

Kaitlyn Appler  
Centerville High School  
Centerville, Iowa  
Zimbabwe, Key Factor #2  
**Water Scarcity Solutions for Zimbabwe**

In 1996, the World Food Summit identified food security as existing “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.” Unfortunately, having food security is rarely the case for many countries around the world, including Zimbabwe. Zimbabwe is a country in southern Africa that is home to more than 12 million people. It houses international tourist attractions, such as the Great Zimbabwe stone ruins, Victoria Falls, and Lake Kariba. Its economy relies heavily on agriculture and mining, due to the wide range of natural resources such as 19 million hectares of forest and more than 40 minerals which include diamonds, ferrochrome, gold, silver, platinum, and copper. Seventy percent of its population lives in rural areas and the majority of those inhabitants are farmers. A typical subsistence farm family on average consists of about 4.5 people. Along with the rest of the country, their diet consists mainly of maize, millet, or sorghum. Zimbabwe’s subtropical climate and desert and savanna terrain allow its farmers main crops to include corn, tobacco, wheat, coffee, tea, sugarcane, and peanuts. The livestock they raise is composed of cattle, sheep, goats, and pigs. The main exports, though, are tobacco, gold, ferroalloys, nickel, and asbestos. Around 85% of the population has access to healthcare and safe drinking water while 68% has access to adequate sanitation. As for education, Zimbabwe possesses one of Africa’s highest literacy rates, with the adult rate being 91%. It is mandatory for children to attend primary school, which they start when they are around seven. After seven years in primary school, the children can pass examinations and further their education. Since its independence in 1980, the enrollment in primary through post-secondary schools has increased from 1 million students to about 2.9 million. Once, this country even had the best health and education statistics in Africa. Sadly, though, Zimbabwe slowly became a country with many struggles economically. Erratic weather patterns have contributed to the worsening economy. These factors and more contribute to the poverty rate increase from 25% to 63% between 1990 and 2003. With all of these struggles shown, the crisis in Zimbabwe needs to be alleviated so that the people in this country won’t have to worry about food security.

The history of Zimbabwe has been an economic rollercoaster. In the early 1970s, citizens’ salaries had reached record highs for both blacks and whites. However, the inequality still was evident with blacks only making about one-tenth of the whites’ earnings. From 1974 to 1979, the GDP decreased while a rising percentage of the national budget was assigned to defense, thereby causing a large budget deficit which increased the public’s debt significantly. With a strong agricultural base and rich mineral resources, in 1980 the country came to be one of the most complete and well-built industrial infrastructures in the sub-Saharan Africa region after its independence. Nevertheless, with the foreign demand of their exports decreasing due to competition with other South Africa countries and a drought beginning in 1982, the economy took another drop. Luckily, only about three years later, the economy took a positive spin with a 30% jump in Zimbabwe’s agricultural production. After that, drought and foreign-exchange struck Zimbabwe hard, which put them into another slump. In 2002, rains stopped in the first months of the year and the country experienced one of its worst crop failures. The farmers fell short of the annual food production requirements by about 70%, which was the worst since 1980. The small amount of food they were able to produce was not enough to feed all of the rural and urban people adequately. The food shortages soon worsened into famine and humanitarian disaster where 70% of the rural population was threatened with starvation caused by famine.

Zimbabwe could not handle the severe drought as it had in the past. This country had formerly produced a surplus amount of food which allowed them to export even more to fellow Southern Africa Development Community countries like Ethiopia and fill a grain reserve that would cover six to nine

months for the people. Having the security of extra food was not the case anymore, and due to the increase in population, the reserve ran out quickly. On top of the food shortage, the country had to deal with additional debt. From 1998-2002, Zimbabwe was involved in war with the Democratic Republic of the Congo, which cost the economy hundreds of millions of dollars. Along with the war debt, the Reserve Bank of Zimbabwe consistently printed money to reduce and support the budget deficit, which, of course, ended up causing hyperinflation in 2007. The government tried to control it, but their acts continually caused more fuel and food shortages by forcing prices to be reduced by half. Zimbabwe, at this point, had the world's highest inflation rate.

Today, Zimbabwe is on its way to improvement. In February 2009, it adopted a power-sharing government that caused an end to hyperinflation by getting rid of the country's dollar and removing the government's price controls. Also, about 800 to 900 programs have brought in help, support work, service delivery, and welfare aide to the country, ranging from big organizations such as the Red Cross to smaller ones like church groups. However, more still that needs to be done in order for the country to prosper again. The 2010 Food and Crop Supply Assessment approximated that between the 2010 harvest and the 2011 harvesting season, around 1.68 million people would maintain their food insecurity and still need help. The residents also continue to have a high unemployment rate, at approximately 80%, and have developed a high HIV and AIDS occurrence rate at 13.7%. The country was also still struggling with a high inflation rate. Many times, in 2008 for example, the country was accustomed to drought so when a great deal of rainfalls came quickly, the land flooded, which led to leaching, erosion, limited farming activities, and late planting.

In Zimbabwe, if a family earns less than \$500 a month, it will fall beneath the poverty line. Unfortunately, most of the teachers and government employees earn less than half that amount. The cost of living a sufficient life is increasing faster than most of the family's salaries; with 70% in the poor or extremely poor category, Matabeleland North is said to have the highest poverty rate in Zimbabwe. Many rural families struggle with poverty, due to their small land plots, no irrigation in the dry areas of the country affected tremendously by drought, and no access to animals for help. Only a small number of farmers have been able to create practical enterprises. Due to the low amounts of crops being harvested, many millions of residents in Zimbabwe are dependent on food aid. The decreased crop yields made the county become a net importer of food productions.

A major challenge for many farmers is water scarcity. The many droughts that come Zimbabwe's way make the economic situation harder for farmers. Without enough water, the farmers have no way of meeting their crops yield expectations, therefore, making it easier for them to fall below the poverty line. By not having enough yield and becoming poor also means that if they can't make enough money from the crops they have produced, they wouldn't have enough to buy other essential food for their families. These farmers need to raise their productivity in this time of drought. With water being hard to find, raising productivity seems close to impossible. For product efficiency to improve, this country needs to find ways to help manage the land's water and adapt their ways of farming to allow the least amount of water possible to be used. If water was managed and used more efficiently, then more farmers would be able to produce an increase in crop yields, thus, making the food security rise as well. A report made by the American Association for the Advancement of Science in 2001 stated that less than half the water used for commercial farming's irrigation systems actually makes it to the crops' roots to hydrate them. This being said, along with improvements in their irrigation systems, Zimbabwe farmers need to adapt their practices so that they can conserve more of their water. Some examples that have been found are natural farming, precision farming, and biointensive farming.

One idea for helping a country like Zimbabwe conserve water would be trying the farming method of natural farming. Natural farming is a process that allows the food to be grown naturally. This technique produces the food without the use of synthetic chemical fertilizers and genetically modified organisms

that are used normally to increase the yield and growth of the crops. Naturally grown foods are said to be better for the consumer's health and for our environment. Many also believe that the food produced is of better quality and has a higher nutritional value than that of commercial farming. Another plus is that natural farming is said to use significantly less water than commercial farming does. A study by David Pimentel, a professor at Cornell University, reported that by using natural farming, one can get the same yield as conventional farming but one can accomplish this yield by using about 30% less energy and water to hydrate the crops. Along with the conservation of water, this farming process also prevents soil loss and erosion. In addition, because the process doesn't use pesticides, natural farming does not contribute to the pollution of the groundwater. Therefore, the groundwater can be safe enough to be used to help with the irrigation or even just as drinking water. This farming practice has already given developing countries, such as India, economic opportunities. These economic opportunities are due to the increasing demand of natural products year-round. Many countries need products imported into their country because they cannot make the crops themselves throughout the year. For Zimbabwe, a demand for their natural herbs has already started to increase, which brings hopes that this demand could increase for their other crops, too. However, one downfall to natural farming would be that it could be more expensive to make and buy than conventional food. It's more expensive to make and buy because of a few reasons: preventing the use of pesticides makes the farmers weed by hand and that could end in a complete crop failure, using compost or manure to fertilize costs more to ship and buy than traditional fertilizers, and natural food costs more to certify than does conventional food.

Another proposal for the conservation of water is precision farming. Precision farming focuses on studying and managing the variability of the fields. This process of studying and managing the variability means that rather than treating the large field as a whole, one would find small sections that have similarities and treat them in a way that will best fit the area. This method recommends the workers to search for and establish what the right seed is, the right planting density, the right soil, and best rate at which to apply water and other nutrients for a specific plot of land. Much of the time, certain areas of farmland in Zimbabwe don't get enough water while others get an overload of it. Therefore, by using precision farming, the crops will get just the right amount of water the area needs, no more and no less, thus, ultimately reducing and conserving the amount of water used to replenish the fields while still creating a sufficient yield that will help fight the country's hunger.

An additional suggestion to help conserve water for farming is using the technique of biointensive farming. Biointensive farming practices focus on getting the most surface area on land so that the largest yield possible is produced from the smallest amount of land. This method of farming is usually used for subsistence farmers and is also referred to as mini farming with the main crop used being corn. A big factor of biointensive farming is using double-dug beds. The soils in these beds are loosened approximately 24 inches deep which aerates the soil, aides the root growth, and increases the retention of water. The seeds are also planted closely together to add to the preservation of water. Having the seeds planted closely together also protects the microorganisms in the soil and maximizes the yield. By allowing the crops to hold on to more water, this farming method decreases the amount of water needed to hydrate them. The amount of water used in biointensive farming ranges from a third to an eighth per pound of food produced in commercial farming practices. The soil maintains its vigor from the use of compost, sometimes from earlier harvests. Another advantage of this technique is that by performing biointensive farming correctly, one can build up a nutrient-rich soil up to 60 times faster than normal while at the same time producing larger harvests and conserving more resources.

Adding on to the conservation of water farming practices, improving irrigation would help decrease the amount of water used. Irrigation is the process of adding water to land or crops artificially. If the irrigation system is not set up correctly, it could result in an inefficient loss of water. Many systems of irrigation are used and could be used to help in with Zimbabwe's food security. One solution for small farms that are less than .5 hectares would be treadle pumps. Treadle pumps take two people to operate.

One person pumps the water, using his/her body weight and leg muscles, while the other directs the flow of the water to the needed divisions of land. The pump retrieves water from up to seven meters below the surface and pumps anywhere from 5,000 to 7,000 liters per hour. It is made from common materials, which allows them to be easy and cheap to manufacture, sell, and use. The pumps are easy to run and do not require an intense amount of labor. However, it does require more tending to the plot of land to ensure the land receives the correct amount of water. Tests have shown that by using treadle pumps, farmers receive higher yields. Also, this system allows farmers to grow crops at a higher intensity which, in return, increases the farmers' yields as well. Plus, because of the amount of water currents flooding the crops, treadle pumps allow the farmers to stop using as much or even all the fertilizers they had been which ultimately saves them money.

Another possible solution to help with irrigation in Zimbabwe would be to use the system of drip irrigation. Drip irrigation is the process of gradually applying an even amount of low-pressure water to the plants through plastic tubes that are directly inserted into the root zone of the plants. The depth of the tubing, however, depends on the seedlings and crops the farmer is producing. This process allows the farmers to manage and to schedule the water added so the crop only gets the amount of water needed for it to thrive, no more; thus, farmers will use the water more efficiently. In addition, using the drip system permits virtually no loss of water due to runoff, deep percolation, or evaporation. Due to the tubing being installed under the surface, it is less likely to be damaged from cultivating or weeding, therefore making it last longer. Because this irrigation system reduces the possibility that chemicals and insecticides will be lost before reaching the roots of the plants, it also allows less of them to be needed. However, the drip system has some minor disadvantages as well. First, the system generally costs from \$500 to \$1200 per acre to install and use. Next, the tubing can be exposed to plugging due to silt or other particles, which would need to be cleaned out and managed. A regular application of chlorine through the tubes could help unplug it and destroy algae or bacteria in the tubes. Not only can plugging occur, though, leaks can develop as well. All in all, drip irrigation systems would benefit many farming practices. However, it is closely linked with precision farming.

Zimbabwe is a country located in southern Africa, where more than 12 million citizens reside. Seventy percent of its population lives in the rural part of the country where most of the tenants are occupied through farming. In addition to growing crops like corn or tobacco, the farmers make money through exporting and raising livestock like cattle or sheep. With the highest literacy rate of the African countries and excellent health and education statistics, Zimbabwe seems as if it should be a country that has no worries. Unfortunately, this country's economy is worsening, which makes many of its residents' food insecure. The food insecurity is partially due to unpredictable weather patterns, which have brought many droughts. These droughts have created a water scarcity problem, which makes it hard for the farmers to produce an adequate yield. Not making a sufficient yield makes it close to impossible to provide enough food for the country and make a living for themselves. Throughout the years the country's economy had signs of improvement, which created an optimistic hope for the citizens. However, with more droughts and inflation the nation has yet to fully recover. Due to water scarcity being a contributing factor to the food insecurity, adaptations to the farming practices could be made to conserve water. These include natural farming, precision farming, and biointensive farming. Natural farming allows the farmers to use less water to hydrate the crops, doesn't contribute to the groundwater pollution because it doesn't use pesticides, and creates economic opportunities because of the increasing demand for natural products. Precision farming splits up the land into sections which allows the farmer to only use the amount of water necessary for a certain segment of land, rather than overloading it because another division needs more. Biointensive farming uses double-dug beds to aerate the soil and allows the farmers to plant seeds closer together. This technique makes it possible for the plants to hold more water; therefore, they will need less watering. Another way to conserve water would be to improve irrigation systems. One possible solution would be treadle pumps. Treadle pumps are cheap and easy to manufacture, sell, and use and do not require a great amount of labor. The pump salvages water from

below the surface and tends to create higher crop yields. An additional solution would be to use a drip irrigation system. This system uses tubes to insert the water in the root zone which prevents run-off, deep percolation, and evaporation. Less water is needed because it allows the farmers to manage and schedule the amount of water a certain section of crops would get. By using any of the techniques previously mentioned, water scarcity could decrease. This decrease in water scarcity would give the farmers hope in producing a higher yield for less money, which means more money in their pockets and more food for the residents of Zimbabwe and exporting. All in all, helping Zimbabwe improve its crop production through improvements in its crop-watering technology will contribute to the fighting battle of improving the food security for Zimbabwe and, hopefully, for the rest of the world.

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