PERCEPTIONS OF WATER QUALITY IN CUBA AS REPORTED BY USERS: PRELIMINARY FINDINGS OF THE CUBA WATER PROJECT

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INTRODUCTION

Potable water is indispensable to sustain human life. Throughout history, water has played a strategic role in promoting nation-building. During the Spanish Reconquista, for instance, Spanish forces manipulated water supply in Andalusia to secure a Moorish surrender and consolidate Spanish rule. As Havana grew to be one of the most important strategic ports for the Spanish empire, water supply caused a major administrative fiasco for the city council when a tax was issued to finance a public works project that would supply the city, and its profitable economic activity, with sufficient water from the Almendares River (Segre, Coyula, and Scarpaci, 1999, 16–17).

Water is considered a contested commodity when it comes to measure how nation-states develop and the extent to which they manage to nurse decent lifestyle standards for their inhabitants. In this sense, the availability of drinking water is another measure of balance for national development. The complex relationship between water and development is the subject of the latest annual UN *World Water Development Report*. Whether one considers the environmental impact, amount of economic activity, or the probability of population displacement, the 2016 report estimates that, "The total cost of water insecurity to the global economy is estimated at US$500 billion annually" (UNESCO, 2016, 5).

In the case of Cuba, the connection between water and development policies takes an even more fascinating dimension. Cuba is in the midst of reinserting its economy into global markets; to accomplish that goal, Cuban officials have chosen to engage foreign direct investment in their development strategy and the availability of fresh water is a significant consideration of business investment. Opportunities to improve water infrastructure constitute another investment area the Cuban government needs to consider. Foreign investment is likely to increase demand for water and could further compromise the distribution of fresh water to the over 11 million Cuban people. Perhaps more significant are the potential political repercussions of Cuba's national hydro policies. The new political discourse of openness and recent demands for more accountability associated with the new relationships between the island and its potential partners could uncover not just the extent of the decaying infrastructure and its impact on public health, but also any arbitrary public policy decisions and resource allocations that might have contributed to the deterioration of the water quality. Cuban officials concede that the country's hydraulic infrastructure is aging and in poor condition and that water distribu-

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tion is inadequate in Cuban cities. But the officials insist that the cause of these problems is a shortage of international financing (Arellano Acosta, 2006).

The purpose of this paper is to summarize the main findings of an ongoing research project that examines the state and availability of drinking water and ambient water throughout Cuba. The initial drive for the project began in the summer of 2015 out of concerns for the lack of reliable national studies on water conditions on the island. While international institutions and a score of Cuban official sources report that affordable access to drinkable water in Cuba reaches 94 percent of the population (Arellano Acosta, 2006), our study is motivated by anecdotal information from recent travelers to Cuba and from family, friends, and acquaintances who live in Cuba about a lack of water availability and concerns of illness from consuming contaminated water in Cuba.

We consider a national water study like the one presented here to be particularly relevant given Cuba's renewed relations with the business community, the incremental path to economic reforms, and a 14 percent jump in tourism in 2014, compared with the previous year. (The Guardian, 2015.) Many studies on Cuban water concentrate on the capital city of Havana. Other studies look at conditions nationally but rely on official statistics (Donoso, 2012 and Cueto, 2014).

Our study takes a different approach. Following the direction set by audience research and software end-user evaluation projects, we gathered data directly from consumers, Cubans and others arriving at Miami International Airport from the island and relatives, friends and acquaintances who visited the island less than a year before taking our survey. In short, our findings do not derive from official sources, but from self-reported data collected via surveys and structured interviews. We are not conducting archival research. Ours is a convenience national sample that captures data from throughout the island from Cubans and from visitors to Cuba. Our goal is to complete 600 questionnaires and a score of in-depth, personal interviews with a rigorous and systematic methodological approach.

METHODOLOGY

Since the conception of the project, the goal was to involve water consumers in the study. We assume that consumers provide rich and fresh data about their experiences. Official data always runs the risk associated with under-reporting specific experiences and political manipulation. Given the vulnerabilities and sensitivities associated with collecting water samples throughout the island, not to mention the cost of conducting such field enterprise, asking consumers (travelers) to evaluate their own experiences was the most practical and feasible research strategy. Another reason for this approach is that the Cuban government consistently denies requests from academics and independent organizations from the United States to conduct surveys in Cuba and therefore it is not possible to survey consumers in Cuba as we were able to do in Miami.

The community-based approach implemented through the Cuba Water project serves as a first step in a potentially larger scale study by which perceptions are documented quantitatively through field studies and water quality measurements. It helps to identify key needs as perceived by community members to guide further studies that address water availability and water quality concerns. If we motivate other researchers to further investigate hydro and environmental policies and programs in Cuba, one of our goals would be satisfied.

The project implementation follows the typical phases of a field research project. In the summer of 2015 Drs. Pumar and Solo-Gabriele, in consultation with our colleague and collaborator Professor Joseph B. Treaster, wrote the project proposal describing the overall goals and strategy behind the study. This initial proposal was funded through a generous grant from the Center for International Business Education and Research (CIBER) at the University of Miami School of Business. Later Professor Treaster took the lead to secure additional funding through a second grant from the Center for Communication, Culture and Change at the University of Miami's School of Communication. This combined funding, although modest, has enabled us to move from the

conceptualization stage to the implementation phase of the project.

Implementation has included the development of a 28-question survey designed to ask recent travelers about their perceptions of water availability and quality. The survey asked travelers the purpose of their travel to Cuba and the places they visited (number of questions, n= 8), the type of drinking water they consumed and their perceptions about its quality based upon aesthetics and its potential for causing illness (n=4), the availability of tap water and the use of cisterns (n=6), their impressions of ambient waters such as rivers, lakes and beach water (n=5), and their perceived causes of poor water availability and quality and possible mitigation strategies to improve the drinking water supply (n=5). Questions were stratified with sub-questions depending upon the initial responses received to obtain more detail about the participant's perception. In addition to the 28 main questions, there were open-ended narrative questions and questions about the demographics of the participants. In addition to the structured interviews, we gathered several open ended comments and testimonies about the water quality by users who either live in Cuba or recently traveled there. We will be analyzing our qualitative data and presenting it in a future paper.

The survey was approved by The University of Miami Internal Review Board (IRB #: 20150691) and the researchers obtained the written approval of the authorities at Miami International Airport to conduct the survey at the airport. The survey was tested with travelers at the airport, modified, and resubmitted for IRB review (IRB#: 20150691 (MOD00011140)). As approved by the IRB, participants must be at least 18 years old and must have resided or visited Cuba within one year of taking part in the survey. To implement the study the faculty team assembled a group of University of Miami students and recent graduates. They mainly met people arriving in Miami from Cuba at the airport and administered the survey. They and members of the faculty also administered the survey in other places in Miami to people who had been in Cuba within the last year.

Thus far, the research team's work has focused on data collection. But the team has begun work on building a bilingual website to disseminate its findings, to present instructions on how to hygienically store and treat drinking water for safe consumption, to provide research, news and case studies on the improvement of water quality and household sanitation around the world and to provide a platform for discussion on water quality and household sanitation issues. The website is being developed to deliver water quality and household sanitation messages visually and verbally and will incorporate interactive social media tools.

LITERATURE REVIEW: VIEWS ABOUT CUBA'S WATER

Studies published in the peer-reviewed and gray literature indicate that the drinking water and wastewater infrastructure of Cuba is in need of repair and upgrades (Cereijo, 1992, Solo-Gabriele and Perez, 2008, Perez et al., 2009, Cueto and De Leon, 2010, Cereijo and Solo-Gabriele, 2011). In many cases, deficiencies in the infrastructure have been documented by professionals working for the Cuban government. In one example discussed, the failure of the San Pedro Pumping Station led to contamination from fecal bacteria and nutrients upstream of Havana's main water supply (Artiles Egües and Gutiérrez Díaz, 1997, Alonso Hernández and Mon, 1996 and reconfirmed by Ortega-Castineiras et al., 2009).

A lack of industrial pollution control has caused degradation of the environment. Metal contamination of land and industrial run-off into rivers and canals upstream of water supplies has been reported in connection with the Antillana de Acero plant in Havana (Olivares-Rieumont et al., 2005). Electricity plants and automobiles have been releasing nitrous and sulfur oxides in Cuba, resulting in acid rain. Pesticides and effluent discharges from beer makers and paper mills have been polluting waterways (Alonso-Hernandez et al., 2014). Mining operations on the Isle of Youth (Toujaguez et al., 2013) and in Nipe Bay on the northern coast of Cuba have caused heavy metal contamination.

Some reports have underscored maintenance problems. For example, the drinking water system suffers

from leaks that drain off half the intended water flow. Water pressure is low because of a shortage of water and of electric power outages. The result is that contaminated ambient water enters the distribution system. The wastewater system is being overwhelmed by population growth. The Central wastewater collection system was designed for use by 600,000 people; now 900,000 people are depending on it. Tourism and the likelihood of a tourism boom in coming years can only exacerbate the strain on wastewater facilities. Already, many sewer lines need repairs. Many pipes from water treatment plants are simply not functioning (Olivares-Rieumont et al., 2005). Discharge of effluents is inadequate. In some cases, wastewater is discharged without treatment. An example is the city of Cotorro (Ortega-Castineiras et al., 2009). In other cases, poorly treated wastewater is discharged through pipes that spew sewage a short distance offshore, contaminating beaches. The Almendares River is one of many contaminated rivers in Cuba. It is particularly significant because the Almendares is one of the sources of drinking water for Havana. The karst that is a predomint feature of Cuba's geology makes the water supply particularly vulnerable (Cuevas-Ojeda et al., 2011, Peralta Vital et al., 2005). It is estimated that 80 percent of the country's water comes from karstic areas. The surface waters in these areas must be kept clean—which is often not the case—because they flow into the groundwater supplies of drinking water (Farfán et al., 2014). Cuba's water in and around Havana and Cienfuegos has also reportedly been contaminated with polyaromatic hydrocarbons. (Santana et al., 2015, Tolosa et al., 2014). Studies of waterways in Havana have shown evidence of antibiotic resistant organisms (Graham et al., 2011, Knapp et al., 2012).

These sources paint a picture of a Cuba in grave need of improvement in the quality of its drinking water and household sanitation. This is in sharp contrast to reports based on Cuban government data and published by the influential public health units of the United Nations, the World Health Organization (WHO) and the Pan American Health Organization (PAHO). These reports, relying on government data, show Cuba to be providing drinking water and household sanitation at a level comparable to that of the United States and the highest performing countries of Europe and Asia.

It was these dramatically different scenarios that drove us to begin our research on the quality of drinking water and household sanitation in Cuba. Which of the scenarios reflect reality? Was Cuba a place where drinking water and household sanitation were the envy of much of the world? Or were Cubans living in a country that compared most closely with some of the world's poorest nations, places where, in order to even have a chance at good health, families had to boil their tap water, provide their own water storage tanks and build outdoor toilets that simply accumulated waste—sometimes near ground water sources?

According to PAHO's annual report, in 2011, 94 percent of Cuba's population received drinking water from improved sources—meaning water treated in some way and provided through pipes. It said that three years earlier, in 2008, 91 percent of the Cuban people were connected to sewage systems. The Cuban government's target for coverage by 2017 (WHO, 2016) is 98.2 percent for improved drinking water and 97.6 percent for improved sanitary sewerage. In contrast, the independent studies suggest that the quality of drinking water is low and in all probability contributes to disease transmission. The independent studies were conducted more than a decade ago and that was one of our motivations: We felt that up-to-date, independent information on the quality of drinking water in Cuba was critically needed.

Table 1. Access to Improved Drinking Water and Sanitary Facilities by Percent of the Population

	Drinking Water		Sanitation Facilities	
	2008[a]	2017 Goals[b]	2008[a]	2017 Goals[b]
Urban	96	98.5	94	99
Rural	89	97	81	93
Totals	94	98.2[c]	91	97.6

a. PAHO 2011.
b. WHO 2016.
c. Computed value based upon a 77 percent urban population using proportions in 2008.

DATA PRESENTATION AND ANALYSIS

The data presented in our study derives from surveys collected between January and August 2016 after expending considerable time perfecting the research design phase of our study. We have collected 346 surveys or 58 percent of our target of 600[2]. The picture that our data presents of the quality of water throughout the island could not be more disheartening. Our findings tend to confirm what seems to be a general consensus regarding drinking water in Cuba. One Internet travel site (TripAdvisor, 2016) that promotes tourism to Cuba carries comments from travelers warning about the poor quality of drinking water in Cuba. Here are some of the comments:

> "I would not recommend that you drink water from the tap anywhere in Cuba. It's OK to brush your teeth with and if boiled. Stick to drinking bottled water which is safe, but always check that the seal is intact."
>
> "The water in resorts and better hotels should be fine—in general it is not a problem with the water but the pipes and storage."
>
> "As B says, best to stay with bottled, but tap water will not kill you—but might upset your stomach."
>
> "Would you like to spoil your vacations with an upset stomach...I mean one that can drive you to the hospital? I don't think so. When I go to Cuba I only drink bottle water, always checking if the seal is intact...and I even brush with bottle water...and, of course, no ice cubes in the drink. Play it safe."
>
> "Yes stick to bottled water. I always had bottled water but brushed with tap water & had an annoying niggle in my stomach for the 1st week which put a dampener on everything & mild bowel problems. I stopped brushing with tap water & my stomach bug cleared up in 2 days."

Some of the travelers commenting on the Internet outlined three additional problems worth exploring: (1) a lack of trust in the quality of the public water supply; (2) the impact of unsafe drinking water on travel plans; and (3) doubts about the integrity of bottled water. Some wondered whether it was safe to use tap water for brushing teeth. Some recommended checking to see if seals on bottled water had been tampered with. In any other country, suggesting to check the seals on bottled water might be regarded as a cautionary tale against malicious intents. In Cuba, however, the persistent apprehension about the integrity of water bottles takes on a political economy dimension and is symbolic of the widespread modification of water in the unregulated informal or secondary economy, a growing sector in which practically all corners of society engage to earn supplemental income to acquire very basic needs. In 2013, Richard E. Feinberg (2013, p.2) estimated that as much of as 20 percent of the 5.1 million work force was self-employed. Renewed social inequalities brought about by a combination of booming self-employment activities and tourist industry activities and salary structures tightly controlled by the state paradoxically increase the dependence on parallel economic transactions. In a paper published in *Cuba in Transition* in 2005, the Canadian economist Archibald Ritter, a well-known expert on the island's economy, identifies four parallel spheres in the Cuban economy: (1) the household economy; (2) the formal economy; (3) the underground economy; and (4) the criminal economy involving illicit activities (Ritter, 2005). It is worth noting that of his four categories, only one is consistently regulated.

Surprisingly, the abundant calls for caution regarding contaminated drinking and recreational water has not reduced the flow of tourists, the number of Cuban visitors, or Cuba's steady reliance on tourism. A recent study by the World Travel and Tourism Council (2015) estimated that in 2014, the total contribution by tourism to the island's GDP was 10.4 percent and was expected to rise 3.7 percent in coming years. Exports derived from the industry amounted to 15.9 percent in 2014 and was expected to increase by another 5 percent in 2015. The report said that travel and tourism represented 15.15 percent of total investment in 2014 and projected an increase of 5.1 percent over the next 10 years. The World Travel and Tourism Council said that it expected 3.1 million international visitors in 2015 and 4.8 million by 2025. These figures ranked Cuba 67th among all nations in absolute importance of travel

2. The paper was drafted in August 2016.

and tourism for economic growth and 81st in long-term growth. The tourism data suggests another incentive for providing quality drinking water and household sanitation.

We are presenting our data according to the following variables: population demographics, state of Cuban water, social and public health impact, and recommendations for the future. We disaggregate all the data, except the demographics of the participant population, according to whether survey respondents stayed in hotels or with relatives. We follow this approach to document the two-sided reality of everyday life in the island among the most and less privileged.

Demographic Profile

The overwhelming majority of our surveys were conducted at the Miami International Airport (84 percent). Seventy seven percent of our respondents live in Miami and 10 percent in Cuba. Of those who were visiting Cuba, the majority (241 of 290) went to Cuba to visit relatives. Of those who were visiting Miami, again, the majority (36 of 38) were visiting relatives. The most common frequency of visits by the respondents (52 percent) was at least once or twice every year. The majority of the respondents (87 percent) stayed with a family member during their visits. Somewhat surprisingly, more than half, or 62 percent, still identify themselves as Cubans, even though 73 percent reside in the United States permanently.

The vast majority of the interviews were conducted in Spanish (94 percent). Of the 326 respondents, 93 percent were born in Cuba. Among those that answered the question about the year they left Cuba, the majority (272 of 297) left Cuba for the first time on or after 1994. The ages of most of our participants (79 percent) fell within the range of 30 and 64 years suggesting that a majority of the travelers has spent at least a decade living in Cuba. Participants were evenly split in terms of gender.

Water Conditions

The majority of those in our survey indicated that the general condition of the water in Cuba was deplorable. Some of the participants in our survey were employed in Cuba within the public health and water supply sectors. Others included Cuban water experts who left the island and now live in the United States. But the quality of the drinking water in Cuba tends to improve in tourist centers at the expense of the general population. This holds true not just with municipal water but with bottled water as well. When we asked about the sources of water, for instance, 85 percent of those who stayed with relatives mentioned that the water they consumed came directly from the tap and was unfiltered; only 20 percent stated that filtering devices were used consistently. The obvious consequence of these numbers is that neighborhood water tends to be purified through other means (30 percent said they boiled their water and 20 percent said they used purification tablets) or simply consumed untreated (35 percent). The survey indicates that many households use their own wells for their water supply, a source of water which is generally trusted by more than half (61 percent) of the participants.

The respondents staying in hotels did not report a far different experience. About a quarter of these participants drank straight from the tap, none reported using water from wells, and all said hotels usually provided filtered water. About half of the group who stayed with family or relatives (53 percent) said they encountered no difficulties finding bottled water. Sixty-nine percent of those who stayed in hotels said they used bottled water. As expected, the usage of small and middle sized bottles was reportedly about the same but households consumed a larger proportion of water from 5 liter containers than did hotels. Five-liter bottles represented 25 percent of the container size used at households compared to 7 percent at hotels. Finally, the place of residence also impacted the type of complaints about water. Among hotel users, the largest problem with the water was its tainted color whereas for households it was odor (10 percent) and taste (57 percent).

The survey also asked travelers to compare their perception of water conditions since their previous visit. With these questions we were trying to get a sense of whether or not there was an improvement in water quality. This is important for two reasons. First, there is a lot of anecdotal evidence of squabbling about the extent of progress in the social quality of

Table 2. Quality of Ambient Waters as Perceived by Users[a]

	Bays			Rivers			Lakes			Beaches		
	Clean	Dirty	Really Dirty	Clean	Dirty	Really Dirty	Clean	Dirty	Really Dirty	Clean	Dirty	Really Dirty
Staying in homes	17	25	36	19	28	31	13	24	31	52	22	3
Staying in hotels	0	14	50	18	43	50	0	14	0	82	29	0

a. All numbers are expressed in percentages.

life or lack of thereof, and we felt that measuring something as essential as water could be a reliable indicator to empirically settle this debate. And second, the Cuban government is on record as stating that an increased reliance on tourism for state revenues is ostensibly different under socialism than before the revolution because the government now reinvests tourism profits for the benefit of the Cuban people. The now versus then responses will give us an idea of how well this policy is working.

Again, when asked about the conditions of potable water, experiences in homes and in tourist hotels are quite different. Ten percent of respondents said that conditions had improved in homes from the last trip; 45 percent stated they were about the same and 30 percent claimed the quality of potable water was worse. A small share of hotel users, 18 percent, deemed the water situation getting worse and 55 percent said it was about the same as the last time they were in Cuba. As Table 2 shows, when one accounts for the type of water, the reported perceptions are far more disparate.

The data in Table 2 also shows that of all four types of ambient waters, the beaches seem to have fared best. And yet in this category, the percentage difference of the "clean" ranking between hotels goers and everyone else is 30 percentage points, another remarkable evidence of the quite different experiences groups of visitors encountered in the island. Respondents were almost evenly split when asked about the sources of water contamination, with seven out of ten identifying garbage as the principal contaminant.

Social and Public Health Impact

When asked about the impact of water quality on public health, about half of those residing with family reported they knew of at least one person who was ill because of poor water quality and 27 percent said they knew of two or more cases. With respect with respondents who stayed in hotels, more than half claimed they knew of one person getting sick and about 31 percent said they knew of two or more cases. Most likely, this distribution could be explained by the comments from random international travelers reported earlier. Although hotels use filter and filtration devices regularly, tourists also consume at least some contaminated water in ice cubes or outside the hotel, where there seem to be much less quality control.

The severity of illnesses was a major consideration. A small minority (less than ten percent) of respondents did nothing when they became ill. The majority (59 percent) of those residing in homes during their stay visited either a hospital or some kind of health care provider if they felt ill. Of those staying in hotels, 38 percent simply rested in their rooms until they felt better. By far the overwhelming majority of respondents, in fact almost all respondents, reported stomach pains and digestive-related problems. About 20 percent of the respondents in homes and hotels reported hearing about cases of cholera.

Besides the direct health consequences, one also has to consider the social impact of water contamination. During interviews, we heard of the many inconveniences, opportunity losses, frustration, disruptions of daily lives, working hours lost, and most importantly the generalized sense of deprivation caused by the uncertainties related to water quality and erratic supply. A frequent visitor to Cuba -- who has travelled to the island as frequently as three times every year for the last few years -- shared the following warning to visitors: "YOU SHOULD NOT drink water from the tap (not even use it to brush your teeth) and should not allow ice cubes to be added to your drinks, nor should you drink water offered to you in restaurants or private homes even if they say that the water has been filtered."[3]

Availability of Water

The majority of those that stayed with family members reported that municipal water was not always available and that households used cisterns to collect water (75 percent). Cisterns were reported to be effective for continuous water availability by 77 percent of the respondents (n=226) who indicated the house where they stayed had a cistern. With respect to being able to control water temperature, here the disparities were again observed between those who stayed at relatives' houses versus those who stayed in hotels. Of those who stayed with relatives, 24 percent reported being able to control water temperature, while 60 percent of those who stayed in hotels reported being able to control water temperature.

Perceptions Concerning Cause of Contamination

By far the most important reason perceived by interviewees for the poor water quality is the lack of maintenance and the need to repair the water collection and distribution systems. This was perceived by those staying with family and those staying at hotels, at almost the same rate (40 percent). Some respondents were very specific about the consistent loss of water pressure in the potable water supply lines and the leaks from the sewer systems. During periods of low water pressure, sewage can enter water lines and contaminate the drinking water. The respondents told stories about flooding and epidemics of gastro-intestinal illness which were consistent with the contamination of drinking water through flooding.

What Needs to be Done

The last section of our data analysis deals with recommendations for ways to improve the water situation. Our survey asked three types of questions. First, what can be done to improve water throughout the island. The consensus was that some kind of official response was urgently needed. At least half of all respondents recommended as top priorities creating better purification water systems, infrastructure upgrades to the municipal water distribution and sewage connection lines, financial aid to repair household cisterns, and the creation of community cisterns.

The second question was whether the average Cuban was willing to buy personal filtration devices. Ninety-three percent of the households and 80 percent of hotel goers answered in the affirmative as long as filters were affordable. The third groups of questions relate to the demographic characteristics of our respondents

It is obvious, however, that the overwhelming perception is one of continuous government neglect and misappropriations. This should not surprise anyone. It is almost impossible for autocratic non-democratic states that have held power for as long as the Cuban regime to persuade citizens that anyone but themselves is to blame for apparently manageable domestic troubles. This is the case when for decades, in their attempt to legitimize themselves, these regimes brag about their capacity to reverse most adversities in their commitment to promote the general wellbeing.

Again, there is consensus on what state policies must do to reverse this alarming situation. Four of 10 respondents said they wanted the government to lift import restrictions on water filters. At least half would like more government investment in water purification and in sewer collection systems. Three of every 10 said they wanted more programs to reduce contamination. The only noticeable discrepancy came when asked about government financing for studies to improve water quality. Here about 17 percent of those staying in houses agreed, compared with 33 percent who stayed in hotels.

CONCLUSIONS

One of the motivations for our study was to analyze current, national, and comprehensive statistics about the usage, the rate and implications of water contamination in Cuba. After contemplating several methods of data collection, we decided on interviewing of

3. From a source who corresponded about her experience and wishes to remain anonymous: "Les especifico que NO DEBEN tomar el agua de la pila (ni siguiera usarla para lavarse los dientes) y que no deben permitir que pongan hielo a los tragos, ni tomar agua que les ofrecen en los restaurantes y en casas de familia que dicen que han sido filtradas."

consumers in the United States as the best available and most convenient.

The results of the study seem to confirm the fears of many: water quality throughout the island is alarmingly poor. If the recent news of expectations of increased austerity in Cuba are credible, the problem is bound to get worse before it gets better—unless radical and targeted measures are instituted urgently. As our study suggests, those left behind with regards to water are the ones most dependent upon public water supply: Cubans who are not living in hotels. In other words, most Cubans.

To the concerns about deteriorating conditions we document, it is worth adding the detrimental environmental effects of droughts. According to the Cuban government, in 2015 the island suffered its worst drought in over 115 years. One hundred thirty municipalities reported a decrease in available water and the decrease was severe for 43 municipalities. Any study of water should consider the rate, distribution, and efficacy of water utilization mechanisms, a topic of further study.

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