When wells run dry: Water and tourism in Nicaragua

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Abstract

This article uses a political ecology approach to examine the relationship between tourism and groundwater in southwest Nicaragua. Tourism remains a growing industry; however, adequate provisions of freshwater are necessary to sustain the production and reproduction of tourism and it remains uncertain if groundwater supplies can keep pace with demand. Integrating the findings of groundwater monitoring, geological mapping, and ethnographic and survey research from a representative stretch of Pacific coastline, this paper shows that diminishing recharge and increased groundwater consumption is creating a conflict between stakeholders with various levels of knowledge, power, and access. It concludes that marginalization is attributable to the nexus of a political promotion of tourism, poorly enforced state water policies, insufficient water research, and climatic variability.

Introduction

Peering over the ledge into the dimly lit, hand dug well, my eyes slowly adjusted so I could see the thirty centimeters of accumulated water at the bottom of the seven-meter deep well. This amounted to a mere 240 l of freshwater—hardly enough to satisfy the needs of the six houses that depended upon the well. Maria explained that it would take three to five days before the well produced another 240 l that could then be pumped and distributed to her relatives.1 Things have changed in the small coastal community of Playa Gigante, Nicaragua. In years past, this well had been more than adequate to meet their needs. Maria and Ernesto have lived in Playa Gigante since the mid-1990s, shortly after a large portion of the area was redistributed to an agricultural cooperative by the Sandinista government. They had moved here to carve out a new life, supported mainly through fishing and subsistence farming. Ernesto had told me on previous visits his well would fill completely at the end of each rainy season. "I could reach down into the well with my hand and scoop out water with a bucket."2 This year (2014), the rainy season brought only 60% of mean precipitation. The two previous years had been below average also. To make matters worse, a local tourism business bought a four-meter by four-meter plot of land within ten meters of his well for the sole purpose of installing a deeper well with a pump. Ernesto told me this was a big reason why his well is now nearly empty.

A decade of tourism growth has brought significant opportunity for local business, including charter fishing for Ernesto. Although many in the community welcome this economic ‘progress,’ they also speak with growing concern about tourism’s impact on limited water supplies. More tourism means more business, but it also means more demand on water—something...
that is in shorter supply due to prolonged drought in the region. Collectively this means a scramble for water security and subsequent conflict with definite winners and losers.

This paper explores the relationship between tourism development and local populations in southwest Nicaragua through the lens of freshwater supply. Particular attention is paid to the political and economic institutions in which tourism is embedded, globally and in Nicaragua. Research for this study involved various aspects of the physical and human geography of the study area gathered over five years of intensive field visits to Playa Gigante (2010–2015). A mixed-method approach was used to gather data on site-specific water availability, use, and conflicts. This included in-depth and informal interviews (n = 90) with local residents, community leaders, tourists, tourism development managers, and local NGOs; well monitoring (n = 92); and geological field mapping. Well monitoring involved bi-annual empirical data collection at each well during the peak of the wet and dry seasons, as well as hourly collections via data loggers. This interdisciplinary and multi-method approach was employed to better understand the complex nature and contingency associated with environmental, political, and economic issues. The research was designed to map the distribution of wells, to track changes in groundwater levels, 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. The research was confronted by limited baseline data, including conditions that existed before the recent growth of tourism.

The paper is divided into three sections. First, the political ecology of tourism development is outlined at the global and regional level, with particular emphasis on tourism linkages to political agendas and water supply. Second, the causes of water crisis in Playa Gigante are evaluated. Water supply is traced through the limitations of geology and climatic variability to the growing demand through tourism development and increase in local populations. Water is shown to flow towards power, with a small number of winners capturing most of the rewards and the remaining participants scrambling for resources with little hope of water security. Third, the water struggle and its consequences for local populations and tourism developers are outlined. Social power is scrutinized through examples of competition over limited supplies of water, while economic consequences for tourism developers are projected. Implications and recommendations for water management are then offered.

**Political ecology of tourism development**

Global tourism has experienced steady growth and expansion over the past six decades and represents one of the largest economic sectors in the world at a value of US$1,245 billion (UNWTO, 2015). International tourist arrivals grew by 4.7% in 2014, the fifth consecutive year of growth since 2009 (UNWTO, 2015). Like most capitalistic ventures, the long-term success of tourism is dependent upon new markets and opportunities. Within tourism literature, these new markets are described as ‘emerging destinations’ and constitute the highest area of growth across the tourism landscape. Arrivals to such destinations are expected to increase at a rate of 4.4% between 2010 and 2030—double that of arrivals to ‘advanced economies’ (UNWTO, 2014). Central America continues to grow in popularity as a tourism destination due to cultural attractions, biodiversity, and affordability. To this end, tourism promoters are increasingly pitching enchanting destinations to tourists with an appetite for discovery and interest in less-crowded destinations. Between 1986 and 2013, tourist arrivals and receipts to Central America grew at average annual rates of 9.3% and 14.2% respectively, exceeding the average global rates. Within Nicaragua, tourism arrivals have nearly tripled in the last 15 years (see Table 1) and contributed 5.0% of total GDP in 2015. This contribution is up from 4.0% in 2013 and is expected to rise by 5.1% per annum from 2016 to 2026 (WTTC, 2016). Given the current and projected growth of tourism in emerging destinations such as Nicaragua, it is critical to evaluate the environmental, social, and economic dimensions of impacts on receiving destinations.

**Discourse of tourism**

Tourism is best framed within the larger discourse of capitalism given its market functionality and tendency for valuation within narrowly defined cost-benefit analysis. Although the efficacy and impacts of tourism are simultaneously argued and defended (Hunt, Durham, Driscoll, & Honey, 2015; Messerli, 2011; Spenceley & Meyer, 2012; Torres & Momsen, 2005; Wilson, 2008; Zapata, Hall, Lindo, & Vanderschaeghe, 2011), there is little doubt that economies and resources in developing countries are often reoriented to serve the needs of tourism and exogenous markets (Britton, 1982). Similar dynamics in Central America can be traced back to the 19th century when production and exchange of commodities such as coffee, beef, and sugar where brokered at the hands of elites who monopolized resources and marginalized certain classes of people to the benefit of external consumption (Beckman, 2012; Dore, 2006; Gobat, 2005). This outcome fits with Marx and Engels’ (1978) observation of the larger global pretension of capitalism whereby “[t]he need of a constantly expanding market for its products chases the bourgeoisie over the entire surface of the globe. It must nestle everywhere, settle everywhere, establish connections everywhere” (p. 476). Although such a teleology is conceptually easy to consign to tourism, it is no easy task to determine social and economic implications given that capitalistic impacts in developing countries produce markedly different results across space and time. This brings us to the on-going debate of tourism as a means for improving economies in developing countries. Presently, many countries throughout Latin America export commodities with high social and environmental costs. Extractive industries (e.g., oil, natural gas, mining) are more costly on the environment and actually produce fewer jobs than other sectors. In contrast, tourism offers countries a commodity that creates jobs
and does not have to be extracted for value in the traditional sense. However, tourism comes with a high demand for water, which can prove problematic for areas with limited water resources, often the case for coastal and island destinations (Gössling, 2001).

Nicaragua has emerged as an attractive tourism option within Central America and threatens to supplant the regional tourism hegemony of Costa Rica (Lane, 2015; McClure, 2014). After decades of being off the travel circuit radar due to political upheaval, Nicaragua is catching the eye of many travelers looking for the ‘next big thing.’ In addition to its ‘unspoiled’ natural beauty and low crime rates, tourism benefits from government promotion and endorsement as a means for generating much needed economic activity. However, tourism development is highly dependent upon sufficient quantities and quality of water supplies. Tourists and residents require safe, dependable supplies of water to meet drinking, cooking, washing, and cleaning needs. Further amounts of water are needed to support tourism related amenities such as swimming pools, golf courses, and landscaping. Stonich (1998) and others (Crase et al., 2010; Deyà Tortella & Tirado, 2011; Gössling et al., 2012) have shown that tourists use significantly more water per capita than local users, thus creating the potential for conflict over water and marginalization amongst users. Despite this obvious link between tourism and local water supplies, very little academic research addresses this issue in developing countries. A few exceptions include work by Stonich (1998) in Honduras, Gössling (2001) in Zanzibar, Cole (2012,2014) in Bali, and LaVanchy and Taylor (2015) in Nicaragua. As argued by Cole (2012), access to water is fundamental to development and an indicator of progress towards Sustainable Development Goals, thus more research is necessary to fully evaluate the nexus of tourism growth and water security. This paper seeks to fill the gap in tourism-water research through a case study of Playa Gigante—a ‘frontier’ of tourism growth in Nicaragua where the national political agenda to promote tourism (Carroll, 2007) collides with unsupported national water policies. A political ecology approach was utilized to fully capture the political, economic, and ecological factors at play. These findings will be of benefit to the stakeholders in Playa Gigante (hereafter referred to as Gigante), as well as to those areas that constitute the next ‘wave’ of tourism growth along the southwest coast of Nicaragua.

Tourism, water, and political ecology

The arc of environmental research combining political ecology, tourism, and water can be traced from the mid-1980s through today. Most notably, the work of Bryant (1992) brought attention to political ecology as a research tool for understanding how unequal power relations mediate human-environment interactions. At the time, mainstream environmental research was largely apolitical and argued, by some, to be ineffective in bringing about change. Stonich (1998) effectively brought political ecology into tourism research through her study on the impacts of tourism on water quality in the Bay Islands, Honduras. Specifically, unrestrained tourism growth was shown to benefit elite stakeholders while adversely impacting impoverished local stakeholders. Gössling (2001) broke further ground on the political ecology of tourism and water through his study on Zanzibar’s fragile island ecosystem and unsustainable groundwater abstraction by the tourist industry. Despite its nuanced explanatory power, political ecology has been underused in research on water and tourism. Cole’s (2016) work on gendered water inequity in Bali represents one of the few exceptions over the past decade. Despite a re-emergence of political ecology in tourism studies, as seen in two recent edited volumes by Routledge, Political Ecology of Tourism: Community, power and the environment (Mostafanezhad, Norum, Shelton, & Thompson-Carr, 2016) and Political Ecology and Tourism (Nepal & Saarinen, 2016), little attention has been given to tourism and water security. Although both volumes covered a range of topics and locations in thorough detail, only one chapter between the two volumes addressed the direct use of water for tourism (Cole, 2016). This lacuna in the literature on tourism research is somewhat remarkable given the precarious state of water security amidst a growing tourism sector and variability of climate change. This gap, however, is well suited for the aims of political ecology where questions of differentiated power in social and economic structures map onto the conflict experiences of stakeholders.

Political ecology is an analytical framework employed across several disciplines that “focuses on the interplay of diverse socio-political forces, and the relationship of those forces to environmental change” (Bryant, 1992, p. 14). It allows for research on local environments to be understood through the actions of local stakeholders, as well as global political and economic processes. Further, it proves useful in distinguishing the social relations and power dynamics operating at multiple scales within politics, economics, and the environment. Although originally posited by anthropologist Eric Wolf in a call to integrate understandings of local ecology with larger economic influences, the field of political ecology has grown along five distinct, but often overlapping, narratives: (1) degradation and marginalization, (2) conservation and control, (3) environ-

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**Table 1**


<table>
<thead>
<tr>
<th>Year</th>
<th>Arrivals</th>
<th>Tourism receipts</th>
</tr>
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<tbody>
<tr>
<td>1994</td>
<td>238</td>
<td>40</td>
</tr>
<tr>
<td>2000</td>
<td>486</td>
<td>129</td>
</tr>
<tr>
<td>2005</td>
<td>712</td>
<td>206</td>
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<tr>
<td>2010</td>
<td>1011</td>
<td>313</td>
</tr>
<tr>
<td>2011</td>
<td>1060</td>
<td>378</td>
</tr>
<tr>
<td>2012</td>
<td>1180</td>
<td>421</td>
</tr>
<tr>
<td>2013</td>
<td>1229</td>
<td>417</td>
</tr>
<tr>
<td>2014</td>
<td>1330</td>
<td>417</td>
</tr>
<tr>
<td>2015</td>
<td>1386</td>
<td>529</td>
</tr>
</tbody>
</table>

Source: UNWTO (2016) and calculated from data.

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a Millions.
b 1000.
mental conflict and exclusion, (4) environmental subjects and identity, and (5) political objects and actors (Robbins, 2012, p. 20). These theses of political ecology have been employed in various geographical and political contexts by an array of scholars (Blaikie & Brookfield, 1987; Escobar, 1996; Nietschmann, 1973; Perramond, 2010; Rocheleau, Thomas-Slattery, & Wangari, 1996; Watts, 1983) to demonstrate that environmental change is effectively a product of political process.

This paper is mainly concerned with environmental conflict and exclusion vis-à-vis water resource access and control in a tourism-laden context. In the case of Gigante, insufficient water supply is a differentiated event, that is to say, consequences are not experienced evenly by all stakeholders. However, it is not enough to simply point out the winners and losers in this conflict. As Robbins (2012) argued, “it is essential to understand the degree to which such outcomes are non-incidental, persistent, and repetitive” (p. 87). To this end, this paper treats tourism developers as diverse actors with degrees of agency, rather than a monolithic entity. Some actors are merely capitalizing on economic opportunity, despite social and environmental consequences to locals, while other actors perceive and pursue sustainable economic and environmental measures as a best course for all.

**Tourism development in southwest Nicaragua**

Gigante is a small coastal community in the municipality of Tola on the southwest coast of Nicaragua (Fig. 1). A small portion of its 550 inhabitants live along a short stretch of beach on the Pacific Ocean, while the remainder are distributed along two stretches of dirt roads connecting the coastal community to a larger municipal road. The community of Gigante has a relatively short history and is currently comprised of fisherman, farmers, expatriates, and a few part-time residents from Managua. As recently as the late 1970s, this area was a cattle ranch owned by former Nicaraguan dictator Anastasio Somoza Debayle.

In the late 1980s, the land was confiscated by the Sandinista government and re-distributed to a cooperative of 72 families who began fishing and subsistence farming. Since that time, the land around Gigante has been settled, sold, and bought in waves as various individuals, entrepreneurs, and developers have recognized the abundant natural beauty and wealth of the area. This commodification of land was stimulated in part by the interest of surfers from North America and Europe who discovered pristine surfing locations along the coastline. Studies of surf tourism in Costa Rica offer some consideration of how surf tourists contributed to a process of economic growth and accompanying environmental and socio-cultural growing pains (Krause, 2012).

As the international surf community became aware and interested in the idyllic surfing conditions around Gigante, small surf lodges emerged to accommodate the interest of well-heeled surfers looking for empty waves and the chance for adventure. Over time, news spread about the opportunities for world-class surfing near Gigante and tourism arrivals and expenditures increased. With this growth came the development of a hostel, a few small hotels, and several restaurants. Additionally, interest in buying land and building vacation homes led to the establishment of several gated communities poised exquisitely along prime coastline. These larger gated communities exemplify the residential tourism outlined by Matteucci, Lund-Durlacher, and Beyer (2008) and reflect the hard pioneering work of both foreign and Nicaraguan ingenuity, capital, and vision. For the most part, these larger tourist enterprises market themselves as environmentally conscious purveyors of local socio-economic progress. Undoubtedly this pioneering effort has ‘opened’ up the southwest coast to development aimed at a range of tourism opportunities, local job productions, education initiatives, and health brigades. This opening up of the coastal face of the Pacific, however, has not come without a struggle and conflict over land (Abu-Lughod, 2000; Ferrando, 2007) and resources (Alvarado & Taylor, 2014; LaVanchy & Taylor, 2015).

**Mass vs. quality**

Numerous studies on the environmental impacts of tourism in developed nations are relevant for emerging tourism destinations where data are often lacking. Several recent papers examined the comparative water demand and consumption of ‘quality’ and ‘mass’ tourism, where quality tourism is characterized by low density, second homes and golf courses, and mass tourism by intensive vertical hotel growth, and high season sun and sand consumption. Hof and Schmitt (2011) and others (Deyà Tortella & Tirado, 2011; Rico-Amoros, Olcina-Cantos, & Sauri, 2009) demonstrated that water consumption patterns are actually higher for low density, quality tourism than mass, or hotel tourism. In part, this is due to the gardens, swimming pools and golf courses that accompany quality tourism. Although tourism is a highly differentiated activity, these findings are significant to the growth of tourism in southwest Nicaragua that is trending towards low-density models. It is worth noting that these types of tourism developments market their ‘quality’ model as more sustainable and environmentally friendly than other forms of tourism, when in fact, little research seems to have been done on their behalf to warrant such claims.

**Water perceptions**

Signs, symbols, and even slogans often give insight into values and perceptions held by certain cultural groups. The global tourism industry has become adept at creating perceptions of certain spaces through the power of marketing (think of the slogan, “what happens in Vegas...”), which can lead to homogenous perceptions and expectations of particular landscapes (Dann, 2000; Pike, 2004). Although Nicaragua is known as a land of water and nature, the country is uniform neither in its...
landscape nor resources. Despite the fact that the southwest coast consists of dry-tropical forest and receives only a modest amount of average annual rainfall, tourism promotion for this region is overtly ‘green’ in its depiction and branding of pristine and verdant landscapes (Fig. 2). One particular tourism development has heavily marketed “Emerald Coast” as a moniker for this stretch of coastline even though the hills are completely brown during the five-month dry season.

Although this type of branding makes marketing sense in its appeal to tourists, the projection of ‘green’ obscures an alternate reality of this tourism hotspot where significant precipitation challenges exist. Website images, magazine advertisements, and billboards singularly portray the wet season version of the landscape, when everything is green and perceivably water friendly. (See Fig. 3 for a contrast between wet and dry seasons.) This projection then creates a fundamental lack of awareness of the hydrological challenges in this area and establishes expectations for green landscapes by visiting tourists. In turn, copious amounts of water (up to 65% of total daily usage) are required by tourism developments to provide tropical and green landscaping for homes and public spaces during the dry season that meet the expectation of owners and visitors.3 Even further amounts are necessary for water consumptive amenities such as golf courses. The disproportional demand and use of water for the golf course is visually illustrated in Fig. 3 by the stark difference between the green course and surrounding brown vegetation in the April image. (April is at the end of the dry season, while January is two months after the end of the wet season). This manufactured landscape has an estimated water demand of 1.7 million l per day in the dry season (QUENCA, 2011). Such water demand for green landscapes drives up business costs and further underscores the disproportional water usage by the tourism sector. Despite these common projections of green landscapes and adequate supplies of water, the tide is turning on perception of water availability and sustainability as many tourism operators are forced to alter their business plans in the face of inadequate water supply.

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3 Identity of developer has been left out to protect confidentiality.
Fig. 2. Selected examples of ‘green’ marketing for the southwest coast of Nicaragua. The term ‘Emerald Coast’ is a recent construction from the tourism sector that captures only a partial reality of dry tropical forests. Photos: Author.

Fig. 3. Contrast in wet and dry seasons, emphasizing the disparity of watered landscapes. Images of January (above) and April (below). Source: Google Earth.
Gigante’s water crisis

The sharp rise of tourism in the municipality of Tola in recent years has led to unpredictable pressures on water resources. Tourism developers use varying amounts of water to provide services to customers. Water is used in nearly every facet of service provided to tourists, including cleaning food (restaurants), cleaning boats (fishing charters), laundry service, showers, swimming pools, landscaping, and keeping golf courses green (to name a few). As recently as 2010, a report issued by the Center for Water Resources Investigations (CIRA) noted that tourism was growing in the region, but that plenty of water seemed available (Delgado, Calderón, Flores, & Salvatierra, 2010). Yet the combined growth of tourism and declining trend in precipitation since then has led to a reversal of perspective on water availability. In fact, many wells are running dry in Gigante. An inventory of empirically derived water levels in artisanal (hand dug) wells (n = 87) revealed that 42% were dry even after the onset of the 2015 rainy season, with an additional 43% approaching critical levels (Fig. 4).

Data loggers (n = 3) in drilled wells showed the longer trend of water table decline in recent years. Fig. 5 shows a negative change in hydraulic head for all three wells since the terminus of the 2013 rainy season. Interviews with well owners revealed unprecedented experiences—none had previously witnessed so many dry wells and nearly 80% acknowledged a growing sense of crisis over water. This crisis conflates a number of human and physical issues, namely rainfall variability, geology, proliferation of wells, and unsupported national water policy. Most people in the region of Tola depend on groundwater to sustain their lives and livelihood since perennial streams are few and in some locations, non-existent. Given this reliance on groundwater, geology and precipitation become controlling factors in the provisioning of water resources for locals and tourism developers, and only those with money and power can overcome these naturally limiting factors.

Rainfall regime

Nicaragua is home to three Köppen-Geiger climate types including fully humid equatorial (Af), monsoonal equatorial (Am), and winter dry equatorial (Aw). The study area belongs to the latter category, also known as dry–tropical forest, and is characterized by unevenly distributed rainfall and distinct wet and dry seasons. Nearly all of the average rainfall of 1450 mm occurs May to October, with the canícula (brief summer drought) breaking the rainy season in July. A portion of the current water crisis in Gigante results from below average rainfall in five of the past seven years (Fig. 6). Given the array of understandings of drought as a concept, it is worth noting its definition by Maliva and Missimer (2012, p. 27)

A drought can alternatively be broadly defined as a temporary, recurring reduction in the precipitation in an area. Key words are ‘temporary’, ‘reduction’ and ‘recurring’. The term ‘reduction’ implies that water levels are less than what are considered normal. The term ‘recurring’ signifies that droughts are a normal part of the climatic cycle. Droughts are thus not ‘abnormal’ events, but are rather low-end extremes in the normal variation in the overall water supply.

This manner of defining drought lends clarity to the recent below average rainfall years against the backdrop of tourism development. The 45-year rainfall record (Fig. 6) shows a periodicity of dry years; however, previous periods of reduced rainfall (drought) did not overlap with the growth of tourism as now seen along the southwest coast. Low population numbers and the absence of tourism driven water demand meant that local users could adapt to episodic lowered water tables. Such resiliency has now been weakened by uninformed tourism growth and many communities are now finding themselves in a state of water crisis.

Geology

Gigante lies in a watershed underlain by the Brito geological formation, a 2500m thick sedimentary sequence of shales, limestones, sandstones, siltstones, and mudstones, with pockets of volcanic breccias and tuffs (Arengi & Hodgson, 2000). The upper extent is mostly fine-grained sandstone with negligible porosity (<2%). Thus, groundwater movement within the aquifer is largely controlled by bedding planes and vertical fractures, making well productivity spatially variable and challenging to predict. Rainfall infiltration (i.e. groundwater recharge) is also constrained by the low permeability of surface rocks and material. Thus, heavier or more intense rainfall events result in excessive runoff to the ocean rather than meaningful contributions to aquifer recharge. Most of the wells in Gigante are manually dug and extend from 5 to 15 m below the surface to intersect the water table. These generally produce limited quantities of water (between 0.5 and 5 l/s) and can supply several households. Drilled wells are few in number and are owned by larger tourism developments or resident foreigners. These deeper wells (35–260 m) tap into the larger cross-section of the fracture network and typically produce greater volumes (up to 970 l/s), though they are susceptible to saltwater intrusion due to over-abstraction. In addition to rainfall and regional geology, anthropogenic factors also play a critical role in water availability.

Human geography of water crisis

Gigante’s growth as an attractive tourism destination has led to an increased number of tourism developments and an influx of Nicaraguans from other parts of the country seeking employment, opening businesses, or merely squatting on land to stake a claim in fishing or establishing ownership of land that might someday appreciate as the coast is further commodi-
tized. Collectively, this means an increase in water demand, as demonstrated by the proliferation of wells since 1990 (Fig. 7). Boutique hotels, restaurants, and new residences within gated communities continue to spring up in Gigante. Recent interviews with several tourism developers revealed plans to expand operations, which will inevitably lead to further demand for water. These developers are actively looking for ways to improve well productivity and for additional areas to drill new wells.

Water management around the world can be categorized by two end-member approaches—free market and government command and control. The latter approach is employed in Nicaragua through a robust and nuanced national water law (Law 620 of 2007) that established water as a public good and provided a framework for the state to ensure its role in social and environmental well-being and to protect against over-abstraction. The law empowers the National Water Authority (Autoridad Nacional del Agua, ANA) to manage national water resources and regulate allocation of water rights amongst users. In

Fig. 4. Well inventory from June 2015 revealing the relative quantity of water in Gigante wells. Minimum indicates less than 0.5 m remaining; Low indicates less than 1.0 m remaining. Sources: Author and Digital Globe imagery.

Fig. 5. Daily hydraulic head values for three drilled wells in Gigante indicating a ~4 m drop in the water table from 2013 to 2015. Source: author.
part, ANA’s mandate is to “prepare a water balance for each basin” and “propose management regulations for basins and aquifers” (Republic of Nicaragua, 2007, p. 20). These directives have yet to be implemented for any of the nation’s twenty-one water basins, thus rendering any notion of recharge quantities or safe-yield extractions for tourism development untenable. Without such guiding data or government regulatory oversight, tourism developers are merely poking straws in the ground until they find sufficient quantities of water to suit perceived needs. This uninformed manner of water abstraction puts tourism developers at risk of untenable business, or worse, saltwater intrusion from over pumping. The absence of sustainable water management from the tourism industry then puts local populations at risk as declining water tables fall below their capacity to manually dig wells. Hand dug wells in this area are typically no more than 15 m deep due to the physical challenges incurred by excavators. Moreover, any deepening of wells is costly to well owners. During the 2015 dry season, most locals were forced to deepen wells, paying local well diggers US$20 a day for their work. Typically, a deepened well requires two diggers working over two days at a cost of US$80 to the well owner. This represents a significant financial strain on local households given the average monthly salary of US$160-$200 per month.

Returning to the issue of the national water law, Novo and Garrido (2010) noted that Law No 620 has great potential to reach its stated goals, but as of yet has no practical success of solving water conflicts due to the barriers of “transaction costs of inter-institutional coordination, information gathering, property rights protection and enforcement, and strategic costs” (p. v). Thus, water conflicts in Gigante and other areas undergoing rapid tourism development along the Pacific coast reflect a gap between policy intent and successful water management. Left unattended, this gap translates to deleterious consequences for all stakeholders.
Water struggles and consequences

The current water crisis induced by increased demand, decreased supply, and ineffective water laws has very real consequences for both local populations and tourism developers. It can be argued that social stratification occurs in Gigante around water access, regardless of nationality. Those with financial means have power to ‘grab’ water (Mehta, Veldwisch, & Franco, 2012) through larger pumps, deeper wells, or simply freedom to range further from home to meet their water needs. Those without power are forced to survive on substandard levels by using less, and often brackish water. This imbalance in turn leads to health risks and further disparity.

The term water ‘grabbing’ is appropriate to describe the activity of securing water in Gigante since groundwater functions as a common property regime and consumption by one individual reduces the amount available for other consumers. Further, groundwater has a non-exclusive quality in that it is impossible, or very costly, to exclude additional users. Given that no water budget or safe-yield has yet been established by ANA for the Gigante area water basin, nothing guides or constrains actors from grabbing water they deem necessary. Several examples are worth noting to illustrate power differential and the marginalization effect of water grabbing.

One of Gigante’s two public wells adequately supplied residents with cleaning and cooking water for the entire 30-year history of the town. Laundry was cleaned at the well and water was drawn and carried by hand to nearby homes. In 2013, a tourism operator began pumping and hauling 10,000 l per day to clean charter-fishing boats. Within two months the once reliable public well dried up and remains unusable to date. The tourism operator then began pumping from the remaining public well. After several months of similar abstraction, owners of nearby wells reported increased salinity in their family wells from seawater intrusion. Presently, six of these wells are unusable for potable water sources (Fig. 8).

Returning to the narrative introduced at the beginning of this paper, some forms of water grabbing are more obscure, but just as impactful on water security. The example previously mentioned involved a tourism surf lodge that purchased a four-meter by four-meter parcel of land adjacent to historically productive wells in order to secure their water needs. However, they dug deeper and installed a larger pump with no regard or understanding for the impact it might have on the local population in the vicinity. This increased abstraction, coupled with decreased recharge has coincided with the drying of the adjacent well, leaving others to now scramble for water. A similar scenario unfolded when another small tourism operator purchased a sliver of land (4 m × 10 m) amidst homes and wells and dug a 28-meter artisanal well, largely with the aid of expensive air hammer tools unavailable to locals. Shortly after pumping from the well, adjacent users complained to the tourism developer that their wells were dry. In describing the incident, the developer’s initial (and limited) reaction was merely “I felt like I stole their water.” Again, the lack of understanding of groundwater movement by tourism developers and absence of water budgets from ANA creates a scramble for water resources that discriminates against those without power or economic means. As one local put it, “There is no more water anywhere, and the poor people are the ones who suffer.”

Further to this point, residents living near the golf course installed in 2011 reported that once reliable family wells are now perennially dry. One resident reported that he approached the luxury resort owning the golf course to request they deliver water to compensate for his dry well. When they refused, he threatened to take the story to a prominent newspaper. This prospect of negative exposure forced the resort to capitulate and now they deliver water to all proximate owners of dry wells. While it is difficult to disentangle the impacts of tourism abstraction from the current hydrological drought, the estimated dry season requirement of 1.7 million l per day for the golf course (QUENCA, 2011) undoubtedly plays a contributing role in the drying of artisanal wells. In the eyes of locals, it is THE cause of their dry wells.

For tourism developers

The current water crisis has very real consequences for tourism developers also, though the impacts are non-uniform since economic and political power varies amongst stakeholders. Again, those with less power (politically or economically) are at the mercy of other more powerful actors and often end up in the ‘loser’ category with local populations. This outcome can be seen when small tourism developments, relying on shallow hand dug wells, have been forced to haul water from public sources or drill costly new wells. Some small tourist operations must make do with using brackish water for most of their needs and buying costly delivered water to meet potable demands. Other, larger developments, express growing concerns about encroachment as they watch others scramble for new locations to drill wells. Without proper studies, nothing prevents new users from installing wells that negatively impact adjacent wells. Of greater concern for tourism developers is the issue of saltwater intrusion. Spatially concentrated and over-pumped wells in coastal environments can easily alter the natural groundwater flow equilibrium and pull the freshwater-saltwater interface inland. Again, without adequate studies to determine sustainable yields, it is too easy for a few users to over-abstract and negatively affect all other users.

4 Personal interview, June 3, 2015.
5 Personal interview, March 23, 2015. (Author’s translation).
Ultimately, much of the water crises hinges on unimplemented national water laws and policy in the face of tourism growth and current cycle of drought. The national agenda to promote tourism as a tool for economic growth has resulted in increased tourism growth and concomitant water consumption in geographical areas with little to no understanding of aquifer dynamics and provisioning capacity. This deficiency is the unfortunate outfall of the inability of ANA to produce a comprehensive water plan as mandated by Law 620 in 2007. Ultimately, the blame of the water crisis can be ascribed to this gap between policy and implementation. Functionally, this means well-intentioned policy remains on paper in government offices and has no real bearing on how water is planned or used in the field. Most tourism developers have little to no background in water prospecting or management, so are forced to figure it out as they go. One tourism operator went so far as to say, “I’m a businessman, I don’t have the time to deal with this.” Most developers are going about business as usual, hoping for a break in the drought and guessing that their demands for water fall within the capacity of the aquifer(s) to provide. Without a proper water budget for relevant water basins, tourism developers are unsupported and unaccountable to the government to develop an informed water budget for their respective needs.

However, some alleviation to the water crisis is being found via management initiatives as the recent drought trend has caused some tourism developers to proactively examine water usage and take steps towards conservation. In part, this has taken the form of small placards and signs in restaurants or hostels to remind tourists to save water. The largest conservation impact has been realized through installing water meters on individual houses in most of the gated communities around Gigante. This strategy has brought much needed realization to homeowners of the amount of water being used (often on landscaping), as well as incentivized the pinpointing and remediation of leaking pipes. Several of the gated communities have implemented tiered tariffs, thereby economically discouraging heavier demands for water. To further decrease their water footprint, one gated community is actively replanting water intensive landscaping with plants that use less water, yet still provide color and variation to the seasonally brown hillsides. Only one development in this study indicated a willingness to invest financial resources for a proper hydrological study to determine the balance between their water demands and aquifer water supply. It is worth noting that tourism developers largely operate on their own, with little to no communication or sharing of best practices amongst each other. To facilitate a modicum of exchange, research results were shared with all tourism developers at various stages of the study. This dissemination led to or promoted most of the water management initiatives mentioned above.

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6 Personal interview, June 3, 2015.
Each of the measures mentioned above are necessary for productive and equitable tourism, yet can often be costly and do not exclude others from disproportionate usage. The larger factor in the water crisis is undoubtedly the role of government and its inability to provide informed support and constraint to water management schemes. Other water scarce global tourism destinations faced with rising consumption have taken steps towards sustainability through various management related schemes and provide helpful examples for the Nicaraguan government and tourism developers to follow (Kelly & Williams, 2007). Some of these could be modified or directly implemented in the Gigante area. Kent, Newnham, and Essex (2002) described a solution for the Balearic Islands whereby a government imposed ecotax would generate revenue to be used towards evaluating water supply, guiding water management based on supply, and educating both residents and tourists in careful water use. In that context, a 'tourism' tax was conceived to support the efforts of the government in providing oversight to water management and education. A similar tourism tax in Nicaragua could fund education and research on water in collaboration with tourism developers in high growth and under water-resource areas like the southwest coast. In addition to funding research to establish safe yields for groundwater abstraction, the fund could provide sustainability education (e.g. best practices) to tourism developers and foster equitable relationship between local communities and developers interested in corporate social responsibility. Once water budgets are established for respective water basins, other creative efforts can be used to support equitable and sustainable tourism.

Cashman and Moore (2012) noted a tradable permit system for hotels in Barbados based on assigned water rights. In such a scheme, an overall water budget is created to determine the amount of water sustainably available to all stakeholders. Allocations are then made to tourism developers in a prioritized fashion that reflects governmental economic development goals and established presence of developers. These ‘water rights’ thus set and cap total water usage by tourism developers and would encourage an increase in efficiency by developers wishing to expand their business. Further credits could be granted to tourism developments implementing water-saving technologies. Such an approach would allow for both economic development vis-à-vis tourism and equitable consideration of the water needs for local populations. Ultimately, a portfolio of management methods is necessary for water security and equity amongst stakeholders, though the primary barrier moving forward is the conspicuous lack of understanding and assessment of water supply vs. demand. Until a water budget is established for those water basins effected by tourism growth, national water policy is unenforceable by the government.

Conclusion

This paper traced the global growth of tourism to the local context of Gigante, where all users are reliant on groundwater. Although southwest Nicaragua receives more precipitation than other global high-density tourist destinations, its complex geology quite often limits the full usage of precipitation as recharge. Declining water tables over the past four years constitute an important signal that water abstraction is exceeding aquifer(s) capacity. The ensuing struggles over water and their unequal outcomes are the result of unsustainable tourism development, recent drought, and unsupported water laws and policy. These struggles were captured through a political ecology lens that scrutinized linkages between politics, economics, and ecology. Following in the steps of Stonich (1998), Gössling (2001), and Cole (2012, 2014), the paper makes a valuable contribution to the gap in research on the tourism-water nexus. Further, it contributes to general political ecology literature by offering rigorous ecological knowledge in its assessment and counters assertions from Bassett and Zimmerer that the field of political ecology is essentially “politics with ecology” (2004, p. 103).

Several conclusions for tourism developers and policy makers can be drawn from the details of this research. First, tourism is expected to grow at a global level and in emerging destinations such as Nicaragua. Economic challenges facing Nicaragua has led to a prioritizing of tourism to generate jobs and economic growth. This puts Nicaragua into the political economy of tourism, thereby subjecting itself to the demands of global capitalistic markets and normative expectations of tourism. The tourism literature shows that arrivals from ‘developed’ countries use a much larger percentage of water than local users, resulting in a strain on local populations and environments in water scarce settings. It is evident that tourism is already impacting water resources in the Gigante area. This pressure on groundwater is anticipated to increase given recent advertising for this area of Nicaragua’s Pacific Coast in prominent international surf, outdoor, golfing, in-flight magazines, and travel sections of newspapers like the New York Times. Its appeal as an “undiscovered luxury beach destination for billionaires and celebrities” (Dobson, 2015) is further enhanced by the opening of a new regional airport able to accommodate Gulf-stream jets. This increased visibility and accessibility will likely translate to increased tourism visits and an array of interest in growing tourism development.

Second, this study provides physical evidence of a water crisis as local consumption has outpaced supply. Tourism driven groundwater abstraction and diminished rainfall in four of the past six years has resulted in lowered groundwater tables and in some cases seawater contamination. Although the national water law requires a water budget for each water basin, none have been completed to date and virtually no technical information exists to inform sustainable abstraction rates.

Finally, this study concludes that the gap between national water policy and implementation has opened the door for water ‘grabbing’ by those with power, whereby the poor are marginalized through lack of access, or control of the benefits of water. When wells run dry, or become contaminated, local populations must walk further to wells with sufficient water supply. This compounding of work for daily water needs inevitably leads to greater cost, or diminished use of water and subsequent potential health risks. Further, accessing reliable sources of groundwater adds considerable stress and expenses for tourism enterprises using deeper and often distant wells to meet their ever-growing demands. The success of these busi-
noses, reliant upon steady water supply, has direct implications on jobs and livelihoods for local populations. Until water budgets are proposed for water basins, poor water management by tourism operators may result in the failure of their operations and simultaneously the creation of a class of losers—the original and less powerful members of this coastal community.

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