



The impacts of tourism development on perceptions and practices of sustainable wastewater management on the Placencia Peninsula, Belize

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ARTICLE INFO

Article history:

Received 3 December 2013

Received in revised form

31 May 2014

Accepted 19 August 2014

Available online xxx

Keywords:

Tourism development

Sustainable wastewater management

Resource recovery

Water-energy nexus

Ethnographic research

Belize

ABSTRACT

One of the consequences of rapid tourism expansion is abrupt pressure on local keystone resources such as water and energy. While novel wastewater technologies have been designed to close resource cycles and thereby diminish resource stress, little research has been undertaken to assess the coupled social, economic, and ecological components of system sustainability and resiliency in these areas. As a result, local decision makers often lack scientific information needed for making evidence-based and context-sensitive choices about new technologies. Involved stakeholders also lack resources to develop appropriate interventions to address human-environmental changes and unintended consequences. This article employs a grounded approach to sociocultural data analysis to critically examine how human perceptions and practices related to water, wastewater, and energy management in a rapidly growing tourist destination on the coast of Belize enable and constrain decision making with regard to technology adoption. Ethnographic research on the Placencia Peninsula in Belize focused on discerning perceptions of acceptability for the recovery of resources such as energy and nutrients from wastewater, local perceptions of health risks and benefits of such recovery, as well as how economic and environmental advantages of these processes intersect with local demands. Research reveals that local understandings are grounded in cultural practices, historical events and processes, contemporary political and economic issues, and variable awareness of environmental change. This study also reveals that the greatest barriers to the adoption and sustainability of new technologies include sharing technical and economic information broadly and providing opportunities for legitimate multilevel stakeholder participation in decision-making processes.

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1. Introduction

Water is a vital component of tourism and tourism-related development, playing a key role in consumption practices of hospitality industries, commercial and industrial processes, transportation infrastructure, human health, and ecosystem services, among other domains (UNEP, 2003; Gössling et al., 2012). The United Nations Commission on Sustainable Development (2012) reports that, in many locations, seasonal influx of tourists can more than double demand for potable water and can create punctuated and acute challenges for managing wastewater and

sanitation. In recognition of the importance of sustainable management of water and wastewater for tourism, in 2009 the United Nations World Tourism Organization (UNWTO) joined UN-Water, an inter-agency mechanism of the UN dedicated to building capacity for member nations to address water and sanitation challenges (WHO, 2012). More recently, in support of the UN International Year of Water Cooperation, the UNWTO organized its 2013 World Tourism Day program under the theme, "Tourism and Water: Protecting our Common Future." The goal of this effort was to draw greater attention to tourism's potential role in contributing to more sustainable water management infrastructure (UNWTO, 2013).

Sustainable management of water and wastewater is especially important in coastal areas and small islands, where tourism development is becoming increasingly concentrated (UNWTO,

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2012; WHO/UNICEF, 2013). In these contexts, potable water is typically scarce and wastewater management is poorly developed (UNWTO, 2011). While new technologies and organizational systems have emerged recently to address water and sanitation in community contexts more broadly (e.g. Antakyali et al., 2008; Gikas and Tchobanoglous, 2009; Guest et al., 2009; Massoud et al., 2009; Fam and Mitchell, 2013; Verbyla et al., 2013), little empirical research has been done to assess the long-term sustainability of these approaches (Hoffmann et al., 2000; Balkema et al., 2002; Goen, 2003; Muga and Mihelcic, 2008). The result is that local actors have limited evidence for predicting resource demands by tourists, and even less information for creating interventions to guide tourist behavior and mitigate adverse impacts on social-ecological systems (Cooper, 2011). Therefore, one of the greatest challenges to evaluating the efficacy of new approaches to wastewater management is understanding the social and cultural contexts in which innovations are developed and deployed (e.g. Tsagarakis et al., 2001; Kontogianni et al., 2003; Orhon et al., 2011; Utarasakul, 2012). Recent research in anthropology and the social sciences has demonstrated the value of cultural analysis for modeling the ways and extent to which engineered systems can be adopted and adapted to local social, economic, and environmental settings across different scales: household, community, and watershed (Whiteford and Whiteford, 2005; Orlove and Caton, 2010; Stroud, 2011; Johnston et al., 2012; Cairns, 2014).

In this article, we use field-based sociocultural data collection and analysis to examine how human perceptions and practices related to water and wastewater management impact coastal health and livelihoods in tourism-dependent economies in the Caribbean. We focus our discussion on our research on the Placencia Peninsula of Belize, which has experienced dramatic growth in the tourism industry after Hurricane Iris devastated the region in 2001. Belize is a small country about the size of the U.S. state of Connecticut with a population of 350,000, and is situated at the intersection of the Caribbean and Central America. Its cultural and linguistic heritage reflects strong influences from both regions as well as from its status as a former British colony until independence in 1981. Particularly since Hurricane Iris, the communities that occupy the peninsula have emerged as a 'development corridor' with tourism, transportation, and residential expansion seeking to be resilient to future climate threats such as increasing storm surge and sea level rise (Key, 2002). Concerns about wastewater collection, treatment, and management have been raised by various stakeholders in response to this rapid development, especially with regard to nutrient loading and pathogen contamination of the 24 km-long tidal lagoon that edges the western side of the peninsula and serves as the foundation for current and proposed tourism (Boles et al., 2011). Partially treated wastewater released from aging domestic and hotel on-site systems (primarily septic tanks) along with untreated effluent from commercial aquaculture have contributed to eutrophication and the formation of phytoplankton blooms in the lagoon, which negatively impact ecosystem services, marine tourism, and fishing industries (Ariola, 2003). These coupled social-economic-environmental issues threaten to become exacerbated since the recent approval of a plan for the development of "niche" or "pocket" cruise tourism (a form of mass tourism) on the peninsula, anchored at Harvest Caye (located a few kilometers off shore) that was recently acquired by Norwegian Cruise Lines (The Guardian-Belize, 2014).

To address the need for a comprehensive wastewater management system in the area, the Government of Belize recently received \$10 million from the Inter-American Development Bank to design and install a sustainable wastewater collection, treatment, and disposal facility to be managed by the private-sector utility Belize Water Services Limited (GEF CREW, 2012). Our research

(funded by the U.S. National Science Foundation) explores the ways and extent to which local village governing councils, environmental non-governmental organizations (NGOs), tourism associations, and other community stakeholders are involved in this process, as well as their beliefs about potential costs and benefits to the economy, the environment, and their livelihoods. An ongoing effort of the project is to assess local groups' interest in reclaiming and reusing water, nutrients, and energy from the proposed wastewater system. Thus, our intent in this article is to consider what the Belize case study has to offer in terms of recommendations for tourism-dependent communities that are considering the adoption of new resource recovery technologies. The greater goal of our research is to better understand how more sustainable management of wastewater enables and constrains relationships between tourism, ecosystem health, local livelihoods, and human wellbeing.

2. Cultural context in the analysis of wastewater management and resource recovery

Our broad research aims align with efforts designed to inform integrated wastewater resource recovery management frameworks (Cosgrove and Rijsberman, 2000), where solutions are viewed holistically and integrate local knowledge systems and stakeholders in decision-making processes. In this way, our research draws on theoretical insights from recent critical anthropological approaches to tourism (Lyon and Wells, 2012), development (Escobar, 2011), policy (Shore et al., 2011), and sustainability (Moran, 2010). Here, we address four overarching and interrelated research questions related to this effort: (1) What are the cultural perceptions of acceptability for the recovery of energy and nutrients from wastewater, and how might the introduction of new resource recovery technologies impact these perceptions?, (2) What are local perceptions of health risks and benefits in using outputs generated from resource recovery technologies (e.g. anaerobic digesters and algal-based facultative lagoons), including biogas and water with dissolved nutrients?, (3) How do the economic and environmental advantages of energy, water, and nutrient recovery from wastewater systems intersect with local demand for sanitation and energy coverage?, and (4) What can cultural analyses of local wastewater management institutions suggest about the potential for successful adoption and long-term sustainability of new technologies that exploit the water-energy nexus?

The first two research questions concern household perceptions and practices. Research has shown that water and wastewater are perceived differently across populations, and that they hold alternative meanings for different groups (Limbert, 2001; Wilk, 2006; Orlove and Caton, 2010). People use locally derived, cultural understandings about the biophysical environment to make sense of water and waste and what they believe is culturally acceptable environmental behavior in managing these materials (Whiteford, 1997; Wells and Davis-Salazar, 2008; Zarger, 1998, 2009; Whiteford et al., 2014). For instance, negotiation and contention about the meanings and values placed on wastewater along gender, class, and ethnic lines fundamentally impacts how water is managed at the local level (Ilahiane, 2001; Izugbara and Umoh, 2005; Zarger et al., 2009). People also often evaluate perceived risks and benefits of new technologies or strategies against their cultural models, especially with respect to the use, management, and meaning of scarce resources such as water (Whiteford and Whiteford, 2005; Whiteford and Vindrola Padros, 2011). For chemical substances associated with resource recovery technologies, including biogas and fertilizers, health concerns can be especially paramount for risk assessment (Whiteford, 1999; Boholm, 2003; Lipson, 2004).

The second two research questions concern broader economic and institutional strategies and responses. In many communities in

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