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Bangladesh, Climate Volatility

Handling Bangladesh's Volatile Climate Through Public Works, Salt-Resilient Rice, and Sustainable Farming Practices.

According to the Global Food Security Index, Bangladesh currently ranks 84th out of 113 countries for food security ("Global Food Security Index (GFSI)"). A major factor contributing to this food insecurity is Bangladesh's volatile climate. Climate volatility is described as how much a climate changes over time. A climate that changes dramatically over a short time has high volatility and a climate that is constant over long periods of time has low volatility. Bangladesh's subtropical monsoon climate is highly volatile because of the switching between the rainy monsoon and typhoon seasons that bring large amounts of rain followed by hot dry periods ("Climate of the World Bangladesh"). As a result of this volatile climate, a large portion of farmland experiences drought, salinization, and destructive flooding preventing Bangladesh farmers from providing edible food for others. Without crops to sell, many farmers cannot purchase a nutritionally adequate diet. In order to decrease food insecurity, Bangladesh should focus on employing the ultra-poor through a public works program focused on infrastructure, introducing salt-resistant rice, and decreasing the rate at which Bangladesh contributes to climate change.

Bangladesh is geographically located in South Asia along the Bay of Bengal. Bangladesh has a population of 161,376,708 people and a land area of 130,170 km² meaning Bangladesh ranks 8th most populous country in the world and 10th overall for a population density of 1,265 per km². On average, Bangladesh is 30 feet above sea level meaning Bangladesh is considerably vulnerable to climate change. ("*Where Is Bangladesh in the World?*"). Bangladesh's climate is described as subtropical monsoon with heavy rainfall appearing between the months of June and October and typhoons appearing between the months of August and November. The reason for the volatile climate is the Himalayan mountains on the northern border producing glacial melt and a low-pressure area prone to storms and the Bay of Bengal in the south providing the moisture needed to generate monsoons. ("Climate of the World-Bangladesh."). Approximately 62.6% of Bangladesh is rural, 70% of Bangladesh is cultivated, and 58.96% of the land in Bangladesh is considered arable or suitable for growing crops. Currently, agriculture accounts for 20% of the nation's GDP and acts as the number one employer. As a result of the high population density, the average farm in Bangladesh is 0.59 acres, substantially smaller than the average size farm in the U.S. of 444 acres. Due to the small size of Bangladesh farms, most agriculture production in Bangladesh follows subsistence farming. This means most farm owners are growing crops to feed themselves and their family and only selling the surplus crops. The typical family size in Bangladesh is 4 people reflecting a nuclear family, but it is not uncommon for grandparents, parents, and children to live in the same household with close relatives living nearby reflecting an extended family style. A typical diet in Bangladesh consists of fish, rice, beef, tea, and vegetable mashes. ("Bangladesh Population 2021"). Major barriers families face to achieving a secure diet is primarily earning a living. The average wage in Bangladesh is 26,000 Bangladeshi Taka (BDT) or 307 USD per month making it extremely hard for Bangladeshis to purchase an adequate diet. For most Bangladeshi, their income fluctuates due to climate volatility. It is not

uncommon for unexpected flooding, drought, or salinization to remove sources of income, increase food prices, and reduce surplus crops (“Average Salary in Bangladesh 2021”).

A leading challenge to Bangladesh’s food security is climate volatility. Bangladesh has three characteristic seasons: a hot, humid summer; a cool, rainy monsoon season; and a cool, dry winter. Bangladesh’s climate volatility is increasing in severity primarily because of climate change and unsustainable farming practices and poor infrastructure. Climate change has been linked to changing the rainfall patterns and increasing the frequency and severity of storms (“Climate of the World-Bangladesh”). In Bangladesh, climate change is characterized by the warming of ocean waters and air. According to the Clausius-Clapeyron relation, for every 1 C increase in air temperature, there is a 7% increase in water vapor in the atmosphere. Since climate change is increasing air and sea temperature and warmer air is able to hold more water vapor, monsoons and typhoons which rely on warm, moist air are increasing in intensity. In the Bay of Bengal, there is usually 1 cyclone recorded per year, but in 2016, four cyclones were recorded. In addition to monsoons and tropical storms, melting Himalayan glaciers cause erosion displacing people and limiting the amount of arable land available to farmers by removing nutrient-rich topsoil (“*Climate Change and Infrastructure in Bangladesh*”). By 2050, it is estimated that sea levels will rise 50 cm resulting in Bangladesh losing 11% of its land and affecting 18 million people living close to the coast. By 2050, it is estimated that one in seven Bangladeshi people will be displaced due to climate change. The effects of rising sea levels lead to salinization. Salinization first contaminates freshwater with salt. This creates a problem for people relying on those freshwater sources for drinking water. Eventually, salts accumulate in the soil preventing the growth of crops by blocking plants’ abilities to absorb water through osmosis. Although rice, Bangladesh’s staple crop, needs to be flooded to grow efficiently, excessive flooding first prevents people from harvesting the rice, can uproot plants, and too much water actually waterlogs rice forcing it to create aerenchyma, tissue containing air spaces, by killing root cells (Eckardt, Nancy).

Bangladesh’s infrastructure is oftentimes inadequate to deal with climate volatility. A lack of infrastructure is seen in delayed warnings to citizens of a climate disaster, delayed capabilities to deal with flooding, and delayed responses to climate disasters. Increasing climate disasters destroy and erode existing infrastructure. Constantly trying to restore current infrastructure while providing disaster relief puts immense stress on the Bangladesh people. On average, 2,000 climate migrants move to Dhaka per day, Bangladesh’s capital, primarily citing climate volatility. As a result of poor infrastructure, migrants are forced to live in urban slums where health, sanitation, and food security are problems. Overall Bangladesh’s infrastructure fails to provide equitable access to programs, warnings of climate disasters, minimize the damage done by disasters, and provide adequate disaster relief (“*Climate Change and Infrastructure in Bangladesh*”).

To minimize climate volatility, Bangladesh should first improve its infrastructure by using stronger materials and introduce new structures designed to minimize the effects of climate volatility. Bangladesh’s infrastructure remains fairly poor in minimizing food insecurity as a result of extreme weather. Therefore Bangladesh should immediately invest in a year-round general infrastructure based government-run public works program that hires the ultra-poor and provides a more sustainable source of income during

extreme climate volatility. Already Bangladesh has the Employment Generation Program for the Poorest (EGPP) that provides work only before harvests. This program has seen success in providing the poor with a seasonal income, most notably employing 700,000 people to build roads per year, but it is not a consistent safety net program for people experiencing the effects of climate volatility when the program is not in effect. Expanding the EGPP to a year-round program will ultimately help the extreme poor that need year-round assistance. The extended EGPP program will not only provide a source of income for the ultra-poor workers but will also prevent climate refugees because of the increased amounts of infrastructure they will be creating. 95% of the current EGPP's projects are building or repairing rural roads. Diversifying the types of infrastructure programs will provide more room for participants and ultimately improve Bangladesh's general infrastructure (Sharif, Iffath, and Ummul Ruthbah). The types of infrastructure the extended EGPP should focus on are raising and strengthening embankments to prevent river flooding; storm surges; saline intrusion; and erosion, improve their surface drainage and pumping capacity to combat intense rainfall from monsoons and cyclones, invest in tree projects, and eco-barriers designed to prevent erosion; flooding; and minimize the impacts of climate change, and improve early warning systems so people have time to prepare for an extreme weather event to minimize the damage done by an extreme weather event (*"Climate Change and Infrastructure in Bangladesh"*). This plan would financially be supported by the international community and the Bangladesh government. The current EGPP is already being supported by the World Bank which grants credit based on its successful results in providing employment to the ultra-poor and the Bangladesh government has shown interest in advancing the EGPP by allocating \$180 million dollars in 2014, \$25 million more than the previous year. Extending the EGPP to support food insecure poor populations affected by climate volatility will increase the success of the program and thus earn greater grants from the International Development Association part of the world bank, which has already committed \$14.67 billion to development projects. Combining the current success of the program, the interest in the Bangladesh program to expand and continue the program, and the large number of Bangladesh citizens in need of such a program will play a crucial role in convincing international nations to increase foreign aid during difficult economic times. Every 5 years, an evaluation of the program will be conducted to determine the amount of future aid. Eventually, Bangladesh will not need continued international funding for the extended EGPP since the program is designed to elevate the economic position of participants so they can leave the program in a more stable position. The number of citizens qualified for the extended EGPP will begin to decrease signaling the decreased need for international funding(Sharif, Iffath, and Ummul Ruthbah).

Now that Bangladesh has a way to minimize the effects of climate volatility on food security by improving agriculture and providing a sustainable income source, Bangladesh should look to implement more resilient strains of rice. Similar to the work Norman Borlaug did, researchers are creating salt-resistant rice designed to be used in areas affected by saltwater intrusion. Bangladesh should look to research and implement new strains of rice capable of surviving climate volatility. In effect, more resilient strains of rice will improve crop production, prevent income loss due to salinization, stabilize crop prices, and increase the amount of land available for agriculture. While implementing a new salt resilient strain of rice, Bangladesh should encourage food producers to incorporate the new strain of rice into their products. This will successfully introduce Bangladesh's population to the new strain of rice, gaining their confidence in the rice for their own consumption, while simultaneously creating a market for farmers to sell the strain of rice. Advertising the advantages of the salt-resistant rice in seed catalogs and higher education will be integral for convincing farmers to implement the new form of rice (Quan, Ruidang).

In the long term, Bangladesh should reward effective carbon-neutral operations and should promote effective ways to eliminate greenhouse gas emissions through pollution control and more efficient technology. Bangladesh is very vulnerable to the effects of climate change due to its unique geography. Climate change has been linked to increasing climate volatility, therefore, Bangladesh should develop a plan to prevent exacerbating climate change and in effect prevent its negative effects on food security. Currently, the Bangladesh Environment Conservation Act (BECA) seeks to conserve Bangladesh's environment, improve environmental standards, and control pollution. However, due to Bangladesh's high population density, BECA has not met its goal of preserving the environment. To increase the effectiveness of BECA and to limit the effects of climate change, Bangladesh should first provide an accessible waste disposal program. Improved infrastructure and providing funding for new waste disposal facilities will make waste disposal more accessible to the general public decreasing the amount of waste such as nitrogen fertilizer that is released in waterways improving water conditions and eliminating a cause of climate change. With improved waste disposal facilities, greater punishments should be placed on industrial facilities that don't follow environmental guidelines. Increasing awareness of the problems of climate change should be presented to the public in order to gather general support for an environmental policy designed to combat climate change. This should primarily be done through the Bangladesh school system by creating a new education goal to teach children at a young age about climate change and the effects on climate volatility and food insecurity while also providing information on how to minimize and prevent climate change. Government-run education programs that teach sustainable farming practices should also be available for adult agricultural workers. The steps taken by the Bangladesh people and government now will ultimately lessen global climate change and thus prevent the exacerbation of climate volatility and helping food security in general (*"The Bangladesh Environment Conservation Act, 1995."*)

In conclusion, Bangladesh's unique geography creates extreme climate volatility that affects food security through saltwater intrusion, flooding, seasonal discrepancies in job opportunities, and drought. Climate change is increasing the damage done by climate volatility by increasing the strength of extreme weather events and increasing sea level causing salinization. Bangladesh can combat climate volatility by improving its internal infrastructure through the extended EGPP which will also provide income to ultra-poor people, introduce salt resilient rice designed to grow in salty waters and thus providing a more stable crop production, and improving BECA to prevent the worsening effects of climate change on climate volatility.

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