

Marin Cooney, PA School for Excellence in the Ag Sciences
Altoona Area High School, Altoona, PA
Botswana, Factor 6: Sustainable Agriculture

Modern Solutions in the Kalahari

On the continent of Africa nestled between Zimbabwe to the North, and South Africa to the Southern portion lies a land-locked country known for its landscape and wildlife which possesses the name Botswana. This country spans across an area of 581,730 square kilometers which is a bit smaller than the United States' Texas (Geography, n.d.). About 70% of its geography is made up of the Kalahari Desert. The country also contains vast plains and wetlands. A geographical landmark is the Okavango delta which is a popular attraction to visitors both domestic and foreign. (Kastle, K, n.d.). Though it is mostly flat it does contain some hills. A common tree is the acacia and common animals include cheetahs, hyenas, lions, meerkats, and antelopes. Botswana has a somewhat arid climate that is higher in temperature and dry most of the year. There are varying levels of rainfall depending on the area. Some locations experience droughts while in other regions where it is scarce, the water evaporates before it can integrate into the ground. The mean yearly rainfall can fluctuate around 650 mm. (Mindq, 2017). Botswana has a population of roughly 2.4 million people with a median age of 24 years old. (Botswana Population, n.d.) The citizens of Botswana, often referred to as the Tswana people, speak several tongues including Bantu, Indo-European languages, and English which is classified as their official language and Setswana as the national language. People of other titles such as Kgala and Herero call Botswana their home as well (Encyclopedia Botswana, n.d.).

A family structure in Botswana is not typically what can be seen in the United States. People live with their relatives and belong to extended families that are larger than the typical 4-5 person family. They tend to follow village-based household styles rather than the typically nuclear family archetype that is more common in other parts of the world. The extended families allow for the productivity of responsibilities within their family village. Labor is divided based on gender. The care and keeping of livestock is generally a task for women to maintain while things like hunting and political affairs belong to men. However, these family structures do not always keep together. Complications and other factors such as urbanization and labor migrations can disperse these groups. Education for a Botswana child can be of differing degrees. Some may receive minimal to no education in the home while others are sent to achieve higher education which is promoted by the government through funding. A main goal of these diligent pupils is to study at the University of Botswana. Medical care is also seen to have varying levels in quality. Some accept traditional treatment from priests and local healers while others seek more modernized doctors and western medicine. The food consumed by the Tswana people is very basic. Stews of meat and vegetables and cornmeal based porridges are very common along with tea and buttered bread. Their meats consist of standard livestock such as cattle and chicken (Countries and their Cultures n.d.).

The Tswana people practice agriculture that includes both the growing of crops and the raising of livestock. However, this only accounts for roughly 3% of their total economy largely due to the fact that most of the surface area of their country is occupied by the Kalahari desert, and that there is an extensive focus on mining as they are the world's second largest diamond producers. (Botswana: Agricultural

Economic Fact Sheet, 2015). A new approach to farming, such as a modernized one could increase the productivity of agriculture in the contexts of both the economy and the livelihood of Botswana's citizens. They rely on the export of their crops such as beans, maize, and millets. (Botswana-Agriculture, n.d.). Food sources are heavily dependent on imports of grain, rice, and processed foods after they have stopped striving for the goal to be independent and sufficient in the sector or crop agriculture. There is now a shift in focus to ensuring food security. (BONCONGO, 2021). Still, according to the World Bank Organization, in the year 2019, a 50.8% rate of differing degree of food insecurity among the population of Botswana is present. (FAO, n.d.). This could be changed through more modern and long sustaining approaches such as farming hydroponically. It would decrease the focus and worries of soil health and overuse and put an emphasis on the production of nutritious crops since the agricultural market also consists primarily of the production of livestock. Farms in Botswana are mainly traditional family owned farms with around only 1,000 commercialized ones at most. The farming methods used are very standard and comparable to that of farms in other locations around the world but with more attention to soil conservation and grazing experiments. (Botswana- Agriculture, n.d.). Around 45-46% of total land is considered agricultural, only 5-1% is utilized and even then, most of that is for the raising and care of livestock. (Buckham-Walsh, L., & Mutambirwa, C., n.d.). The economy of Botswana has transformed itself from harsh poverty to a middle income nation through mining, revenue through agriculture, and small start up businesses in urbanized areas. (Botswana: Agricultural Economic Fact Sheet, 2015). Despite this, issues of food insecurity are still prevalent and growing.

One of the main barriers to the access of food security to families and individuals as a whole in Botswana is the lack of domestic crop-based agriculture and consistent food production due to the natural climate and geography of the region. According to The Borgen Project, only 0.65% of agricultural land is able to be used in crop production. (Thelwell, K., 2020). These areas still can experience droughts. Botswana has created relief programs (Holm, J. D., & Morgan, R. G., 1985) similar to what can be seen in countries like the United States to ameliorate the impacts of these occurrences. The somewhat arid climate combined with the lack of workable land makes for a growing selection of just a few crops including cowpeas, millet, maize, and sorghum. Crops of other types have to be imported into the country which can be unreliable for consumers. The major imported crops include fruit and vegetables, sugar, dairy, corn, and wheat. Much of these imports go to animal feed which is needed to support the already small agricultural component of the economy that the country already has. (Countries and their Cultures, n.d.). South Africa is a leading country that sells their crops to Botswana. During the COVID-19 pandemic there was a strain on exports and supply chains in almost every other part of the global economy, which most likely only intensified the levels of food insecurity.

Botswana's history of agriculture, similar to the present, shows a trend of poor grain yields and rises of livestock farming. Factors such as inadequate soil health and sporadic weather patterns/conditions contribute to this in addition to unidyllic farming practices. Practices like mixed cropping or polyculture which can be resourceful in the way that if one crop fails there is still potential for others. (Roe, E., 1982). However, both strict polycropping and monocropping present harmful affects. It is difficult to manage and maintain these varieties of crops together, but varying root structures can take a toll on soil. While this source is dated, it is relevant as it shows what Botswana once was like in relation to how it is now. If soil quality then was already on the decline, forty years forward in the present could demonstrate even more severe affects. However, history can avoid repeating itself. The utilization of regenerative agriculture and

crop rotation (*Why regenerative agriculture*, 2021) alongside the implementation of innovative farming practice such as hydroponics could be a viable solution.

Issues involved in the lack of food insecurity through the climate and inconsistencies in food production may be ameliorated through sustainable agriculture. The reliance on imports can have effects on the environment as well. If goods are imported by means other than on foot or by animal labor, emissions are given off. The already semi-arid and warmed climate will not be able to support long term effects of pollution in our already warming up earth. (BONCONGO, 2021). In 1991, the government of Botswana launched a plan and took a step of action towards the use of sustainable agriculture through the National Policy on Agricultural Development, also known as NPAD. Other initiatives such as The Arable Lands Development Program and The Tribal Grazing Land Policy have also been implemented to aid smaller farmers in more remote areas. The governing body of Botswana has also passed policy to bring importance to the production of food crops. (Buckham-Walsh, L. & Mutambirwa, C., n.d.). While good intentions were there, the policy only benefited the portion of agriculture dealing with livestock farming. The factor of sustainable agriculture brought some effort and thought by the country's government but not enough to enact serious improvements. The World Bank Organization shows data of an increasing trend in food insecurity in Botswana. In 2015, the rate of food insecurity was 45.9%, 47.1% in 2016, 48.3% in 2017, 49.5% in 2018, and 50.8% in 2019. (FAO, n.d.). This was even before the ongoing pandemic which caused further implications worldwide through supply and shipping issues, which the country relies on for a multitude of necessary nutritious foods. These statistics show that pandemic aside, the situations surrounding access to food for average people and families is only worsening.

To ensure food security through reliable food production systems despite the climate that does not support the growth of a variety of crops and the issues of imports, a solution that could provide more domestic farming is the method of hydroponic farming. Hydroponics involves plants and crops being grown in a nutrient-rich water solution that eliminates the need of soil. (Bartok Jr, J.W., 2017). Then in is aspect is a key component to the method's success in Botswana. The topography of the country is mainly desert and contains soil that is not easily workable and does not have ideal conditions to bear the growth of crops. It is also recorded that hydroponic farming produces higher yields of crops that are also of better quality. Diets may have to be altered to fit the standards of what can grow well in these hydroponic basins. Crops with deep roots and or crops that grow tall such as cucumbers and tomatoes may represent a problem and call for more equipment such as supports. Spacing of these crops is also important to take note of as roots can also clog the gutters of the system. Although water is scarce in parts of the country due to drought and this method is water based, it actually requires less water to maintain that traditional farming methods. The lesser amount of water that is needed can be found and or harvested in the scattered rivers, the emergence of newly constructed dams, and aquifers. Boreholes are what most rely on for their drinking water. (Water Policy Brief, n.d.). Hydroponic farming would increase the amount of domestically grown crops diminishing the need for the reliance of imports from other countries such as South Africa, ensuring a steady supply of nutritious foods that are easily accessible to all which would in turn, decrease the rate of food insecurity. Hydroponics can be done both indoors and outdoors but will require a UV lamp if the indoor option has no access to a bright window, which would raise the energy costs.(Bartok, Jr, J.W., 2017). For outdoor use, high tunnels may help promote crop growth. The use of hoops and netting can also be employed as a form of integrated pest management. Since the country has an emphasis on education, the care and management of hydroponics could be promoted to students studying at The

University of Botswana who then introduce this to their families as a way to integrate this into society and bring back younger generations to agriculture if they can see a viable future in it, keeping this sector of work alive for the economy and for the benefit of food security. Necessary equipment entails basins with gutters, drip irrigation tubes, end caps, spouts, water pumps, and other odds and ends such as garden hoses and clamps. Once a trough is constructed and a basin is established and all the tubes, spouts, etc are in place, a covering is put into place to prevent the growth of algae in the nutrient-rich solution. pH is another factor which must be maintained at a somewhat neutral level of 5.5-6.5. (Smith, T., 2002). Overall maintenance on a small scale such as on a back deck isn't difficult but on a scale a bit bigger it could be expected to ask for upkeep.

The cost for hydroponic farms can vary. Some small farms may cost upwards of \$10,000 to start and a few thousand more to maintain. An average of \$3.45 per square footage on energy, and about \$20 to maintain. (Jacobson D & Jacobson T, 2022). The establishment of hydroponic farms would be done on a smaller scale. Instead of creating large farms, each family village would have its own like they have had with their previous traditional farming methods. Funding can be raised through several methods. The first method is microlending from other countries. (Microloans, 2022). Since the yield of hydroponic crops is higher compared to standard growing methods, there will be enough yield to feed the village but all have a surplus to sell to other countries. This aligns with the non-commercial based farms that are private to family villages. These countries or businesses in these said countries would provide a loan, aid in the starting of these farms, and also provide technology with the farmers to stay in contact with those who granted the loan which would also benefit the farms by adapting and learning the uses of more modernized technologies in several different aspects. The use of this technology such as smartphones for example also makes it easier for their supply to be exported as they are not connected to their loaner but also to the rest of the world. As crops are grown and exported, the loan is paid off. Another method is philanthropy. New technology, especially in areas of the world where it is not as common, will be quick to catch the eyes of the wealthy and their organizations such as The Bill and Melinda Gates Foundation, and more specifically, Larry Ellison whom has promoted sustainable agriculture in Hawaii through the implementation of aquaponics and hydroponics. (Amenlinckx, 2018). A prospective agency could be the National Sustainable Agriculture Information Service. This program provides free resources surrounding new farming techniques that focus on sustainability. Such techniques include alternative crops and diversity, improved soil and water wellness, and saving energy. (ATTRA, 2019). A second agency is the Specialty Crop Research Initiative. They provide grants for research in the sector of fruits and vegetables, or specialty crops. The basics of the program promote ideas that express wellness in food quality and production. In addition, the agency conducts research into crop breeding, genetics, and pest management. (Specialty Crop Research initiative, 2020). While both of these agencies are domestically based in the United States, there could be opportunities for volunteer work, humanitarian projects, or collaborations with a country such as Botswana. A third solution is government subsidies. Government support would tremendously assist these endeavors. The establishment of domestic agriculture would also save money as there would be little to no need for the purchase of goods from other countries. Rather, they could now sell more in their own exports. Though the launching of this can be costly, the effects in the long term are sustainable for both the environment, the economy, and steady food sources.

In the final analysis, it is observed that the country of Botswana deals with the implication of food insecurity due to unreliable food production and shipment issues, and a climate not suited for widespread

agriculture to support its citizens. The rate of food insecurity is only on the rise. Sustainable agriculture in the form of hydroponic farming is a solution to this barrier as it requires no soil which this region lacks, it utilizes less water than traditional farming methods which is helpful in the situations of droughts that are common, and it eradicates the heavy need for imports from other countries which tend to be unreliable, leaving citizens without necessary nutritious foods. Modern methods can mitigate such a problem that should not be modern, but a thing of the past.

References

- Amenlinckx, A. (2018, October 10). *5 billionaires with ties to agriculture"and why they do it*. Modern Farmer. Retrieved June 15, 2022, from <https://modernfarmer.com/2015/11/billionaire-farmers/>
- Bartok Jr. , J. W. (2017, January 26). *Hydroponic Systems*. Center for Agriculture, Food, and the Environment. Retrieved February 26, 2022, from <https://ag.umass.edu/greenhouse-floriculture/fact-sheets/hydroponic-systems>
- BOCONGO. (n.d.). *The Big Governance Issues in Botswana - SAIIA*. Retrieved February 23, 2022, from <https://saiia.org.za/wp-content/uploads/2021/04/AGDP-BAPS-Report-BOTSWANA-March2021-FINAL-WEB.pdf>
- Botswana - Agriculture*. Encyclopedia of the Nations. (n.d.). Retrieved February 22, 2022, from <https://www.nationsencyclopedia.com/Africa/Botswana-AGRICULTURE.html>
- Botswana population (live)*. Worldometer. (n.d.). Retrieved February 23, 2022, from <https://www.worldometers.info/world-population/botswana-population/>
- Botswana*. Countries and Their Cultures. (n.d.). Retrieved February 22, 2022, from <https://www.everyculture.com/Bo-Co/Botswana.html>
- Botswana: Agricultural Economic Fact Sheet*. USDA Foreign Agricultural Service. (2022, February 25). Retrieved February 23, 2022, from <https://www.fas.usda.gov/data/botswana-agricultural-economic-fact-sheet>
- Buckham-Walsh, L., & Mutambirwa, C. (n.d.). *Overview - IUCN*. Governance Book- International Union for Conservation of Nature. Retrieved February 23, 2022, from https://www.iucn.org/downloads/governance_book_botswana_1.docx

Encyclopædia Britannica, inc. (n.d.). *Botswana*. Encyclopædia Britannica. Retrieved February 22, 2022, from <https://www.britannica.com/place/Botswana>

FAO. (n.d.). *Prevalence of moderate or severe food insecurity in the population (%) - botswana*. Data. Retrieved February 23, 2022, from <https://data.worldbank.org/indicator/SN.ITK.MSFI.ZS?end=2019&locations=BW&start=2015>

Geography of Botswana. Where is Botswana? (n.d.). Retrieved February 23, 2022, from <https://www.victoriafalls-guide.net/geography-of-botswana.html>

Holm, J. D., & Morgan, R. G. (1985). Coping with Drought in Botswana: An African Success. *The Journal of Modern African Studies*, 23(3), 463–482. <http://www.jstor.org/stable/160661>

Jacobson, D., & Jacobson, T. (2022, February 18). *15 stats about hydroponic system costs*. Pure Greens: Custom Container Farms. Retrieved February 23, 2022, from <https://puregreensaz.com/hydroponic-system-costs/>

Kästle, K. K.-. (n.d.). ____ *Botswana*. Botswana Country Profile - Southern Africa - Nations Online Project. Retrieved February 23, 2022, from <https://www.nationsonline.org/oneworld/botswana.htm#:~:text=Botswana%20is%20well%20known%20for.reserves%20and%20wildlife%20management%20areas>

Microloans. National Sustainable Agriculture Coalition. (2022, March 23). Retrieved June 17, 2022, from <https://sustainableagriculture.net/publications/grassrootsguide/credit-crop-insurance/microloans/>

Mindq. (2017, October 30). *Climate*. Botswana Tourism Organisation. Retrieved February 23, 2022, from <https://www.botswanaturism.co.bw/climate#:~:text=Botswana's%20climate%20is%20semi%20arid.erratic%2C%20unpredictable%20and%20highly%20regional.>

National Sustainable Agriculture Information Service (attra). National Sustainable Agriculture Coalition. (2019, November 18). Retrieved June 17, 2022, from

<https://sustainableagriculture.net/publications/grassrootsguide/sustainable-organic-research/national-sustainable-agriculture-information-service-nsais-attra/#eligible>

Roe, E. (1982). Second thoughts on the History of Botswana Arable Agriculture. *Botswana Notes and Records*, 14, 30–34. <http://www.jstor.org/stable/40979664>

Smith, T. (2002, Annual). A simple hydroponics system. (2002 Feature Section--Landscape Design). *Prairie Garden*, 76+. <https://link.gale.com/apps/doc/A94078535/PPGL?u=pl1853&sid=bookmark-PPGL&xid=83d54e9f>

Specialty Crop Research initiative. National Sustainable Agriculture Coalition. (2020, January 2). Retrieved June 17, 2022, from <https://sustainableagriculture.net/publications/grassrootsguide/sustainable-organic-research/specialty-crop-research-initiative/#basics>

Thelwell, K. (2020, July 27). *Hunger in Botswana: Causes and prevention*. The Borgen Project. Retrieved February 22, 2022, from <https://borgenproject.org/hunger-in-botswana-causes-and-prevention/>

Water policy brief final version - united nations. (n.d.). Retrieved May 19, 2022, from [https://sustainabledevelopment.un.org/content/documents/1007National%20Report%20\(Water\)%20-%20Botswana.pdf](https://sustainabledevelopment.un.org/content/documents/1007National%20Report%20(Water)%20-%20Botswana.pdf)

Why regenerative agriculture? Regeneration International. (2021, February 3). Retrieved September 28, 2022, from <https://regenerationinternational.org/why-regenerative-agriculture/>

