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Restoring Heritage Waterworks for Climate Adaptation on Curaçao: A Case Study at Hòfi Rooi Catootje

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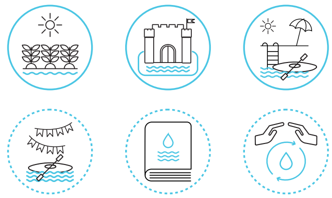
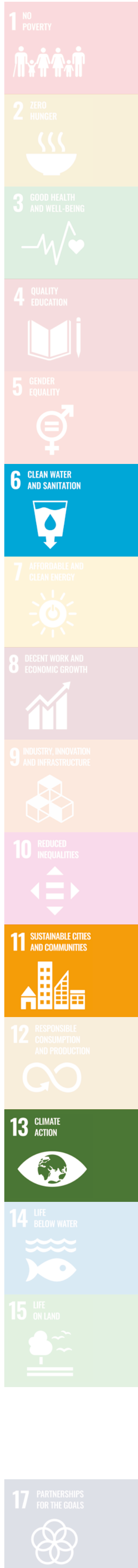
Abstract
Historic water systems should be recognized not only as cultural heritage but as active assets for climate adaptation. The case of Hòfi Rooi Catootje in Curaçao illustrates how the restoration of earthen dams and spillways can contribute to contemporary water management by reducing flash flood risk, supporting groundwater recharge and creating cooler green spaces in urbanized areas. This integrated approach connects directly to the UN 2030 Agenda, advancing sustainable water management (SDG 6), resilient cities and heritage protection (SDG 11) and climate action (SDG 13). By combining historical cartography, hydrological modeling and community engagement, the project demonstrates how heritage landscapes can be mobilized as nature-based solutions. The lessons extend beyond Curaçao, offering a transferable model for other heritage sites where neglected water systems hold potential for sustainable development and climate resilience in the decades ahead.

KEYWORDS

water heritage
climate adaptation
groundwater replenishment
water retention
flood management

WATER VALUES





Policy Recommendations

- Governments should legally protect historic dams, *rooien* and wells by including them in zoning plans, restricting urban development nearby and allocating funds for regular inspections and maintenance.

- Governments should carry out hydrological studies to inform pilot projects aiming to restore historical dams and spillways to capture rainfall, recharge groundwater and reduce flash floods to align with climate adaptation targets under the Sustainable Development Goals.

- Local NGOs, schools and heritage foundations, supported by UNESCO, should raise awareness by creating walking tours, school programs and public campaigns that highlight the climate benefits of heritage water systems.

< Fig. 1 Traditional stone spillway before restauration in Hofi Rooi Catootje (Source: Kasper Theo Lendering, 2025).

Introduction

Curaçao is a small island in the southern Caribbean with a semi-arid climate. Its weather is characterized by prolonged periods of extreme heat and drought, interspersed with short but intense rainfall events during the wet season, which regularly cause flash floods. In the absence of natural freshwater sources, more than 1,000 earthen dams were constructed across the island's watersheds during the colonial period. These dams played a crucial role in capturing rainwater, replenishing groundwater and reducing soil erosion and flash flooding. Distributed over 48 watersheds, the network of small and large dams significantly enhanced local water availability and supported the island's inhabitants.

Despite their historical and functional importance, many of these structures have fallen into disrepair. Today, approximately 800 remain, though their effectiveness has reduced due to urban expansion and insufficient management and maintenance. As Curaçao increasingly experiences the effects of climate change — including longer droughts, rising temperatures and more intense rainfall — the conservation of this water heritage infrastructure has become critical. Notably, areas surrounding the earthen dams still support dense vegetation and tree cover, providing cooler microclimates compared to adjacent developed zones.

The Awa pa Kòrsou – Water for Curaçao[1] project seeks to restore water heritage infrastructure within the island's natural and cultural-historical water systems. Among its activities, the project assesses the current state of these structures, restores and preserves selected works in two case study areas (one rural and one urban), and develops educational materials to raise public awareness of their value. This article focuses on the interventions in Hòfi Rooi Catootje, a former plantation now located within the urbanized area of Willemstad at the outlet of one of the island's largest watersheds. Today, this watershed is heavily urbanized and prone to flash flooding during heavy rainfall. The project aims to restore the historic water works and their functions in water retention and infiltration, thereby contributing to flood risk reduction in the immediate vicinity of the *hòfi*.

Brief History of Water Management on Curaçao

Historically, food production on Curaçao was largely local, making effective water resource management essential for sustaining livelihoods (Loen 2021). The island's first inhabitants adapted to the semi-arid climate by constructing *rooien* and dams to retain scarce water. The term *rooi* derives from the Spanish *arroyo*, meaning a dry watercourse that temporarily or seasonally carries water after sufficient rainfall. During the Spanish and Dutch colonial periods, persistent freshwater scarcity led to the establishment of water plantations, where rainwater was captured in wells for agricultural use. Rainwater harvested on these plantations was also sold for drinking purposes (Beautiful Curaçao 2024).

A turning point came with the establishment of the Shell refinery in 1918, which brought a rapid increase in population (Curacao History, 2025). To meet the refinery's substantial water demand, Shell acquired numerous water plantations, expanded them with larger dams, and

1. https://awapakorsou.my.canva.site/

^ Fig. 2 Water plantation at Julianadorp, Curaçao (Source: Lendering family archives, mid-twentieth century).

extracted groundwater for freshwater supply without immediate declines in aquifer levels (Möhlmann 1945). This industrial demand underscored the importance of large-scale and efficient rainwater management.

With continued population growth, the strategic management of water became even more critical. Dams were constructed at natural points of water convergence to capture runoff from higher elevations, reducing rapid outflow. In the 1950s, engineer J. Beijering designed and oversaw the construction of several larger dams to address the island's increasing water needs (Beijering 1950). This period also saw a marked increase in the number of water plantations (van Meeteren 1949).

Despite these developments, balancing the competing water demands of plantations, urban settlements, and industry remained challenging. To address shortages, Curaçao initiated seawater desalination as early as 1928, with progressively larger plants constructed in subsequent decades. By the early 1960s, groundwater had been phased out of the drinking water supply, and potable water was produced exclusively through seawater desalination using reverse osmosis (RO). While this transition ensured reliable drinking water, it also contributed to declining attention to the island's traditional water infrastructure of *rooien* and dams (van Buurt 2022).

Case Study: Hòfi Rooi Catootje

Hòfi Rooi Catootje represents a historic water plantation and serves as a case study for the restoration of traditional water heritage infrastructure on Curaçao. The term *hòfi* refers to the plantation grounds surrounding the main house, where water systems were constructed to support agriculture and supply drinking water. Historically, fruit tree cultivation and livestock management at Rooi Catootje depended on water conservation practices, particularly the use of *rooien* to guide runoff toward earthen dams, where water was stored and then extracted through wells located on the estate.

^ Fig. 3 Map of the waterworks in Hòfi Rooi Catootje, with photographs of spillway 1b (top right) and well 4b (bottom right) (Source: Dienst Ruimtelijke Ordening en Planning Curaçao, 2010).

The existing water infrastructure at Rooi Catootje dates to the early twentieth century, as documented on the Werbata maps (fig 5). Four large reservoirs, enclosed by earthen dams and equipped with masonry spillways, were designed to store runoff from the watershed. These reservoirs allowed sequential filling before the water continued downstream toward Schottegat Bay. Over time, however, the dams and stone structures within the *hòfi* have deteriorated. Dense vegetation has rendered many areas inaccessible, large trees have destabilized the earthen dams, and breaches are visible in several sections. In addition, the spillways and sluice gates are no longer functional (fig 4).

Comparisons between the Werbata maps (early twentieth century) and the present situation highlight the extent of land-use change in the watershed. At the time of mapping, approximately 95 per cent of the watershed remained undeveloped. Today, only about 35 per cent is undeveloped, limited primarily to Kabouterbos, Zapateer and the *hòfi* itself. Urban expansion has increased impervious surfaces, accelerating runoff and contributing to recurrent flash floods in the Rooi Catootje area during heavy rainfall events.

To address these challenges, five key steps were undertaken to restore the water infrastructure's functionality and reduce local flood risk (fig 6):

1. Assessment of Current Conditions: A detailed survey documented the state of the watershed and its water management infrastructure.

^ Fig. 4 Photo of overgrown stone spillway connected to a flattened earthen dam (Source: Kasper Theo Lendering, 2024).

^ Fig. 5 Werbata map of Rooi Catootje (Source: Werbata Maps, 1910; personal archive of Kasper Theo Lendering).

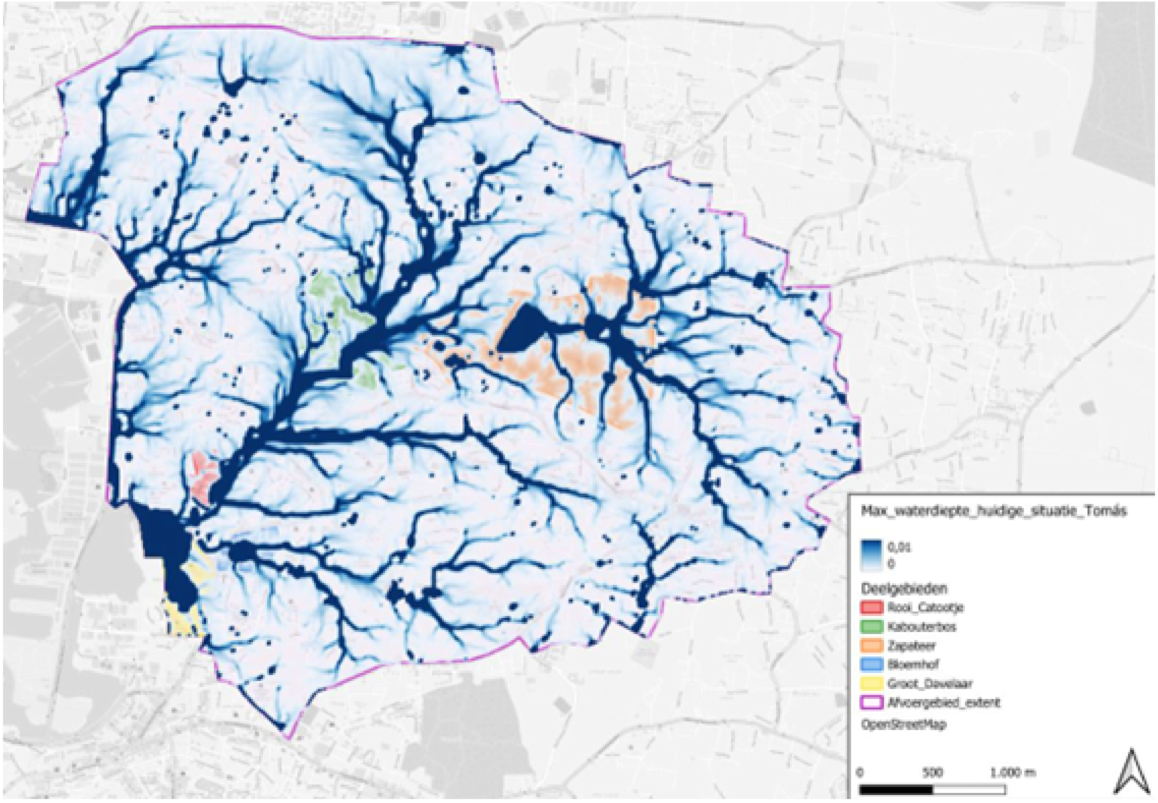
2. Historical Data Collection: Archival data were gathered and used to support hydrological analysis and rainfall–runoff modeling.
3. Rainfall–Runoff Model Development: A model was constructed and validated against historical data to simulate watershed dynamics under different rainfall scenarios.
4. Design-Oriented Research: Alternative watershed interventions were identified and tested within the model to evaluate their potential for flood mitigation and water conservation.
5. Selection and Implementation: Promising interventions were implemented through the clearing of secondary vegetation and the restoration of dams and spillways, reinforcing the plantation's original water retention functions (fig 7).

The restoration works at Hòfi Rooi Catootje provide multiple benefits. By reestablishing retention capacity in the watershed, runoff is slowed and flash flood risks in the immediate surroundings are reduced. The restored reservoirs also act as infiltration zones, supporting groundwater recharge and promoting vegetated green spaces that create microclimates with lower temperatures than the adjacent urbanized areas, demonstrating the wider ecosystem services of restored heritage infrastructure.

Beyond the physical interventions, the project also emphasized awareness raising. Walking tours through the *hòfi* and the development of educational materials by Carmabi and the University of Curaçao were integral to engaging the public on the impacts of climate change and the opportunities that water heritage restoration provides. This outreach component is expected to facilitate scaling up the approach to other watersheds across the island and to other islands with similar challenges (Krul 1949).

Conclusion

The case of Hòfi Rooi Catootje shows that historic earthen dam systems are not only cultural assets but also functional infrastructures that can contribute to climate adaptation and sustainable water management. At the World Heritage level, planning should move beyond



^ Fig. 6 Model of entire watershed showing in the red circle the area of Rooi Catootje (Source: Kasper Theo Lendering & Dimitri Schreuder, 2024).

^ Fig. 7 Restored spillway (Source: Kasper Theo Lendering & Dimitri Schreuder, 2025).

preservation alone and actively integrate traditional water systems into contemporary strategies for water retention, groundwater recharge and flood mitigation. This requires systematic inspection, maintenance, and protection against urban encroachment to secure their long-term performance.

The restoration process in Curaçao demonstrates a transferable approach: combining historical research, hydrological modeling, technical rehabilitation and community engagement. These elements are applicable to other heritage sites where traditional water management structures have been neglected but retain potential value. Key lessons include the importance of linking scientific methods with cultural interpretation and of raising public awareness to build support for restoration and future management.

Sharing these experiences more widely can position heritage water systems as living laboratories of resilience. By showcasing how historical practices continue to address modern challenges, the Awa pa Korsou project can inspire regional and global audiences to view heritage landscapes as active contributors to climate adaptation. In doing so, World Heritage sites can advance both cultural preservation and sustainable development.

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