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Somalia, Plants

Using the Integration of Underutilized, Antioxidant Rich, and Genetically Modified Plants to Address Food Insecurity and Malnutrition Contributing to the Food Syndemic in Somalia

Throughout history, agriculture has been the building block of civilization. Agriculture has played a critical role in the development of nations through the exporting and importing of raw materials, feeding the global population, and supporting global economies (“Why Is,” 2022). Although agriculture is important to society as a whole, its role is even more critical in developing countries. The economies of developing countries are highly dependent on their agricultural sector, with nearly 70% of the population engaged in agriculture (“Sustainable Agriculture,” 2011). Agriculture serves as a pathway for economic prosperity in developing nations through the exportation of goods. Locally, especially in rural areas, agriculture is a means for survival as it provides food security and a source of income for the population. Somalia is a perfect example of a developing country that is highly dependent on its agricultural sector’s success. However, with the majority of its population being rural and impoverished, and its dry climate making it difficult to sustain agriculture with current methods, change needs to be made to secure a better future for the Somali people.

Somalia is a developing country, in the easternmost part of Africa, at the tip of a region known as the “Horn of Africa”. Somalia has a federal parliamentary republic form of government with a population of 17.1 million people. The majority of the population is rural, representing 53.27%, with the urban population comprising the remaining 46.8% (“Somalia population,” n.d.). Somali families are very tight knit with a strong bond of kinship. Their families are generally large, with Somali women giving birth to an average of six children during her lifetime. It is common for multiple generations to live within the same household, creating a strong sense of support within the family. Somalis follow traditional gender roles, with the men being the head of the household and financially supporting the family, meanwhile, women carry out domestic tasks and raise the children (Evason, 2019). There is a struggle to provide basic needs to the Somali population such as education, healthcare, nutrition, transportation, etc. (“Economy of,” n.d.). Economic problems prevent access to healthcare, which is gravely needed in Somalia. Many have to pay for their own treatments out of pocket, but many more reject treatment because it is unaffordable. Poor sanitation and lack of clean water puts many Somalis at risk of waterborne diseases like cholera, measles, and malaria, and low access to healthcare leaves many to suffer without help (“Water, Sanitation,” 2019; “Somalia: An,” 2022). Additionally, there are many obstacles that prevent Somalis from having access to education. 3 out of 5 million Somali children do not attend school and strict gender roles prevent girls from pursuing education past primary school. The constant migration in search of water and open pastures of nomadic pastoralist families that make up 60% of the population, prevents a stable education (“Agriculture and,” 2023).

Agriculture makes up the largest economic sector, with 70.3 % of land in Somalia used for agriculture, both livestock and crops (“Agricultural Land,” n.d.). The average farm size in Somalia is 8 hectares, where crops are typically cultivated in dryland areas using rain-fed farming or irrigation from the country's main rivers, Shabelle and Jubba. Typical crops grown in Somalia include bananas, sorghum, maize, sugarcane, and rice. The main exports are animal produce along with cash crops such as bananas and sugarcane (“General Introduction,” n.d.). Agriculture faces challenges in Somalia due to its hot and dry climate, sparse rainfall, predominantly flat and highland terrain with infertile soil, and limited irrigation, having a significant impact on families in Somalia, as they heavily depend on agriculture for their livelihood. The majority of Somalia’s workforce relies on agriculture, with jobs in nomadic or

semi-nomadic pastoralism, farming, and fishing. Because wages in these occupations are generally low, and vary based on skill level and experience, many also rely on informal trading to make a living. Moreover, a typical Somali diet consists of meat and cultivated grains like wheat, sorghum, rice, and maize and though some of these foods may be high in caloric value, economic hardships result in a lack of accessibility to these and other nutrient dense alternatives (“Nutrition-Sensitive,” 2020).

A total of 6.6 million Somali people face acute food insecurity (“Somalia Emergency,” n.d.). The ongoing climate crisis has forced Somalia into decades of drought and consecutively failed rain seasons resulting in low crop yields. Low food supply cannot keep up with high demand, driving food prices higher. With 70% of the population living below the international poverty line, earning less than \$3 a day, many are forced to live in starvation and malnutrition exacerbating health issues present in the population (“Somalia Economic,” 2022). Another factor affecting food security is war. Somalia is dependent on imports for a lot of its consumer products, and the war has cut down 90% of its wheat supplies (“Crisis In,” 2022). This has resulted in families being displaced from their homes in search of food and water, making this population the most vulnerable to the food crisis, and increasing the likelihood of famine by about 25 percent if unattended (“Somalia: Likelihood,” 2023). Among these, women and children face the greatest risks of malnutrition and displacement. A high number suffer from a vitamin A deficiency, and lack of other minerals like zinc and iron. Children are at risk of not making it past infancy, with 1 in 20 women aged 15-49 dying due to pregnancy, or birth-related complications every year (“Nutrition,” 2023).

Ways of mitigating these risks include the introduction of native underutilized plants to Somalia’s agriculture, the use of genetically modified plant varieties, and the introduction of plants that increase antioxidant production in response to environmental stressors like drought and poor soil quality. Neglected and underutilized species of plants have been used traditionally for centuries because of their rich nutritional value, but are unrecognized in modern agricultural practices. Of the approximately 30,000 edible plant species recognized globally, over 7,000 species have been grown specifically for food production, with less than 150 species commercially cultivated. This means that there are tens of thousands of plants with immense potential to solve modern problems like food poverty and malnutrition, yet the world does not know about them. Why? Commercial agriculture is one of the main reasons these plants have gone underutilized. As countries began to industrialize and develop their global economies, they turned their focus towards cash crops. As a result, they displaced and/or destroyed natural lands originally inhabited by these native species in order to make space for new, foreign, but profitable, crops. With the recurring droughts in Somalia intensifying, cash crops currently grown are struggling to survive, threatening the economy, but above all, threatening the lives of those who live there. For centuries, these crops have been traditionally used for food, medicine, and fiber, but another reason why these crops have gone underutilized is their unrecognized nutritional value (Li et al., 2020).

There have been efforts in Somalia to grow a variety of nontraditional crops to increase food production : tomatoes, peppers, onions, lettuce, and garlic have been tested. Though these efforts have helped increase food availability, these test plants are still common non-native commercial crops susceptible to the impacts of climate change in Somalia (“Agriculture And,” 2023). In contrast, reintroducing neglected and underutilized species would mean reintroducing crops that originated in Africa and brought to Somalia. Generally, these plants are naturally nutrient dense, climate resistant, and resulting in more sustainable agriculture. This would mean higher crop yields, meeting demands that may effectively lower food prices, and increasing accessibility to more nutrient dense foods for those in poverty. This method has been adopted in various parts of the world as a way to aid food insecurity. For example, although native to South America, cassava is an underutilized crop vegetable that was introduced to Africa and many countries because of its ability to grow in degraded land, with little to no irrigation necessary for proper growth. It has become a major candidate in the fight against food poverty because of its high nutritional value and versatile uses across cultures (Kolawole et al., 2010).

Underutilized plants that are native to Africa, and can grow well in the severe conditions of Somalia include, but are not limited to, cowpeas, okra, bambara groundnut, guar, and yam. These crops would ultimately transform the diets of the people in Somalia. A common problem many Somalis face is “hidden hunger”. This is characterized by the lack of essential vitamins, as a result of an energy-dense, but nutrient-poor diet (Li et al., 2020). A typical Somali diet consists of high caloric grains and starchy foods that are filling, but do not meet the nutritional requirements to be classified as a healthy balanced meal (“Nutrition-Sensitive,” 2020). Underutilized plants can diversify Somalis’ current diet, and are nutritionally balanced alternatives. These plants are naturally rich in vitamins and minerals that are essential to human health, and can even be natural remedies to specific ailments that Somalis may experience. Cowpeas, for example, are packed with fibers, proteins, and vitamins—including A, C, B6, folate—and minerals such as iron, and zinc. Okra is rich in vitamins and minerals A, C, folate, and iron. Vitamins A and C in both plants boost immunity, and reduce risks of serious health conditions like cancer, heart disease, and strokes. Folate is a primary component in prenatal vitamins, aiding pregnancy and fetal development (“Health Benefit,” 2022). This goes to show how these plants can provide natural supplements in an accessible form of food.

In conjunction with the introduction of underutilized plants in Somalia, the use of genetically modified crops (GM crops) is another preventative measure that we can take against food poverty. Essentially, the DNA of GM crops has been altered through genetic engineering in order to produce a desired trait in a crop. The majority of GM crops have been modified to repel pests without the need for pesticides. In Somalia’s case, plant varieties may be modified to tolerate drought and produce targeted vitamins (“Center of,” n.d.).

Drought is one of the biggest challenges when addressing food insecurity through sustainable agriculture in Somalia. As mentioned before, Somalia is facing prolonged dry seasons, resulting in agricultural loss. With most of their crops originating from tropical regions, crop productivity is jeopardized as they are forced to grow in Somalia’s hot climate and dry land. By genetically modifying crops to be drought tolerant, it gives them a higher chance of survival in the foreign environment, increasing crop yields. Additionally, drought tolerant GM crops would allow for agriculture to expand to more areas of land in Somalia as the pressure to find irrigable land and water reduces. As a result, less Somalis will have to depend on nomadic farming, and be able to focus on building communities, which can further develop the country as a whole (Martignago, 2019).

Alongside drought resistance, GM crops can be modified to produce specific vitamins and supplemental minerals that Somalis may lack in their diets. This is especially important in staple crops like rice, wheat, and maize since they are often the most affordable and accessible food crops in developing countries like Somalia. Many Somalis depend on these to survive, however, these crops often have high caloric value with little of the nutrients necessary to make a well-balanced, healthy diet. By modifying plants to produce vitamins and other important micronutrients, it would nutritionally enhance Somalis’ diets with easier accessibility to these new crops (Hefferon, 2015). Golden Rice is an example of a GM Crop that was modified to produce Vitamin A in the grain. Since rice is a staple crop in many developing countries with Vitamin A deficiencies, this crop made the vitamin more accessible and affordable to those who are financially disadvantaged (“Golden Rice,” 2022). Using genetically modified varieties of traditionally grown crops that are drought tolerant and have a targeted nutritional profile, can result in higher crop yields, sustaining the economy while also addressing malnourishment, deficiencies, and other health issues faced by Somalis (Grote et al., 2021).

As a response to environmental stressors, some plants increase production of phenolic compounds which we commonly refer to as vitamins and antioxidants. So an additional method for addressing vitamin and antioxidant deficiencies and health issues that doesn’t require genetic modification is using these environmental stressors to aid in the production of more nutritious foods. Phenolic compounds are

secondary plant metabolites, with antioxidant phenolics having the ability to protect the human body from the effects of oxidative stress, which contributes to the development of human diseases, including cancer, cardiovascular, respiratory, and neurodegenerative diseases, and inflammation. Different exogenous factors can lead to an overproduction and imbalance of reactive oxidative species (ROS), which causes oxidative stress in the human body, impacting cell health, and potentially causing such diseases. Antioxidant phenolics scavenge and inhibit ROS, mitigating the effects it has on the human body (Minatel, 2017). This antioxidant defense system would enhance the nutritional value of a typical Somali diet.

In Somalia's case, the biggest environmental stressor to agricultural productivity is drought. Although research is limited, there have been studies that have observed an increase in phenolic compounds in different plants. Amaranthus is a leafy vegetable that results in an increase of phenolic compounds when experiencing drought stress (Saker et al., 2018). Instead of working against the conditions present in Somalia, by putting this information to action, farmers can increase the health benefits of cultivated plants.

With existing solutions, why are countries like Somalia still facing these issues? This comes down to accessibility and implementation. Nonprofits and organizations who focus on improving global food security (e.g. FarmSahel and the United Nations) could aid in the introduction and incorporation of these methods into Somalia's agriculture. FarmSahel, a non-profit that works towards increasing food quality and adopting methods of sustainable agriculture in Sahel, Africa, provides their population with quality seeds and teaches them to use farming equipment. Their model can be extended to Somalia. With the support of the United Nations, humanitarian organizations can provide the necessary resources and education to begin the outplanting of the aforementioned plant varieties, working towards ending world hunger by 2030 with Sustainable Development Goal 2: Zero Hunger as the driving framework. Education on proper farming techniques can be supported by the United States Agency for International Development. This agency has already worked on implementing different cash crops into Somalia's agriculture. With the support of the Somali government in providing improved infrastructure and roads for humanitarian assistance, proper planning and implementation, Somalia can experience an increase in food security and nutrition that is vital to the development of the country and its people.

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