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Tanzania: Increasing Crop Yields

Agriculture is the largest component of Tanzania's economy. With one-third of the nation's income being related to agriculture, it is the biggest opportunity for employment with its abundant resources (Otunge). Agriculture represents half of the national income and 80 percent of its labor force ("Agriculture"). But Tanzania is considered one of the poorest countries in the world with 30 percent of its population in poverty (Otunge). Africa, as a whole continent, has proven that improved crops, new techniques and quality seeds are raising African farmer's yields and incomes. Africa has begun to create improved crops and varieties such as drought-tolerant maize, rice, sweet potato and coffee. Tanzania has the ability to become a self-sufficient country with plant varieties that already exist. Through grants and sponsoring organizations, Tanzania can have opportunities for new improved varieties of crops that will benefit the country's agriculture.

In 2010, Tanzania had a population of 41.8 million (Background Note: Tanzania). Their biggest goal is to become self-sufficient as a country. In order to do this the government is working on improving transportation and making food more accessible for consumers. In recent years, the problem of producing enough for themselves has become an issue causing them to import food aid.

In Tanzania, because of the climate, they can only grow certain crops. Tanzania's climate goes from tropical along the shore to temperate in the highlands. Some of the crops that they can grow are maize, sorghum, millet, rice, wheat, beans, cassava, potatoes, bananas, and coffee. As of 2010, the top five commodities they produced are bananas, indigenous cattle meat, maize, whole and fresh cow milk, and cassavas (Top Production). Their largest export of value is coffee green followed by unmanufactured tobacco whereas for quantity Tanzania exports are cashew nuts with the shell followed by cotton lint (Top Exports).

The average Tanzania family has about 6.1 persons in the household. The higher class tends to have less people in the household and tend to live in urban areas. In more rural households they tend to have more people but they are also either younger or older than the able working age groups. Also 1.4 percent of rural households have electricity. Eighty eight percent of the average families in Tanzania, both high and low class, own land. The typical amount of land owned is 5.9 acres. For income, it is most common to have livestock and in a high-income the standard amount is 7.4 animals and in a low-income is 6.9 animals. When it comes to consumption of food, for rural households, cereals are the main meal. Sixty-five percent of the cereal that is being consumed is from their own production in a rural household. Other foods that are consumed in a low-income household are maize, seeds and pulses in contrast to higher income families where they are buying fruits, vegetables and meats (*Tanzania: Social Sector*).

There are many causes for food insecurity in Tanzania: poverty, malnutrition, and agriculture production. The causes of a non-permanent food security are unstable food production and food prices for household incomes, most likely in regions of Dodoma, Singida, Shinyanga, Tabora, Tanga, Arusha, Kilimanjaro, and Manyara. Most farm households sell their surplus product immediately after harvest creating the need to buy food from the market six to nine months later. Local production is the major source of food supply in Tanzania, averaging ninety-five percent of its food requirements.

The major reasons for scarce food availability in Tanzania are low production due to low productivity of land, labor, and other production inputs, high incidences of crop and livestock pests and diseases,

inadequate processing, storage and marketing infrastructure. These are caused by poor finance to acquire productivity intensifying inputs or capital, limited availability of support services and appropriate technologies. Pre and post harvest losses are also another effect to food availability due to climate conditions, pests or diseases. Food is not available for consumption, if inappropriate food management is used.

In order to help with Tanzania's food security, AgriSol Energy and Serengeti Advisers are contributing to develop a solution. The solutions include: the use of modern and sustainable agriculture methods and to address East Africa's food security problem. This project had plans to establish two farms (13,750 hectares) in Kigoma. However, AgriSol dropped its plan to develop land it had considered using after the company learned about problems in the Tanzanian government's removal of up to 160,000 Burundi refugees who've been living there. Instead, AgriSol is developing uninhabited land elsewhere in Tanzania on a smaller scale (Foley, Ryan J.).

AgriSol Energy and Serengeti Advisers are going to use world-class, sustainable and environmentally responsible farming methods that will improve yields of food crops in Tanzania higher than their current average (Why are you). The project intends to develop a new private/public/academic partnership model that combines large-scale, commercial farming with local outreach and out grower programs for small landholders, providing them with efficient and transparent markets for agricultural products, and increased access to modern inputs, micro-financing, crop storage, value-added processing and distribution. Profits generated from the farms will provide long-term support for cooperative organizations and community investment trusts. Such funds will help construct medical clinics, schools, water sourcing and treatment systems, power generation and other infrastructure that will improve the quality of life for local populations ("AgriSol Energy Tanzania).

Some varieties of corn have been genetically modified or what the industry calls Genetically Modified Organisms(GMO). GMOs are organisms or microorganisms that with genetic engineering, has altered the genetic material. The population of Tanzania in 2007 was 43.7 million and is projected to rise to 109 million by 2050. That is a projected change of 150% in their population. The advancement of GMOs utilization will be required to continue feeding this population growth.

Through grants and organizations, African countries including Tanzania have been researching for new varieties in seeds and new advances in agriculture in order to improve their crops and adapt to their climate. Several researchers believe that management practices are the problem, but in reality the seed varieties have proven to be the opportunity. Access to high yielding and climate adapting varieties are not widely available to farmers in Africa. This causes them to use low quality seeds, that mixed with poor soil, and has made Africa produce on the global average yield only one-quarter of its capabilities. The fact is that there are already varieties and new advances out there that they can use such as GMOs. Bill Gates believes that GMOs are a necessity for our future in agriculture. "If you care about the poorest, you care about agriculture. We believe that it's possible for small farmers to double and in some cases even triple their yields in the next 20 years while preserving the land," (Bill Gates: We).

In Tanzania, along with many other African countries, drought is a common problem. Yes, grants are always going to help because they can find new and better varieties but we have already created drought resistant corn. Monsanto has a DroughtGuard Hybrid that is designed for instances when water is readily available that the yield will still be stable (DroughtGard Hybrids). The International Maize and Wheat Improvement Center has also created drought tolerant maize. It has produced 30 percent more maize than those without and they are now developing even greater producing drought-tolerant maize. These breakthroughs have the potential to benefit up to 30-40 million African people. Rice is another crop that new varieties have changed its production drastically by the International Rice Research Institute. It has become tolerant to drought, flood, cold and toxic minerals in turn, helping 100,000 African farmers (Agriculture Development in).

In a journal article from *Agriculture and Forest Meteorology*, the authors state,

Here, we examined the relationship between seasonal climate and crop yields in Tanzania, focusing on maize, sorghum and rice. The impacts of both seasonal means and variability on yields were measured at the subnational scale using various statistical methods and climate data. The results indicate that both intra- and interseasonal changes in temperature and precipitation influence cereal yields in Tanzania. Seasonal temperature increases have the most important impact on yields. This study shows that in Tanzania, by 2050, projected seasonal temperature increases by 2 °C reduce average maize, sorghum, and rice yields by 13%, 8.8%, and 7.6% respectively. Potential changes in seasonal total precipitation as well as intra-seasonal temperature and precipitation variability may also impact crop yields by 2050, albeit to a lesser extent. A 20% increase in intra-seasonal precipitation variability reduces agricultural yields by 4.2%, 7.2%, and 7.6% respectively for maize, sorghum, and rice. Using our preferred model, we show that we underestimate the climatic impacts by 2050 on crop yields in Tanzania by 3.6%, 8.9%, and 28.6% for maize, sorghum and rice respectively if we focus only on climatic means and ignore climate variability. This study highlights that, in addition to shifts in growing season means, changes in intra-seasonal variability of weather may be important for future yields in Tanzania.

New seed varieties are using modern biotechnology techniques- the process of genetic engineering that isolates, selects and transfers beneficial genes from one organism to another. More income, less cost of production, higher yields and safer environment are just a few that benefit biotechnology. The National Biosafety Framework (NBF) has been able to regulate, govern research and develop Tanzania's agriculture system. As of May 2009, the Tanzania government issued a national biotechnology policy in order to regulate the proportions of safe and responsible application of modern technology. The country now has sixteen research centers called ARIs which are research institutions and five have human and infrastructural magnitude in order to research biotechnology and development.

In Tanzania, the first research project in direct actions in confined field trials for genetically modified (GM) crops was the Water Efficient Maize for Africa (WEMA) which was created in 2008. Drought is severely affecting maize and it is Africa's staple food crop. This partnership was created in a direct relief of the drought that is a less costly way from smallholder farmers in Africa, this is in reply to a call by the African farmers, scientists and leaders. The African Agriculture Technology Foundation (AATF), International Maize and Wheat Improvement Center (CIMMYT), Monsanto, and the National Agriculture Research Systems (NARS) have all worked together to develop and create a maize that is drought resistant by using conventional breeding, marker-assisted breeding, and biotechnology. The Bill and Melinda Gates Foundation along with the Howard G. Buffett Foundations have created WEMA, which is a goal to make drought-tolerant maize that is available to Sub-Saharan African smallholder farmers. The risk of crop failure is one the biggest worries that African farmers are faced with and with this 25% higher yield this drought-tolerant maize might be the solution. In turn, then the African farmers will want to adopt more farming practices and new technologies.

It is a fact, that these grants and sponsoring organizations have helped other African countries to improve their crop yields. The agriculture GDP's growth rate had increased in Sub-Saharan countries from 3 percent in the 1900s and 2000s to 5.3 percent in 2008. In Rwanda, the food production in 2008 had risen to 15 percent because their government had invested 30 percent more into agriculture from 2007 to 2009. Ghana has become one the most progressive in decreasing world hunger in the world. Their agriculture is increasing more than 5 percent each year and cutting 75 percent of hunger since 1990 up to 2004. Ghana is close to achieving the UN Millennium Development Goal of reducing poverty and hunger in half from the 1990 levels.

There are many grants that are currently in play to help African countries including Tanzania. One of these grants revolves around farmer productivity is “Revitalizing Africa’s depleted soils (AGRA’s Soil Health Program)”. This grant is a second program that AGRA will help small farmers renew their soils and increase their productivity through the use of appropriate fertilizers and soil management practices that will cost \$164.5 million over a five year period. Another grant is “Tapping into premium coffee markets (Techno-Serve). This will provide equipment and training that allows small coffee farmers in East Africa to grow higher-quality coffee, and fetch higher prices for their product over a four year period for a cost \$47 million. One more grant is the “Development of Drought-Tolerant maize (African Agricultural Technology Foundation AATF). More than 300 million Africans depend on maize for their survival, but drought often leads to crop failures, hunger and poverty. This grant will use conventional breeding and biotechnology to develop drought-tolerant maize varieties that will enable small farmers to have more reliable yields during droughts over a five year period for a cost of \$42 million (Working to Break).

The PASS Seed Production Grantees of 2007 were grants that helped many countries in Africa including Tanzania. One grant is from the Tanseed International Ltd. that will assist in improving production and dissemination of seeds of maize, pigeon pea and sesame in Tanzania. Another is from Zanobia Seeds Limited that is helping to improve production and delivery of improved seeds to poor smallholder farmers of Tanzania. An additional one is Krishna Seeds Limited that is looking to reduce hunger and poverty of small-scale farmers of Tanzania by improved seeds. Itente Company Limited is also helping in Kagera region in Tanzania with Seed Production and Dissemination by Itente Company by up scaling the crop productivity. For the Northern Tanzania smallholder farmers, Meru Agro-Tours and Consultants Co. Ltd. is improving production, promotion and distribution of select improved seed varieties at an affordable price. In the central region of Tanzania (Singida, Tabora, and Dodoma Districts), Agriseed Technologies Ltd. are looking to help deliver improved seed to small-scale farmers in those districts (AGRA's Programme for).

Another way to reach Tanzania, is through their youth with 4-H. The youth is being strengthened by DuPont and National 4-H Council in rural African communities. They are creating sustainable livelihoods and improving household and national food security all across Africa. Tanzania, along with six other African countries are launching a year-round Leadership Institute for 4-H leaders and volunteers. The African-based 4-H leaders and mentors will be trained by the institute about agriculture innovation and farming practices. Their expertise, resources and research-based tools they learn will be used at local levels ("DuPont, 4-H focus).

In conclusion, there are many grants and programs in place and being developed to encourage the smallholder farmers to adopt new seed varieties that enable Tanzania to increase their crop yields. Each of these programs use a variety of methods to encourage smallholder farmers to adopt new and more efficient methodologies. Every farmer is unique and therefore introducing enhanced practices in different ways will hopefully encourage these individuals to adopt these methods. Other countries have shown that these grants and sponsoring organizations have improved their agriculture. Tanzania needs to use these examples to illustrate what they can become in the future, a more prosperous agriculturally established country. It is just a matter of them using it and for people to educate them about how to use it properly. Advanced agriculturalists have created these varieties in order to help create and improve the seed so that as the world population increases we can increase our food production as well.

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