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South Sudan, Factor 1: Plant Science

Aquaponics: Efficiently Exterminating Hunger in South Sudan

“Food is the moral right of all who are born into this world”, said Norman Borlaug, father of the World Food Prize. In today’s technologically advanced universe, this vision has not become reality. Across the world, human beings are starving for meals in a row. When children in some countries are surrounded by delicious, wholesome food, others are deprived of a meager morsel for several days at a time. Some children have the luxury of munching on popcorn while watching a movie. Others are foraging for forest firewood at the crack of dawn or walking barefoot across miles of scorching desert land for water. The glaring disparity in these two lifestyles calls for global creativity and immediate action to put an end to hunger. Humans are the masters of innovation. We have resolved issues that other species will never recognize. Together, we must tackle this issue through innovation by replenishing the lands afflicted with hunger across the universe.

Practically landlocked, with a sliver of the Nile River running through it, South Sudan is a land of cultural diversity. The major ethnic composition comprises of a deeply rich tribal origin coupled with middle eastern flavors. Plagued by rampant, heinous warfare in the Darfur, South Kordofan, and Blue Nile regions, millions in the country are fighting to stay alive. Following the 2011 Sudan succession, South Sudan has been hit with massive waves of population displacement, stimulating raging conflicts such as the vast 2016 carnage in the Jabal Marra region. With approximately 5 million people, just under half of the population is facing food insecurity (Los Angeles Times). South Sudan’s situation is exacerbated by the cross-cultural conflict and battles, which leave little room for plant science innovation. While supranational organizations such as the United Nations have striven to change the state of South Sudan, the utilization of the invaluable Nile River will truly make or break the fate of this country. By abandoning the ethnic fights and engaging in a combat against its widespread hunger issues through aquaponics, South Sudan will not only survive, but thrive.

The typical subsistence family farm in South Sudan is made up of large extended families, primarily lead by male authorities. Usually comprising one hectare of land, these family farms are mostly devoted to the production of cereal grains. While women are the predominant intensive field workers who endure back-breaking hours of labor, the society is largely patriarchal as females are segregated from their male counterparts. This gender divide persists during family occasions, worship, festivities, and meals. Marriage is not viewed as a celebration of love, but rather a way to form alliances between tribes and acquire more livestock, especially cattle. This race for cattle dowry has propagated the harvesting of cereal grains such as sorghum, millet, maize, and rice throughout the country. While groundnut is cultivated as a cash crop in sandy areas, the impoverished subsistence families rarely have access to nutrition found in fruits and vegetables.

As of late February 2017, following two decades of bloodshed, famine has been declared in South Sudan. Over 42 percent of the country’s population is considered “food insecure”, by international standards(OregonLive). According to the World Food Programme, an affiliate of the United Nations, this degree of severe hunger tragedy has not struck any country in the world for the past three or four decades. Warfare and displacement has left many adults in the country uneducated on efficient crop-production. It has forced the farmers of South Sudan to resort to a nomadic lifestyle with no financial means to implement sophisticated, expensive agricultural systems.

With much of the population on the run for their lives, education systems have sunk terribly in South Sudan. South Sudan’s education indicators rank among the worst in the world, as low rates of primary

school completion have trickled into a largely uneducated upper class. Adult literacy rate is 27 %, while 70% of the country's children have never set foot in a classroom(unicef.org). The existing schools are unsafe learning environments with inept teachers who cannot give their students access to comprehensive learning materials.

The absence of a solid education background has contributed to the lack of food science understanding in the country. Community leaders, who wish to reach out to non-governmental organizations(NGOs) must be able to understand the basics of science and communicate fluently in English. To drive initiatives for food science funding in the country, the common people of the South Sudan must have the conviction to reach out for help. The lack of strong education systems is one of the greatest hurdles to increasing crop yields and promoting peace in the country.

According to the United Nations Mission in the Republic of South Sudan, over 30% of the country is facing malnutrition (Los Angeles Times). As war swept through the country, farmers' lives were devastated. Their livestock were killed and were their farming tools destroyed. This chaos has caused many inhabitants of the young country to flee as food prices have escalated over 800%(Los Angeles Times). South Sudan, a flourishing country in its earliest days is breaking, as more and more of its people are starving to death each day. Monetary aids provided by the United States and other security council members have been squandered by the corrupt government, which is slow to recognize and meet the needs of its people.

The World Health Organization reports that over one million of the young country's five million people could succumb to death (UN News Centre). The camps set up by United Nation peacekeepers are crowded with civilians who are seeking safety from the dangerous government militia groups. Without the once present oil pumps that brought an influx of wealth into the country, there remains bleak sources of money for expensive agricultural implements. "Our worst fears have been realized," said Serge Tissot, head of the Food and Agriculture Organization in South Sudan. Tissot asserts that the war has disrupted the otherwise fertile country, causing civilians to rely on "whatever plants they can find and fish they can catch."

Despite its war-torn condition and poverty rate, geographically, South Sudan is an area of potential. With an estimated water surface area of 70,000 km, comprising of the Nile River and many large tributaries (fao.org), the country's waters are home to nutritious fish such as tilapia, Nile fish, and the catfish. Rich in nutrients such as Omega-3, these fish can help improve the lives of millions of residents who are starving in the country each day. Along the Nile River Basin, lie many fertile lands, suitable for crop production. While subsistence fishery (when a fisher fishes to feed their family) is common among the close-knit tribal river basin communities, South Sudan lags in innovation and efficiency. Farmers often fish and plant for hours in sultry climate, developing painful spinal curvatures, among other injuries. Increased advocacy for fish farming, or aquaponics, can be a catalyst of positive change in the country. While the current fish catch is 30,000 per year, with its abundance of resources, South Sudan has the capacity to catch up to 300,000 tons of fish a year(fortuneofafrica.com). Lack of agricultural education initiatives by the government and internal strife have prevented these areas of fish-farming from full exploitation.

Aquaponics is a key to solving many of South Sudan's problem, beginning with the fight against famine. It's a leap in the right direction that will boost the country tremendously, when implemented properly. An organic, year-round method of farming with little need for plant watering, aquaponics will revive the devastated people of South Sudan by feeding hunger with hope. With the abundant source of fish from the Nile River and its sultry climate, South Sudan's physical features are adept for aquaponics. Aquaponics, also known as fish farming is a combination of both hydroponics (a method of growing plants indoors without soil) and aquaculture (the cultivation of marine animals). Unlike aquaculture, which was initiated in South Sudan, but failed to take root due to costs, aquaponics eliminates the cost of

filtering water for the fish. Instead, it draws upon the positive aspects of both sciences and creates a symbiotic relationship between plants and fish.

A technique that can be incorporated both indoors and outdoors, aquaponics begins with raising a small group of fish in a tank. Fish are fed periodically based on their species. After a few days, the fish leave behind excretions that are rich in ammonia. The waste is transported to the bacteriolytic soil; which after combining with water is converted into nitrites and nitrates. Nitrates are absorbed by plants; causing stimulation and enhancing plant growth. Plant stems filter out remnants of water which are purified and circulated back to the fish tank. Oxygen from the water is a vital key to the survival of fish. The cycle repeats, without a hint of material being wasted.

By putting this system of plant science to use, the South Sudanese farmers can incorporate a large source of protein into their meager diets. Aquaponics can be used to grow crops that form a large portion of South Sudanese diet such as: beans, peanuts, and cassava. Although the fruits and vegetables do not comprise a major portion of the South Sudanese diet, the implementation of aquaponics can change this situation. According to Ken Konschel, founder of Aquaponics Africa, who set up fish-farming labs in Zimbabwe and South Africa, “a large variety of herbs and vegetables can be grown in any climate through the nitrogenous wastes of fish.”(Aquaponics Africa). Additionally, for those who like meat, fish provide an ample source of protein and Omega-3. Humid landscapes across the country can also utilize this discovery. The humid climate would cut costs on heating systems for the fish and the recirculation of water would benefit communities where water is scarce. Aquaponics only requires 10% of the water used for terrain farming. This reduces the financial strain placed on a rural farmer. In an estimate made by the Africa Aquaponics Association in Kampala, Uganda, feeding 9 billion people through aquaponics is estimated at 50,000-100,000 United States Dollars(Mulamata,Charles).

In 2016, Action Against Hunger, a non-profit organization stresses innovation in fighting food insecurity, helped over 100,000 displaced families across South Sudan plant small vegetable gardens. In keep with its mission of microlending, Action Against Hunger would greatly enhance its impact by creating small-scale aquaponics centers across South Sudan. In a country where fertile farmland has burned with the scars of war, aquaponics facilities reduce the wait time needed to address the ongoing food access crisis.

Additionally, unlike farming on land, aquaponics isn't as mentally or physically straining. The South Sudanese women will be liberated of the painstaking drudgery of hand-farming. Backaches and spinal curvatures can be avoided with this safe, secure approach of farming. Aquaponics would evade the need to travel painstaking amount hours of hours on foot to market places in the violent city. According to pineapple farmer, Marko Bagayowya, farmers cannot risk transporting their products on large scale due to frequent, deadly street outbreaks near the capital of Khartoum(Alfred, Charlotte). Bagayowya and his wife Susan are natives of South Sudan, who have been utilizing aquaponics to produce pineapple juice and peanuts for their community of Tambura. It is initiatives such as these that must be ardently encouraged by the FAO. While it is inevitable that hunger will persist in an unpeaceful South Sudan, initiatives like Tambura's will ensure an adequate food source among the numerous tribal communities who currently lack such a basic need. Villages and cities in South Sudan can utilize aquaponics within the environs of their homes. Eventually, scientific change in the country will feed social change.

Project Education South Sudan(PESS), initiated in 2005, would greatly enrich its mission and the quality of life in South Sudan by scaling-up its farming initiatives, particularly in aquaponics. Founded by Daniel Majok Gai, a native of South Sudan who has chosen to return from the United States to his native country to empower his people, this organization effectively encourages local community leaders of the country. PESS's success is due in part to its genuine origins, as it was founded by a man who lived and breathed South Sudan's struggle for succession. The people of South Sudan can connect with Gai's authenticity because they know he cares for his country. In the past, PESS has focused heavily on

educational initiatives in South Sudan by constructing three schools and inspiring young women to take up roles in student government.

By incorporating aquaponics instruction into their educational outreach program, PESS can further invigorate its ultimate mission to help the South Sudanese people thrive. Aquaponics education will help the country's farmers gain a solid understanding of efficiency in agricultural science and inspire them to seek out similar opportunities. By personally interacting with female farmers, encouraging them to put aquaponics into action, and stressing the opportunity for women in a third world country to be plant science pioneers, PESS will catalyze a social and scientific revolution. Since female farmers are a long-standing, deeply rooted tradition in South Sudan, it is vital that they utilize their agricultural roles to further leadership opportunities. According to WorldConcern.org, there are currently no methods for year-round farming in South Sudan. If South Sudanese women learn to feed a country steeped in starvation, they will gradually gain more respect in the society. It is the responsibility of PESS to be a role model and expose these women on the need to enact change within their realms. In addition, PESS should recruit South Sudanese men to join the aquaponics mission. The years of segregation between the sexes have thickened the social divide. While it may be an organization of humble origin fighting hate in a dangerously violent country, the power of grassroots organizations like PESS are unparalleled. They are the trailblazers for aid provided by supranational organizations such as the United Nations, Amnesty International, and many others. The spread of aquaponics is destined to begin through village interactions and eventually morph into nationwide phenomenon that will shatter hunger in South Sudan, and promote peace among the Sudanese.

Non-governmental humanitarian organizations such as the International Red Cross, are sweeping the South Sudan, setting up clinics in swamps. The famine has had its direst consequences in these swamps, where people are surviving by "chewing on water lilies" (United Nations). As of March 2017, The World Food Program has provided food to over 338,000 South Sudanese families in South Sudan's key areas of famine. (United Nations). In addition, sanitation kits, nutritional supplements, and livelihood assistance have also been air dropped into these regions.

While South Sudan is an impoverished country, with a lack of resources to support the population, the biggest obstacle is knowledge rather than money. Physical help, no matter how big or small always trumps financial aid in its impact. The aid with the greatest sphere of impact would be physically teaching community leaders plant science methods such as aquaponics. While the airdropping relief methods currently most useful in acute measures, it's vital that there be long term plant science initiatives put in place that prevent a famine of such severity in the future. Airdropping equipment to build an aquaponics lab could lend itself to providing a long-term solution, granted that agricultural educators are willing to teach the South Sudanese how to utilize the lab. The United States must send envoys who will enable the South Sudanese to become a self-sufficient population. While the United States is currently facing a tough economy back home, it is important that we don't repeat the deadly mistake of ignorance during the Rwandan genocide. Signs of genocide fill the streets of South Sudan, and we cannot let time be the ultimate truth-teller. Although the United States should not take sides in an ethnic war, we must help the innocent citizens of the world who are on the brink of their last hours.

Per the United Nations, it will take over 1.6 billion United States dollars of funding to feed the current famished population of South Sudan (Sudan Tribune). Funding will be temporary solution, whereas aquaponic implementation will be a permanent one. The World Food Program should tame this escalating crisis by sending envoys to instruct South Sudanese famers on aquaponics. Along with the currently imported food, the United Nations should begin airdropping materials needed to build an indoor aquaponics labs. The introduction of the labs should begin in currently existing international relief camps to stimulate interest in the South Sudanese population itself. It's clear that there is a lack of plant science, given that the famine can reach its apex. The educational aspect is already late, but it's time for the non-governmental organizations place an emphasis on aquaponics before it is too late.

The plant science solution is not new to the international aid organizations. In 2011, a hauntingly similar situation occurred in Horn of Africa. The East Africa Drought left over 11.5 million people in need of food aid in Djibouti, Kenya, Somalia, and Ethiopia (Earth Observatory Nasa). In Kenya, the price of grain rose 30-80% above average(BBC). The Al-Shabaab terrorist group rebelled against foreign aid, causing a ruckus in southern Somalia. Carcasses of people and animals were found in the desert sands. Amid this tragedy, the greatest source of sustaining aid was provided through plant science. The East African people were taught to build strategic canals and harvest plant seeds that provided greater yields. According to the U.N. Office of Coordination of International Affairs, the U.N. and the United States partnered to help dig wells deep into the ground to promote water flow in the canals(Fajarado). According to agricultural economist, Patti Kristjanson, Kenyan farmers planted crops with shorter lifecycles to minimize drought impact. Additionally, half the farmers planted trees to minimize erosion, thus increasing soil and water quality in the area. However, since there was a scarcity of water, aquaponics was not the adequate solution in Kenya. It was these long-term initiatives that truly redefined life in the Horn of Africa.

Today, South Sudan is facing an almost identical crisis. But, unlike East Africa, the Nile River runs through South Sudan. The Nile river is an unparalleled resource for the spread of aquaponics. Village leaders could easily take on this method of crop production, enabling them to feed their people. The population would be provided with an ample source of vitamins they lacked before. Painstaking hours of labor and injuries in the fields could be avoided. The process begins with educating the local leaders. The international community must convince the rural families of South Sudan to tap into their invaluable river resource and abundant fish supply. As Former USDA Under Secretary Rajiv Shah wrote in March 2017, “There is no more powerful tool for creating healthy, prosperous, stable societies than education. We need to continue to seek evidence-based approaches and innovative solutions to providing engaging learning opportunities for the world’s most vulnerable children.” Shah’s quote embodies a call for aquaponics in South Sudan. Nowhere in the world is plant science education currently more vital than in South Sudan. By efficiently exterminating their famine, South Sudan will resolve its internal strife. Now is the time to translate Norman Borlaug’s vision to innovate and mission to end hunger into reality.

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