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Bahamas, Factor 5: Climate Volatility

Bahamas: Minimizing and Living with Climate Volatility

The Bahamas is a chain of islands in the North Atlantic Ocean just off the coast of Florida. According to Boslaugh of the Sage publications, the Bahamas has an area of 5,359 square miles. As stated by www.bahamas.gov, “The Bahamas achieved independence from Britain July 10, 1973, and is now a fully self-governing member of the Commonwealth.” The islands are very popular sites for American tourists to vacation. The location of the Bahamas also draws immigrants seeking a port of entry into the United States. Half of the labor force is employed in the tourist industry, which provides more than 60 percent of the gross domestic product.

Most families in the Bahamas live in urban areas. Boslaugh of Sage Publications reports that, “in 2010, 84 percent of the population lived in urban areas, and the 2010 to 2015 annual rate of urbanization was estimated at 1.3 percent.” According to the "Preliminary Populations and Housing Count by Island and Supervisory District, All Bahamas: Census 2010," the average household size in the Bahamas is 3.4 persons.

Currently city cultures in the Bahamas have behaviors at the individual and community level that have a positive effect on their carbon footprint. According to Hoornweg et al, “residents of denser city centers can emit half the green house gas emissions of their suburban neighbors.” This is true because many people living in relatively small areas shorten the chain of carbon used to get products from the producer to the consumer. Since people living in dense cities take up less area of earth’s surface per person, they leave more space open to be left as healthy undeveloped forests that can sequester carbon or as farmland to produce food. Transport is also more environmentally friendly in cities since people tend to have shorter commutes and use public transport systems such as busses and subways or walk. Gaigné et al. confirm that, “There is a wide consensus among international institutions and national governments in favor of compact (i.e. densely populated) cities as a way to improve the ecological performance of the transport system.” Therefore moving the remaining citizens who do not live an urban lifestyle or participate in agriculture either towards agriculture or urban developments would benefit the health of the islands by reducing the emissions of greenhouse gases.

According to www.bahamas.co.uk, virtually every type of international food can be found in the Bahamas {probably because of the massive tourism industry}, but seafood is the staple of the Bahamian diet. Although it is difficult to find reported specific details, the typical diet of a subsistence family in the Bahamas likely consists of the food they grow, such as coconut, citrus, sapodilla, alligator pear, bread fruit, pineapple, with possibly sugar cane, yams, sweet cavasa, onions, tomatoes and other local produce, as well as seafood and rice. Urban food production is very limited in the Bahamas because most food is imported. To increase urban food production, residents could be introduced to hydroponics and aquaculture. According to Kenneth, “Freshwater supply for residential areas is generally from subterranean freshwater lenses. Desalination technologies are expensive but are found in many of the hotels and other tourist facilities; to cut costs some hotel process slightly saline ground water as opposed to seawater.”

Barriers to improving agricultural productivity in the Bahamas include erratic weather and lack of education in food safety and production. The Sage publications of 2006 add that, “Only five percent of all Bahamians are employed in agriculture, which is subject to extensive wind and rain during tropical storms.” Buchan writes that, “On many of the smaller Bahamian Islands small-scale subsistence

agriculture is carried out. Limited soils, which are usually deepest in carbonate sink holes and other dissolution features are utilized to grow sweet potatoes, watermelon and other produce. Fertilizers are rarely used." Livestock manure could be used as fertilizer along with dead plant matter on a small scale by rotating land as livestock pens and gardens.

Barriers to employment at a living wage include a low minimum wage. According to laws.bahamas.gov. "If the employee is employed by the hour the minimum wages shall be four dollars per hour." The U.S. department of state says that, "Almost one-quarter of the work force belonged to unions. Workers freely exercised their right to organize and participate in collective bargaining, which the law protects. Unions and employers negotiated wage rates without government interference. Undocumented migrant workers often earned less than the minimum wage. The minimum wage did not provide a decent standard of living for a worker and family."

The availability of healthcare is an issue in the Bahamas. The Sage Publications of 2006 report that, "With a population of only 301,790, the islands have been devastated by a rising HIV/AIDS prevalence rate of three percent. In 2003, it was estimated that 5,600 people were living with this disease. All Bahamians have access to proper sanitation, and only three percent lack access to safe water. There are 163 physicians for each 100,000 residents, and less than 20 percent of the population are able to afford essential drugs." As a result of these hardships, Sage Publications reports that, "Some 84 percent of islanders are likely to live to the age of 40" According to the Sage Publications of 2008, "The government has instituted a series of health-care reforms and is working to broaden the safety net for the most vulnerable members of the population"

Education, in contrast to healthcare, is much more readily available to citizens of Bahamas. According to The Economist Intelligence Unit, "Access to primary and secondary education is universal, and the literacy rate among adults is estimated at 98%. Tertiary education is concentrated in the College of the Bahamas."

Renewable energy sources are not being used, in fact, according to Trevino, "The government-owned public Bahamas Electricity Corporation (BEC) has owned the oil-fueled power plants that have supplied the majority of the nation's electricity demands since its authorization under the Electricity Act of 1956." While more convenient ways to obtain energy, such as use of fossil fuels, require a lower initial capital than environmentally friendly practices, they are contributing to global climate change, which will result in future costs such as habitat loss and a dramatic reduction in species diversity. The current practices of using nonrenewable energy in the Bahamas is contributing to increasing the carbon dioxide in the atmosphere and according to NASA this will result in worldwide rising of sea levels, intense heat waves, droughts, heavy downpours, ocean acidity, insect outbreaks, tree die out, and much more. Erratic weather will result in destruction of farmlands. These human caused events will result in widespread detrimental effects to the Bahamas economy and environment including climate volatility. Trevino reports that, "The Fichtner Report on Sustainable Energy in the Bahamas has identified a number of potential renewable energy sources, including solar, wind, biomass, and ocean thermal energy conversion." Tidal power is also being considered as a promising renewable alternative to burning fossil fuels, but before it is implemented some possible environmental effects must be discussed. Tidal power generators emit noise and electromagnetic fields while they are generating power and this could harm wildlife. For example, according to Polagye et al. "Some species of fish, such as sturgeon and eels, appear to be particularly sensitive to electromagnetic fields." Sharks, sturgeons, and others whose ampullae of Lorenzini can detect electromagnetic fields should be carefully monitored for effects from tidal power generation. Trevino continues, writing that the government of the Bahamas "is still in the process of establishing a legislative and regulatory framework for the implementation of renewable energy technologies. Possible changes

include eliminating a ban on private power generation, the introduction of net metering, and incorporating green building designs into public housing projects and building codes.”

Climate volatility affects agricultural productivity on the Bahamas presently because extreme weather damages and destroys crops. "Climate Volatility" is different than "Global Climate change" and the terms should not be interchanged. Global climate change is a global phenomena and climate volatility is a local manifestation that can range from drought to frigid temperatures depending on the location. The extreme weather that is of most concern in the Bahamas according to the previously cited Sage publications of 2006 is “extensive wind and rain during tropical storms.” Presently the fluctuation of climate conditions is becoming more powerful at an alarming rate. Currently the situation is life threateningly severe because of hurricanes and floods. In the future, climate volatility will affect the Bahamas agricultural productivity more than any other factor because capricious weather will become more frequent and more extreme. Population growth on the Bahamas will require more food to be produced or imported, but it will be more difficult to produce food because of increasing climate volatility. As carbon in the atmosphere increases, extreme weather events such as hurricanes are expected to continue to occur, and even become more powerful; therefore we must increase use of renewable fuel sources as soon as possible. Halting human-induced climate volatility would lead to economic development in the agricultural field and reduce poverty by maintaining available farms and reducing costly hurricane and flood damage by making hurricanes less frequent and less powerful. Improving the state of human induced climate volatility would increase the amount and quality of food available to the people of the Bahamas. It would also preserve tourist attractions such as coral reefs, leading to income for the people of the Bahamas.

Insect outbreaks and widespread plant death are both results of global climate change. Barbosa Schultz warns us that, “Warming also enables some insects to increase the number of generations per year, thus increasing damage to plant communities,” and adds that, our current agricultural practices cause changes in plant hormones potentially increase susceptibility to chewing insects. If insects become more powerful and abundant as a result of global climate change, their damage to agricultural crops and wildlife would increase proportionately. We do not have extra crops to allow insect outbreaks to occur, and we also do not want them to feed on wild vegetation because that would result in even more carbon in the atmosphere by releasing carbon from where it was being collected in plant material. Climate change and insect populations effectively create a feedback cycle with increasingly negative outcomes. In order to combat this problem, the people of the Bahamas should grow pest resistant genetically modified organisms and minimize their greenhouse gas emissions while encouraging other countries to do the same.

A logical solution to erratic weather and increased pests is to utilize genetically modified organisms as crops. GMOs can drastically increase yields per acre while being more nutritious than non-GMOs. A great example of GMOs being put to use is Norman Borlaug’s wheat variety, which according to the World Food Prize Institute, he developed so Mexico could obtain self-sufficiency. Many people consider his legacy in Mexico an agricultural miracle. After scouring many sources, no evidence can be found that GMOs are being used in the Bahamas. Assuming that the lack of information means that GMOs are not widely used, one can deduct that the reason GMOs aren’t currently used in the Bahamas is because of the lack of participation of scientifically trained personnel. Farmers of the Bahamas lack support from trained individuals to help them increase their yields. Help from scientists to utilize technology like GMOs holds great possibilities and these possibilities should be pursued.

Based on my research, one of my recommendations on how to effectively address climate volatility to improve the food security of rural and urban families in the Bahamas is to encourage fishers to hunt Lionfish. I got this idea from the Island School on Eleuthera in the Bahamas. Lionfish are an invasive species in the Bahamas, and they are harmful to native fish. Lionfish are venomous, but not poisonous. They can be easily hunted and killed with spears because they are relatively slow moving. While Lionfish

can sting humans, their sting is not deadly and can be easily treated with warm water. Lionfish are delicious and can be eaten once their venomous spines are removed. Their spines can be simply pulled out using gloves. It was recorded in *Biology, ecology, control and management of the invasive Indo-Pacific lionfish* that, “Recent efforts to focus collections by divers has resulted in over 1400 lionfish collected in one day during derby-style events and up to 19 lionfish collected in 14 minutes by one dive team.”

A program that I recommend scaling up is going on in the Bahamas with a goal of reducing the grocery bills of Bahamians by helping them plant gardens. According to the Caribbean Update, “The program will continue for the next six months and one objective is to assist persons in establishing gardens in their backyards, hopefully reducing grocery bills by about 20%, he said. Some vegetable seeds will be distributed, and an equal number of plants, such as lime and mango trees, will be offered for each constituency.” Additional value could be added to the program by educating successful gardeners on collecting seed stock for use the following growing seasons. That way the program has a better chance of continuing with minimal input requirements from outside sources. Even if education is not available, simply distributing seeds with pamphlets on how to grow the crop included and use some of its seeds to grow more next year would be exceedingly helpful. Programs should be constructed and efforts should be made to make public places including schools more sustainable with rainwater, gardens, and fruit trees.

As humans rapidly emit carbon dioxide into the atmosphere, it is absorbed in huge amounts by the ocean's surface waters, causing them to become rapidly more acidic. Doney says, “One well-known effect [of ocean acidification] is the lowering of calcium carbonate saturation states, which impacts shell-forming marine organisms from plankton to benthic mollusks, echinoderms, and corals.” If the oceans continue their present course down the pH scale, marine life will suffer and as a result ocean-dependent economies will crash. This danger is a good reason for the Bahamas to encourage the United Nations to act. Buchan reports that, “To date, the fishing industry has benefited from the relatively high ecological productivity of the shallow banks and their related habitats. Commercially important fisheries include spiny lobster, conch and Nassau grouper which, together, make up the bulk of fisheries income.” All of this maricultural success is in danger because of greenhouse gasses. I suggest that the appropriate role of the United Nations would be to tax carbon emissions to protect the safety of present and future generations. Since many countries are contributing to ocean acidification the Bahamas cannot stop this danger on their own. This could be funded in the Bahamas by reducing other taxes such as the massive import tax, which according to stanford.edu, “generates 63% of tax revenue”.

The human activities that are causing the most global climate change, and therefore that the people of the Bahamas should be most concerned about, are the burning of fossil fuels to produce energy and the mass production of livestock in agriculture. The Bahamas should push the United Nations to specifically focus on limiting these activities around the world in order to minimize climate volatility. The sources of greenhouse gas emissions are ranked in Johnson's article on greenhouse gas. The article states, “A recent inventory of the United States green house gas emission separated major emitters into categories: (1) energy (86.6%), (2) agriculture (6.3%), (3) industrial (4.5%), (4) waste (2.7%) and (5) solvent and product use (<1%).” This ranking makes it appear that agriculture is only a minor source of global warming potential compared to energy production, but that is not true. There are a variety of greenhouse gasses, and they all cause a different amount of heat to be reflected back to earth, and therefore they have different global warming potentials. Johnson's article verifies this, saying, “A mole of CO₂ is defined to have a global warming potential of one; the global warming potential of other green house gases are higher. Therefore, even though non-CO₂ green house gases represent only a small percentage of the green house gas mixture, they can make a sizable contribution to the total global warming potential.” Johnson's article states, “Methane contributes about 20% of the estimated anthropogenic radiative forcing [climate change caused by humans], second behind CO₂ at 60%.” That makes the two biggest causes of global warming potential carbon dioxide and methane. A figure displayed in Johnson's article portrays that agriculture is a leading cause of methane emissions, with enteric fermentation causing 21% of methane

emissions and manure causing another 8%. Although energy production releases much more green house gas by volume than livestock, the gases released by livestock have a greater global warming potential, and therefore to effect a positive change in the Bahamas the United Nations must push for renewable energy and minimal livestock meat.

Indications are that climate volatility is rapidly worsening. The trends for climate volatility are measured by the frequency of extreme weather events, and that is rapidly increasing. The situation for rural farmers is getting worse because of this weather. If allowed to continue, global climate change will have catastrophic effects on the Bahamas's economy. Costello reports that, "According to the UK Government commissioned Stern review on the economics of climate change in 2006, if we do everything we can now to reduce global greenhouse gas emissions and ensure we adapt to the future effects of climate change, the average estimated cost is 1% of the world gross domestic product (GDP) every year. However, if we do nothing, the effects of climate change could cost 5-20% of the world GDP every year." The most inexpensive way to deal with climate change is to change behavior patterns and address it right now. The Bahamas should adopt laws stating that each power company's production of energy must be 90% renewable in the next five years. This change is imperative to minimize impact on the economy and families in the Bahamas and the best time to do it is now. There is a Chinese proverb that illustrates this situation well, it says, "The best time to plant a tree was 20 years ago. The second best time is it today."

Human health has been and will continue to be directly impacted by our reliance on fossil fuels. According to Costello, "Although vector-borne diseases will expand their reach, and death tolls, especially among elderly people, will increase because of heat waves, the indirect effects of climate change on water, food security, and extreme climatic events are likely to have the biggest effect on global health." Dr. Brian Rotskoff's Climate Change Series: The Global Impact Continues, warns that, "The global impact of climate change is causing extreme allergies in patients of all geographic and socio-economic levels, many of whom have limited access to quality healthcare . . ." According to Dr. Rotskoff, these allergies can be very dangerous to those children affected. Reducing greenhouse gas emissions is necessary to avoid widespread human suffering. This is another important reason for the Bahamas to advocate for minimizing world greenhouse gas emissions.

The saddest part is that the people who are contributing the most to global climate change will be the last to be effected. While wealthy people have the money to afford luxuries that result in pollution, such as cars, beef, and air conditioning that runs off of fossil fuels, they also have the money to provide themselves with excellent healthcare against climate change stimulated epidemics and protect themselves from extreme climactic events such as heat waves and hurricanes by building safe buildings. That means the people with the lowest economic status will suffer first and therefore the poor are particularly disadvantaged.

The Bahamas is a member of the intergovernmental panel on climate change, which has determined that human-induced climate change exists and is a threat. To quote Epstein, "In 2001 the (IPCC; Houghton et al. 2001) concluded that climate is changing, humans are contributing, weather has become more extreme, and biological systems on all continents and in the oceans are responding to the warming." This article implies that scientists have taken the first step, which is to recognize that there are negative effects resulting from our actions. The next step is to incentivize people to reduce and eliminate carbon emissions. Rural farm and urban families should be involved as key players in implementing these recommendations by making their homes as environmentally friendly as possible.

The problem of CO₂ emission from fossil fuels is detrimental and we must do everything we can to minimize the economic cost in dollars and humanitarian cost in lives. The article "Climate Change" reminds us that "There is now a widespread view [in the scientific community] that emissions of greenhouse gases need to be cut by 80 percent by 2050, that is in little more than a generation, if we are to

avoid catastrophe,” and the IPCC confirms that, “the more human activities disrupt the climate, the greater the risks of severe, pervasive and irreversible impacts for people and ecosystems.” Once the general population recognizes that greenhouse gas emissions are a problem, we must enact laws to induce a positive change. The current practices of raising massive amounts of livestock, burning fossil fuels, and leveling forests are increasing the carbon dioxide in the atmosphere and according to NASA will result in deadly weather, insect outbreaks, ocean acidification, and much more. These human caused events will result in widespread detrimental effects to the Bahamas's economy, environment, and to typical families in the Bahamas. There are many things an individual can do to reduce their carbon footprint and promote change on a broader scale by voting for politicians that support laws to curb the effects of fossil fuel emissions, avoiding meat, living in cities, recycling, and conserving resources. Each individual holds responsibility for our current predicament along with the ability to enact change. Specific opportunities for individuals and government of the Bahamas include moving to renewable energy, promoting fulfilling lifestyles in either agriculture or urban settings while minimizing semi-urban living, expanding programs to grow urban gardens, make personal choices to conserve energy, continue to local seafood rather than importing other meats, and advocate for greenhouse gas reduction policy at the international level.

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