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### **Investing in Agricultural Infrastructure of Mozambique**

Mozambique is a small nation located on the western coast of Africa; the nation possesses 36 million hectares of arable land with only 3.9 million hectares of land being cultivated (Food and Agriculture Organization of the United Nations). Of the land that is currently cultivated 97% percent of production comes from over 3.2 million small stakeholder farms. Mozambique's economy was crippled by a 16-year civil war that caused the destruction of much of the nation's infrastructure along with several typhoons that did extreme damage to the nation's coastal cities. However, a strong government has been put in place and the nation has begun a process of rebuilding and growth, but there is still a long way to go. Several corporations, such as the Chinese-owned Wanbao Corporation, have begun development within the nation-building Midwest-style industrial farms. In 2013 Mozambique was the third poorest nation on the planet with almost fifty percent of the children suffering from malnutrition, however since industrial farms have started to be established the nation has seen 7% economic growth linking to a decrease in poverty among citizens. However, these industrial farms make up an insignificant fraction of Mozambique's agriculture and it's necessary to give access to equipment and other resources to local farmers to better-industrialized agriculture in the nation. Most families cannot feed their families during any given season. Their small plots of land and primitive tools reduce their farms' crop yield, which results in high levels of hunger throughout the country. By introducing a plow into the equation one man could do the same work as ten in half the time making his work easier, but also giving him the means to feed his family. Investment into the nation's infrastructure along with incentivizing industry in the region would improve the quality of life for the people of Mozambique. Industrialization would provide help to provide goods and jobs to the region. By encouraging corporations to set up factories in the underdeveloped country it would work to bring Mozambique into the twenty-first century while working to reduce poverty through its contributions to the economy. Mozambique infrastructure is in critical disrepair (Dominguez-Torres), investments from the government need to occur to ensure that goods produced will even be able to make it to market.

The first step in increasing the country's agriculture production is selecting crops that are easy to grow on a large scale and live well in Mozambique's environment, which will also provide food to the nation's citizens. Mozambique is home to many different ecological regions including marine, coastal freshwater, mangrove, Zambezi lowveld, tropical, subtropical, savannas, and shrublands (Elisha- Sawe). Crops that grow well in these environments include maize, rice, cassava, sweet potatoes, and sugarcane (Food and Agriculture Organization of the United Nations). Rice is the product that I want to focus on primarily because of how well acclimated Mozambique's climate is to grow it. Mangrove areas are perfect for growing rice due to the ecosystem's naturally wet environment, but although it is not currently illegal to cut down mangrove trees in Mozambique the trees endangered status makes mangrove wetlands a less than perfect area to create large scale farms. However, a new technique of growing rice is being used by the Africa Rice Center (WARDA) to grow upland rice in savannah environments. Mozambique's savannas receive on average 13ml every 5 days between February, which is the typical cultivation period in the region. The region is capable of growing rice, but the next step is educating farmers on proper cultivation techniques, farm setups, and irrigation methods. The government could hold seminars and demonstrations led by members of The Africa Rice Center helping to aid farmers in starting up rice farms throughout the country. Issuing monetary kickbacks, in the form of tax incentives, towards farmers starting up rice farms may also help to stimulate an interest in establishing new savannah-based rice farms throughout the country.

The second major issue is finding a way for farmers to plant, harvest, and plow their crops on a larger scale. By upgrading their equipment and planting methods farmers could increase their overall yield. This increase in yield would not just provide the farmers the ability to feed their families, it would give them a surplus that they could sell for a profit. Modern farming equipment is extremely expensive to both purchase and maintain. To counteract this problem local farmers can start at an early stage of agricultural production, with livestock pulled plows. Many higher-class farmers have been using oxen-led teams to plow their farms for years, but the average farmer doesn't have access to a plow and has continued using handheld tools. If these lower-class farmers were able to access higher quality equipment, they'd be able to increase the number of hectares they could cultivate in a season. The Mozambique government should begin to offer tax incentives or reduced regulation to encourage production, such as the United States' domestic product deduction Section 119 of federal tax code that allows for the deduction of any domestically produced item, for agriculture equipment-based producers such as John Deere or CNH Industrial N.V (Lent). This act would encourage the construction of factories within the nation and provide access to equipment. Subsidies may also be granted to these companies for the production of light plows and two-row planters to encourage their production and sale, while also providing the companies with low export costs to keep their factories viable in the future. For farmers to be able to afford this equipment it may be necessary for the government to issue low-interest, long-term loans for farmers to pay back as they begin to see equity from their farms. This process is designed to be adaptable and will need to change as time goes on. It may be several decades before farmers generate enough capital to increase production size. Over time this process will increase the number of industrialized farms throughout the country while also putting money into the pockets of farmers while also providing future generations means for a better life by combating the nation's hunger problem.

This light equipment needs a method of propulsion. The use of tractors in the region is invalid due to the high poverty rates. Angoni cattle grow on average to 1,330 pounds (AGTR) and would be more than capable of providing the necessary power to pull this light equipment. The Angoni are native to the region and have been bred there for generations so farmers know how to care for and maintain these animals. Sixty- four percent of farmers in the country own one or more heads (2021 Index of Economic Freedom) making them viable for the majority of the country. Steers would be preferable to use as plow animals as they grow to have similar size and strength when compared to a bull without the aggression that comes with them.

Farmers having a surplus is a solid starting goal, but it means nothing if they are unable to transport their goods to market. Mozambique lacks much of the infrastructure necessary to participate in the local and world agriculture trade (Stratford). The nation has three major ports: Maputo, Beira, and Pemba. Maputo is located at the southern point of the nation and hosts the countries' most sizable port; it is also the most accessible port for inland settlements as it is built near the convergence of the Changane, Limpopo, and Lagoa rivers which snake throughout southern Mozambique. There is, however, very limited infrastructure along these rivers along with no active barges running meaning that they have no transportation capability. In the central region, Beira is situated along the ocean at the head of the Pengue river, whose tributaries spread across the majority of the central region. 19 active barges transport cargo throughout the waterways, but 7 of them are owned by private companies and use the majority of their capacity hauling cargo for their companies. The northern region is the least developed of the three regions, Pemba is a minor port and isn't located near any major river head. There is no transport, civilian or cargo, along any rivers in this region. Railway transportation is minimal; the only expansive line, the CFM North Network, stretches six hundred and ten kilometers from Tete to Nampula. The southern and central regions of many rivers make it ideal for barge transportation. To make this solution viable the amount of running barges needs to increase. Creating a government-owned corporation that would invest in purchasing and running barges from inland settlements to Maputo and Beira would allow farmers to get their products to the international market. Seven million five-hundred thousand dollars of capital would

need to be invested into this corporation initially to purchase 8 MET10 utility barges, valued at eight hundred thousand dollars, along with crews and various other equipment and fuel. While the initial investment is steep, the long-term revenue generated by parties buying and selling a product that needs to be transported has the potential to be profitable for the government while also providing a service for its citizens.

The northern region poses a different challenge for transportation as it lacks any previously established river infrastructure making rivers a non-viable option. The north's lack of river infrastructure is made up of its already established railway system. However, this system, while expansive, needs to be further expanded to be viable. By creating a Civil Works Administration, the Mozambique government can provide jobs for impoverished citizens, the way President Roosevelt did during the Great Depression, as well as expand its railroad system. The city of Nampula would act as a central point for the project as it is connected to the ocean by the river. The first line created would be the northern loop, this loop would be composed of a two hundred- and the twenty-three-kilometer line north from Nampula to Montepuez, and a four hundred- and eight-mile line west from Montepuez to Lichinga. A line already exists from Lichinga back south to Cuamba from which a line connects back to Nampula completing the loop. A second southern route would also need to be constructed, this route would shoot two hundred and twenty kilometers southwest from Nampula to Mocuba, then from Mocuba, the line would head north two hundred and thirty-three kilometers to Cuamba which then connects back to Nampula. This plan connects the major cities of northern Mozambique with one thousand eighty-four miles of railway, costing one billion eight hundred million dollars. To fund a project like Mozambique can apply to the International Monetary Fund (IMF) of the United Nations for a loan or request loans from larger nations like China or the United States (Studebaker). Taking out a loan would be more advantageous than increasing taxes on citizens despite it adding to the overall national debt. However, citizens and corporations alike would have to pay to use the lines so the lines over time could be used to pay for themselves while also providing jobs to people throughout the country. This project would be a massive undertaking and would take several decades to pay back, but the positives for this project are worth the overall cost. Profits from being the sole method of cargo transportation for not just northern Mozambique but Ethiopia and Northern Kenya as well would have significant positive effects for the area.

Storage is another common issue throughout Mozambique. Storage wouldn't be an issue for most Mozambique farmers for several years as most of what they harvested would either go to feed their families or straight to market. Once markets begin to become flooded with goods farmers may want to wait to sell products, or they may just not be able to get the product sent to market right away. Without properly sealed storage containers the fruit of farmers' labor would rot. Many farmers cannot put up quality grain storage even here in the United States. During the 1940s farmers in the United States banded together to create agricultural cooperatives to give them access to items they otherwise couldn't afford. The idea of a cooperative is that a group of people pool their resources together to purchase items that they otherwise would be incapable of (Kitteredge). Following this example, farmers in Mozambique can pool together their excess money to purchase shared grain silos. Everyone who contributed would get a set amount of storage space in the silos that they could use at their discretion. A trusted record keeper would need to be appointed to determine who had how many tons of grain stored at any given time to ensure everyone kept their share. This method could also be used to expand existing farming operations throughout the country. Co-ops could pool money to increase the rate at which farmers could modernize their equipment. Say all the farmers in the area pool money to buy a tractor and planting equipment, they use that tractor to plant all their farms that season. Then after a few more seasons, they buy another tractor that they can now use to plant at double their previous rate. Using this pooled resource method farmers could expand their group operations at a much faster rate than they could on their own, eventually being able to rival the foreign industrial farms. Co-ops are in technicality a cooperatively owned business therefore they are subject to taxes, if the government wanted to encourage private industrialization from citizens, they would provide tax breaks to cooperatives to provide them with potential for unrestricted

growth. As the cooperatives grew, they would need to put annual dues into place along with a full-time board of directors to oversee the investments of the cooperative. An increase in members would also lead to an increase in funds at cooperatives' disposal allowing further expansion throughout the country. Cooperative members could also operate as a type of union to ensure their members get fair deals from the government-owned transportation systems. The cooperative system was used to great benefit for American farmers following The Great Depression and the use of the same principles in Mozambique will have similar benefits.

Education of the complicated profession of farming is critical in order for farmers to bring in high enough yields to feed their families. Education would be largely up to Mozambique's Government, but I believe by bringing in experts from universities around the world as part of a study abroad program the government could implement strong educational programs for farmers during the off-season. These education seminars could be done through the cooperatives in order to reach a larger system of people all at once, as well as obtain a list of the active farmers within a region. Education programs would be created by the government and presented monthly to local farmers. Government educators could also be deployed to various farms in order to help implement plans for larger-scale rice farms. The research conducted by University members helping with the education programs could be used to aid other struggling countries.

With Mozambique's government being a young one, the implementation of a United Nations task force with the purpose of overseeing the implementation of funds towards the various projects that the government has been loaned money for may be necessary. This group would set up various accounts with money designated towards specific projects, then monitor when and how the money is used. This group would also take up an advisory position to the Mozambique government aiding in the implementation of programs as well as the education of civilians on new policies. However, how programs are implemented and what regions money is invested into would be up to the discretion of the Mozambican government, as long as their actions don't violate any loan agreements. This course of action helps to prevent any foreign powers from demanding too much control over the country due to the nation's debts, while at the same time ensuring that the country of Mozambique uses the finances presented to it in a responsible manner.

Africa will be the home of the next large agricultural expansion, with Mozambique being an ideal place to start. By encouraging the growth of the industry through tax cuts, and investing in the region's infrastructure, the nation's rates of poverty and malnutrition could drop by as much as twenty-six percent (Lent). Implementation of more efficient rice farms would help to decrease overall hunger throughout the entire country. Construction of the railroad and jobs created from the factories and barges would provide millions of jobs to the region, reducing the country's historically high unemployment rate. With the proper education and oversight, money issued from foreign nations would be used to help the people not just in Mozambique but throughout the entire world. These investments have the potential to take Mozambique from one of the world's biggest food importers to a major player in agriculture markets throughout the world. Most important of all, these solutions will improve the overall quality of life for the people of Mozambique.

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