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Bolivia: Food Development is the Key to Stable Food Security

Food is a valuable commodity, one that most Americans take for granted. The process of growing, processing and transportation flows efficiently and effectively in the United States, enabling most to live life without a second thought from where the next meal comes. Unfortunately, there are many countries in the world that lack the ability to grow sufficient provisions requiring them to rely heavily on the imports of crops from other countries to make ends meet. Consequently, this results in food insecurity and hunger among the population. One such country is Bolivia. Located in the heart of South America, amongst the Amazon Rainforest and numerous mountain chains, lays the fifth largest country in South America- Bolivia. It is a landlocked nation, having lost its coastland to neighboring countries. The terrain consists of plateau and mountain chains to the west and plains and rainforest to the east. Composed of both indigenous and non-native people, this country has a population of almost ten million people, many of which live well below the poverty line. Although Bolivia is abundant in natural gas and oil resources, it still lacks the ability to provide food for its own people.

Due to Bolivia's diverse terrain and climate zones, many different crops can be grown such as soybeans, potatoes, brazil nuts, rice, corn, barley, sugarcane, cocoa, wheat, rye, numerous tropical fruits and quinoa. There are three primary agriculture regions in Bolivia. The Altiplano region extends from Lake Titicaca to the Argentinean border and between the Cordillera Occidental and the Cordillera Real. This is an area of paradox. Almost sixty percent of farming is performed here although it is the least fertile region of Bolivia, and the high altitude makes farming challenging. Inter-Andean Valleys are the areas east of the Cordillera Central at altitudes below the Altiplano. This region is the most fertile area of the country and is more conducive to commercial farming. More recently, agriculture has begun to expand in the Santa Cruz valley area due to infrastructural improvements and land reform.

Subsistence farmers make up the majority of farmers in Bolivia. Farming primarily on the Altiplano and the Inter-Andean Valley regions, farmers have cultivated their small plots of land for generations, leading to degradation and erosion. This condition is compounded by inefficient crops which do not yield substantial amounts of food to support the region's demand. The lack of infrastructure in these regions also makes any crops available for market sale virtually inaccessible to the market. This compounds the malnutrition and poverty situation within these areas.

Bolivia is home to as many as forty different ethnic groups with some thirty-eight recognized languages. The majority of those people live as subsistence farmers eking out a living from Bolivia's land. Among the rural households of Bolivia, approximately eighty percent work in agriculture (Lara). In 2002, almost two thirds of the population lived in poverty, with one third living in extreme poverty (Lara). Poverty in rural areas reaches up to eighty percent in the most afflicted regions of the west and south (Lara). The poorest Bolivian households, forty percent of the population, spend sixty-five percent of their income on food including cereal grains, potatoes and meats (Lara).

A typical farming family, consisting of five to six people-a mother, father and three to four children-, lives in the infertile Altiplano region with 1-3 hectares of land on which they cultivate crops of haba, quinoa, potatoes and maize. These farmers, equipped with the outdated farming technologies, struggle to produce enough food for themselves and their families. The poorest ten percent of the Bolivian populace makes sixty-six percent of their income in agricultural activities, forty-four percent of that being for their own consumption (Lara), which leaves very little to sell to support non-food, living functions. With the increase or decrease in local food prices due to the lack of food available on the Bolivian market, and the importation of over sixty percent of cereal grains, farmers' earnings rely on market fluctuations (World Food Programme). To increase their earnings, the farmers' yields must first be increased so as to increase their competitiveness on the market. However, there are many barriers that farmers face that inhibit this yield.

More often than not, the farmers of the Altiplano region face drought, while the farmers in the valleys are afflicted by excessive rainfall (World Food Programme). These weather patterns can be attributed to the recurrence of the La Niña and El Niño weather patterns in the Pacific Ocean affecting weather in inland Bolivia. These weather cycles cause both drought and excessive rains in areas that receive light to moderate rainfall usually. This disrupts the sowing period, delaying or even cutting it off, causing lower yields or even crop failure (World Food Programme). This brings further hardship for these families who rely on their crops to sustain themselves.

Lack of farming technology further hinders the farmers' endeavors. Relying predominantly on traditional farming practices, farmers often cannot sow enough land in the planting period. Also, the lack of fertilizers in the region contributes to the small harvests that the farmers have. Fertilizer, though used in some areas, remains virtually inexistent in the Altiplano and Inter-Andean Valley regions due to the lack of infrastructure that is required to transport the fertilizer to the areas. Fertilizer usage in Bolivia is far below the rate of other countries within the region. Bolivia's total usage levels for 2002 were five kilograms per hectare while Columbia was at three hundred and two kilograms per hectare (Lara). Lack of improved farming technology and lack of fertilizer in the region, impedes agricultural success with the majority of farmers still relying on traditional farming methods to cultivate their land.

Because most farmers raise what they eat and the infrastructure and income prevents diversity in diet, a typical homegrown diet for a farmer's family comprises primarily of potatoes and cereal grains, rice or noodles. This diet, high in carbohydrates, lacks many of the proper and necessary nutrients that are needed for bodily function, leading to high malnutrition rates. In the poorest areas, up to four out of ten children under five are stunted due to the lack of nutrition. (World Food Programme) Access to medical care also compounds the problem. Lack of infrastructure makes attaining medical care difficult to impossible for most Bolivian farmers. Because of the aloofness of medical assistance for poor farmers and lack of proper sanitation throughout most of the country, the children from the poorer areas of Bolivia are up to three times more likely to die before the age of five than the children of the richest twenty percent (CESR).

Electricity is also one valuable commodity that most are unable to have. Typically only thirty-four percent of these families have access to electricity (Lara). The head of house usually has around four years of schooling. Fifteen percent of all children fail to complete a primary education with rural children

five times more likely to drop school before the end of their fifth year(CESR). In total, approximately only three percent of all men in Bolivia are illiterate, while a staggering thirty eight percent of all women are illiterate (CESR). This gap in education between the women and men can be attributed to the demand for women to stay home and serve a domestic role in the family while men, considered the bread winners, are expected to provide for the family and education is a means of achieving that.

Ultimately, for Bolivians to become food secure and rise above subsistence farming, they will have to overcome the barriers as discussed above to improve yields, enabling them excess production to sell at market price. One way to improve yields is through plant breeding and the use of genetically modified crops.

GM, genetic modification, is the modification of plants or other organisms through the insertion of beneficial genes into the organisms' genome. These genes express themselves through particular phenotypes, or physical characteristics, that benefit the crop. These genes can provide a wide range of benefits. In America crops have been modified to become resistant to crop diseases and have been enhanced to be resistant to herbicides. Others crops have been modified to become more drought resistant or enhanced with certain nutrients to prolong shelf life. These beneficial crops have increased food yields in America although not without controversy. Some parties believe that the GM products could have adverse effects on the human body and could hurt more than they help. This however is still undetermined.

While there is an interest from Bolivian commercial farmers to produce higher crop yields with the use of GM (Genetically Modified) crops, there is a faction of farmers, including President Evo Morales, who are opposed to any GM products and wish to phase out the current GM plants in the country. These people, mainly the indigenous people of the area, are focused on maintaining their cultural ties and protecting the biodiversity of their country (Cabitza). They are more concerned about protecting their native plants and using organic methods of producing these crops than they are about producing enough for the country's populace. In 2011, considerations were been made to open the country up to more GM crops, however strong opposition was made by the pro-organic groups and in 2012 a new proposal was made to prohibit any GM use out of fear that they would threaten native plant species (Vargas). This rejection of the GM products was politically motivated to keep big companies out of Bolivia and to keep the farms small (Cabitza). Essentially, the majority of people in Bolivia are working to make their agricultural stability less stable than it is currently.

Disrupting the use of the only currently certified GM product, soybeans, would cause catastrophic effects for the rest of the crop industry. Many growers believe that the new regulations against GM crops are a giant step backward and could threaten the production of other valuable crops, such as corn, rice, and sorghum, which many farmers use in rotation with the soybeans (Popper). If Bolivians could think past the big business mentality and see how the GM crops could benefit subsistence farmers then Bolivia would be headed in the right direction. Crops such as corn that is grown in the infertile Altiplano region could be modified to fix nitrogen thereby increasing soil fertility. Potatoes, a mainstay of the Bolivian diet, could be modified to enhance the nutritional profile of the starchy tuber. This would help alleviate the stunting in children alluded to earlier. GM products have great potential in helping to enhance food stability in Bolivia due to their versatility.

Widespread acceptance for GM products may be far off in Bolivia, but a way to start learning about the genetic diversity of current crops could be found in the creation of a Bolivian seed bank. The objective of this seed bank would be to help Bolivian farmers, who depend on major seed manufacturing countries such as those in the United States, become independent from the seed market in order to make profits. Most seeds on the market are GMO based, funding of a Bolivian seed bank would help this country, who currently seeks GM independence, attain this status. If Bolivia were to start producing their own seeds they could potentially reverse their current food security status, turning a importing country into an exporting nation (Cabitza). Improving this factor, either through new technology such as GM use or seed development, would have its benefits. The foundation of a seed bank, GM or not, in Bolivia could potentially cause the country to see more food exports than imports. The use of Genetically Modified products could increase crop yields and have positive impacts on the nation by providing more food for its citizens across the country.

Solving this issue does not come without complications. Such problems can arise from a variety of areas such as climate change, population growth, water scarcity, energy demand and pollution. Climate change could pose an issue due to the many unknown consequences that it possesses. Plants that are accustomed to a certain temperature range could prove difficult to cultivate if that range is warmer or cooler than usual.

Population growth in the country would stress the food security of Bolivia more. Finding effective ways of cultivating crops and increasing food production in Bolivia is crucial to addressing this issue. Growing populations would further stress the food production therefore more food would need to be made to sustain a rapidly increasing populace.

Water scarcity and changing weather patterns can cause problems with irrigation and planting. Water scarcity isn't an issue that can easily be fixed, so instead, it must be worked around. Planting drought-hardy crops such as those that have been modified to endure such conditions may be a solution to this. Other such solutions may include creating infrastructure, such as irrigation systems and water lines, to transport needed water to fields that produce plants that require greater amounts of water. Another way around the water dilemma is by following weather trends and educate farmers when to plant certain crops. For example, if they know that the year is going to be a dry one, then they should plant more drought-hardy crops such as sorghum.

Creating infrastructure, particularly in the Altiplano and Inter-Andean Valley regions, is also another issue that affects crop yields. The utter lack of infrastructure in these areas contributes greatly to the lack of crop development and poor crop yields. Without the proper infrastructure in place, it is virtually impossible for produce to get to market before it goes rancid, molds or gets too old. If some sort of infrastructure is not put in place so that farmers can get food to market quickly, then increasing crop yields would prove pointless.

Combating this factor will take time and resources. Crop yields need to be addressed due to their vitality in increasing food security in Bolivia. Either through the use of GM crops or even through the funding of

a non-GM seed bank for Bolivia, crop yields must increase if the typical farmer is to be able to produce enough food for both their family, and to send to market for others in Bolivia to purchase.

This plant science program should be corporately funded. Government finance of the seed or GM program would create further debt in Bolivia. Frankly, the government of Bolivia doesn't have the funds to create such a program, therefore either an already existing company should take the opportunity to grab this non-GM Bolivian market, or a new company should come forth to fill this gap. However, the best and most efficient way to increase crop yields without the funding of a new company or company program would be to expand the market for GM crops within Bolivia. This would increase crop yields for the typical farmer, allowing them to both provide for their family and send goods to market to sell. GM crops have also been made to combat drought conditions as well as many parasites and diseases that wipe out many crops in Bolivia today. Soy, the one GM crop that is allowed in Bolivia, is also the number one crop export in the country. If GM crop use could be scaled up and become more widespread in Bolivia, then crop exports would increase, helping the typical farmer make more money and more food to sustain the country's population. Increasing production of GM crops would be the most efficient way to expand crop yields though a food science program and, in turn, put Bolivia on the right track.

Implementing these recommendations with the assistance of a typical Bolivian family would provide much needed support. Voting for the expansion of the GM seed market in Bolivia, or the creation of a Bolivian Seed Bank, would be the first step of many to getting these recommendations implemented. Also, once the new seeds become available, purchasing the seeds and planting them locally would be helpful contributions that local farmers could make.

Bolivia: a nation of poverty and hunger. A nation blighted with malnutrition and low education levels. A nation lacking in one of the most valuable commodities the world has to offer, food. This can change. Bolivia may be the poorest nation in South America, but it still has hope. Advancing food science programs and creating important infrastructure programs are essential to reversing these statistics. Creating a new non-GM seed bank to protect indigenous and organic interests, or expanding Bolivian use of GM products to increase food yields are important in furthering the food and crop science programs and helping the country become an exporting country, rather than an importing one. With the increased use of these crops over a sustained period of time local farmers will be able to sustain not only their families, but will also have surplus crops to send to market for a profit. The increase of food products on the market and greater access to them will have positive effects on the rest of the nation; malnutrition rates will drop over a period of time, health will increase, and children will be able to attend school instead of staying home to help their parents with the farm, leading to an increase in literacy rates especially amongst women. There is hope for the people of Bolivia and way out of poverty by increasing their food security through food science is a giant step in the right direction.

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