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Puerto Rico, Factor 5: Climate Volatility

Climate Volatility in Puerto Rico

Puerto Rico is an island located in the Caribbean which has been a United States territory since 1898. It is populated with approximately 3.3 million people ("The World Factbook: Puerto Rico"). The average household consists of roughly three people while it is also not unheard of to have three generations living under the same roof. The typical family structure in Puerto Rico is close-knit, as in this culture, family is valued greatly. This is shown through many traditions and unspoken laws of the family. One important example of this strong bond is their sense of immediate family. In comparison, the typical American immediate family is considered to be parents and their children, while Puerto Rico's shows big differences. This is so, as an immediate family in Puerto Rico includes parents, children, aunts, uncles, cousins and may even extend further.

Puerto Rican family structures are considered very close due to many other reasons than just their definition of immediate families. This is also demonstrated through their day-to-day beliefs. This includes having the expectation that children are to live with their parents until they marry even until adulthood if necessary. Once married, the children are to live in close proximity to their parents. Daughters are expected to marry young and to bring more members into her family by welcoming in her husband's and creating her own. These aspects of Puerto Rican culture are so, as importance is placed upon communication and family ("Family Structures").

Although there are not enough educational facilities to provide top level education in Puerto Rico it is valued immensely with large numbers of students who obtain tertiary education. The country is ranked sixth for the most students attending tertiary institutions for education in the world while literacy levels are at about 90%. Here there are two main forms of elementary schools which include urban and rural. Urban schools provide basic classes along with Spanish and English and experience-based learning. Rural schools provide an opportunity for the students to obtain some form of formal education while receiving training and skills used for a trade ("An Overview of the Education System in Puerto Rico"). Roughly 74% of the population obtains an education of high school graduate or higher while about 25% get a bachelor's degree or higher.

Despite the successes with education, income remains low at an estimated average of about $19,600 per year ("QuickFacts Puerto Rico"). Along with these low average incomes are high unemployment rates which are at 26.6% and continuously rising while public debt remains high. This debt lies at 92.5% and about $17,000 per person. As Puerto Rico cannot pay back the approximate $76 billion debt, appropriate deals have been made with creditors ("The World Factbook: Puerto Rico"). As the island is a United States territory its overall economy and commerce is heavily subject to US congressional authority (EconomyWatch Content). The natural resources located on this island have little economic value as the breadth of this island is covered with mountains while the coast is mostly sand and its size measures to under three times the size of Rhode Island ("The World Factbook: Puerto Rico"). Due to this, United States companies comprise large amounts of the units set up for the manufacturing industry. Even so, one of Puerto Rico's main problems is the elimination of tax preferences that beforehand, until the 1950s, allowed for the United States to invest its companies there ("Economy Summary."). This paired with the

world recession caused the abundant lose of job opportunities, the eventual economic crisis of Puerto Rico, and increased dependency upon the United States. The most consequential and continual effect is that Puerto Rico lost the advantage of being a United States territory and remains in crisis (Borrás and Gabriel).

From sugar to its current main export, pharmaceuticals, agricultural products are not largely exported as these products are mainly circulated within the country. This shows the switch from an agricultural based economy to a manufacturing one. This industrialization is also seen throughout other products mainly exported from the island including electronics and textiles. Some of the agricultural products produced include sugarcane, plantains, and chickens. This Caribbean island has dedicated roughly 22% of the total land for agricultural purposes ("The World Factbook: Puerto Rico"). The remaining land, the infrastructure, in Puerto Rico is considered to be built informally at approximately 60 to 70%. This informal infrastructure is not only a representation of the high poverty levels on the island but also the threats placed upon it from the climate ("Hurricanes Can Turn Back the Development Clock by Years.").

Along with poverty and infrastructure, the location of Puerto Rico, in the Caribbean, creates a larger impact for the effects of climate change and leaves Puerto Rico more vulnerable. Climate change is a result of a buildup of gases in the atmosphere which traps the heat of the sun creating several major problems in the world. These major problems can include changes in rainfall patterns, rise in sea levels, increased potential for droughts, and the overall increase in temperature ("Impact of Climate Change on Caribbean Agriculture."). The role played in contributing to increased climate change in the Caribbean was little and now increases with its shifting economy. The move to industrialization from an agricultural based economy allowed for the beginning of the large consumption of fossil fuels. This fact lead to the Caribbean becoming a large, and eventually one of the greatest, contributors of global warming yet are not considered to be among those regions of great greenhouse gas productions ("Global Climate Change Overview.")

Geographical location is not the only factor of the increased threats placed upon Puerto Rico. The declining economy of the island and lack of adequate protection against climate volatility also play a part. Some major problems caused by climate change in Puerto Rico specifically include largely rising sea levels to increased flooding to widespread destruction of vital reefs and coral bleaching. A pattern developed of the negative effects of climate change has been seen throughout the rest of the Caribbean islands. This means that consequences of climate change are no only seen daily in the rising sea levels and the increasing temperature and so much more but also the frequency of things like hurricanes and destruction of reefs.

Due to such climate change, ocean waters have been not only more acidic but also have risen in temperature by nearly two degrees Fahrenheit since 1901. Warmer water along with increased temperature allows hurricanes to become more likely alongside longer hurricane season, larger rates of rainfall and increased wind spreads. This goes hand-in-hand with increased temperatures as a whole, causing elevated evaporation and therefore dry soil, less ideal for agricultural purposes. This temperature increase also causes more frequent yet unpredictable, heavy and severe rainstorms and decreasing regular rainfall, risking drought. On the other hand, is the rising sea levels at a rate of approximately an inch every 15 years. Increased inland flooding results and therefore increased vulnerability to cities, roads, ports, and food security ("What Climate Change Means for Puerto Rico.").

These critical and devastating effects of climate change are what could and will continue to spread if not helped. Puerto Rico's coastlines, infrastructure, and farmlands are continuously threatened by flood, drought and natural disasters. These can cause a breakdown of essential imports and exports, electricity and more, alongside access to food, clean water, and other necessary supplies (Holthaus).

With threats this places on agricultural production and food security, solutions need to be made to solve such a problem, but due to a lack of monetary resources an average household in Puerto Rico continually battles food security. The island as a whole is severely dependent upon food imports as only 65% of their food is grown within its own boundaries and continues to decrease. Not only are they dependent upon other countries for resources but also their own agricultural productions are critical since taking in additional exports means the spending of even more money that Puerto Rico does not have (Bellido).

Recent hurricanes Irma and Maria are great examples of the damages that can be done so suddenly and so devastatingly to crops and farmlands. It is estimated that after 2017, and such hurricanes, 80% of crops were destroyed along with 780 million dollars accounting for agricultural damages (Robles and FerrÉ-sadurnÍ). These increased risks to crop damages and harmfully increasing temperatures result in the lack of diversity in crops due to inability to survive. This means solving such problems, relating to crop damages, can come from producing crops that are more resilient while aiding the land ("Impact of Climate Change on Caribbean Agriculture.").

This can be possible through the production of cover crops. Cover crops are promoted greatly and have shown immense improvements upon farms proving to be great for the balancing of agricultural systems. The benefits of this crop are wide ranged including attracting pollinating insects to fixing nitrogen levels. They can also reduce the need for herbicide, provide structure, absorb water in efficient ways, and enrich the soil. This is done with the crops' ability to reduce weeds and promote pollination along with preventing soil erosion. The cover crops retain excess water and when they die they are incorporated into the soil as green fertilizer (Monsanto). On the other hand of the positive results, cover crops may also be seen as unprofitable and a waste of time due to location. As the negative results have also been documented, an example rises from a farmer, Roy Arends, 100 miles north of Des Moines, Iowa in Franklin County. This farmer, along with others in his area, have reported the attempted use of cover crops upon their farms only to show failure. In areas like these, you can sense the stigma of the attempts yet the lack of communication happening about it due to its overall promotion.

This technology is clearly unwanted and inappropriate for places in which they show inefficiency and/ or loss of profit. As Mr. Arends says, just 150 miles south makes all the difference with these crops. This shows that this is a solution that needs to be precise to location (Bennett). Despite negative results in areas like Franklin County, cover crop implementation has had successful results on farms in Puerto Rico. Even after the atrocious hurricanes in late 2017, farmers are seeing the increased promotion of cover crops due to the positive results. Farmers report increased organic matters, improved soil quality, and the reduction of erosion and herbicide use ("USDA Delays the Puerto Rico Census of Agriculture"). The seemingly meager costs of the cover crops compared to the great worth of implementation is well worth the investment. Individual farms will be able to afford such crops with the affordability and eventual profits.

With the use of cover crops, promising and positive outcomes have been seen in the agricultural industry and must continue. This continuation can come from the protection of coasts where flooding and infrastructure damage are most concerning. The destructive effects of climate change could be lessened

with the use of artificial reefs. Artificial reefs can have a wide range of benefits from biological replenishment to economic growth and lessening wave impacts. These reefs, firstly, encourage local populations of marine life to repopulate in increasing numbers by replenish themselves. They will do so by refilling past habitats that have been previously harmed or destroyed which then attracts such marine life. This increased marine life could in turn increase economic activity with the creation of jobs associated with the selling of the products, creating both a source of money and food supply. The beautification of the coasts due to the marine life, reefs, and prevention of rising sea levels also encourages tourism (Adams et al.).

Implementing artificial reefs means the consideration of the cost involved. These reefs must be affordable and efficient; from research and data they have shown to do exactly that. With this new monetary flow it would be well worth the cost of rebuilding the reefs artificially. The median costs of artificial reefs as of 2014 is approximately $1,290 per meter. This may seem like much but it is not especially when comparing it to the many benefits and to the costs of alternative artificial wave defenses being at roughly $19,791 per meter. The reefs not only provide healthy marine life and coral reefs but also the protection of people on the island (Valentine). This protection is from the dissipation of wave energy caused by the reefs which results in an average of 97% reduction of wave energy lost in the reef crest. This means the waves may not build up and continue with large amounts of energy that cause inland flooding and storms. Artificial reefs as a whole continue to become more and more of an asset as they keep up with the rising sea levels while supporting marine life and biodiversity, restore reefs, improve water quality, reduce local pollution impacts, and support fisheries and tourism (Carey).

In conclusion, Puerto Rico is an island that is heavily affected by climate change. The effects of climate change are emphasized by its geographical location seeing as the island is located in the Caribbean. This influences the threats of climate change and therefore on food security, further monetary loss, and more. To work towards solving the problems that immensely effect the planet as a whole but especially those areas being constantly threatened with the loss of their homes and way of life because of their geographic location, certain solutions must become a reality. These include the use of cover crops and artificial reefs. These solutions were chosen as they have not only proven to have greatly positive results but also as they reflect the needs and ability of Puerto Rico. The cover crops, being one of the solutions, could be implemented by individual farms based upon their needs while providing a helpful protection for the crops. Artificial reefs would protect the coasts from land destruction and infrastructure ruins by keeping dangerously powerful waves at bay and rebuilding the marine life that surrounds Puerto Rico. This combination of solutions allows for the island to prevent immense losses due to the the volatility of the climate.

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