Marissa Duarte

Union County Vocational High School

1776 Raritan Rd, Scotch Plains, NJ 07076

United States

Multi Tiered Solution to Protein- Energy Malnutrition in South Sudan

South Sudan, the World’s newest country, is located in Eastern Africa. The quality of life for people living in this country is poor. The ongoing corruption and violence within the country forces its citizens to be displaced, increases economic strain, and causes food scarcity. This has caused a majority of the people living in South Sudan to suffer from extreme Protein Energy Malnutrition (PEM). The country, which is in dire need of an immediate solution that is accessible to people of all ages, could implement an effective multi-tiered solution that combines the use of Gizera baby formula, Ready-to-Use Therapeutic Food (RUTF) packets, and fortified foods. In addition, to ensure that the improvements in nutrition are long-lasting, the solution also needs to address the economic instability, so that the population is able to purchase additional food.

After six years of fighting for its sovereignty from Sudan, in 2011, South Sudan became an independent country when the Comprehensive Peace Agreement was implemented. As of 2023, the population of South Sudan reached 12,118,379 people. Once the country won their independence, its citizens were faced with extreme food insecurity caused by displacement during the civil war. The country is currently governed by a democratic republic. However, the government is young and inexperienced in how to establish and run itself. The current government and economy are not fully stable, which allows for a great deal of corruption to occur. This corruption has prompted an enduring power struggle between leaders, causing constant violence, and disputes throughout the country. This continually forces people to be displaced and have to relocate. These people are mainly families who could own farmland and grow crops if they did not need to flee their homes and abandon their lands.

South Sudan has a tropical climate, meaning that it is very warm with a median temperature between 64 and 80 degrees Fahrenheit. The country also experiences severe dry and rainy seasons. The soil in South Sudan is exceptionally fertile and advantageous for growing many crops. In particular, some commonly grown crops are grains, such as finger millet and sorghum. However, only 4% of the land is productive and used for this purpose; while 41% is used for pastures. Of the people who live in the country, “85% of households cultivate land and 65% own cattle”1, while a small group works to extract oil. Most households in South Sudan practice subsistence farming to provide food for their families. The average farm size ranges between 0.99 to 4.2 acres2, which is extremely small in comparison with farms in the United States which average 445 acres. These small sized farms result in low productivity and little to no food abundances to sell. Nutritious food is slightly more accessible to those who are living in urban areas of South Sudan in comparison to rural areas. This is because the people who are living in urban areas are generally wealthier, allowing them the ability to afford improved nutrition. The country's GDP is amongst one of the lowest in the world, as it was estimated to be about 6 billion dollars in 20213. Its exports are heavily reliant on petroleum oil that is available in the country’s north. Up to 80% of its international export revenue comes from petroleum oil, while the country mainly imports cars and other machinery4.

In South Sudan, the average home is a one room hut that does not have access to electricity and has a designated cooking area outside. It includes 8.7 people5 and only earns an income of 460 USD annually6, which is an extremely low income with which to feed a family. Additionally, the country’s national currency has depreciated in value, which further reduces a family’s purchasing power. Therefore, even if there is food available on the market, the average family cannot afford to purchase it. Since most families do not have access to food from a market, they practice subsistence farming and they often only consume the foods that they grow. This causes the population to eat a diet with meals based around sorghum and finger millet, so people are primarily consuming carbohydrates and have little to no meal variations. When there is little to no variety in meals or daily consumption, it causes a lack of nutrients. The high-carbohydrate diet that the South Sudanese consume leads to high rates of Protein- Energy Malnutrition (PEM), since people’s diets lack enough protein and calories, as well as essential vitamins and minerals, to grow and develop. PEM is an extreme form of malnutrition that is caused when someone lacks enough energy due to a deficiency in calories, protein, macronutrients and micronutrients.

In addition to food being scarce and PEM rates in South Sudan being among the highest in the world, people do not have access to adequate healthcare, clean water, sanitation, and electricity, which further exacerbates the situation. There are only 400 operational medical centers in the entire country7, compared to the 3,706 medical centers that exist in Ethiopia, a neighboring country similar to South Sudan. However, even if medical services were available, they would be inaccessible to the majority of people because they would be unable to afford these services. Therefore, most people would not be able to receive treatment for PEM. Access to other essential services such as clean water, sanitation and electricity are limited. For example, 14% of the population does not have access to clean drinking water, 88% do not have access to clean sanitation and 98% do not have access to electricity. Due to ongoing violence within the country and corruption in the government, these problems are continuing to be exacerbated and a solution is needed to combat PEM. 8

Education is another factor that impacts food accessibility. In South Sudan, the education rate is extremely low, with 80% of the population not having any form of formal education. This impacts food accessibility for families because those who have received higher education may be able to work for higher paying jobs, which would increase their income and access to food. Also, with increased education, people can learn how to better care for crops, which can increase their yields and help them produce higher quality foods. Therefore, increased education could then lower a family's hunger and increase their economic status.

In South Sudan, around 6 million of the 11.7 million people in the population facing hunger and malnourishment.9 The population most affected are children, of which 1.65 million are malnourished.10 While these rates usually tend to improve for most countries over time; however, South Sudan’s malnourished population has increased in recent years. Corruption in the government has caused the country's economy to decline and this impacts the cost and availability of food. Since food for many families is so scarce, people, especially children, are lacking calories, protein, and many nutrients such as vitamins A, B, Iron, magnesium and zinc. PEM is severe especially when present in children and it leads to low body weight, stunting, kwashiorkor, Marasmus, weakened immune system and death within up to 30% of children diagnosed.

However, there is a solution that can be used in South Sudan to help combat malnutrition in children, as well as the rest of the population. This solution is multi-tiered and addresses the nutritional needs of the people in South Sudan by different age groups. Initially, the solution would involve providing Gezira formula as a supplement for children who are under 5 years old. Then, ready-to-use therapeutic food (RUTF) packets would be provided as a supplement for older children, and finally fortified food nutrient packets would be provided for adults. Gezira formula is a baby formula that is made of dried skim milk, sugar, cereal flour, vegetable oil, a mineral mix and water.11 It is extremely similar to traditional baby formula that is given to children all over the world except it has additional nutrients and supplements added to it. These include magnesium, Iron and Vitamin A, which are commonly missing in the traditional South Sudanese child's diet. This formula has been implemented in a hospital in Sudan and has shown extremely promising results in helping children recover from PEM. In the study that was conducted at the hospital, there were many infants who were able to reach a healthy weight after an average of 18 days of using Gezira formula treatment.11 An issue that arises when implementing this is that hospitals are difficult for many people to access. In addition to the fact that there are very few hospitals in South Sudan, the constant violence within the country makes it difficult for many displaced families to access hospitals. If the Gezira formula was made accessible to families outside of hospitals, it could be given to babies and used as a supplement to make sure that they receive the proper nutrition that they need. If a mother is malnourished, then they are unable to give their baby all of the nutrients that it needs through breastfeeding, so the Gezira formula could provide the extra nutrients that the babies are deficient in.

 A promising treatment for older children with PEM is RUTF packets. RUTF packets are a peanut butter based product that contains, full-fat milk powder, sugar, peanut butter, vegetable oil, vitamins and minerals.12 It is high in calories and protein, as well as other essential nutrients that malnourished children are lacking. Because of its small size, it is easy to store and it is easily digestible by children whose stomachs are not able to handle large amounts of food. In addition, it does not require refrigeration and has a long shelf life, so it can be easily transported and distributed to families. Another name for this product is Plumpy’Nut and has been used with great success in similar countries in Africa, such as Niger and Ethiopia. Additionally, fortified foods should be provided to the adult population as a treatment and preventive solution to PEM. Both men and women could sprinkle a supplement packet onto meals to enhance their nutritional value after being prepared. Packets like this have already been implemented by humanitarian organizations all over the world and can be personalized to fulfill the specific nutritional needs of a region. A further benefit of providing these packets would be increased nutrients available to lactating women who would then produce higher quality and quantities of milk for their children.

Implementing these solutions into South Sudan is actually very viable and can be done through the help of powerful countries, as well as humanitarian organizations working together. The main organization that would support these efforts to nourish South Sudan would be UNICEF which has already been working in South Sudan and has many distribution centers and hospitals in the country. They could easily begin to distribute Gezira formula to babies, RUTF packets to children suffering from PEM and nutrient packets to families. All three of these treatments require no formal training to use, but have impeccable success. The distribution process for these solutions would have to be carried out once multiple distribution sites are chosen throughout the country. These sites will be chosen based on where there is the most need and where organizations will be able to reach the most people. Once sites are choses then it is possible for organizations such as UNICEF to send these shelf stable products to the selected sites. When products are received at sites then aid workers can be trained and will be able to organize its distribution to the people who need them most. In addition to humanitarian organizations assisting South Sudan to combat PEM in children, there are also powerful countries that would be inclined to support these efforts due to the economic benefits that they could gain from it.

Another significant step in helping combat malnutrition in South Sudan would be to improve the economic situation. Since South Sudan is a country that is extremely rich in petroleum oil, this could be used to increase the wealth of the country. China, who is the main consumer of petroleum oil from South Sudan, purchases the oil for extremely discounted prices because they dominate the industry there. However, if other countries began purchasing oil from South Sudan, this would create healthy competition for the county’s resources. This competition would increase demand for South Sudanese oil in turn increasing its value. South Sudan would be able to take advantage of the increased earnings and the government could invest more money into improving their infrastructure and increasing access to healthcare and education. Access to better healthcare would play an important role in the treatment of PEM since severely ill patients could receive specialized treatments from hospitals and doctors. It would also increase specialized medical treatment for individuals, improving overall quality of life. The country's people should be better educated in proper nutrition and ways to improve farming practices. Better nutritional education for people is an important preventive measure to combat PEM before it occurs. Improved education in farming practices causes higher crop yields and a population that is more knowledgeable in growing a wider variety of crops. If people are able to produce higher quantities of crops, then they will have less reliance on emergency food supplements from humanitarian organizations, like UNICEF, and may even produce surpluses that they can take to market and sell. This leads to an increasing GDP and allows people to have more money to spend on buying quality nutrient dense foods.

In conclusion, ongoing corruption and violence in South Sudan cause its citizens to be displaced and increase economic strain and food scarcity. This has caused a majority of the people living in South Sudan to suffer from extreme Protein Energy Malnutrition. The country should implement a multi-tiered solution that addresses the immediate needs of its people, as well as working to address the larger problems that the country is facing. An effective solution is the combined use of Gizera baby formula, RUTF packets, fortified foods and increasing demand for oil in the region. Regardless of education and social status, these solutions can improve the life of all citizens in South Sudan. When this solution is implemented with the assistance of humanitarian organizations such as UNICEF, it will drastically decrease the rates of PEM and help to stabilize the country’s economy effectively preventing extreme PEM in the future.

Works Cited

*1 Republic of South Sudan Ministry of Agriculture, Forestry, Cooperatives ...*, faolex.fao.org/docs/pdf/ssd149325.pdf. Accessed 7 Feb. 2024.

2 “Development of Agriculture in South Sudan .” *South Sudan: An Infrastructure Action Plan*, www.afdb.org/fileadmin/uploads/afdb/Documents/Generic-Documents/South%20Sudan%20Infrastructure%20Action%20Plan%20-%20%20A%20Program%20for%20Sustained%20Strong%20Economic%20Growth%20-%20Chapter%206%20-%20Development%20of%20Agriculture%20in%20South%20Sudan.pdf. Accessed 7 Feb. 2024.

3 O’Neill, Aaron. “South Sudan - Gross Domestic Product (GDP) 2018-2028.” *Statista*, 23 Nov. 2023, www.statista.com/statistics/727342/gross-domestic-product-gdp-in-south-sudan/.

4 “South Sudan - The World Factbook.” *Central Intelligence Agency*, Central Intelligence Agency, www.cia.gov/the-world-factbook/countries/south-sudan/. Accessed 7 Feb. 2024.

5 “South Sudan - Inter Sectoral Needs Assessment Report- Rural Component (September 2022).” *South Sudan - Inter Sectoral Needs Assessment Report- Rural Component (September 2022) | Displacement Tracking Matrix*, dtm.iom.int/reports/south-sudan-inter-sectoral-needs-assessment-report-rural-component-september-2022#:~:text=Among%20the%20total%2C%2053.8%20per,member%20answered%20on%20their%20behalf. Accessed 8 Feb. 2024.

6 “Country Comparison: South Sudan / United States.” *Worlddata.Info*, www.worlddata.info/country-comparison.php?country1=SSD&country2=USA. Accessed 8 Feb. 2024.

7 Glinski, Stefanie. “For Medical Workers in South Sudan’s War, Just Reaching the Sick Is a Challenge.” *UNHCR Web Archive*, webarchive.archive.unhcr.org/20230522005821/https://www.refworld.org/docid/5b740111a.html. Accessed 8 Feb. 2024.

8 “Poverty & Equity Brief South Sudan .” *Global Poverty SSD*, World Bank Group, Apr. 2021, databankfiles.worldbank.org/public/ddpext\_download/poverty/987B9C90-CB9F-4D93-AE8C-750588BF00QA/AM2020/Global\_POVEQ\_SSD.pdf.

9 “Food Assistance Fact Sheet - South Sudan: Food Assistance.” *U.S. Agency for International Development*, 28 Feb. 2023, www.usaid.gov/food-assistance/south-sudan.

10 “South Sudan: IPC Acute Food Insecurity and Malnutrition Snapshot l September 2023 - July 2024 - South Sudan.” *ReliefWeb*, 6 Nov. 2023, reliefweb.int/report/south-sudan/south-sudan-ipc-acute-food-insecurity-and-malnutrition-snapshot-l-september-2023-july-2024#:~:text=Between%20July%202023%20and%20June,Moderate%20Acute%20Malnutrition%20(MAM).

 11 Ahmed, Hassan Mohamed, and Sawsan M Ahmed. *Gezira Journal of Health Sciences Vol.2(2) 2006 - Core.Ac.Uk*, 31 May 2006, core.ac.uk/download/pdf/288210333.pdf.

12 2005, Project Update12 August. “Africa’s Miracle Food: Plumpy’nut: MSF.” *Médecins Sans Frontières (MSF) International*, www.msf.org/africas-miracle-food-plumpynut. Accessed 7 Feb. 2024.

Ahmed, Tahmeed. “Protein-Energy Malnutrition in Children.” *Hunter’s Tropical Medicine and Emerging Infectious Diseases (Tenth Edition)*, Elsevier, 28 May 2019, sciencedirect.com/science/article/abs/pii/B9780323555128001435?via%3Dihub.

Buechner, Maryanne. “To Improve Kids’ Nutrition, a Little Sprinkle Goes a Long Way.” *UNICEF USA*, 15 Oct. 2019, www.unicefusa.org/stories/improve-kids-nutrition-little-sprinkle-goes-long-way.

HE, el Bushra. “Vitamin A Deficiency in Sudan: A Call for a Surveillance System.” *East African Medical Journal*, U.S. National Library of Medicine, pubmed.ncbi.nlm.nih.gov/1644048/#:~:text=There%20is%20evidence%20that%20vitamin,famine%20conditions%20and%20civil%20unrest. Accessed 7 Feb. 2024.

Olson, Rebecca, et al. “Food Fortification: The Advantages, Disadvantages and Lessons from Sight and Life Programs.” Edited by Ganmaa Davaasambuu, *National Library of Medicine* , 13 Apr. 2021, www.ncbi.nlm.nih.gov/pmc/articles/PMC8066912/.

“Quick Facts.” *Ministry of Agriculture and Food Security South Sudan*, mafs.gov.ss/quick-facts/#:~:text=South%20Sudan%20is%20blessed%20with,percent%20is%20currently%20being%20cultivated. Accessed 7 Feb. 2024.

“Requested FY 2012 Requested FY 2013 South Sudan - Climatelinks.” *South Sudan Climate Vulnerability Profile*, www.climatelinks.org/sites/default/files/asset/document/south\_sudan\_climate\_vulnerability\_profile\_jan2013.pdf. Accessed 7 Feb. 2024.

Schofield, C, and A Ashworth. “Why Have Mortality Rates for Severe Malnutrition Remained so High?” *Bulletin of the World Health Organization*, U.S. National Library of Medicine, 1996, www.ncbi.nlm.nih.gov/pmc/articles/PMC2486901/?page=3.

Schoonees, Anel, et al. “Ready‐to‐use Therapeutic Food (RUTF) for Home‐based Nutritional Rehabilitation of Severe Acute Malnutrition in Children from Six Months to Five Years of Age.” *National Library of Medicine* , 15 May 2019, www.ncbi.nlm.nih.gov/pmc/articles/PMC6537457/.

“South Sudan: World Food Programme.” *UN World Food Programme*, www.wfp.org/emergencies/south-sudan-emergency. Accessed 7 Feb. 2024.

*United Nations Development Programme*, www.undp.org/sites/g/files/zskgke326/files/2022-12/South%20Sudan%20Agriculture%20Value%20Chain%20Study\_UNDP\_Print.pdf. Accessed 7 Feb. 2024.