

Adaptation to Water Scarcity: Water Management Strategies Led by Women on the Caribbean Island of San Andres

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Karibische Inseln leiden typischerweise unter Wasserknappheit. Als Reaktion darauf sammeln die Bewohner in der Regel Regenwasser in ihren Häusern. Dies ist eine Praxis, die auf sozialen Strukturen und Wassermanagementfunktionen (WM) basiert, die Frauen stillschweigend und historisch zugewiesen sind. Die von Süßwasser benachteiligte Insel San Andres (27 km²) beherbergt 68.000 Kolumbianer und ist nun mit den Auswirkungen des Klimawandels und der Variabilität (CCV) konfrontiert, die das Niederschlagsverhalten verändern und längere Trockenzeiten erzeugen. Diese Fallstudie untersucht vier WM-Strategien, die in San Andres implementiert wurden, um gleichzeitig mit CCV und einer wirtschaftlichen Chance im Tourismussektor umzugehen. Die Ergebnisse zeigen, dass Frauen in San Andres eine entscheidende Rolle bei der WM spielen, indem sie nicht nur ein Haushaltsbedürfnis lösen, sondern auch den Haushalten die Möglichkeit geben, den Tourismus zu Einkommenszwecken zu nutzen. Diese Ergebnisse zeigen, dass geschlechtsspezifische Rollen sowohl bei der Anpassung an CCV als auch bei der wirtschaftlichen Entwicklung eine entscheidende Rolle spielen. Maßnahmen zur Verbesserung der Anpassung an CCV in der Karibik können von einem besseren Verständnis der Rolle von Frauen bei inländischen und wirtschaftlichen Aktivitäten profitieren.

Introduction

One of the main challenges for Caribbean communities is the scarcity of freshwater for human consumption (Cashman 2013). In response to this problem of critical vulnerability, bottom-up informally driven mechanisms of domestic rainwater harvesting (DRWH) have been developed. These mechanisms—of considerably ancient technology (Peters 2017)—are presently of great interest to scholars, due to the technology's low cost and the increasing scarcity of freshwater in the Caribbean (Solano, de la Rosa, and Padilla 2012).

To contribute to the discussion surrounding these mechanisms, this paper presents a comprehensive description of the context on San Andres island (Colombia) and a sample of four strategies of DRWH technology (Figure 1). The study focuses on native inns or guesthouses managed by women. This sample of native inns is representative of both inns on San Andres (the island's official registry lists 82 inns, in which the given managers and families also live) and Caribbean islands in general, where DRWH

is a common practice. Taking this into account, this paper explores the vulnerability of the local population, focusing on gender relations in a context of CCV. This paper seeks to answer the following questions: How does the community of San Andres address access to water? And, furthermore, what can be learned from these strategies in the context of adaptation to CCV?

To identify actors and understand the situation of the four inns observed in San Andres, a set of research tools proposed by Pink (2017) was applied that can be used in homes such as the native inns. The research approach is short-term ethnography, and includes interviews of informants in the living environment, photos, and videos (Pink et al. 2017). The following sections describe the situation on San Andres regarding freshwater scarcity, the disproportionate increase in tourism compared to the limited capacity of the island's natural resources, and the impact of CCV on the population. Finally, the paper presents the analysis of results, and conclusions.

Freshwater scarcity on San Andres

The Colombian island of San Andres is currently part of the archipelago of San Andres, Providencia and Santa Catalina. It has a territory of 26 km², and a population of 75,000 inhabitants (Martínez 2018). The current San Andres population is composed of: 30% *Raizal*—mixed-ethnicity descendants of Anglo-Saxon, mestizo, and Afro-descendent peoples (Parsons 1985), and about 70% so-called *pañás* (Colombian immigrants). The economy of the island is mainly based on tourism (e.g., hotels, restaurants, inns) and commercial activities (e.g., sales of imported products). In 2017, one million tourists (both from Colombia and abroad) visited San Andres. This situation offers the local economy significant advantages, but also poses a problem regarding the demand for natural resources, such as water.

Figure 1: General view of San Andres. Source: The Authors





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Figure 2: Coconut Paradise.
 Source: The Authors

Throughout history, the people of San Andres have collected rainwater or extracted water from deep wells in their homes to survive. The island does not have any surface freshwater (there are no rivers or lakes suitable for human consumption). This form of water management is an example of a considerable adaptation capacity of efficient distribution of the workload among household members. Women play a central role in this distribution of water, and, even though, their responsibility for maintaining the home's water supply is often taken for granted.

However, today these water-management techniques are insufficient to meet the needs of everyone on the island, due to the rising numbers of permanent residents and tourists. Tourism has grown as a result of policies formulated in the latter half of the 20th century, and has risen consistently almost every year since then. Indeed, over the past ten years, the number of tourists grew by 10 percent every year (Aguado 2010). The number of tourists seeking accommodation in the native inns has grown because there are not enough traditional hotel accommodations to meet demand during the high season, and because the inns offer lower prices than hotels. More tourists mean the demand for water also outstrips supply.

The conventional techniques for harvesting rainwater and what little potable water is available from the aqueduct are not enough. Therefore, inn managers often must purchase bottled water or water from water-tank trucks, which considerably reduces their profits. Until 2005, the island's primary source of drinking water was deep wells dug into the island itself, and there was no potable water treatment plant. That year, however, saw the beginning of a formal water treatment and distribution process when the government contracted a private organisation to build an aqueduct and manage water treatment and distribution services.

Still, the coverage and availability of this service is insufficient. For instance, aqueduct water is available for only a

few days per month (Guerra 2018). Thus, inhabitants must depend on alternative sources of water, such as rainwater.

In addition to the problems mentioned above, climate change is increasingly affecting San Andres (Guerrero 2018). In the past, the rainy seasons occurred regularly—from April–May, and October–January, with an average rainfall accumulation of 180 mm/month. With each passing year, however, these rainy seasons are becoming increasingly distorted.

Currently, the dry and rainy seasons are more intense and more concentrated (Guerrero 2018, Guerra 2018), making it hard for managers of native inns to predict their businesses' water needs. These changes in rainfall patterns have made it increasingly difficult for the native inns to harvest enough rainwater. Rainwater harvesting was during XIX century done in a very rudimentary way, but since XX century the collection systems became more technologically sophisticated. Nowadays, storage systems are built with wood and/or concrete to hold rainwater collected from roofs. *Raizal* have traditionally practiced rainwater collection, and more recently added wells as

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Figure 3: Coconut Paradise Lodge's domestic rainwater harvesting system. Source: The Authors



Figure 4: Cli's Place.
Source: The Authors



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Figure 5: Cli's Place's domestic rainwater harvesting system. Source: The Authors



a secondary method. Originally, these water wells were communal property of the *Raizal* and used by all community members. As time passed, more *Raizal* families built private wells, and thus their communal character was lost (Steele 2018). Today, these wells are used in different ways, presenting overexploitation due to the increase in population and tourism (Guerra 2018). Furthermore, contamination of the wells is increasing due to leaks in sewer lines. On the other hand, the island's aqueduct company, Proactiva, has done likewise and now distributes water through a pipe system to part of the island. The companies that transport water in tank trucks also extract water in the same manner.

Therefore, a whole system of extraction, purification (applying chlorine to the water extracted from wells), and distribution of water on San Andres has developed. This system is deficient; the aqueduct system covers only 60% of all homes. Close to the half the island's inhabitants

are forced to buy bottled water (at high costs) due to the scarcity of water at peak time periods. Inhabitants are currently unable to consistently access water at a reasonable price. Water thus makes up 30% of each household's necessary expenses (Guerra 2018).

Despite the high price of water, native inns manage to offer lower lodging rates than hotels. So, native inns have grown as an alternative throughout the island (Henry 2018). Also, many tourists prefer to have a more "unique" and culturally immersive experience than that offered by conventional hotels.

Consequently, the inns have become a focus for cultural tourism. Many *Raizal* have opened inns within their own homes by partitioning their living space. The *Raizal* defend the idea that a "typical *Raizal*" inn is different from the other types of inns that are generally administered by immigrants from other parts of Colombia (Down 2018). In the context of managing *Raizal* inns, women play a central role. They are in charge of promoting the inns, welcoming guests, and developing attractions (Oliveira 2018, Pérez 2018).

However, their involvement goes beyond simple management activities. The four inn managers involved in this study agreed that historically on San Andres, women have been responsible for water management at the household level. Tradition holds that men are responsible for work and bringing home the bacon, while women manage the home. Part of that care is to do everything possible so that the water available for the home is enough for the consumption of all members. Consequently, in the first half of the 20th century women managed the communal water wells, and since then they have managed the harvesting of rainwater and its use (e.g., for drinking, cooking, bathing, washing clothes, and in toilets and sinks). Currently, the idea that this is "women's work" is taken for granted; who should carry out these household tasks is never discussed, always assumed. This traditional role of women within a household has been transferred to the management of inns without significant distortion because the native inns are established inside native homes.



◀ **Figure 6:** Justina's Place. Source: The Authors

Four case studies and four strategies

The first inn of the case studies is Coconut Paradise Lodge, which is located in the geographic centre of San Andres, in an area called La Loma, Barack (Figure 2). This inn is managed by Opal Down Mitchell, a native of the island. It is located on a property of 1760 m², occupies an area of 175 m², and has two levels and an attic. It is an architectural landmark on the island due to the conservation of its outstanding traditional characteristics of San Andres housing. It is currently the home of its owner and her husband. It has considerable capacity (seven rooms) for the accommodation of tourists and visitors to the island. Rainwater provides the inn's main source of water for general use. It is stored in a 20 m³ cistern that is connected to the roof with pipes. The owner buys bottled water for drinking purposes (Figure 3).

The second inn is known as Cli's Place, and is managed by Mrs. Cleotilde Henry, an important Raizal leader on San Andres. It is located in the town centre of the island, in an area known as North End, very close to the beaches most frequented by tourists (Figure 4). The inn is composed of a set of houses built from concrete and masonry. The water supply is mainly from boreholes, and is then filtered through imported filters. The inn is also connected to the Proactiva aqueduct, but the supply of water from the aqueduct is not stable. Like Mrs. Mitchell, Mrs. Henry relies on bottled water for drinking water (Figure 5).

Justina's Place is the third case. It is managed by Mrs. Justina Pérez, a Raizal who has converted her home into a native inn (Figure 6). It is located near the geographic centre of the island, in an area known as La Loma, Barack. It is mainly built from masonry and concrete. The inn has a concrete cistern, with an approximate capacity of 12 m³, located just below the kitchen. In a manner similar to the first case, water is harvested from the roof and piped to the cistern. Also, the inn is connected to the aqueduct system, which provides water a few days per month (Figure 7). The fourth case is Carson's Place 2. This inn is managed by a well-known Brazilian sculptor, Aurea Oliveira (Figure 8). The inn is located on the western side of the airport in an area known as Sarie Bay. Rental space is

located on the second floor of a rented multi-family house built with concrete and masonry. The inn is connected to the aqueduct network. Mrs. Oliveira often decides not to consume running water from the aqueduct. The inn has its borehole to collect rainwater for general use. Mrs. Oliveira prefers to purchase bottled water for preparing food and direct consumption (Figure 9).

Native Inn, Manager/ Sources of water ¹	Rainwater harvesting and cistern	Borehold for wells	Aqueduct	Bottled / Tank truck
Coconut Paradise, Mrs. Opal Down	X			X
Cli's Place, Mrs. Cleotilde Henry		X	X	X
Justina Place, Mrs. Justina Pérez	X		X	
Carson Place 2, Mrs. Aurea Oliveira		X	X	X

Table 1 presents a summary of the different water sources used by each of the four inns. Different combinations of water sources support these inns. These combinations are determined by the manager's decision, which is limited by the inn's location on the island, and the experience of its manager. The inns in the geographical centre (Coconut Paradise and Justina's Place) are mainly sustained by rainwater. Currently, it is difficult to extract



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▶ **Table 1:** Summary of the water sources used in the inns studied. Source: The Authors



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◀ **Figure 6:** Justina's Place's domestic rainwater harvesting system. Source: The Authors

Figure 8: Carson's Place 2.
Source: The Authors



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See the former article for biography of Holmes Pérez, and Gonzalo Lizzaralde.

Figure 9: Carson's Place 2's domestic rainwater harvesting system. Source: The Authors



water from deep wells there due to the local water depths (the area is approximately 80m above sea level). The inns located closer to the populated centre of the island (Cli's Place and Carson's Place 2) are predominantly supplied by borehole water (this area is located at sea level). Water from the aqueduct reaches three inns (Cli's Place, Justina's Place and Carson's Place 2). However, the supply is unstable, so the managers cannot rely on this source. Water from these sources is used for all household services, because the inns do not necessarily require potable water for things like laundry, toilets, showers, sinks, and dishwashers. Three of the inns buy bottled water for human consumption. The one exception, Justina's Place, frequently uses rainwater for human consumption (its manager trusts in the quality of the rainwater that collects in its cistern and did not report health problems caused by this practice).

Conclusions

The combinations of water supply methods at these four inns (rainfall, wells, an aqueduct, and bottled water) are vary considerably within the island's range of limitations.

The method with the lowest operating cost is rainwater harvesting, since rainwater is free. However, it has relatively high initial investment costs. For example, the construction of a storage tank for this type of water for one inn costs approximately \$4000, while the GPD per capita in Colombia is \$6300/year (all figures in US dollars).

Informal initiatives in adaptation to water scarcity contrast with the ineffectiveness of formal measures to deal with water scarcity. The inns that harvest rainwater must have the capacity to make a high initial investment. Wells are an alternative, with a slightly lower up-front price. This cost is highly variable, though, because it depends on where the inn is located. On average, the initial cost is \$1500.

Unlike the collection of rainwater, the wells have higher operating costs due to the consumption of electric power for the operation of hydraulic pumps (USD 30/month). The aqueduct water, as already explained, is insufficient and more expensive than the two previously mentioned systems. However, many people use the aqueduct anyway due to the location of their settlement or the high costs of building a rainwater storage tank. Finally, there is a high dependence on the purchase of bottled water for human consumption, which is quite expensive (one litre of water can cost as much as \$1.20).

Despite these high relative costs, the administrators find a way to maintain competitive accommodation rates. We conclude that this is possible due to these women's extensive experience in water management (e.g., by moderating consumption and making tourists aware of the importance of saving water), and by storing water whenever possible.

This experience is the result of a long-established tradition in San Andres that previously worked in homes and that is now put into practice in the inns. The description of this context can aid our understanding of how to overcome water scarcity in regions like San Andres, and how to face the problems brought about by climate change.