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A Lack of Energy in Tanzania is Affecting Food Security

The food on tables in a family home, the light shed upon houses, emanating from street lamps. The warmth provided by modern innovation in heating, and the gentle purr of an engine outside. This sense of security stems from energy, copious amounts of it. Imagine now, the men, women, and children who suffer for days on end, due to a lack of energy, and food that is provided by it. This is a common occurrence for citizens of underdeveloped countries. The answer to these problems is the development of clean, cost effective, reliable, and efficient energy sources for the use of billions worldwide. With the introduction of clean energy, humanity will only advance further.

Tanzania, being one of the fifteen poorest nations on Earth, suffers greatly from a lack of reliable energy. Though societies in the past thrived under circumstances which would today be thought of as primitive, the problem here is the stagnation in the production of food. 85-90% of Tanzanian homes are not electrified, which does not allow the proper storage of food in the long term (Energypedia, 2020). These staggering amounts only increase when referring to rural areas, there, only 2% of homes have access to electricity (Central Intelligence Agency [CIA], 2020). Oftentimes, traveling markets do not reach secluded Tanzanian villages due to the sheer energy expenditure it takes to reach them. This dilemma could be remedied by the production of energy in said villages, without the reliance on others for assistance. Though Tanzania has made a strong effort to incorporate hydroelectric energy into their infrastructure, the country is still sorely lacking in clean energy sources and the efficacy of said sources. The 2016 Tanzania Energy Access Situation Report showed that inland Tanzania suffers most from lack of energy. Tanzania is more or less surrounded by at least one type of water, which is utilized for hydroelectric power. Inland Tanzania has virtually zero access to these sources, and relies greatly on fossil fuels and biomass for the majority of their energy (Sanyal, 2017).

While the lack of food production may be the apparent problem in Tanzania, the energy required to produce enough food for Tanzanian citizens greatly outweighs the current energy production. Due to the fact that a typical Tanzanian home relies greatly on charcoal for cooking due to the lack of electricity; deforestation to produce said charcoal is at an all time high (Energypedia, 2020). Increased rates of deforestation and an almost complete neglect of reforestation, along with the flippant use of charcoal which offgasses tremendous amounts of Co₂, greatly impacts the environment in which Tanzanian families call home. With an average family size of 4.9 people, these amounts of charcoal contribute greatly to air pollution (CIA, 2020). It is not an uncommon occurrence for several generations to be living under one roof, all cooking with charcoal. Charcoal is a necessity in Tanzania, and it would be understandable that some apprehension may show itself with the proposition for the abandonment of it.

These problems can considerably impact the daily life of the average Tanzanian citizen if left unchecked.

The rampant deforestation sparked by the need for reliable energy, simultaneously emits Co₂ into the atmosphere, as well as removes a source of reliable oxygen. Even with this constant, albeit low, influx of unclean energy, the food production in Tanzania remains embarrassingly low. With only one third of the forests being replanted, this energy source will soon be nonrenewable (Energypedia, 2020). While the coal produced by these actions only account for 0.3% of total energy consumption nationwide, biomass (animal/human power) makes up a staggering 90% of all energy consumed (Energypedia, 2020).

It seems the problems in Tanzania are not caused by inaction of the government, but by a lack of knowledge and technologies. Foreign aid does not seem a viable option, but the education of Tanzanian citizens on these subjects, very well may be. Aid from other countries' governments may not be well received and hostility could occur. Being under a unitary presidential democratic republic, which means a country's government is mainly ruled by a single governing body, which has an absolute rule (CIA, 2020). Meaning that unhostile actions by other countries could easily be vetoed. The answer here is the introduction of education which allows for the development of clean, efficient, and cost effective energies.

With these dilemmas; lack of energy, failure to produce food, air pollution and deforestation, a saving grace must be initiated. One of these saving graces is biodiesel, which is any type of fuel which can be grown biologically; usually created from either recycled materials or biological substances. One type of biodiesel is produced by extracting oil fats from algal bodies, which can be used to power engines (Newman, 2008). An added benefit is the respiration process of these algae, which is almost fifteen times more efficient than plants in converting Co₂ to oxygen (University of Virginia, 2008). Efficiency can be improved even further with the help of genetically engineered organisms, or GEOs. These GEOs can be tweaked so that fat production is exponentially increased, or so that respiration rates are doubled, taking more Co₂ out of the air (Saar, 2018). This, combined with the cost effectiveness, availability, and ease in manufacturing are a few reasons why biodiesel is a viable option for Tanzanian citizens. If citizens were to be aware of these technologies, and taught how to harness and manufacture them, energy production would increase drastically.

Alternatively, the production of multiple sources of clean biodiesel is also a promising option. The diversity of energy is an important factor when dealing with energy stemming from biological sources. Life is susceptible to innumerable downfalls, such as disease, starvation and dehydration. Growing and producing types of life with different environmental preferences is a wise course of action. If a drought were to befall regions of Tanzania, and those regions just so happened to be the epicenter of all algal biodiesel production, then certainly the effects would be disastrous. "This was clearly visible in the years 2010/2011, where recurring droughts effectively removed around 420 MW from a system of around 900 MW, forcing the country to endure a programme of load shedding coupled with unplanned outages" (Energypedia, 2020). As a result of this drought, which incapacitated a hydroelectric plant, a 572 MW Emergency Power Plant was constructed at the end of 2011, to be fully fueled by liquid fossil fuels (Energypedia, 2020). This is a living example of the downfalls which would befall Tanzania if only relying on one source of biodiesel. The loss of power, then arguably worse in the long run, resorting to fossil fuels as a safety net. Growing a diverse selection of plants which can thrive in a myriad of ecological circumstances is a much better option. Growing algae in wet environments, such as along the

coastlines, rivers and lakes etc. Growing fields of nettlespurge bushes in the drier portions of Tanzania, and growing maize in the more temperate regions. This wide variety of biofuels is an insurance against the investment of resources, all toward one source. Especially if that one source were to be compromised.

Biodiesel can be cultivated from many easy to grow, easy to store and cheap to raise plants, such as maize, soybeans, canola, nettlespurges, coconut and many more (Gunes, 2014). Many of these plants can easily be grown in Tanzania, and some already are. One of the most promising to the citizens of Tanzania, maize. Though the current yield of traditional Tanzanian farmers is fairly low compared to more developed countries' yields, it can still be utilized. Multiple factors may be introduced in order to increase harvest. As previously mentioned, genetically engineered organisms have a future in the fight against hunger. If these fields of maize can be engineered to produce more ethanol, then the overall yield may remain low, but the ethanol production can skyrocket (Hay, 2019). Additionally, proper fertilization techniques can be introduced, to help spur production along, and increase yield.

The lack of energy in Tanzania is an interesting and exciting opportunity. Unlike many developed countries, Tanzania can begin its venture into clean energy with a clean slate. Instead of slowly introducing technologies which can be powered by oils from the crops listed above, Tanzania can begin with said technologies. It is a common concern that biodiesel will damage engines which are typically designed for normal diesel. If normal diesel is a scarce commodity, and clean biodiesels are more widely available then surely newly developed engines will be better suited to run on clean energy. Thus is the importance of the expedited implementation of biofuels. This process of production is fairly straightforward, making it easy for Tanzanian farmers to reap the benefits of their efforts fairly easily. "The process of making biodiesel is simple enough that farmers can consider producing biodiesel to meet their own needs by growing and harvesting an oil crop and converting it into biodiesel" (Ciolkosz, P.E., 2016).

Though biodiesel is a promising technology, changes must occur in Tanzania beforehand. Industrial food production companies must slow production to allow for the steady growth and development of biodiesel's acceptedness. Only nutrient rich foods are a necessity, whereas energy intensive foods such as "...instant coffee, milk powder, French fries, crisps and bread..." (Ladha-Sabur et al., 2019), need to be reduced or abandoned altogether, at least until energy production is stable and effective. The abdication of previously used energies is not necessary but is undoubtedly beneficial. Seeing as though 10.2% of all energy in Tanzania is either natural gas or petroleum, the extraction of these materials consumes energy that could be put towards increasing food production (Energypedia, 2020). With this increase in food production, more time can be put towards the development of new ideas and technologies, instead of towards the need for survival.

Despite the long term benefits of abandoning the practice of traditional food production, it is likely that said food companies will retaliate and refuse to slow their production. After all, this is a solution that will presumably take more than a few years to implement, and will most definitely have a fiscal impact. With

slowed production and a clientele who no longer relies on their energy intensive products for survival, some companies will inevitably decline. Though this certainly isn't the goal of this proposal, it is an unfortunate, but necessary casualty. To ease the financial burden of these companies, it could be a viable option to enact tax breaks for corporations who willingly give up their production, and even further decrease their taxes if they were to begin producing the crops which can be utilized for biofuels. This would require some government intervention, and perhaps a mix of private and government efforts could be the best approach.

The cessation of inefficient productions does not come, however, without a price. Though the technologies involved with biodiesel are cost effective and easy to produce, the implementation of this is a different situation. Ranging from unacceptance, to the albeit low cost, to the laggards which find themselves caught in a continuous cycle of unclean energy. The implementation of clean energy is arguably one of, if not the biggest challenge facing mankind. Even developed countries find themselves struggling with implementing new technologies. Again, this is where education comes into play, if citizens do not realize what they are doing is wrong, then surely they will not cease. Teaching populations that unclean energy has disastrous effects on mankind is a crucial step in the implementation of clean energy. Aid from the Tanzanian government will most likely not be well received, on account of their blatant disregard for renewable energies in the past. In recent years, their efforts have unquestionably improved, however, have still lagged behind other private organizations. The Tanzanian government's political adroitness could be harnessed in other ways, such as putting into practice tax breaks for companies who agree to forgo their harmful productions, and adopt newer and cleaner alternatives.

Private organizations which focus primarily on education in renewable energy, may be more suited for the task of implementation. One of these organizations, The World Bank, is a privately funded organization primarily focused on education in renewable energy (The World Bank, 2016). This organization not only focuses on renewable energy and education, but the finances behind it as well. With implementation comes a fiscal burden, and The World Bank focuses on lessening this burden and making renewable energy more reliable, cost effective and available. With the ever looming threat of hunger and electrification, The World Bank has improved the situation in a manner that represents the best of human ingenuity, allowing for more steady growth of Tanzanian power plants. "Through the Tanzania Energy Development and Expansion Project (TEDAP), 576,000 people, including 125,000 women, now have access to electricity. The project's off-grid component also stimulated private sector-led development in renewable energy and resulted in one of the strongest and most transparent enabling environments for small power producers in Africa. They would not otherwise get connected to the national grid within a decade or longer" (The World Bank, 2016). This further demonstrates the point that private agencies and organizations will be exponentially more effective in implementing clean and reliable energy sources, than local government. Though some of the sources introduced were not entirely clean, it was still leaps and bounds better than complete lack of energy. With this newfound source of hope, Tanzania has outlined a plan to become a middle-income country by the year 2025, an undoubtedly ambitious goal, but an important one nonetheless (The World Bank, 2016).

Altering the education system to be more focused on solving the problems of the present, than of the ideals of the future is undoubtedly a crucial step. Making it known that fossil fuels and unclean energy are actively destroying the only planet we have as of today. Teaching children from a young age that they possess the power to change the world with their ideas in renewable energy is one of the first steps we must take. It is absolutely critical that we make it known, not just to Tanzanian citizens, but to the inhabitants of earth, that unclean energies are one of the deciding factors in human extinction. Unclean energies seem, to an abundance of people, a problem of the future, that they in their lifetimes will not have to suffer the consequences of their actions. But their actions will affect their children, and their children's children. This concept applies to every single inhabitant of planet Earth. From the Tanzanian farmer to the richest person on earth, it must be understood that this step is the most important. Without generational education programs, this will be viewed as a futile effort to end hunger. If this plan is backed by everyone involved, and those people have a sense of hope, and those people have the will to change their lives in order to not be hungry every day, then there is no doubt that the situation will change. The understanding that this will benefit everyone involved if some sacrifices are made is undeniably important. Every step of this proposal, must stem from compassion, and the understanding that this massive undertaking can and will save lives.

Though Tanzania's problems stem from a lack of energy, this is not the root cause. The problem here, rooted deep within the traditions of former generations, is the lack of educational opportunities. Instead of harnessing biomass for the vast majority of their energy, Tanzania could progress further than they could have ever hoped with renewable energy (Energypedia, 2020). Before these goals can be attained, proper education measures need to be implemented first. With increasing stress placed upon struggling families, something must be done to provide for their nutritional needs. After the education programs have been established, then, and only then, can the next phase begin; biofuel. This biofuel will be diverse, grown in a myriad of ecological conditions, and will be genetically engineered in order to produce the most yield. When energy has become abundant, this energy can be utilized to store food properly, increase food production, and open stores and markets where the Tanzanian citizen can shop for food, uninhibited. This is not a matter of food and energy, it is a matter of education and the renewed passion to blaze a path to a future with only clean energies.

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