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Challenges to Water Security along the “Emerald Coast”: A Political Ecology of Local Water Governance in Nicaragua

G. Thomas LaVanchy ^{1,*} , Sarah T. Romano ² and Matthew J. Taylor ¹

¹ Department of Geography & the Environment, University of Denver, Denver, CO 80210, USA; matthew.taylor@du.edu

² Environmental and Sustainability Studies, University of Northern Colorado, Greeley, CO 80639, USA; sarah.romano@unco.edu

* Correspondence: thomas.lavanchy@du.edu; Tel.: +1-303-871-7521

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Abstract: Despite being a water-rich country, Nicaragua struggles to secure clean water access for many of its residents. In addition to distributional and water quality issues, a prolonged drought affecting all regions of the country has compounded preexisting governance challenges to ensuring rural water needs. This article focuses on a rural community along the southwest Pacific Coast of Tola, Nicaragua, where tourism development and drought converge to produce and exacerbate water insecurity. This article examines this water insecurity in the context of two recent national water laws in Nicaragua (passed in 2007 and 2010 respectively) that sought to provide a more comprehensive legal framework for freshwater water governance. Drawing upon semi-structured interviews and groundwater and meteorological data, we contend that water laws have not effectively mediated the hydrological effects of prolonged drought and tourism development, resulting in pronounced water insecurity for local populations in Tola. We cast the findings of this research as relevant to other water insecure areas in Latin America where industry development and weak policy implementation impact the creation and resolution of local water security—including insecurity compounded by increased climatic variability.

Keywords: water policy; water insecurity; tourism; drought; governance; political ecology; Nicaragua

1. Introduction

Water security for local communities remains a challenging enterprise despite decades of effort by governments, aid organizations, and collective local-level leadership. Globally, it is estimated that over 780 million people still lack access to sufficient quantities of safe drinking water [1]. Within Central America and the Caribbean, population growth and economic development constitute main drivers of water scarcity [2], while climate change is expected to amplify these drivers as less water is expected across this region in the future [3]. Although these factors of water (in) security are not unique to this region, countries such as Nicaragua provide a compelling case study given the overlap of its political history (successful social revolution) with current economic and climatic complexities (neoliberal economic agendas and drought).

Similar to other countries in Latin America, Nicaragua has instituted water policy reform during the past decade that is intended to equitably and sustainably secure water for its citizens. Two recent national water laws (passed in 2007 and 2010 respectively) sought to provide a more comprehensive legal framework for freshwater governance. Their language and structure reflect a decidedly socialistic ideology, whereby water is viewed as a human right, is owned by the state, is managed through a bottom-up approach, and is prioritized towards the individual, rather than industry. This should be

no surprise given the progressive socialistic nature of a government that upended four decades of dictatorship through a successful revolution in 1979. Despite these ideological underpinnings and resulting legislation, water insecurity has become a reality for rural residents in coastal southwest Nicaragua [4]. Reasons for insecurity are a combination of physical, social, economic, and political factors and have been documented elsewhere [5].

The interest of this paper is to inductively evaluate Nicaragua's two recent water laws in the context of Gigante, Tola—a water insecure region along the southwest Pacific coast that is experiencing a boom in tourism development. We examine, in particular, how tourism development and drought have both produced and exacerbated water insecurity in the region in the context of the aforementioned national water laws. The paper begins by describing the dynamism of literature centered on water security, as well as its epistemological roots in the Dublin Principles and Integrated Water Resources Management (IWRM) framework. Next, we present the case study of Gigante. Drawing upon semi-structured interviews and groundwater and meteorological field measurements gathered over five years, we argue that new water laws have not effectively mediated the hydrological effects of prolonged drought and tourism development in order to lessen water insecurity for local populations in coastal Tola. The paper concludes by casting the findings of this research as relevant to other water insecure areas in Latin America where industry development and weak policy implementation impact the creation and resolution of "local" water security—including insecurity compounded by increased climatic variability.

This article adopts a political ecology approach to understand water (in) security in Gigante as produced by complex physical, social, and economic processes. A political ecology approach to water governance entails attention to the multiple spatial scales, be they geographic, social, political, temporal, and/or ecological [6–11]. For example, national water laws mediate the experience of "local" water use, access, and distribution; these laws thus merit attention even in contexts that appear insulated from national legislation and political governing centers, as is often the case for rural settings. Moreover, and as this article demonstrates, situations of water insecurity are not always defined by the physical amount of water available via natural processes, but are more often the result of a convergence of issues reflecting power dynamics and relations based upon race, ethnicity, gender, class and/or political systems [5,12–16].

2. Theoretical Framework

There is now a sizable literature on the concept of water security. Originally considered by academics and practitioners within the framework of sustainable water resources, the paradigm of water security emerged within policy and scholarly discourse over the past two decades in an effort to move beyond simply balancing supply and demand, to include (1) relations between water scarcity and geo-political conflict [17]; (2) the centrality of water to other fundamental necessities such as food [18–20], energy [21], and the natural environment [22]; and (3) to address the linkage between water supply and climate change [23]. Whereas previous understandings of water-society problems were largely technocratic and engineering centric, the new paradigm includes social, economic, and political aspects that converge to secure (or disrupt) sufficient supplies of water [24]. The new paradigm, then, mimics the approaches advocated in the field of political ecology and concurs that environmental change can only be understood through scrutiny of the political and social structures in which they are embedded [25].

Amidst this expansion of scope and emphasis within research on water security is a growing divide between analytical approaches, and even within defining the term itself. The challenge in defining water security is, in part, a reflection of the degree to which water touches so many facets of the human experience, the nature of the hydrological cycle, and variance in approaches to governance. Cook and Bakker [26] provided a review of the literature on water security and noted the range of disciplines (social, natural, and medical sciences) engaged in the topic, and the resulting divergence in definition. Further, they observed two general categories utilized in framing

water security issues—“narrow and discipline-specific,” and “broad and integrative”. They saw the conciseness of the former as being more easily assimilated into policy for development agendas, but argued the latter facilitated good governance in management applications.

Since this seminal review, others have contributed valuable assessment of the state of evolution of water security as a framework for research and development agendas. Zeitoun et al. [27] offered an updated literature review and further confirmed the entrenchment of disparate ideology. Evidence was offered via identification of eight different definitions of the term water security and two contrasting approaches within the literature on water security research. One approach, termed “reductionistic”, is usually centered on hydrological and economic data, and offers analysis through its reduction of complexity. In their estimation, this approach leads to “shortcomings when it crosses into policy-making processes” (p. 145). The second identified approach, termed “integrative”, mirrors the findings of Cook and Bakker [26] and describes analyses that are broad and intentionally political in order to capture diversity within societies and governance capability.

The epistemological underpinnings for much of the literature on water security are linked to decades of changing social and environmental landscapes and the resulting consensus of thought by practitioners and academics wrestling with how to integrate equity and sustainable management vis-à-vis supply and demand, regulatory frameworks, and competence and capacities of managing governance. Indeed, many of the changes to national water laws that have emerged over this period of time are the result of discussions at international fora like the 1992 International Conference on Water and the Environment (ICWE) in Dublin which was attended by representatives from 114 countries in addition to dozens of nongovernmental organizations (NGOs), international NGOs, and UN agencies. The resulting Dublin Statement addressed the importance of water management and the need for governments to commit to investment, institutional and legislative changes, public education campaigns, and capacity building programs [28] (We acknowledge alternative viewpoints and critical responses by Andean water scholars to the Dublin Principles for its emphasis on integrated water management and perceived encouragement/promotion of privatization of water resources). In 2002, the United Nations declared access to water and sanitation as a human right, a decision it reaffirmed in 2010 via Resolution 64/292 [29].

After the recognition that water problems had become multi-dimensional and multi-sectoral, resolution was deemed possible only through multi-disciplinary, multi-institutional, and multi-stakeholder coordination [30]. This gave rise to the methodological tool known as Integrated Water Resources Management (IWRM), which was viewed as a means of translating the agreed principles of equitable and sustainable access to water, as defined in the Dublin Statement, into practical and holistic application. The Global Water Project [31] (p. 13) defined it as:

a process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital eco-systems.

This management concept recognizes the social and economic value of water, focuses on watersheds as the planning unit of action, and is predicated on broad stakeholder participation in decision making. Despite its apparent potential in an ideal world, IWRM has not been implemented effectively in the real world and has become a point of debate and criticism among scholars [30,32,33].

While international meetings and resulting agreements have influenced national efforts to address water (in) security, the issue remains concurrently a global and local challenge. In addition to population growth and economic development, securing access to water in many parts of the world is further complicated by climate change [34]. In scientific terms, climate change alters the global water cycle, which in turn impacts ecosystems and the societies they embed [35–38]. Thus, the persistent challenge of improving access to safe and reliable water for large segments of the global population has become more difficult. In [39] (p. 367), Solomon asserted, “the challenge of freshwater scarcity and ecosystem depletion is rapidly emerging as one of the defining fulcrums of world politics and human

civilization". Fortunately, the connection between climate change and water security has reached a critical point of awareness. As recently as late 2016, the UN Framework Convention on Climate Change (COP), held in Marrakech, prioritized water on its policy agenda.

Effective water management is integral to water security and depends upon supportive legal and institutional frameworks [40,41]. In recent decades, water policy reforms have pervaded large portions of the Global South in an effort to secure water for citizens [42–47]. Despite modifications to national legal frameworks towards addressing issues of water insecurity, the results of new legislation have been mixed. In some respects, water laws fall short because they fail to be implemented adequately. This has been well-documented in the Nicaraguan case [5,44,46,48]. (See [49] for discussion of the challenges associated with wastewater governance across Latin America). Indeed, some components of new legal frameworks may go entirely unimplemented owing to issues of political will and/or inadequate expenditure of public resources which tend already to be stretched thin [50]. Formal devolution of decision-making authority to grassroots and community-based water managers across Latin America has constituted a particular legal strategy of governments seeking to embed *rural* water management within national frameworks and visions for water governance. The results have been mixed in ecological, social, and political terms [51–53], and have begun to demonstrate some notable cleavages along the lines of management for domestic use compared to irrigation [54].

The research for this paper integrates hydrological data and economic drivers of water consumption into political and social frameworks to define and understand water security for rural residents in a specific geographical region. In this sense, it recognizes the efficacy of place-based supply and demand notions of water security (i.e., reductionistic), while also extending the analysis to include political and social factors that serve to produce insecurity (i.e., integrative). In moving beyond solely material perspectives of water, our research is able to include social understandings and solutions that involve policy, governance, and management schemes [51,55–58]. We employ the definition of water security outlined by the Global Water Partnership whereby "every person has access to enough safe water at affordable cost to lead a clean, healthy and productive life, while ensuring that the natural environment is protected and enhanced" [31] (p. 12).

3. Methodology

The results presented in this paper rest on long-term research into water resources along the southern Pacific Coast of Nicaragua, with a focus on the community of Gigante, located in the municipality of Tola (see Figure 1). Our mixed-methods field research began in 2012 and continues to the present. This region was selected given the convergence of drought and tourism development and resulting opportunity to examine the implications of these intersecting phenomena on local water security. Research findings from the northern highlands in the Department of Matagalpa have been integrated in the discussion section of the paper for comparative perspective in regard to the implementation of national water laws (see also Figure 1). This region, where one of the authors has conducted field research on rural water management since 2007, does not have the compounded pressures of tourism development as in Tola. However, urban and rural areas in the Department of Matagalpa experience similar competing pressures on freshwater resources, including agricultural and other land use practices. Both regions, coastal and highland, importantly, have been experiencing the effects of prolonged drought.

A political ecology approach was taken in our attempts to understand the dynamics of water resources. A comprehensive political ecology approach, similar to the integrative water security studies promulgated by Bakker [59], requires in-depth investigation of both the physical and human dimensions of water [60]. Because very little physical data about Nicaragua's natural resources exist, we developed a monitoring scheme for water in coastal Tola. Groundwater measurements from every hand-dug well in the Gigante area ($n = 72$) were taken biannually (end of wet season and end of dry season) from June 2012 to December 2016. Nine deeper, drilled wells were monitored with data loggers collecting hourly data for water temperature, levels, and salinity values. To understand how

groundwater levels relate to rainfall amounts, we deployed five weather stations. Data from these stations, plus results from five years of manual rainfall measurements, were aggregated with a longer (39 years) record from a regional meteorological station in Rivas. Collectively, these data (49 years) allowed us to compare qualitative descriptions of water insecurity collected during informal and semi-structured interviews with measurements of rainfall and groundwater levels.



(a)



(b)

Figure 1. (a) Map of Nicaragua and study areas; (b) Map of Gigante and coastal Tola.

Research on the physical aspects of water was complimented by informal and semi-structured interviews with rural water committee members, rural well owners, tourism developers, and state agency and local government officials. Across several weeks in 2014 and 2016, a total of 19 semi-structured interviews were conducted with water committee members, local and national government officials, and multilateral agency staff. Additionally, eight semi-structured interviews were conducted with water committees, with multiple committee members present, in the communities in which they worked. The majority of these interviews were conducted in the Department of Matagalpa, with one conducted with the newly-formed water committee in the community of Gigante in the Department of Rivas. These interviews lent insight into water committees' and government and multilateral officials' knowledge and understanding of national water legislation, as well as views on and roles in law implementation. Informal interviews ($n = 320$) were conducted with well owners in Gigante during well monitoring to track changes in water availability, to estimate the relative water usage of various stakeholders, and to discover perceptions of groundwater level changes with respect to tourism growth and variation in precipitation (93% were repeat interviews). Informal interviews of tourism developers ($n = 14$) in Gigante were conducted in person biannually from 2012 to 2016 to determine their perspective on water security and legislation.

4. Description of Study Area

Gigante is a small coastal community in southwestern Nicaragua with a relatively short institutional history. Previously, the area was a large cattle ranch owned by former Nicaraguan dictator Somoza. The land was later confiscated as an outcome of the successful 1979 revolution, then redistributed to a cooperative of 72 families who began fishing and subsistence farming in the mid 1990s. Subsequently, the land around Gigante has been sold and bought in cycles as various individuals, entrepreneurs, and developers have discovered its natural beauty and tourism potential. Currently, its nearly 800 inhabitants consist of fisherman, small-business owners, expatriates, and a growing number of migrant squatters looking to improve their economic condition by laying claim to land still contested from the war (nearly 40 such families have settled in the area since 2013). Gigante's range in socio-economic demographics, along with its recent inception as a community, is reflected in the absence of strong, coordinated community leadership.

Tourism travel to the area was initially confined to adventurous surfers looking for empty waves and non-typical tourism routes. As the international surf community became aware and interested in the idyllic surf conditions found near Gigante, small surf lodges emerged to support the influx of visitors. Over time, the development of hostels, small hotels, and restaurants expanded to individual vacation homes and several gated communities—each in turn requiring larger amounts of water to support business.

The study area belongs to the winter dry equatorial (Aw) Köppen-Geiger climate type, and is characterized by distinct wet and dry seasons and unevenly distributed rainfall. Nearly all of the average annual rainfall of 1467 mm falls between May and October. The geology of the region plays a critical role in water provisioning, since nearly all water sources exist as groundwater. The watershed for the study area is underlain by the Brito geological formation, a 2500 m thick sedimentary sequence of shales, limestones, sandstones, siltstones, and mudstones [61]. Of note is the negligible porosity (<2%) of the fine-grained sandstone that comprises the upper extent of the formation [5]. This effectively constrains recharge (i.e., infiltration of rainfall) and confines movement of groundwater to bedding planes and vertical fractures within the aquifer. Collectively, these are problematic to aquifer yield and serve to complicate the process of siting wells and predicting output.

Most of the wells in Gigante are manually dug and extend below the surface 5 to 15 m to intersect the water table. These wells generally produce limited quantities of water (between 0.5 and 5 L/m) and are typically shared between several households. The few drilled wells that exist in the area are owned by larger tourism developments or resident foreigners. These deeper wells (35–260 m) typically

produce greater volumes (75–450 L/m), though they are susceptible to saltwater intrusion due to their depth, high rates of pumping, and proximity to the ocean.

5. Case Study: Water Insecurity along the Emerald Coast

Despite being a water-rich country, Nicaragua has struggled to secure clean water access for many of its residents. As a whole, Nicaragua (area of 130,370 km² and population of 5.9 million) is considered to have adequate resources of freshwater [62], though some regions receive annual rainfall in excess of 4300 mm (Atlantic Coast), while other regions receive less than 800 mm annually (western mountains) [63]. Similar to the larger global context, water supply in Nicaragua can be mismatched with demand. Reasons for insecurity vary spatially and include issues of distribution, competition with industries such as agriculture, unsupported water institutions, physiological parameters such as rainfall and geology, and contamination of water sources from industrial, mining, and agricultural activities [44,64].

5.1. Connection between Tourism and Water

More recently, tourism has emerged as an industry competing for water resources in Nicaragua, especially along the Pacific Coast [4]. Beginning in the early 1990s, tourism gained traction as a strategy for economic growth to alleviate economic hardship incurred over several decades of conflict, including a decade of war (1980 to 1990) [65,66]. In addition to heavy promotion of the industry through strategic advertising and partnerships, national laws were created to incentivize foreign investment. The 1999 *Ley de Incentivo para Industria Turística* (Incentives for Industrial Tourism Law, Law 306) and 2004 *Ley General de Turismo* (General Tourism Law, Law 495) provided substantial economic incentives and tax breaks for tourism developers and operators [67]. Since 2000, tourism arrivals have nearly tripled and tourism receipts contributed 5.0% of total GDP in 2015 [68]. This contribution is expected to rise by 5.1% per annum from 2016 to 2026 [69] and reflects a long-term relationship with tourism. While these figures provide a positive perspective on the contribution of tourism to Nicaragua's economy, the global use of water by tourism reveals an alternative perspective on the impact of tourism.

The dependency of tourism on water has been well documented by Gössling et al. [70] and others [71–73]. Although agriculture accounts for the largest demand on global freshwater, tourism is a major driver of water consumption, often in dry destinations with limited water resources. Research reveals that tourists are likely to use substantially greater amounts of water than local residents, in some cases up to 15 times more water than local populations [74]. In part, this is due to the water demands of landscaping, swimming pools, and golf courses that accompany luxury style tourism in dry landscapes. Disproportionate water usage by tourism has been known to produce conflict and often results in water insecurity due to physical, social, and political contingencies [5,11,14].

5.2. Climate Change and Water Availability

The implications of this imbalance in water usage by the tourism sector are compounded by varying climate (i.e., cyclical droughts) and predicted climate change. The southwest coast of Nicaragua has minimal surface water resources; thus tourism development is particularly dependent on groundwater (replenished through rainfall) to meet its consumptive needs. However, this region is predicted by Global Circulation Models to experience drying conditions, which in turn will impact aquifer recharge and subsequent water quantities available for abstraction. The Intergovernmental Panel on Climate Change (IPCC) Fourth Assessment Report (AR4) reported that Central America is “likely” (>66% probability) to experience declines in rainfall in both dry and wet seasons, and Nicaragua specifically will see an increase in frequency of dry days [75]. These predictions are problematic for the current trend of tourism growth along the southwest coast of Nicaragua given the linkage between precipitation and aquifer recharge, on one hand, and tourism and groundwater abstraction on the other.

Rainfall has fallen short of the long term annual mean of 1467 mm for the past five consecutive years (see Figure 2). Although the 49-year rainfall record reveals periodicity of drought, previous events did not coincide with tourism growth and its accompanying increase in groundwater abstraction. It is important to emphasize that most agriculture in this region is rainfed and thus not in competition with tourism over groundwater supplies. Over the period 2012 to 2016, annual rainfall yielded (respectively) 80%, 83%, 56%, 39%, and 66% of the annual mean and resulted in the drying of a majority of wells and subsequent hardship for nearly all stakeholders [5].

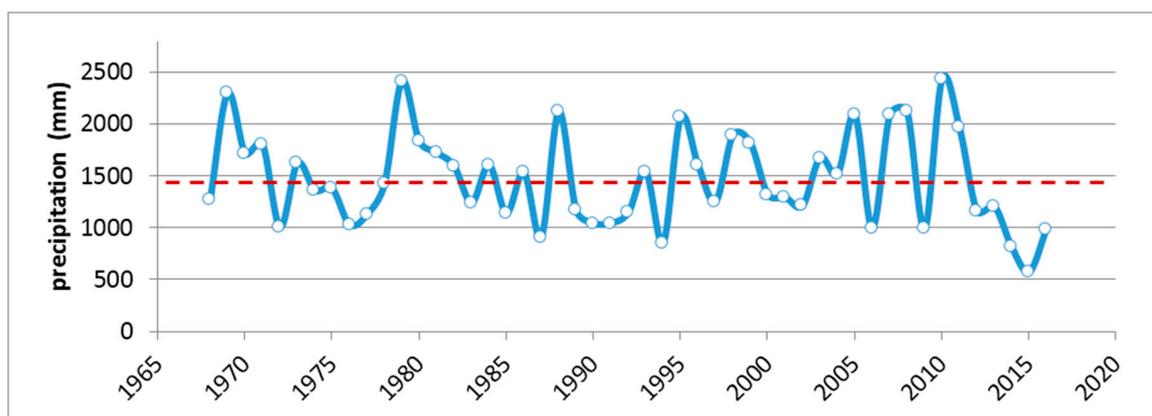


Figure 2. Annual rainfall for study area from [62,76]. Dashed horizontal line represents the mean of 1467 mm for the climatic series of 1968–2016.

The decline in rainfall is characteristic of a region-wide decline that was especially notable in 2015 and 2016 when much of the Pacific Coast region of Central America was affected by insufficient and erratic rainfall associated with a strong El Niño event. Drought conditions reduced crop production for small-scale producers of maize and beans in several areas of Central America between 50 and 100 percent [77]. This same drought resulted in a significant drop in static water levels of the aquifers in our research area [5]. The combined influence of drought and tourism related abstraction of groundwater meant that shallow, hand-dug wells (used by 99% of the local population) no longer reached the water table. Over 40% of these wells went dry, while an additional 43% were at a critical stage of less than 1 m of remaining water depth [5].

Despite a lack of recharge to aquifer(s) in the region and subsequent lowered water tables, tourism developers continue to pump groundwater to meet their needs. Their collective abstraction exceeds recharge rates and has resulted in drawing the coastal freshwater/saltwater interface landward, thus contaminating many of the coastal wells and further contributing to water insecurity (Several drilled wells of tourism developments also have incurred saltwater intrusion, but the consequences of dry or saline wells has more immediate and dire consequences for impoverished populations within the region who live at the margins of domestic water sources). Central to the issues of drying wells and saltwater intrusion is the general lack of hydrological knowledge by tourism developers. In principal, national water laws should inform and provide oversight of groundwater abstraction. In reality, tourism developers have pumped water for their development needs without knowing the sustainable yield of the provisioning aquifer(s). Beyond endangering the economic sustainability of tourism, this lack of knowledge has led to depleted or saline wells for local populations—a particular hardship imposed by the combined forces of drought and tourism development [5]. As one resident described it, “there is no more water anywhere, and the poor people are the ones who suffer” (23 March 2015). This hardship takes on discrete significance in national contexts like Nicaragua’s (and many other Latin American countries) where responsibilities for rural water management are shouldered primarily by residents themselves, albeit oftentimes in coordination with state agencies and officials [48,78–80].

On the part of tourism developers, lack of hydrological knowledge and subsequently depleted aquifer(s) and saline intrusion puts them in tenuous economic positions. Most developments were designed with nominal thought to sustainable water supply. The general assumption by developers was that this region had plenty of groundwater to support whatever tourism ensued. At the onset of tourism growth in the early to mid 2000s, tourism operations were small and had less water demands. Since that time, tourism has grown both in number of operations and in size. Additionally, the bulk of development in coastal southwest Nicaragua consists of gated residential communities—a type of luxury tourism heavily dependent on water. Thus, the issue of declining water availability undermines promotional imagery of the Tola region as the “Emerald Coast.” The term is a recent branding effort by prominent tourism developers in order to attract tourists and promote investment. In reality, this coastal area consists of dry-tropical forest, characterized by distinct wet and dry seasons (unimodal precipitation pattern) and brown landscapes (leaf-off) for five months of the year. Thus, expectations of verdant landscapes by visiting tourists has “forced” tourism developers to use large amounts of water (up to 65% of total daily usage) to irrigate landscaping for homes and public spaces within gated tourism developments during the dry season [4].

Water insecurity has prompted a myriad of responses by all stakeholders. Tourism developers have begun to realize the unreliability of groundwater to meet their inceptive development needs and have begun to monitor usage by individual tourism households, educate staff on water conservation, and implement tiered water pricing schemes. Developers have also re-thought the viability of water intense landscapes during the perennial dry season and have changed to landscape compositions better suited to dry tropical regimes. The community of Gigante, the focus of this study, responded to water insecurity by organizing a committee (akin to those in other rural parts of the country) to represent their common voice and to work with an NGO interested in drilling new wells in the Tola region. A community well was eventually drilled in 2016; however, its low yield required a hand pump and only serves a small percent of the community. To date, the water committee has been unable to sufficiently organize and move forward on its desire for a piped water supply for all Gigante residents.

Following the onset of the government-promoted tourism development strategy, two national-level water laws were passed in Nicaragua—the 2007 *Ley General de Aguas Nacionales* (General Water Law) and the 2010 *Ley de Comités de Agua Potable y Saneamiento* (Special Potable Water and Sanitation Committees [CAPS] Law). While each law has distinct aims, both pieces of legislation entail formal government delegation of water management and/or provisioning to new entities, both public and community-based [47]. Both laws are also similar in their genesis in terms of the role civil society actors played in developing and promoting each prior to their passing. For example, Law 722 passed unanimously in 2010 in the wake of transcommunity mobilization on the part of the country’s grassroots water committees, or CAPS, who advocated their formal political recognition [47,48] (see [81,82] for a discussion of the emergence of Law 620 during anti-water privatization protests in the mid-2000s). This role of diverse popular sectors in promoting the modification of legal frameworks indicates broad public support in Nicaragua for strengthening water governance—as well as a high level of public awareness of and attention towards issues of freshwater governance. As the below discussion elaborates, however, new water policies have fallen short in terms of effectively mediating rapid tourism development in this region of Nicaragua, now intersecting with a period of prolonged drought affecting local residents and tourism developers alike.

6. Discussion

In theory, water policy serves as an instrument for addressing water insecurity in social, ecological, and economic terms [83]. The fundamental changes and re-structuring of national water policies over the past several decades in Nicaragua and elsewhere in the Global South demonstrates attempts to more effectively manage water resources in accordance with international policy trends, like those reflected in the Dublin Principles. Nevertheless, the Nicaraguan case presents caveats to the logic that better laws will necessarily produce a praxis of better water governance; in other words, governance that

produces more equitable and ecologically-sound outcomes. In the context of Gigante, implementation of Law 620 (General Water Law) and Law 722 (Special Potable Water and Sanitation Committees [CAPS] Law) hold potential for promoting more effective governance of water in the Tola coastal region. Yet, examination of both laws in the Gigante context reveals shortcomings in regard to the implementation of new legislation, and hence water policies' ability to mediate the combined effects of tourism and drought in the region.

6.1. The General Water Law

Law 620 regards water as a public domain and governance is framed so as to ensure sustainable and equitable use of water and the promotion of social and economic development (Art. 1 and Art. 4). Within this framework, water is prioritized among uses and users when granting concession, permits, or license for water use. Table 1 indicates the relative priority of tourism use to human consumption.

Table 1. Prioritization for granting water concessions in Law 620.

1	Human consumption
2	Drinking water services
3	Agriculture and livestock
4	Environmental conservation
5	Production of energy for public use and self-use
6	Industrial
7	Aquaculture and fish farming
8	Medicinal, pharmaceutical and cosmetic use
9	Tourism and recreational uses
10	Navigation
11	Use in a variety of beverages, processed for sale to the national public only
12	Other unspecified uses in which water is a relevant component or factor

Source: [84].

Under Law 620, management of water is accomplished via an integrated watershed approach, whereby water basins are used to define the total amount of available water and subsequent allocation of water. In addition to establishing a formal legal framework managing freshwater resources and regulating the allocation of water rights among uses and users, Law 620 mandated the creation of several new governance bodies. These included the National Water Authority (*Autoridad Nacional del Agua*—ANA) to oversee the implementation of the new water law, and Basin Organizations to manage, monitor, and oversee water use within respective water basins (Art. 31). Law 620 also advocated for citizen participation in water management through Basin Committees. These committees are intended to work in consultation with Basin Organizations and to foster civil ownership of water management decisions.

Given the prominent role of tourism in coastal Tola and strong linkage between tourism and water consumption, it is helpful to consider the interaction of tourism development in this region with Law 620. The efficacy, or lack thereof, of the new water law can be analyzed from the standpoint of (1) degree of policy implementation and (2) degree of access to knowledge and information by all users.

Perhaps most striking about Law 620 is the degree of non-implementation of policy. Most notable in this respect is the absence of water budgets for any of the country's 21 watersheds and the lack of formation of Basin Organizations and subsequent Basin Committees. Collectively, these elements reflect the inability of an otherwise robust water law to protect both citizens and businesses—the former with respect to marginalization and the latter with respect to supporting a nationally prioritized economic industry (tourism). Although ANA has been established (nearly five years after Law 620 was passed), its role to regulate, administrate, monitor, and control water resources remains largely confined to the capital city of Managua. Without a defined Basin Organization for the “Emerald Coast”, oversight by ANA of tourism abstraction of groundwater is nominal at best. Currently, all that is

required for permission to drill a well is a rudimentary study of available mean annual water supply and the potential social impact of water extraction via the well. These reports are typically generated by non-specialized engineers with limited data sets, and have thus been unable to forecast or capture the current state of water insecurity felt by all stakeholders. Tourism developers then, have little productive interaction with Law 620. Although most developers comply with its mandate to permit wells, none that we interviewed knew about its proposal and requirement of Basin Committees and Organizations, nor its requirement for basin specific water budgets to inform allocation.

Beyond the absence of an entity in touch with localized water insecurity (e.g., Basin Organization and/or Committee), is the overwhelming lack of data to inform decisions of prioritization and allocation. Without a complete spatial and temporal water database, Nicaragua is unable to carry out the policies of a socially forward water law. Thus, its prioritization of human consumption over tourism and recreation uses (defined in Table 1) is rendered mute. Law 620 cannot carry out its aim to ensure sustainable and equitable water management without the production of hydrological knowledge that can guide and hold accountable tourism developers, and provide protection to local users, who have less power. In the case of Gigante, hydrological budgets could have informed allocation of water to tourism development and prevented over-pumping of the aquifer(s) and induced saltwater intrusion in coastal wells. A local Basin Committee could have been integral in educating local stakeholders on the aspects of Law 620 that define their rights and due process in situations of water conflict. As it stands, enforcement of allocation and prioritization within Law 620 is virtually impossible without enforcement of the mandate of the water law to create Basin Organizations and Committees, and water budgets for basins.

6.2. *The Special CAPS Law*

The purpose of the Special CAPS Law (Law 722) is to recognize CAPS as constituting a community-based water management regime in Nicaragua, in part through providing guidelines for the formation and operation of CAPS and their process of registering with the government. Much like Law 620, however, Law 722 has fallen short in regard to supporting the community of Gigante in achieving greater water security. Part of the shortcoming is attributable to limited information on the law available to rural communities and the resistance to formalization of local water governance in accordance with the new “norms” required by the law. The rate at which local governments themselves have learned the provisions of the law, thus allowing public officials’ potential promotion and implementation of the law within their jurisdictions, also matters. In the Gigante case, it is interesting to note that the impetus to learn about Law 722 and to form a CAPS was tied less to local government and more to the tourism industry—reflecting patterns observed in northern Nicaragua and elsewhere where NGOs (as opposed to industry) have oftentimes prompted communities to organize in accordance with the law. Specifically, the Guacalito de la Isla resort (adjacent to Gigante, see Figure 1) presented the community with an opportunity to have a new well drilled for community use with resort funding of USD\$80,000. The offer came with a stipulation related to Law 722. As a CAPS member shared in 2014: “Guacalito always told us that they were going to help us with a water project, but they said that the CAPS had to be formed [before agreeing to proceed]; so we invited the community to several meetings until we finally had a good number of attendees” (3 May 2014).

Motivated by the opportunity to leverage water project funding from the resort, the community formed a CAPS in July 2014. Nevertheless, the community did not receive funding from Guacalito to drill a well owing to the combined factors of a delimited timeline of funding availability and the rate at which the community organized. Knowledge of the national law was relatively slow to come to Gigante compared to other communities (and respective regions) in Nicaragua. For example, unlike the northern highlands of Nicaragua, where CAPS have regional history of organizing in the wake of water system construction and where many CAPS collaborate with rural development organizations [10], the community of Gigante first learned about “CAPS” several years after the passing of Law 722. Residents received a guide for forming a water committee from the local government, although much

was learned about CAPS and their functioning at a national scale from the internet research of a resident who was elected to the CAPS that formed in 2014. She described learning the history of CAPS in Nicaragua “from Google”: “Supposedly, some women in the rural areas in the north started organizing because of the need for water, so they started with community wells . . . now they have implemented meters, conduct maintenance, and keep [the system] clean . . . ” (3 May 2014). Despite not ultimately receiving funds from the tourism industry to drill a well, the formation of a Gigante CAPS is significant in regard to potential *future* law implementation in that it started to sensitize residents to the water governance principles and norms within Law 722.

Nevertheless, the initial reaction of community members to the idea of a new well and the CAPS’ role in its management reflected resistance to implementation of several of Law 722’s provisions. One CAPS member referred to the “people of the community” as the “principle block” in terms of moving forward with the formation of a water committee, and relatedly, Guacalito’s offer to construct a well. In particular, community members were strongly resistant to the idea of paying household-based tariffs for water usage—collection of which is an implicit stipulation of CAPS’ functioning in order to have funds for necessary repairs and other maintenance, even though communities throughout Nicaragua have varying degrees of success in regard to collecting regular payments from system beneficiaries [10,47]. As one Gigante resident expressed in 2014 in relation to his private well, “If I charge, the well will dry up . . . you can’t sell water” (3 May 2014). Across informal interviews, residents in Gigante expressed awareness of lowering water tables; yet, while highly inclined to share water from household wells with neighbors, they were opposed to the notion of charging for water. At a collective scale, this reluctance to view water in economic terms translated into community resistance to the idea of paying monthly tariffs for water, even if it meant a potentially larger scale and sustainable water source for the community built with outside funds (e.g., a local tourism development or NGO). One take away in regards to water policy is that the introduction of new legislation and respective norms does not guarantee receptiveness to these nor change in practice.

Reflecting unevenness in the Law’s implementation regionally within Tola, the coastal community of Astillero (north of Gigante) formed a water committee in conjunction with construction of a new water project several years before residents in Gigante had even heard of the new law (Astillero is similar to Gigante in that it is a rural coastal town, influenced by tourism, and dependent upon groundwater). The CAPS is registered with local and national government officials, and hence is legalized in accordance with Law 722. According to local government staff in Tola, residents in Gigante had the opportunity to direct local government funds towards a new water project in 2013, but, during an annual meeting with government officials, the community voted to fund new roofs for homes instead (4 June 2014).

Although further research would be necessary to assess the differences in outcomes between the communities of Astillero and Gigante in regards to the development of community-based water projects and respective water committees in line with Law 722, several preliminary assessments are worthwhile. First, the community of Astillero does not have as large a foreign, immigrant, nor tourism industry population like Gigante. This relative homogeneity of the local population may have made collective decision-making in regards to new water projects and CAPS formation relatively easy in relation to Gigante. For example, interviews in Gigante revealed foreigner-local tensions in regard to resource differentials and issues of trust. Owners of hand-dug wells near a large gated tourism community cited the building of a golf course, and subsequent demand for water to keep it green during the dry season, as the reason for their wells drying up. Second, the relationship to local government appears starkly different across the two cases. A CAPS member in Gigante expressed in regards to Astillero: “It’s that the mayor [of Tola] is from there, so I think that he put in a lot of effort to help that area because those are his people”. (3 May 2014). In the same interview, a different CAPS member emphasized that Astillero residents for several years prior to receiving a new, local government-supported water project had voted for water to be prioritized. Significantly, the Gigante CAPS spoke of developing all of the requisite documentation to be officially registered with the

government via Law 722, but indicated ostensibly political blocks to the completion of this process; in one member's words: "... we went to the mayor's office and they were super annoyed [including because] their office would incur legal costs to send [our documents] to Managua" to be approved (3 May 2014). Determining the interplay of the local government's personal connection to Astillero and broader issues of political will and capacities would require further interviews within local government and residents in the region.

Importantly, some of the shortcomings inherent to Law 722 itself would caution against the presumption that full implementation in a local context would serve to promote better CAPS' functioning or improved water security. Law 722 extended a much sought-after legal recognition for CAPS, but the law has proved to be a double-edged sword when implemented. For instance, while offering benefits like tax exemptions to the most financially secure and well-organized water committees, the law has placed what are perceived as financial and reporting burdens on others. Some CAPS have chosen not to register with the government for fear of additional burdens on their local committee and/or the risk of government cooptation. For registered and non-registered CAPS alike, the idea that water committees should be "self-sustaining" is inherent to the perspective of many local elected officials and NGOs working with rural water committees—and is also inherent to Law 722 and its provisions regarding CAPS' operations. The notion of complete self-sufficiency in regard to local water system management and maintenance carries financial and other risks for impoverished rural populations given local monetary limitations and organizational capacities [80]. Indeed, recognition on the part of both rural water committees and government officials that the law has placed excessive burden on some CAPS has led to much discussion amongst CAPS, NGOs, and public officials regarding a potential reform of the law.

7. Concluding Remarks

Nicaragua's recent restructurings of its national legal framework for freshwater use and distribution reflects an alignment with other countries in Latin America to more comprehensively govern water resources to ensure water security for its citizens, the environment, and economic industries. This paper contributes to analysis of the new laws and presents findings relevant to other water insecure areas in Latin America where industry development and weak legal and policy frameworks impact "local" water security. We conclude, in the case of Nicaragua, that sound laws have not translated to sound governance as evidence by the production of water insecurity along the "Emerald Coast" via the converging issues of drought, tourism development, and lack of progress in water policy implementation. Thus, water insecurity is not the result of conceptual simplicity of water availability on the part of the government vis-à-vis legislation, but rather an inability (or disinterest) in implementing all facets of progressive laws. Embedded within both laws is an implicit understanding that securing water is more than a matter of harmonizing supply and demand, and that prioritizing water among users and uses, as well as granting agency and voice to diverse stakeholders, is essential to promoting resolution of conflict over water in dynamic economic and ecological settings.

Law 620 mandated the formation of Basin Organizations to provide decentralized oversight of water management at the basin level. In theory, this bottom-up approach to ensuring equity and sustainability should be able to mediate conflicts such as the one documented in Gigante. However, to date, there are no such organizations for the Emerald Coast, thus leaving tourism developers unsupported and unaccountable for abstraction of groundwater. This has become particularly pronounced in the wake of a 5-year drought. Further, the absence of mandated Basin Organizations and Committees leave local stakeholders particularly vulnerable as they are unarmed with knowledge of rights and due process. When limited water supply is contested, insufficient knowledge and inability to financially compete with tourism's deeper wells and larger pumps results in unequal water access for local populations—ostensibly those for whom the new law was designed. In practice then, Law 620 matters little to local stakeholders or to tourism developers. In regards to Law 722, continued evaluation of its implementation and effects on water security and broader water governance will be

needed to gauge its effectiveness. Although Law 722 was meant to empower rural water managers, Gigante's CAPS has been unable to secure the water needs of the community. They have indicated little involvement of the local government, despite the legally mandated role of local government support for rural water projects and CAPS' formation in accordance with Laws 620 and 722.

Ultimately, both laws, though founded on sound principles (as derived from the Dublin Principles and IWRM framework) have failed in implementation in this region of Nicaragua. Contrary to assertions by scholars such as Biswas [30], failure is not necessarily a reflection of ambiguity in language, terms, or concepts, but rather a confluence of cultural and environmental contingencies specific to this location. Certainly, there is ample evidence within development literature of failed attempts to operationalize IWRM. Biswas, and other scholars critical of the efficacy of IWRM, decry the "validity" and "applicability" [30] (p. 16) of the framework and demand evidence, regardless of scale, of a good IWRM project within Latin America [85]. However, evidence does exist. Rossing [2] provided a compelling example of success in Brazil, where national-level water reform empowered basin-level committees and other stakeholders to secure water, despite obstacles of drought, conflicting interests, and clientelism. Further, numerous CAPS have proven successful in other parts of Nicaragua despite lack of national level support [10,47,48]. Our point is not to address the overall efficacy of IWRM, but to say, in the instance of Gigante, that a combination of factors is at play when explaining water insecurity. The contingent factors relevant to Gigante are described as follows:

Firstly, lack of hydrological data severely hampers any effort, decentralized or otherwise, to allocate water on the basis or prioritization established in Law 620. It does no good to have an integrative law designed to account for all the factors contributing to water insecurity if a simple water budget is not generated. Additionally, the absence of Basin Committees and Organizations prohibits stakeholder participation and limits equity. Neither of these issues reflect insurmountable obstacles. The reason for lack of implementation then is more likely in line with the voice of former executive president of ENECAL, Nicaragua's national water and sanitation utility [50] (p. 1).

Although the issue of water is essential and understanding the problems it presents involves a certain complexity, virtually no one seems to want to spend even a couple of hours thinking about this vital service . . . We haven't had a single government that has grasped the appropriate dimensions of the water problem, much less one that prioritizes it in its administration. And that's a tragedy. If we'd had some government with the will and capacity to understand what it means to adequately manage the ecosystems that produce water and to conserve and responsibly administer that water . . . our country wouldn't be in the worrisome situation it now finds itself.

Secondly, the lack of success of CAPS in Gigante can be attributed to a lack of community cohesiveness, as evident in its demographic heterogeneity and relatively young history. These factors surfaced in numerous interviews where residents identified a propensity for individualism over collective action. Currently, every household and business makes their own water deals. Further, the community of Gigante displayed strong disinterest in paying for water (as reported previously). The NGO that provided a well to portions of Gigante in 2016 is actively drilling wells throughout the municipality of Tola. In an interview, the field manager of the NGO reported that among all the communities in which they worked, only Gigante delayed organizing a CAPS and were unwilling to pay small tariffs to maintain the system. "There is an expectation of free water by the community". (1 December 2016). This, in part, might be explained by the initial decision of a tourism development in Gigante to supply free, piped water to roughly 30% of the community from 2002 to 2013. Later, as water became scarce and the development expanded their footprint, water supply to the community was terminated. These caveats help explain the struggle to organize an effective CAPS in Gigante.

Moving forward, it is clear that change must happen. No evidence suggests the government will intervene or implement current policy. Persistent drought and subsequent conflicts might indeed force local mobilization to invoke change, or perhaps result in outmigration and/or diminished tourism

profitability. Variation in climate along the southwest coast (as previously mentioned) will undoubtedly require dynamic responses to ensure water security. One possible response might come on the part of stakeholders in the tourism industry. To date, they have not been required to understand the balance in supply and demand, nor held accountable to constrain water consumption so as to protect local populations and the environment from water insecurity. Many of the tourism developments along the “Emerald Coast” have tremendous financial resources at their disposal to invest in understanding their hydrological setting, as well as contribute to the well-being of local communities. As they begin to understand the linkage between their long-term economic viability, a well-managed watershed, and healthy relationships with the surrounding community, they are in a position to contribute to equitable water security. Currently, only a handful of academics are driving the collection of hydrological data and educating tourism developers on the reality of water resources in this area.

In addition to continued evaluation of these two laws, future research on water security in Nicaragua would benefit from embracing a justice focus that interprets differentiated outcomes of new water policies. For example, the ways in which laws are (and are not) implemented may worsen existing conditions, as well as produce new inequities among diverse socio-economic groups. Study of water governance must subsume these issues of justice and human rights if we are to gauge how governance produces socially-equitable and ecologically-sound outcomes—results that should be of utmost concern to governments, policy makers, and industry alike.

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