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## Food and Nutrition Security In Bolivia: A Practical Approach

The year 1945 marked the beginning of a revolution, the Green Revolution. By applying the newest technologies to breed higher yielding crops and develop new farm machinery, fertilizers, and irrigation methods, the Green Revolution saved close to a billion lives. It doesn't stop there. A "new phase of the Green Revolution began in the mid-1980s" to fight discrimination against women, global warming and the poor use of environmental resources around the world (Lipton). Now it's up to us, the next generation, to continue the work of our predecessors by exploring sustainable paths toward food and nutrition security.

An area that requires much of our attention is the South American Tropical Region. These countries represent some of the poorest in South America and the world. But because they differ so drastically in climate and geographical characteristics, it is difficult to apply the same agricultural methods in each location. I chose, then, to focus my research on Bolivia, a country made up of struggling small-scale farmers.

The political history of Bolivia is unstable. The country has survived almost 200 coups and counter-coups and somehow managed to maintain its sovereignty. In 1982, the military handed over the government to civilians, ending an eighteen-year military rule. During the War of the Pacific in 1880, Bolivia lost its only path to the ocean to Chile. Since then it has been the only landlocked country in South America, besides Paraguay. A major industry in Bolivia is mining. Tin is plentiful, as are other minerals, and recently, large natural gas deposits were discovered. The country is divided into three main geographical regions: the Andes Mountains and the Altiplano in the west, the semi-tropical valleys in the middle of the country, and the tropical lowlands of the east. The majority of the population lives in the western Altiplano region. The topography and climate make agriculture production here difficult. The majority of the country's agricultural workers are engaged in sustenance farming (Country Profile).

A family farm in Bolivia is usually home to a conventional family, consisting of parents and children. Occasionally, one or more of the grandparents may live with the family. Their diet is made up of pasta, rice, corn, a grain called quinoa, meat (depending on availability), and many potatoes, often in a dried form called chuno used in porridges and stews (Aragona). In regard to education, a survey by analyst Friedrich Huebler, in June of 2006, stated that the literacy rate in Bolivia is near 86.5%. Overall, 89.5% of all children ages five to fourteen are enrolled in school. Literacy rates and school attendance are lower in rural areas, as children must help their parents both in the house and on the farm (Huebler). Often, the income from crops alone isn't enough. Some family members may work outside the home at other low paying jobs to supplement their income (Aragona).

Farm size ranges from one to ten acres. Extended families may share farmland but live in separate houses and plant different crops. Crop varieties include potatoes, corn, quinoa, and barley. Some farmers grow tomatoes and onions as cash crops (Aragona). Water is scarce on the Bolivian Altiplano, so irrigation is necessary. One common form of irrigation is a ditch that runs behind and in between two rows of houses. Farmers dam up and move the water in the ditches with blocks of mud. Some ditches are made of concrete, which reduces water loss by up to 70% (Aragona). However, even farms with concrete ditches don't receive enough water for their plants to grow well. Many farmers fertilize their crops with manure, either from animals of their own, or

bought from neighbors or commercial dealers. Unfortunately, this practice doesn't put enough nitrogen back into the soil. There are some problems with erosion due to farming on hills without the necessary precautions and these practices may also degrade the soil quality (Aragona). On small Bolivian farms, the main marketing tool is local farmers' markets, or one in a nearby city.

There are many factors working against the sustenance farmers of Bolivia. The climate of the Altiplano is relatively cold and dry. This causes a short growing season in an area unsuitable for many kinds of vegetation. Unfortunately, this is the region in which the majority of sustenance farmers live (Country Profile). The soil in the Altiplano has very little organic matter, being especially low in nitrogen and phosphate. Nitrogen can be somewhat replenished with manure fertilizers, but phosphate fertilizers are expensive, and farmers are rarely aware of the problem (Aragona). Many families don't understand basic health and nutrition requirements. This lack of education results in poor general health and high infant and child mortality rates. Also, the Bolivian government recently globalized much of their economy, which many say hurt the prosperity of the people. Newly elected President Evo Morales, Bolivia's first indigenous leader, promises to impose the will of the people and take back the country's markets (Random).

I chose to focus my research on sustainability research into climate in Bolivia. It seemed that this factor was not the recipient of much attention. Most sustenance farms in Bolivia are found on the Altiplano, which is located in the southwest part of the country (Country Profile). The Altiplano is the second largest plateau in the world, smaller only than the Tibetan Plateau in China. It lies more than 12,000 feet above sea level and is surrounded by the Andes Mountains (Altiplano). The word altiplano means "high plain," but the region is not actually very flat. The area is made up of small hills and valleys, rivers, lakes, even volcanoes and the world's largest salt flat, the Salar de Uyuni (Bolivia). The daily temperatures on the Altiplano fluctuate drastically. In the warmest months of November through March, the temperature can reach 80° F in the daytime hours and drop to almost freezing at night. The temperatures in the winter months of April through October frequently drop below freezing after dark. As a result, the Altiplano is nearly treeless and hardly suitable for farming (Climate). The climate variability in the region affects the choice and mix of crops, their productivity, and household nutrition security.

In 2000, the World Food Program released figures stating that "94% of rural households were unable to fulfill basic nutritional requirements" (Bostock). This is largely because much of the food they need cannot be grown on the Altiplano. It also relates to the fact that the people are unaware of their own dietary needs. The World Food Program also confirmed that "only 12% of Bolivian families consume 2,250 calories per person, a number that is thought to represent the bare minimum energy requirement" (Bostock). Altiplano dwellers show the highest levels of malnutrition over all, with 50.4% of those living in rural areas suffering from anemia due to malnutrition (Bostock).

There is evidence indicating that the climate in Bolivia has changed slightly due to global warming. Some scientists say that the temperatures have risen one degree centigrade over the last century. Also there are some indications that the only glacier in Bolivia is melting. However, these changes have had very limited impact on the average family farm; therefore the situation has stayed the same (Forero).

The sustenance farmers in Bolivia lack a way to obtain the vitamins and minerals their bodies require. The harsh climate and water scarcities contribute to this problem. We need to find a simple and cost-efficient solution that will allow families to grow vegetables containing these nutrients. The amount of sickness and malnutrition in rural villages would decrease markedly if family farmers could grow this produce themselves. Obviously, there is no way we can change

the climate of the Altiplano, but there is an answer that is both practical and inexpensive.

Greenhouses are a simple and sustainable answer to this problem. They provide a year-round growing season and access to fresh vegetables that would not otherwise grow in the Altiplano climate. There is only a small amount of extra work involved in keeping a greenhouse, and it could be done by mothers and children, leaving fathers free to continue their regular farming duties. Any excess produce can be sold for additional income. This solution is sustainable, and could be put into effect immediately (Velasco).

The Benson Institute of Brigham Young University developed a successful, cost-efficient design created specifically for poor farmers in Bolivia. It is known as the pankar-huyu, which means “garden bed” in Aymara. Bolivian native Noel Velasco completed much of the fieldwork for this design. Velasco is a former student at the University of San Andrés in La Paz and has fine-tuned the pankar-huyu project. Velasco also worked with the Benson Institute in Bolivia and received the Gilbert Award, “given to a foreign student who develops exceptional ideas for improving food production and nutrition” (The Pankar-huyu).

The pankar-huyu is a semi-subterranean mini-greenhouse. Like other greenhouses, the pankar-huyu accumulates thermal energy by allowing the sun’s rays to enter and maintaining the heat that is produced. The bright, glaring sunlight that is often distressing at such high altitudes is now used to the plants’ advantage. The pankar-huyu’s earthen walls are good insulators, much more so than the thin walls of traditional greenhouses. Even during the winter months, the temperature stays above freezing, rising as high as 100° F. The design works so well, the cover must be opened in the daytime, so the temperature inside doesn’t rise higher than what is healthy for the plants (The Pankar-huyu).

Water efficiency is a major factor in any agricultural project on the Altiplano. Fortunately, the pankar-huyu is very resource friendly. It doesn’t take much water to keep the plants alive. Having first-hand knowledge of the water scarcity in the region, Velasco stated, “The pankar-huyu is very water efficient; it needs very little water to produce plants. In part this is because when the water inside evaporates, it accumulates on the cover and drips back down to the soil” (qtd. in The Pankar-huyu). In most greenhouse designs, water accumulates on the sides of the structure and doesn’t benefit the plants. Also, some water will flow into the pankar-huyu because it is in the ground.

The design and construction of the pankar-huyu is very simple. It starts with the excavation of a hole about 1.3 meters wide, 3.0 meters long and 0.8 meters deep. An ideal location would be within thirty meters of a water source, in an area with loamy soil, and on a small rise or hill, to prevent flooding. The long side of the hole should run east to west to catch the most sunlight. The floor is leveled and filled first with gravel and then an equal mixture of topsoil and manure. The gravel in the bottom drains the soil and prevents it from getting soupy due to too much moisture. The cover is made of a rectangle frame that covers the top of the hole. Polyethylene is stretched over the boards and nailed in place. “Agrofilm” is the commercial name of polyethylene on the Altiplano and is easily available. The cover is installed so that it slopes down towards the north and receives more sunlight. A small trench must be dug all the way around the pankar-huyu for drainage purposes. During the day sturdy wooden stakes can be used to prop open the cover. This pankar-huyu will last a family about six years, and the polyethylene cover needs to be stretched yearly to avoid cracks and dips (Velasco)

One of the best things about this design is that it only costs around \$13 (US currency) to build. Two men can dig the hole in two working days, and the whole project can be completed in

about four. All the materials are readily available to the people, and an easy, seven-step guide to building the pankar-huyu is available online at

<http://benson.byu.edu/Publication/BI/Lessons/volume22/building.html>. However, there is little to no available Internet access near these villages, so expecting families to acquire the information through this means is unrealistic.

Building a greenhouse is really only half the solution. According to Velasco,

Many times the rural residents accept the greenhouse but they stop using it. This has happened because the important first step was not taken. The first step is, and should always be, to teach the people why they need to eat vegetables. When the people realize they need vegetables to be healthy, they will ask for the technology. It is only after this first step that the technology should be taken to them. (qtd. in *The Pankar-huyu*)

If the pankar-huyu is going to do a family any good, they need to understand the importance of nutrition and how to modify their diet with the vegetables they grow.

How can we get this idea to the people and be sure they understand the basic concepts of nutrition? Bolivia's Altiplano is made up of roughly 5000 communities. I propose to send teams of two into the region for four months. These teams would be assigned four villages, one out of every five in their area. The teams would initially spend three weeks in each village. One member would hold meetings to explain the need for the pankar-huyu and how families can use what it produces. The second member would explain how to build the greenhouses, and both would assist in construction. After spending three weeks in each of their four villages, the teams would return to each village for one week. This final week could be spent checking the villagers' progress, helping interested families from nearby villages get started, and assisting in any problems before going home.

This plan would require about 500 volunteers and an organization that would be willing to head the project. One such organization that I think could get the job done well is the United Nations Division for Sustainable Development. "The Division for Sustainable Development provides leadership and is an authoritative source of expertise within the United Nations system on sustainable development" (qtd. in *About the United*). One of their priorities as stated on their website is to "provide technical assistance, expert advice and capacity building to support developing countries and countries with economies in transition in their efforts to achieve sustainable development." (qtd. in *About the United*). It would be possible for a smaller organization to take control of the project and ask other groups, churches, or individual to sponsor one volunteer or a whole team. This way the financial burden would not rest on one group alone. Either the United Nations or a smaller organization could get the job done.

Right now, Bolivia and all the inhabitants of the Altiplano region are in need of our help. The political scene in Bolivia is chaotic. The economy is unstable. Riots and protests are commonplace events in the capital city. Any one of them could cause the country's fragile infrastructure to collapse. Most of the Bolivia's farmers reside in the most arid part of the country. Water is always wanting. The irrigation methods in place aren't enough. Soil there lacks the amount of nutrients needed to grow healthy crops. Farmers can't afford the fertilizers to fix the problem and their small efforts aren't enough. The climate on the Altiplano is inhospitable, limiting the diversity of crops grown. All these factors contribute to widespread sickness and malnutrition. Furthermore, families are unaware that they aren't receiving the foods they need to stay healthy.

So what is being done? Bolivia recently elected a new president, one who promises to stay true to the people and their interests. New technology helps farmers dig wells and sanitize their water. Different farming methods and crop varieties that will put nutrients back in the soil are being introduced. Micro-credit agencies are willing to loan small, manageable amounts of money to those trying to improve their standard of living. There is a growing list of sources for nutritional education being made available to farmers and their families.

This paper discusses a simple way to improve the quality of life in Bolivia, one family at a time. The pankar-huyu is an efficient design in both cost and resource management. A solution such as this can be put into effect immediately, with long-term results. Handouts of food and money are simply quick fixes. The Bolivian farmers need a sustainable answer to the everyday problems facing them. Greenhouses provide this needed stability.

People everywhere are responding to the call for help coming from Bolivia and the surrounding region. We need to continue seeking new and applicable solutions to the problems facing the less fortunate, but this alone will never be enough. For any real change to take place, we have to show that there is something better, a higher standard to work towards. Many of those living in poverty simply accept the situation as their fate, the way it always was and always will be. They don't search for ways to improve their lives because they aren't aware a better quality of life exists. We know differently. It is our responsibility to share our blessings and knowledge for the benefit of others. Only this will result in sustainable paths to food and nutrition security.

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