

Elizabeth Lesko
Susquehannock High School
Glen Rock, PA
Sudan & South Sudan, Factor 1

Sudan & South Sudan: Introduction of GM crops to increase yields and engender autonomy

Sudan and South Sudan are two sovereign countries in northeastern Africa located at the source of the Nile River, where the White and Blue branches of the Nile begin to converge, providing the countries with their only major source of fresh water. The environment of Sudan is largely arid, and farming relies on seasonal rainfall or irrigation from the rivers. South Sudan is slightly more suited to agriculture, with more arable land, though water is still scarce. The majority of the population lives in rural communities and is involved in subsistence farming, with only a small percentage involved in industry or services. The HIV/AIDS prevalence rate in both countries is below much of Africa, and is therefore not considered severe compared to most of the world. The major religion in Sudan is Islam, though Christianity has a strong presence in the southern part of Sudan and South Sudan. Most of the northern population and government is Arab, while much of the population in southern areas is black. The major divides in religion and ethnicity based on region have created conflicts including civil wars involving Darfur, and South Sudan's secession. This has resulted in thousands of refugees throughout both countries, putting a strain on the farms to provide enough sustenance for the entire population, and, as a result, hunger is rampant throughout the countries. In recent years, this hunger has become an even greater problem due to widespread crop failures caused by drought, disease, and pests. Malnutrition is also widespread in both Sudan and South Sudan, as the climate is not suited to widespread cultivation of many types of fruits and vegetables, and not all farms grow all of the varieties of food necessary to a healthy diet.

The majority of the Sudanese are subsistence farmers, though large populations of refugees also reside in the country due to civil conflicts. Most farm families are fairly large and exist in small communities of extended family with uncles and cousins in addition to a married couple, children, and parents. Women are often restricted to the domestic life but are heavily involved in agriculture and often do much of the field work. Most farms are run by a village, and farm size is small compared to the population; about one hectare per family. One hectare is insufficient for any family to live on, as the average amount of land necessary per person is considered to be over two hectares. The major rain-fed crops are sorghum and millet, with the most common animals being donkeys, goats, sheep, poultry, and cattle. Wheat, legumes, vegetables, spices, maize, and dates are also grown in some regions. Diet is based on the local availability of foods and those grown by the community. Therefore, there is a heavy reliance on cereal grains and legumes. Consumption of animal products varies by region, with the most common being beef and dairy, goat, and poultry, though fish is the most popular in regions with access to fisheries.

The level of education is generally low, with an average of four years expected school life for men, and a literacy rate around 60%, with greater male literacy. Healthcare is poor, with few trained doctors and extremely low availability of hospitals or professional care for rural families. The types of agriculture can be divided by irrigation, with irrigated agriculture existing only in areas near Nile and its tributaries, and rain-fed agriculture elsewhere, where most subsistence farmers live. Few low-impact or modified types of agriculture are widely practiced despite the low rainfall in much of the country, and many other barriers exist against improving agricultural productivity, including very little infrastructure, poor education, little healthcare, few advanced sanitation techniques to protect against water-borne or food-borne disease, discrimination, conflicts resulting in large numbers of refugees, and a climate poorly suited to agriculture.

Much of Sudan and South Sudan has very little infrastructure, meaning that most farm families have little to no access to decent markets, healthcare, education, or various other services available in the more developed or urbanized regions. This includes poor access to clean water for consumption or irrigation.

The average distance to urban centers available to provide education and healthcare is far enough to hinder the spread of education and literacy to more isolated farm communities such that secondary education is rare. The lack of healthcare and quality sanitation in more isolated regions also lowers life expectancy and quality, hindering development. These problems are major barriers to the spread of improved agricultural education and practices, preventing rapid development of agricultural productivity.

Sudan and South Sudan have many problems with discrimination and interior conflicts between ethnicities and religions, surfacing with the recent conflicts in the North-Western region of Darfur. This has resulted in large numbers of refugees in need of food, putting a strain on the already limited resources available. Discrimination of women also hinders the development of the workforce and creates another barrier. By far one of the largest barriers to improving the agricultural productivity of Sudan and South Sudan is the climate. The poor rainfall and above average temperatures of many regions in Sudan limit the types of crops that can viably be grown for consumption or export, as well as the amount available. Although drought-resistant strains of the crops regularly grown in these regions are available and in use in some places, genetically modified varieties that could further improve agriculture are under suspicion, and very few are allowed into the country in the form of aid, let alone for use in agriculture.

In recent years, crop yields in Sudan have dropped due to extended droughts and other environmental issues. While most crops grown in Sudan are naturally adapted to arid climates, the country would benefit from research investigating crop varieties with high drought resistance, and implementing these crops throughout the country in smaller farm communities where irrigation is rare. Few crops are capable of being grown by subsistence farmers in Sudan, so biological and nutritional diversity is limited, leaving farmers subject to crop failure in the event of drought, disease, or pests that target one of their crops. Without access to improved crop varieties, the farm communities that are common in Sudan suffer from poor productivity. Currently, several organizations are attempting to remedy the issue of poor resistance in crops to drought and disease, with some organizations implementing improved farming techniques that trap water and others aiding in research and implementation of improved or genetically modified (GM) crop varieties suited to Sudanese agriculture. However, due to the strong presence of the European Union in both countries, GM foods are generally not allowed into the countries either as aid form or crops to be grown, creating a barrier to improving productivity through GM crops. With the strain of feeding thousands of refugees from limited resources without GM foods, the situation is becoming severe.

Sudanese farmers often use crops such as maize and sorghum that are available in drought-resistant varieties elsewhere in the world. Several countries in Africa, including Ghana and Malawi, use new GM varieties such as Quality Protein Maize varieties and ZMs 309 and 523. Many varieties of non-GM strains even more resistant than the genetically modified version have already been released for farmers in Africa. Only a few years ago, in 2009, the winner of the World Food Prize, Dr. Gebisa Ejeta, introduced a non-GM drought- and disease-resistant sorghum for use in Sub-Saharan Africa. The continuation of such developments into crops such as cotton or wheat would be highly beneficial in providing higher nutrition and a stronger variety of one of Sudan's cash crops. While breeding new strains of crops without artificially altering the genes is often a more stable and safe science, possibilities are limited when relying on natural gene mutations that may not be beneficial. With genetic engineering, traits such as drought resistance can be generated more rapidly through inserting known genetic sequences into normal crops than in crossbreeding experiments hoping to achieve similar results. Because GM crops have the potential to offer higher nutrient content in addition to resilience more quickly than traditional methods of breeding, they offer a choice in Sudan and South Sudan that is of greater benefit in the short term than developing non-GM crops with the same improvements through natural methods.

The implementation of naturally drought resistant crops in high-yield high-nutrition GM varieties, specifically maize, would provide better nutrition to subsistence farmers and their livestock. Many crops grown in Sudan, including cotton, require further research to create the best-suited strain for non-irrigated

farms, but could provide great opportunities for subsistence farmers. Implementing GM cotton varieties that could reasonably be grown on smaller-scale farms as other GM crops provide surplus food would allow small subsistence farms to grow and begin to take part in the economy and government, strengthening autonomy as well as solving hunger.

Sudanese subsistence farmers would benefit from being given the choice to adopt or reject GM crop varieties. Most distrust of GM foods stems from a lack of knowledge, so education about new types of crops, provided by organizations already working towards introducing water-saving farm practices, could encourage farmers to adopt GM crops if they were made available. These organizations could gradually introduce GM crops to farming communities that have already accepted new farming practices, as these farmers would be more open to trying new crops after they have already seen the benefits of other non-traditional farming practices. The organizations could also promote GM crops to farmers by describing their success in other countries, as well as emphasizing that such crops would not only require no additional work, but may also cut back on labor. Farmers who are already adjusted to farming arid land could help spread GM crops to less open-minded communities, and may have an easier time persuading other farmers to adopt the crops due to their personal experience with farming before and after the use of GM varieties.

The governments of both countries could also help subsistence farmers adopt these ideas by starting projects to build infrastructure, allowing isolated farmers to access the more populated areas of the countries, where new ideas are more accepted, and practices such as voting are available to allow farmers a voice in the government and economy. This could help farmers improve their education and accept new technologies deemed controversial, such as GM foods, retaining the ability to decide their own stance and have a voice in government when possible. The farmer could reject GM crops and opt for non-GM breeds, providing an incentive for non-GM research such as selective breeding. However, acceptance of GM foods could be increased across the country by providing facts about the development and testing of GM foods such that concerns based on non-scientific claims are eradicated, as these concerns are the basis of the majority of fear surrounding GM foods, such as that the crops can alter human DNA or may suddenly become toxic. Both of these claims are widespread, even in highly developed countries, and ridiculously unlikely to the point that neither claim should be a concern.

Without the benefits of resilient crops to lessen the strain on already poor farmlands, desertification is an alarming issue in rain-fed agricultural areas where many subsistence farm communities are struggling with drought, further exacerbating the problem of poor agricultural productivity. The rural poor are at a disadvantage, with little say in the government decisions to forbid GM crop varieties that could be beneficial, due to their distance from highly populated areas possessing more direct access to the government and polls. Because Sudan and South Sudan are still considered developing countries, they are disadvantaged by the influence of supranational powers, such as the European Union, more concerned with the ethics of GM foods than with solving the rampant problem of hunger. In reality, improving the quality of life of the poor and hungry in these countries should take priority over the slight possibility that certain varieties of GM foods may not be safe in the long term. Without the benefits that GM crop varieties could provide, it could take much longer to solve the problems of hunger and malnutrition in countries currently bordering on severe hunger statuses.

As more GM crops are reviewed and more drought-resistant crops become available to world markets, this situation has begun to show signs of improvement. However, farmers are still struggling to produce enough food and have little to no access to urban markets or modern conveniences, belying the trends in acceptance of GM foods. Trends in research and breeding as indicated by new developments are certainly improving, with drought-resistant maize varieties developed in past years and Monsanto's first GM drought-resistant maize approved for the United States in 2011. Similar trends are occurring with other crops such as sorghum, and while the improvements are not necessarily measurable, they are certainly

occurring. Unfortunately, technology improvements are counterbalanced by stagnation in economical and infrastructure improvements due to recent conflicts and the official secession of South Sudan. Overall, the situation for subsistence farmers is staying much the same, with some indications of future improvement.

Improving the infrastructure necessary for the spread of new techniques and crop varieties as well as research into higher-yielding crops that are nutritious and drought resistant would greatly increase the amount of food available to Sudanese subsistence farmers and their communities. With increased crop yields, more food would be available to assist in feeding the thousands of refugees in Sudan, and farmers could even begin pulling an income by selling extra crops. Because excess food aids development, the economy would receive a boost from farmers that are able to expand past subsistence farming. In the pattern of development, expansion follows the ability to direct energy towards activities beyond survival, and thus farmers would have the means to an education and communication with the wider world if drought-resistant crops and new ideas were to become available to the isolated subsistence farms. This would likely lead to specialized farms that grow crops for export as well as consumption, engendering a high-functioning economy and reducing poverty overall as jobs associated with trading and industry become necessary. People in urban and rural areas alike could improve their quality of life, and women would have the means to reach out beyond the household as urbanization occurs. Essentially, with hunger reduced, Sudan and South Sudan would be free to follow the stages of development and industrialization.

Environmental degradation is a major concern in Sudan as poor farming practices and little irrigation result in desertification and nutrient depletion. Crops that require little water are less likely to deplete the soil when paired with water- and nutrient-conserving farming practices that are already beginning to spread throughout Sudan and South Sudan. Drought-resistant crops help preserve the remaining arable land while subsistence farmers improve their yields and infrastructure is developed in more isolated regions. Unfortunately, water scarcity is not likely to improve, but with an improved economy pipelines and irrigation systems could be put in place to gradually remove rain-fed agriculture in a sustainable way, such that farming can exist without degrading the land. Climate change may cause future food insecurity in extreme circumstances but, with crops suited to harsh environments, the farms in these countries are likely to suffer less than those unprepared for harsh conditions. Thus climate change may be a concern, although not in the very near future nor on the same level as environmental degradation.

While population growth is a global concern that could put pressure on the limited resources both in Sudan and South Sudan, introducing superior GM crops could help combat this in the short term while the countries develop. After a few decades of development, population growth is less of a concern, due to better education and access to population control methods including birth control. The increased women's rights that generally come with development, as in the case of the most developed countries today, will also help to negate the issues of population growth and overcrowding. Urbanization will be greatly beneficial to Sudan and South Sudan, as it will provide needed infrastructure, including basic electricity and plumbing. Pollution will not be a major issue until the countries develop further, and will, along with increased energy demands, be solved more easily by technologies developed in other countries.

The most effective way to address food security in Sudan and South Sudan would be to provide farmers with access to improved crop varieties. However, due to a lack of roads and transportation in many parts of both countries, this would require infrastructure developments. The Millennium Development Goals (MDGs) established by the United Nations in 2000 address many issues, including hunger, education, and women's rights. In the past several years, these goals have expanded to include policies intended to spur lesser developed countries such as Sudan and South Sudan to achieve progress in these goals by 2015. One of the most vital pieces to gaining success with the MDGs is the development of proper infrastructure such that all parts of such countries as Sudan and South Sudan are accessible, with decent sanitation and living conditions. Therefore, investing in MDGs and policies involving road development and lines of communication is a priority to help permanently solve hunger in Sudan and South Sudan.

While infrastructure is important for the complete eradication of hunger, in the short term it is not the most viable solution to the current demand on food in Sudan and South Sudan. The recent conflicts and resulting refugees, in addition to failed harvests and pests that place added strain on both countries' resources, have attracted the attention of many volunteer and nonprofit organizations offering food aid. Organizations such as the World Food Programme that have already established a strong presence in both countries providing food aid to the hungry could work to expand and refocus their efforts to include providing drought-resistant seed to subsistence farmers. These projects could use already existing lines of communication to provide farmers with access to new crops that are drought-resistant and high-yielding, and education on water-conserving farm practices, such that the relief efforts work to provide future food security as well as immediate relief. Several organizations such as Practical Action, a charity that is currently working in the Darfur region of Sudan to integrate water-saving farming techniques, are already present in Sudan and South Sudan, and could expand with funding to become a country-wide effort to eradicate hunger. The success of both of these organizations stems from their ability to directly reach the people they aim to help, focus on the most severe problems in each area, and have worldwide influence due to their size. These organizations could increase in scale and focus to include introducing GM or new varieties of crops to the subsistence farmers already being introduced to new ideas and practices.

While non-profit, non-government agencies best fit a role providing technology and new crops directly to the subsistence farmers, government and supranational organizations would be beneficial in introducing new ideas and infrastructure. The governments in Sudan and South Sudan would be helpful in starting projects to build roads and pipelines across the countries to aid communications between the government and more distant populations. This would create interest in the government among isolated communities, and allow more people to have a say in future policies, thus strengthening the democracy. Government infrastructure improvements would help to improve living conditions, education, and healthcare, allowing the countries to develop and become world powers. Supranational organizations like the European Union, United Nations, and World Bank could work to increase acceptance of GM foods, such as the European Union increasing the pace of its approval of various GM crops, and resolve inter-regional conflicts in both Sudan and South Sudan to ease development. With such issues being resolved by other organizations, research agencies, including colleges such as Purdue University in Indiana, would be free to continue developing new varieties of crops, GM or otherwise, that thrive in the harsh climates of northern Africa.

With the rapid technological developments of the past few decades, the genetic modification of crop varieties promises to provide a lasting solution to the problem of feeding a growing world. Crop varieties that are high-yielding, nutritious, and resistant to drought, disease, and pests could multiply the productivity of current farmland while simultaneously halting deforestation, desertification, and other forms of environmental degradation taking place in the hunt for arable land. In countries such as Sudan and South Sudan, however, difficulties lie in implementing these new varieties of crops. The lack of roadways and other infrastructure makes many farm communities inaccessible, cutting off communications to urban areas and hindering both development and the spread of knowledge. With careful policies implemented by the governments of these countries, projects introducing new infrastructure could spread to isolated farm communities, providing water for irrigation and allowing environmentally friendly, water-conscious farming practices and crops to reach subsistence farmers. Along with halting desertification, these new crops and practices can ease hunger and stimulate the economy by allowing the resources necessary for specialization and growth. The conflicts that halt progress and create thousands of refugees in both Sudan and South Sudan can be mediated by supranational organizations such as the European Union and United Nations that provide relief as well as a medium for peace, allowing focus to return to development and the MDGs. Hunger in Sudan and South Sudan is a multifaceted problem, and therefore requires many different parts to a solution, with the farmers working to provide the physical solution while governments work towards the developments that allow the food to reach the hungry. Thus, GM crops and research into all methods of creating superior crops is only at the base of the solution to hunger in Sudan and South Sudan, and the rest of the world.

Works Cited

- “Africa: Sudan.” *The World Factbook*. 2012. CIA. Web. 28 July 2012. < <https://www.cia.gov/library/publications/the-world-factbook/geos/su.html>>.
- Alaminos, Maria. “The EU’s Engagement in Sudan: The Convergence of Development and Security Priorities.” *New Trends in the Security and the Cooperation for Development Agendas*. 2012. IPSA. Web. 28 July 2012. < <http://www.ipsa.org/myipsa/events/madrid2012/paper/eu%E2%80%99s-engagement-sudan-convergence-development-and-security-priorities>>.
- Butcher, Mavis. “Genetically Modified Food – GM Foods List and Information.” *Fitness and Nutrition*. 2009. Disabled World. Web. 28 July 2012. < <http://www.disabled-world.com/fitness/gmfoods.php>>.
- “Do we need GM? Drought resistance.” *GM Watch*. 2012. Web. 28 July 2012. < <http://gmwatch.eu/component/content/article/31-need-gm/12319-drought-resistance>>.
- “Dr. Gebisa Ejeta.” *News*. 2009. The World Food Prize Foundation. Web. 28 July 2012. < <http://www.worldfoodprize.org/en/press/news/index.cfm?action=display&newsID=7950>>.
- “Fact sheet: Sudan - Women, agriculture and rural development.” 2012. Food and Agriculture Organization. Web. 28 July 2012. < <http://www.fao.org/docrep/V9105E/V9105E00.htm>>.
- “Farming Techniques.” 2012. Practical Action. Web. 28 July 2012. < http://practicalaction.org/farming_techniques>.
- “Food: Rumpus over GM food aid.” *IRIN: Humanitarian News and Analysis*. 2010. IRIN. Web. 28 July 2012. < <http://www.irinnews.org/Report/93991/FOOD-Rumpus-over-GM-food-aid>>.
- Gustin, Georgina. “Report questions Monsanto’s drought tolerant corn.” 2012. St. Louis Post-Dispatch. Web. 28 July 2012. < http://www.stltoday.com/business/local/report-questions-monsanto-s-drought-tolerant-corn/article_f03e2af4-af42-11e1-8572-0019bb30f31a.html>.
- “The IMF and the Millennium Development Goals.” *Factsheet*. 2012. International Monetary Fund. Web. 28 July 2012. < <http://www.imf.org/external/np/exr/facts/mdg.htm>>.
- “Race Against Time To Reach The Hungry In South Sudan.” *News*. 2012. World Food Programme. Web. 28 July 2012. < <http://www.wfp.org/stories/race-time-hungry-south-sudan>>.
- “Sudan.” *Encyclopedia Britannica*. 2012. Encyclopedia Britannica, Inc. Web. 28 July 2012. < <http://www.britannica.com/EBchecked/topic/571417/Sudan/24346/Mechanized-agriculture#toc24347>>.
- “Sudan.” *The World Bank*. 2012. The World Bank Group. Web. 28 July 2012. < <http://web.worldbank.org/WBSITE/EXTERNAL/COUNTRIES/AFRICAEXT/SUDANEXTN/0,,menuPK:375428~pagePK:141159~piPK:141110~theSitePK:375422,00.html>>.
- “Sudan / Genetically Modified Food.” *Feargal Quinn*. 2010. FeargalQuinn.ie. Web. 28 July 2012. < <http://www.feargalquinn.ie/index.php/News/Oireachtas-Committees/Sudan-/Genetically-Modified-Food>>.

“Sudan: Ten Hunger Facts.” *News*. 2012. World Food Programme. Web. 28 July 2012.
<<http://www.wfp.org/stories/sudan-10-hunger-facts-nation-goes-vote>>.

“The Sudanese Family Life.” *About Sudan*. 2012. Sudan Embassy. Web. 28 July 2012.
<http://www.sudanembassy.org/index.php?option=com_content&view=article&id=42&Itemid=\8>.

