

Michayla Goedeken  
Humphrey Public Schools  
Humphrey, Nebraska  
Bolivia, Factor 6: Sustainable Agriculture

## *Solving Bolivia's Food Insecurity Using Sustainable Farming Practices*

### **Introduction**

World food insecurity is one of the most crippling issues facing the world today. Between the years of 2012 and 2014, one in nine people on the planet suffered from malnutrition due to food insecurities. The population is expected to increase steadily within the next thirty-five years, as three billion more people will be added to the planet. In order to have the resources to sustain nine billion people, current food insecurities need to be resolved. Multiple food insecurity issues can be resolved by using sustainable agricultural practices to increase yields.

Virtually every country in the world has an agriculture industry of some sort. Some are more efficient and produce more yields than others. In many up and coming countries, farmers are considered to have the least significant employment in the country. Several times people do not want to become farmers because they are paid very poorly. This is because the prices for crops and crop yields are too low to make a significant difference in the farmers' livelihood. Farmers, however, are what keep the world running. Agriculture is food. Without, food and therefore crop yields, this world will crumble. To feed nine billion people farmers need to be able to produce significantly more crop, especially in second and third world countries.

One country that is not using farmland to its full potential is Bolivia. Bolivia is one of the most troubled and poorest countries in South America. Within the last 190 years, Bolivia has had over 200 shifts of power and changes to their constitution. Political instability, poor natural resource management, and lack of agricultural technology make Bolivia inevitably prone to food insecurity. Bolivia is an incredibly low population density area. However, over 7 million people live under the poverty line there (Bolivia). Over half of the population does not have regular access to food, and 63% cannot meet the minimum calorie intake.

### **Rural Life**

In the rural areas, life is much worse: three out of four, 75%, are in poverty (Rural Poverty in Bolivia). Most families contain an average of three children and many times have multiple generations living in the same house (Bolivia- Language, Culture...) Natural materials such as mud and trees make up many of the houses (Exploring Bolivia's Biodiversity). Numerous people in rural areas rely on agriculture as their main source of income and nutritional needs. This is an issue due to the fact the agriculture industry in Bolivia is highly unreliable because of environmental factors, namely seasonal droughts and floods.

One hundred and eight million hectares are devoted to farming in Bolivia. Over half of Bolivia's farmers are made up of small family farmers in the highlands that own 5 hectares or less of farm ground (Bolivia: A Country Study). However, in the lowlands, landowners own as much 5,000 hectares.

Farmers and traders have the lowest income in the country. Because the government's pricing policies that lower food costs for urban Bolivians, farmers there receive significantly lower incentives than they would in many other countries (Bolivia: A Country Study). The average income of a farming family in Bolivia is 220 bolivianos a month, which equals \$15.71 in United States currency. National average monthly wage is about 440 bolivianos a month. Government law requires 23% of Bolivians' income has to go towards running water. Therefore most Bolivians go without running water. With this low income,

many Bolivians cannot afford adequate education or necessary healthcare (Bolivia: A Development Overview). Banks also will not lend money to farmers because of government policy. A majority of people in pastoral areas don't have enough money for even a small quantity of livestock, rendering themselves insufficient in necessary protein needs.

People in rural areas consume only what little they are able to grow. Crops grown in Bolivia consist of potatoes, corn, quinoa, wheat, barley, rice, soybeans, beans, fruits, and vegetables. Basic diet staples are starchy foods such as potatoes and rice (Bolivia: A Country Study). In the mountainous areas, families eat a grain crop called quinoa. Other foods consumed include locally grown fruits such as papayas and prickly pears.

Due to flooding in early 2014, houses, farm ground, and infrastructure was demolished. When environmental factors lead to poor yields, many farming families experience food and nutrient deficiency (Bolivia). Most rural peoples don't have money for food storage, so products that are produced must be consumed quickly before they spoil. This leaves people with little to nothing after the perishable yields are consumed.

Farmers experience many problems due to the lack of infrastructure. Lack of infrastructure inhibits food from getting to market and diminish the opportunities for exports. There is little infrastructure in the secluded mountainous areas. Commodities that do get to market, many times, have to compete with other illegally imported products (Bolivia: A Country Study). Isolation in rural areas because of terrain and lack of infrastructure limits work opportunities, sets back technology, and hinders the option of education (Cannon).

Education in rural Bolivia is lacking severely. Primary education from the age of 6-13 is "required". Reprimands are never handed out, however, if children do not finish schooling. Hence, 1 in 7 people don't finish primary school. Some education is better than none, however the only good quality education is provided in private schools. Unfortunately, many rural Bolivians cannot afford send their children to these schools (Exploring Bolivia's Biodiversity). Numerous children in Bolivia's education system drop out of school because of language barriers. A majority of rural children speak in one of 36 indigenous languages accepted in Bolivia. Public schools typically do not teach bilingual classes. Instead all classes are taught in Spanish and many rural children struggle. Also, many children drop out of school to assist adding to their families' income. Consequently, over one million people in Bolivia are illiterate (Bolivia: A Country Study). By meeting the short-term need of the family, these children are missing out on the skills needed to climb out of poverty. Because of the lack of education, their healthcare system is failing as well.

In rural Bolivia, efficient and reliable healthcare is hard to come by. There are three medical services licensed by the Bolivian government: the Ministry of Public Health, Social Service and private clinics (Arnade). However, because of lack of infrastructure, there are not many of these clinics in the rural areas, and what clinics are there, don't provide sufficient services. Also, over 80% of people in rural areas do not have access to clean safe water. These issues, compounded with malnutrition, leave rural peoples vulnerable to respiratory diseases, malaria, yellow fever, and others. (Country Profile: Bolivia) Traveling doctors provide care in some of the rural areas. Folk medicine is the main source of healthcare in other areas, especially in the mountains populated predominantly by Indian culture, where modern healthcare is nonexistent.

### **Current Agricultural Practices**

Farmers grow a vast variety of crops in the diverse environmental areas. Sixty percent of the farmers live in the cold and dry mountainous areas where potatoes, corn, beans, quinoa, and other vegetables are grown. Farmers in the Andes Mountains use a traditional Inca-style terracing to farm on the steep slopes.

This, however, leaves the field at risk to frost and erosion from unpredictable rainfall patterns. The crops grown are mainly food crops used to feed their families. In the mountains there is lack of seeds and money for other inputs; therefore, smaller areas are planted.

The other 40% of farmers are in the “lowlands”. In the fertile valleys farmers grow corn, wheat, rice, barley, soybeans, coffee, sugar, cotton, cocoa, and sorghum (Bolivia: A Country Study). Farmers in the lowlands use integrated techniques from both the days of the South American Indians and the 20<sup>th</sup> century. Here they use more modern technology because the field sizes are larger. They grow a mixture of both food and cash crop. In the valleys, it is warmer and there is higher rainfall. Yields here are lower but there are two crops grown in a year.

Bolivia uses the lowest amount of fertilizer per hectare than any other country in the Western Hemisphere. On average they only use two kilograms a hectare (Bolivia: A Country Study). That is only 1.8 pounds per acre of total fertilizer usage. The United States, in 2010, used an average of 140 lbs of nitrogen on corn alone, not to mention all the other nutrients and crops (Fertilizer Use and Price). This small amount of fertilizer is all most farmers can afford. In Bolivia, fertilizer is extremely expensive because of transportation costs. Some farmers use natural fertilizers like livestock manure.

Furthermore, Bolivia has the lowest use of tractors in the Western World. This is due to the lack of communication with other countries caused by isolation and lack of technology. In addition, tractors are expensive (Bolivia: A Country Study). Tractors are unnecessary in the mountains because the fields are so small. Here the fields are plowed mainly by what few animals there are.

Bolivia, like many South American countries, uses the traditional method of slash and burn agriculture. Here they cut down all the vegetation in an area then burn the residue. Farmers use the nutrients from the burned remains as nutrients for the next year. This is effective for a couple of years, but after each year the deficit between the nutrients needed and nutrients used grows. Once the nutrients are depleted, there is nothing left for the farmer to use and the ground is often left barren (Slash and Burn Agriculture).

Slash and burn agriculture, overgrazing, and poor tilling practices have led to many issues in Bolivia. In Bolivia, nearly all fields are cultivated; this, over time, has led to erosion. Erosion has depleted the top layer of the soil where all of the nutrients are. Every year about 2/3 of fields in Bolivia are cultivated but are left fallow, or unsown with seed (Bolivia-Agriculture). Fallow fields and recent droughts have created severe desertification in many regions. Rainfall on these now hydrophobic soils can lead to even more erosion.

### **Possible Solutions**

Erosion is an issue, but it can be solved quite simply. In the off seasons, cover crops could be planted to prevent soil movement due to rain. When the fields are to be planted again, the cover crop could be cultivated under. The decomposing cover crops would then provide nutrients for the next year's crops. Furthermore cover crops help with pest, weed, and disease management (Pimentel). Cover crops could also be used as fire material for homes or forage for livestock. Additionally cover crops benefit crop production because they reduce soil compaction. Borders of fields could be planted with permanent plants such as trees or shrubs to reduce erosion as well. This could also lower the potential for desertification because cover crops conserve moisture.

The potential for desertification could also be diminished greatly by irrigation. Currently only 5% of Bolivia's farm ground is irrigated. Irrigation can be as primitive as a coordinated grid of ditches to direct water. In the rainy season, rain could be collected in troughs on the side of houses or other buildings. These troughs could be connected to hoses that lead to a poly-plastic underground storage container to prevent evaporation. The water could then be stored until the dry seasons when it could be pumped out of

the ground with a hand pump, Then it could be dispersed with an irrigation system. Rainwater harvesting is already used in many Latin American countries such as Brazil, Argentina, and El Salvador (Rainwater Harvesting...). Farmers in Bolivia do not use this practice because many of them have not come to knowledge that such a process exists.

A non-profit organization called Water for People is currently helping improve water knowledge, sanitation, and practices in Bolivia. Their goal is to put sustainable water practices to ensure everyone in the country has safe water and everyone is informed about the sanitation of water. Bolivia's government asked Water for People to come in in 2008 (Making a Difference in Bolivia). This organization already has a strong connection with people in the rural areas they are centered in. Water for People works with many schools, communities, and local governments to personalize each solution. The practice of rainwater harvesting could be easily integrated into practices they already teach. Currently they are working on reaching out to the people that live in the mountainous country far away from villages. These are the people that could benefit from rainwater collection the most, especially those who farm. Therefore if Water for the People could incorporate teaching rainwater harvesting along with their water sanitation, they would not only be helping the water issue but the agricultural industry as well.

All plants need three major nutrients to thrive: nitrogen, phosphorus, and potassium. Rotating crops is one way to add nutrients to the soil without having to buy expensive fertilizers. If farmers rotate crops with high nitrogen demands such as potatoes and corn with nitrogen fixing plants such as soybeans and lentils, called legumes, natural nitrogen would be added to the soil. These nitrogen-fixing legumes would convert nitrogen from the air into usable nitrogen in the soil that corn and other crops could use. (Soil Improvements With Legumes). This could be an easy transition from current practices. Instead of leaving fields barren Bolivians could plant nitrogen-fixing legumes and replenish the soil for the next year. In the lowlands where fields are planted with two crops every year anyway, legumes could easily be incorporated. Legumes however only fix nitrogen.

Another nutrient needed for plant growth is potassium. This is the main nutrient that is provided in the slash and burn method of Bolivian farming. When the vegetation is burnt, the nitrogen that was in the plants is turned into its gaseous state, and a majority of the phosphorus is used as fuel. The potassium, however, is left in the soil (DeBano). As mentioned above, this is not a reliable source for nutrients in a long-term scenario. Instead of slash and burn, Bolivian farmers could harvest their crop then collect the remaining vegetation. After collection they could then burn this in a hole or fire pit with a solid bottom. The ash could then be collected and spread on the fields the next year as a sort of natural potash fertilizer. This process could indefinitely recycle the nutrients the plants.

The third necessary nutrient for plants is phosphorus. This nutrient is in almost all livestock manure. Small farmers in the mountains already use this method to add nutrients to the soil. Manure can also supply nitrogen and potassium along with secondary micronutrients that also help increase yields. Organic matter can also be put back into with the use manure as a fertilizer. However, large-scale farmers in the lowland areas of Santa Cruz could sign contracts with large-scale animal plants. Farmers would have to be taught how much manure to apply however because, too much can lead to runoff and nutrient leaching (Rosen, Beirmen) and not enough will not effect yield, rendering contracts senseless.

All of these solutions would help Bolivia tremendously. However, these solutions will not be helpful until Bolivian farmers understand, accept, and implement these techniques into their fields. The biggest issues with this is getting the information to the farmers then convincing to apply these practices. This can be a very difficult process because the ideas would be very foreign to these farmers. Some may be offended when people try to change their practices. One way to integrate these techniques slowly is to set up a sort of Extension program. This program would teach proper stewardship of land and how to get the most out of every acre using new farming methods. Demonstration fields could be set up in areas surrounded by

other farms or near heavily traveled areas. The Extension program could also offer incentives to farmers who are willing to try new ideas. The program would most likely be government run and operated. The information of practical farming methods could come from other countries, however. Chances are that the government would be willing to put this organization into place because they are as desperate as the rest of the country to see a change in the economy and the amount of food available.

### **Conclusion**

In order to meet the food needs of 2050, steps need to be taken to manage the resources that are currently available. More food will need to be produced with less. To feed nine billion people, second and third world countries need to be able to fulfill their own food requirements. They will need help putting feasible practices in to place that will increase their yields, add infrastructure, and change education policies. Countries that are already self sufficient in crop production and government policies have the obligation of assisting the undeveloped countries in reaching a successful state. Only when these steps are taken will the world be able to meet the needs of nine billion people.

Bolivia is in a state of crisis both politically and in the area of food insecurity. Many of their problems are deeply rooted in the cycle of poverty present there. Bolivians cannot afford things as rudimentary as running water and a regular food source. Other issues affecting the country range from lack of infrastructure to not enough food storage. One issue that is relatively economical and straightforward is to resolve is the lack of adequate farming practices.

Simple ideas such as planting legumes and basic irrigation ditches are groundbreaking methods there. Many farmers in Bolivia are using the methods of their Incan ancestors. New ideas, such as the use of natural fertilizers and water storage containers, need to be transitioned into their current methods of farming to assist them in increasing their yields. Organizations such as Water for People could be tweaked to not help with just water sanitation but also teach about rainwater harvesting for agricultural purposes. An Extension-type program could be put into place to educate and show people the effects of using these new agricultural practices. Current practices that work in other countries and new ideas for natural fertilizers are realistic for the future Bolivia as a country conquers poverty with the power of agriculture.

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