for their historical significance with pragmatic considerations of their utility in present-day livelihoods.

From a social perspective, the Toledo Plantation holds deep meaning for descendants of the Weegman family and the surrounding community. Their relationship to the site extends beyond its technical functions; it is a place of memory, identity, and connection to ancestral narratives. This empowers the idea that heritage sites are embedded in social networks and cultural meanings, which must be recognized in any management or preservation strategy.

#### 5.5 Post-Emancipation Transitions and Water Management Decline

The shifts in water management following emancipation, as described in

Chapter 2.3, are directly observable in Toledo's present-day condition. The decline of large-scale maintenance regimes led to the gradual deterioration of primary canals and sluices, with smaller, more flexible systems taking their place. This reflects a broader pattern across post-colonial Suriname, where the absence of centralized labour forces and investment shifted responsibility for water management to local communities.

Field observations suggest that while these smaller systems were well-adapted to diversified cropping and localized needs, they lacked the capacity for large-scale flood control. Over time, this has contributed to sedimentation and partial obstruction in some of Toledo's main canals, altering water flow patterns and reducing overall system efficiency. However, this degradation should not be seen solely as a loss; it also represents a re-scaling of infrastructure to match the socio-economic realities of smallholder agriculture.

This transition illustrates the concept of infrastructural agency, the idea that built systems are not inert but actively participate in shaping social organization. The downsizing of Toledo's water management network both reflected and reinforced the shift from plantation discipline to community autonomy, changing patterns of labour, land use, and social interaction. The role of the land has shifted. What started as wild lands across the Suriname River, transformed into a large-scale profit-based farming system, scaled down to subsistence-based farming, and now has found its new role as a cultural safe haven for all who are connected to Toledo. The land is and always will be changing to fit the people around it.

#### 5.6 Comparative Insights from Other Plantation Contexts

Similar patterns have been documented in other post-colonial plantation landscapes in the Caribbean and South America. For instance, studies of Guyanese sugar estates show that while main canals and drainage systems often survive, their contemporary uses range from irrigation to aquaculture, depending on community needs. This suggests that Toledo's evolution is part of a regional trend where colonial water management frameworks provide the structural skeleton for diverse post-colonial adaptations.

These comparisons also highlight the importance of considering environmental pressures in shaping adaptation. In coastal Suriname, salinity intrusion and

sea-level rise are increasingly relevant factors. While Toledo is somewhat buffered by its inland location, the gradual increase of saline water into low-lying areas could pose future challenges, making the historical resilience of its design all the more valuable as a reference point.

### 5.7 Cultural Memory and the Politics of Heritage

A deeper anthropological reading of Toledo also involves examining how its history is remembered and narrated. The oral histories associated with the Weegman family, as mentioned in Chapter 4, are selective and shaped by both personal and collective memory. The relative silence about the slavery period, especially from the Dutch perspective, for example, reflects a broader pattern of historical amnesia found in post-emancipation communities, where traumatic pasts are often under-communicated to subsequent generations.

This selective remembering has implications for heritage interpretation. On one hand, it challenges the assumption that community-based heritage preservation will encompass all aspects of history. On the other, it opens space for critical engagement with how history is told, whose narratives are prioritized, and how these narratives influence contemporary identity and land use.

The politics of heritage are also evident in the tension between preservation and development. While the Toledo site has potential as an educational and cultural resource, there is also a risk that heritage exploitation could lead to commodification or exclusion, particularly if external stakeholders prioritize tourism or conservation over local needs. Any sustainable management plan must therefore navigate these competing interests, ensuring that heritage serves the community as well as the historical record. Among the local community, this is also heavily disputed. While some argue that by remembering and taking power over a traumatic past, you regain your strength and can benefit from your setbacks; others remain steadfast that nothing good will come from the exploitation of something that happened hundreds of years ago.

### 5.8 Implications for Sustainable Water Management

Drawing these threads together, the Toledo case offers several lessons for contemporary water management in heritage contexts. First, it demonstrates the value of hybrid systems that combine technical efficiency with cultural adaptability. The integration of Indigenous, African, Asian and European

practices created a resilient infrastructure that could endure shifts in economic systems, labour organization, and environmental conditions.

Second, it underscores the importance of scale in water management. Large-scale colonial systems were effective for monocrop plantations but unsuited to diversified smallholder agriculture. The post-emancipation downsizing of Toledo's infrastructure shows how matching scale to social and economic capacity is essential for sustainability.

Third, the case highlights the potential for heritage-based water management to contribute to local identity and community cohesion. By recognizing historical systems as living heritage, communities can draw on them not only for practical benefits but also for cultural affirmation and education.

Finally, the anthropological insight is that water management cannot be divorced from its social and cultural context. Infrastructure is embedded in systems of meaning, power, and identity, and these dimensions must be considered in both historical analysis and contemporary planning.

## 5.9 Conclusion

The discussion presented here shows that Toledo Plantation is more than a historical site; it is a dynamic landscape where past and present converge. Its water management system reflects centuries of adaptation, negotiation, and cultural exchange, producing a hybrid infrastructure that continues to shape the land and its uses. By situating these findings within the broader literature on colonial plantation layouts, post-emancipation transitions, and heritage-based management, this chapter underscores the value of Toledo as both a subject of academic study and a living resource for sustainable development.

Future research could build on this study by conducting detailed hydrological modelling of Toledo's canal system, ethnographic interviews with current land users, and comparative analyses with other heritage plantations in the region. Such work would not only deepen our understanding of historical water management but also contribute to practical strategies for preserving and revitalizing these systems in the face of contemporary challenges.

## Chapter 6 – Conclusion

### 6.1 Restating the Research Question and Purpose

This research set out to answer the central question: *What are the cultural and historical influences that have shaped the current water management on the Toledo Plantation in Suriname?*

Toledo was approached as both a site of historical engineering and a living landscape, still shaped by the decisions, labour, and knowledge systems of those who have worked its land over the past three centuries. Through combining historical sources and direct field observations, it became clear that Toledo's water management is not just a colonial relic, nor purely a product of post-emancipation smallholder adaptation. Instead, it is a hybrid system that retains the influences of 18th and 19th century Dutch sugar plantations while also reflecting the layered cultural knowledge of Indigenous, African, and other Surinamese communities who have adapted it to their own needs.

### 6.2 Summary of Key Findings

Research Question 1: *How has historical water management influenced the water systems found currently on the Toledo Plantation?*

Field mapping confirmed that Toledo's current water network still follows the structural hierarchy common to colonial plantations described by Van Stipriaan (1993) and Armstrong & Kelly (2000). The primary canals are aligned along the plantation's long axis, secondary canals branch toward planting beds, and the remnants of a sluice remain at a hydrologically strategic point. These features match both the physical patterns in historical plantation maps and the engineering logic of Dutch polder systems, albeit adapted to Suriname's tropical hydrology.

While degradation and vegetation overgrowth have obscured parts of the system, the original skeleton remains intact. Even where the canals are no longer actively maintained, their placement continues to shape water flow and land usability. This persistence shows how durable these layouts are, and how environmental constraints, rather than solely human intervention, help preserve them over time.

Research Question 2: *What role did traditional knowledge and cultural heritage play in the water management on the Toledo Plantation?*

Although the visible infrastructure is rooted in colonial engineering, its post-emancipation use reflects the influence of Maroon and Indigenous practices. Raised planting beds near the northern and southern boundary creeks resemble

African mounding techniques and Indigenous flood-adapted agriculture. The re-orientation of certain beds, the smaller scale of modern plots, and the informal governance of canal maintenance all point toward localised adaptation rather than rigid adherence to the colonial blueprint.

This aligns with Maat et al. (2023), who note that Maroon escape agriculture relies on diversity, flexibility, and seasonality rather than monocultural precision. Toledo's current layout reflects that; it is an agricultural patchwork that blends inherited infrastructure with context-specific modifications.

Research Question 3: *What can the water management on the Toledo tell us about the assumed historical layout?*

Comparing Toledo's map to archival records confirms that the plantation likely followed the rectangular/trapezoidal field block model common to Suriname's sugar estates in the 18th and 19th centuries. The positioning of the sluice near the southern creek, the perpendicular orientation of some planting beds to the primary canal, and the integration of boundary creeks all suggest a deliberate design optimised for both drainage and transport.

### 6.3 Reflection on the Research Process

Conducting this research was not only an academic exercise but also a physical and sensory experience of Toledo itself. Much of the plantation is in varying states of waterlogging, from knee-deep stagnant pools in shaded areas to slow-moving brown water in the primary canals. Traversing the land meant walking over narrow, slippery dikes, sometimes submerged under various grasses that hid the drop into the canal below.

One afternoon, while recording measurements near the northern boundary creek, the weather turned abruptly. The sky darkened in a way that only happens in the tropics as if someone had pulled a thick grey curtain across the sun. Within minutes, rain hammered down in sheets so dense it blurred the treeline. The plantation's surface came alive: raindrops pocking the canal water, small rivulets forming in the planting beds, and the sound of distant thunder rolling over the Suriname River. Moving through this sudden storm felt like stepping into the same environmental theatre that past plantation workers, both free and enslaved, would have navigated daily. While the canopy acted as a solid umbrella shielding us from the hail from above, one could only imagine what a fully open plantation might have felt like.

These conditions were not just a backdrop but an active participant in the research. The heavy rains reminded me that Toledo's water management system was not simply a technical arrangement but a dialogue with an environment that can change from stillness to flooding in under an hour. The same rains that slowed our GPS mapping also revealed drainage patterns, showing where water still followed the paths laid out centuries ago.

The flooded terrain was a constant challenge. The back of the plantation, now a podosiri (açai) swamp, was impassable without wading waist-deep in dark water. In some areas, fallen trees blocked access, while in others, soft mud sucked at boots and made every step a calculation. These environmental realities shaped not only how we could document Toledo but also our understanding of why its infrastructure is the way it is. The elevated planting beds, the proximity of canals, and the strategic sluice placement all make far more sense when you've tried to cross this ground in the wet season.

#### 6.4 Contributions to Knowledge

This research makes three main contributions:

1. **Historical-Contemporary Link:** It confirms the persistence of colonial water management layouts in post-emancipation Suriname, even under radically different labour systems and cropping patterns.
2. **Hybrid Heritage Systems:** It provides evidence for Toledo as a hybrid agricultural landscape, where colonial infrastructure coexists with locally adapted practices informed by Indigenous and African traditions.
3. **Heritage-as-Function:** It reframes heritage not just as something to be preserved but as something actively used, adapted, and embedded in present-day livelihoods.

#### 6.5 Implications for Heritage and Sustainable Development

Heritage in water management should be seen as a living system, offering lessons for resilience. Toledo illustrates this perfectly. The surviving canals and sluice are not museum pieces; they are functional structures that could still serve in modern smallholder farming, flood control, or even eco-tourism if maintained.

Furthermore, Toledo's layered history, from Indigenous occupation to colonial exploitation to Maroon and smallholder adaptation, makes it a site where heritage is inseparable from social identity. Preservation efforts must therefore go beyond protecting physical features; they must also safeguard the stories, memories, and meanings attached to them.

## 6.6 Limitations and Challenges

The main limitations of this study were environmental and logistical. Flooding restricted access to several areas, meaning some tertiary canals and planting beds could not be documented in detail. Dense vegetation, particularly in abandoned sections, made GPS mapping difficult. Oral histories were valuable but biased. Most of the oral history came from the family itself so Toledo might be a singular example. Budget constraints were a large part of it too. The costs to even arrive at the plantation let alone spend several days researching it, are up in the thousands of euros, with ample funding and good enough equipment, a full transect walkthrough could be made together with drone mapping.

## 6.7 Recommendations for Future Research

Future studies could build on this work by:

- Conducting detailed hydrological modelling of the existing canal system.
- Aerial mapping of the plantation.
- Expanding oral history collection, including outreach to other families connected to Toledo.
- Comparing Toledo's water management directly with other surviving Surinamese plantations, as well as analogous sites in Guyana and French Guiana.
- Exploring heritage-based sustainable development models that combine tourism, education, and agriculture.

## 6.8 Final Reflection

Toledo is not a frozen remnant of the past but a place where history breathes through the soil and water. Its canals still hold rain from the latest storm alongside the engineering intent of Dutch surveyors from centuries ago. Its planting beds still rise above seasonal floods as they did when both enslaved labourers and later smallholder farmers worked them. The sluice remains, silent and weathered, and still mark the point where human intervention once met the forces of the river.

In walking this landscape, in slipping along its muddy banks and watching the rain carve paths into the earth, I came to see Toledo as more than a research subject. It is a layered conversation between people and environment, between past and present, and between different knowledge systems that have each, in their own way, learned to live with water.

historical artifacts, they are living features that continue to shape the land and the people who interact with it.

## References

- Maat, H., Pinas, N., & Van Andel, T. (2023). The role of crop diversity in escape agriculture; rice cultivation among Maroon communities in Suriname. *Plants People Planet*, 6(5), 1142–1149. <https://doi.org/10.1002/ppp3.10435>
- Ehrenburg, H., & Meyer, M. (2015). *Bouwen aan de Wilde Kust: geschiedenis van de civiele infrastructuur van Suriname tot 1945*.
- Hauser, M. W. (2017). A Political Ecology of Water and Enslavement: Water Ways in Eighteenth-Century Caribbean Plantations. *Current Anthropology*, 58(2), 227–256. <https://doi.org/10.1086/691053>
- Miller, R. P., & Nair, P. K. R. (2005). Indigenous agroforestry systems in Amazonia: From prehistory to today. *Agroforestry Systems*, 65(2), 151–164. <https://doi.org/10.1007/s10457-005-6074-1>
- Comptour, M., Caillon, S., Rodrigues, L., & McKey, D. (2018). Wetland Raised-Field Agriculture and Its Contribution to Sustainability: Ethnoecology of a Present-Day African System and Questions about Pre-Columbian Systems in the American Tropics. *Sustainability*, 10(9), 3120. <https://doi.org/10.3390/su10093120>
- Van Stipriaan, A. (1993). Suriname and the abolition of slavery. In D. Geggus (Ed.), *The Abolition of Slavery in the Atlantic World* (pp. 249–270). University of Rochester Press.
- Armstrong, D. V., & Kelly, K. G. (2000). Settlement Patterns and the Origins of African Jamaican Society: Seville Plantation, St. Ann's Bay, Jamaica. *Ethnohistory*, 47(2), 369–397. <https://doi.org/10.1215/00141801-47-2-369>
- Brown, K. L. (2021). An Archaeology and History of a Caribbean Sugar Plantation on Antigua, by Georgia L. Fox (ed.). *New West Indian Guide /*

*Nieuwe West-Indische Gids*, 95(1-2), 192-193.

<https://doi.org/10.1163/22134360-09501007>

- Ryzewski, K., & Cherry, J. F. (2015). Struggles of a Sugar Society: Surveying Plantation-Era Montserrat, 1650-1850. *International Journal Of Historical Archaeology*, 19(2), 356-383. <https://doi.org/10.1007/s10761-015-0292-7>
- Yarak, L. W., & Emmer, P. (1999). The Dutch in the Atlantic Economy, 1580-1880: Trade, Slavery and Emancipation. *The International Journal Of African Historical Studies*, 32(2/3), 443. <https://doi.org/10.2307/220361>
- Dai, T., & Hein, C. (2023). Exploring the descriptions of World Heritage properties through the perspective of water using a narrative approach. *International Journal Of Heritage Studies*, 29(12), 1315-1338. <https://doi.org/10.1080/13527258.2023.2252792>
- Van Stripiaan, A. (1993). *Surinaams contrast*. [https://doi.org/10.26530/oapen\\_374613](https://doi.org/10.26530/oapen_374613)
- Sarijoen, D. (2025). *Toledo Plantation Report*.
- info@driebit.nl © 2014. (z.d.). *General map of the plantations in Suriname*. Atlas Of Mutual Heritage. <https://www.atlasofmutualheritage.nl/page/9815/overzichtskaart-van-de-plantages-in-suriname>
- Alatas, S. F. (2024). The Coloniality of Knowledge and the Autonomous Knowledge Tradition. *Sociology Compass*, 18(8). <https://doi.org/10.1111/soc4.13256>
- Harley, J. B., Woodward, D., & Monmonier, M. S. (1987). *The History of Cartography: Cartography in the European Renaissance*. History of Cartography.
- Mager, T. (2024, 4 september). *World Heritage Water Management for sustainable site development*. PortCityFutures. <https://www.portcityfutures.nl/news/world-heritage-water-management-for-sustainable-site-development>