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The Gambia, Renewable Energy
Getting Electricity to Rural Gambians

In a world that is constantly changing, ensuring that the actions of humans are not detrimental to their future success as a species is essential. Climate change is a problem that is widely accepted as needing to be addressed because if nothing is done, there will be problems with liveable climates, growing food, and finding water to survive. The use of fossil fuels and other non-renewable sources of energy are considered one of, if not the largest, contributor to climate change by emitting greenhouse gases, but there are other options. Renewable energy has grown rapidly in recent years, but it still isn't enough as non-renewables have also grown in many places, especially in the developing world. It is in the best interest of humanity that non-renewable energy is replaced with renewable energy quickly, before the harm is irreversible.

With a population barely the size of Houston, around 2.2 million people call The Gambia home, a number that is increasing each year. Like most of Africa, The Gambia is a young country both in the sense of average age and years since independence. Declaring independence from the United Kingdom in 1965, foreign relations were rocky until the establishment of free and fair elections in 2016. Along the Atlantic coast of Africa, entirely encompassed by Senegal, The Gambia sits on the edge of the Sahara Desert and the savanna, a small country that surrounds The Gambia River. They have a dry season from November to May and a wet season from June to October. Most of the country is employed in agriculture, growing primarily groundnuts, millet, and oil palm fruits (Qamar). These factors lead to the makeup of the country as it currently is, which unfortunately isn't great in the present day, but the future could be promising given the right developments.

The average family in rural parts of The Gambia consists of eight people living in a house that would be considered very small in the United States, often just one or two rooms. Their homes are often made of bricks, thin metal sheets, or wood with thatched roofs. Families in the cities, like the capital, Banjul, are often slightly smaller and live in nicer houses or apartments. Rural Gambians rely mainly on the food they grow for meals, eating peanuts and cereal crops, and occasionally having fish. The average income in the United States is between \$41,000 and \$42,000 (Shrider et al). The average income in The Gambia sits around \$8,000 USD a year which is extremely low, but goods and services in the country reflect this income level, being cheap by American standards (Cost of Living in The Gambia); however, the goods and services aren't as high quality in The Gambia. The price of food in The Gambia is increasing faster than the average income is. This is largely due to the lack of technologically advanced agricultural equipment that can keep up with the population growth and worsening yields (Thelwell). Although more advanced agricultural techniques would likely increase the crop yields, it could be potentially harmful to the workforce of the country. They rely mainly on agriculture for a source of income. Many of the farms are small in comparison to other countries, only about two hectares per farm (Qamar). All of this suggests that, like most of Africa, The Gambia is still very much in a developmental stage, most noticeable in their access to essentials that are commonplace in developed nations.

Infrastructure in The Gambia is decent for a small, developing country, but isn't consistent throughout the country. Over 87% of the country has access to clean water, 66% has indoor plumbing connected to a sewer system, and 49% has electricity. But these numbers are much more reflective of the urban population, only 16% of the rural population has access to electricity and 44.5% has access to indoor plumbing (Central Intelligence Agency). This lack of electricity in rural Gambia means people are cooking food by burning wood or other biological matter and have little to no communication with the urban parts of The Gambia, creating a disconnect between rural and urban populations. This gulf in access to electricity can lead to division within the county and create separate social classes based on electricity

availability, a problem that if unchecked could cause unrest or fractures between the two ways of life. The country as a whole is producing more energy than is currently being consumed, showing that it isn't a problem of having enough energy, but not being able to distribute it (Energy Consumption in The Gambia).

Different sources quote different percentages for the amount of energy produced by renewables in The Gambia, either 3% or 48% and knowing how it is in most developing countries, it is likely that the former is more accurate, regardless, these numbers can be improved on (Energy Consumption in The Gambia and Energy Profile Gambia). The non-renewables that are currently being used in urban settings, mainly oil, can release greenhouse gasses when burned that are associated with the acceleration of global climate change. Additionally, emitting pollutants that can cause health issues or land in waterways that are used for drinking water, which when drunk can cause possible reproductive and nervous system damage (Jessel et al). In rural areas, people often burn wood or other organic matter for energy, also contributing to greenhouse gasses. Climate change can have massive implications on the agriculture industry worldwide by changing weather patterns in areas to the point that the food produced in certain areas will no longer be viable. Water pollution caused by the use of non-renewables can also affect the water used for growing foods, especially in areas where accessing large quantities of clean water can be difficult.

At first glance, it may seem that The Gambia River is a plausible source of clean energy as that is the main geographical feature of the country, but the areas that need energy aren't necessarily close enough to the water for it to be a reasonable renewable solution. Wind and solar on the other hand make much more sense because they can be easily hooked up to any home's electrical system without running miles of cables through the desert. Harnessing the energy of the river would be possible for the people near it, but solar panels and turbines would be both more cost effective and easier to install and maintain. In The Gambia, the sun is out for anywhere between 11 and 13 hours, with clear skies over half the time, providing about 7.2 hours of sunlight per day, which is plenty of energy to power solar panels in rural areas (Climate - Gambia). The wind is strong enough to provide electricity, but not a whole lot, that's why it's better to pair the two sources up as the country only gets five to nine mph winds on average (weatherspark.com).

The implementation of small solar panels and turbines would provide enough energy to get electricity throughout The Gambia, before likely needing to switch to larger scale operations once the country has developed more. Solar panels and wind turbines are also able to connect to the same electricity grid, so if there was ever a period without much sunlight or wind, the other could cover for the decrease in electricity production. It has also become more common in the United States for families to go off the electricity grid, relying on their own energy production of a wind turbine, solar panels, a generator, and batteries to power their day to day lives, which is exactly how it would likely have to be structured in the rural regions of The Gambia (Small Wind Guidebook). The cost of solar in Africa has significantly decreased over the years, making it possible for developing countries to have access to renewable energy without having to use non-renewable resources first. According to Lee Calderone, "wind turbine prices had an average cost of \$0.06 per kWh, and at times dropped to \$0.04 per kWh. At the same time, the cost of solar photovoltaic (PV) had fallen to \$0.10 per kWh. In comparison, electricity produced by fossil fuels typically ran from \$0.05 to \$0.17 per kWh. This same report predicts that within the next few years, solar and wind will be able to furnish electricity for as little as \$0.03 per kWh." Clearly, at these rates, it wouldn't cause a severe economic burden on the country while still providing enough energy and being able to get electricity where it isn't currently available because wind and solar energy can be harnessed anywhere. And if the costs aren't feasible because of the increased electricity usage, there are other ways of affording it.

Although the costs of wind and solar energy are very similar to fossil fuels in Africa, the increased use of energy means an increased annual cost for developing countries like The Gambia. This is where another

country could come in to help, such as China, which is currently the largest producer of solar energy and wind energy and is the largest investor when it comes to foreign renewable energy, making China the perfect country to provide the funds necessary to help The Gambia become more sustainable as it continues to develop (Chiu). China is also the leading producer in solar panel manufacturing, making them easily accessible if a partnership between The Gambia and China was created, which is likely due to their pre-existing relationship (Meyer). This help could be in the way of funding the project to set up renewable energy throughout rural parts of the country or loaning money to The Gambia and having them repay the loan once they have established themselves more internationally, allowing for economic growth necessary for repayment. It's unlikely that The Gambia would be able to pay the entirety of this project on their own because much of the country relies on money from their family that is working abroad. Their economy isn't very strong, especially following the coronavirus pandemic, but there is evidence of decent growth beforehand (Thewell).

Although this solution increases the potential energy available, it wouldn't be able to replace the fossil fuels that are already being used. This is due to the fact that it isn't changing where the energy is coming from for people already with electricity, but rather it is providing energy to places that don't currently have any or lack sufficient electricity. This project would act as a test to see if it is possible for the country to integrate sustainable energy while they are still developing and cut out non-renewables before they become too reliant. Once it's determined how effective these renewable alternatives are, it is possible that solar panels and wind turbines are built in or near cities, with solar panels and turbines being able to be built on some of the taller buildings that get more sunlight and wind. There's also the possibility that wind turbines can be built on the water near the larger cities that are primarily along the coast or the smaller towns along The Gambia River. Installing solar panels and turbines aren't just great because they generate electricity from non depletable resources, but they also provide other economic benefits.

Setting up the solar panels and turbines creates jobs in the short term, but the maintenance required to keep them running efficiently creates permanent jobs (Advantages and Challenges of Wind Energy). These jobs would require education, which is low within the country particularly in the rural areas that lack electricity, so a program would need to be set up to educate the populations that are relying on these panels and turbines for energy. This could include both information on the importance of sustainable energy and classes on building and maintaining the turbines and solar panels that are built. The education would likely be led by professionals from abroad, but as time goes on, Gambians that have used this technology would be able to lead the classes.

The biggest problem with getting renewable energy throughout the countryside, besides getting the materials, is managing to get it to the people that need it. The Gambia only has about 3,000 kilometers of road, 2,500 of which are unpaved (Central Intelligence Agency). This would make it very difficult to distribute the solar panels and wind turbines, but with the help of either government funding or Chinese investment into the project, it is very possible for it to be done. Due largely to the fact that it wouldn't take much to get a village or town electrified based purely on the limited amount of energy they demand, getting this project started is well within reason and wouldn't take an unrealistic amount of time. Engineers will be needed to provide help setting up the project and teaching people within the community what needs to be done to maintain the different sources of energy.

All of this development would still allow for The Gambia to become the developed country they aspire to be while preventing them from going the way of every other developing country, polluting their own land with the use of non-renewable sources. By setting them up with renewable energy now, they can remain stable in the future without a heavy reliance on fossil fuels that will only hinder them in the future. The rural parts of the country will be able to connect with the urban parts while improving the quality of life in rural sections and allowing them to move into a more developed world without having to leave their current lives behind. Ultimately, using renewable energy to get electricity to rural Gambians will help The

Gambia make strides forward in technological advancements as the country looks to grow and further their climb towards a more prosperous nation.

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