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## Food Security: Improving Farming Practices in Bolivia

### Introduction

Imagine a world where there is not enough of a food source to feed everyone. With the population growing and limited farmland, that image is not that obscure. According to the 2002 census the world population is going to increase by about 3 billion people in the next 50 years. That means there will be an increase of about 33 percent more people. To feed all these people crop yields need to increase and farmland needs to be used more effectively. If actions aren't taken now to guarantee food security for the rise in population, then billions of people will be left starving. Some countries are already behind in food production, and have been for quite sometime.

Bolivia could be considered one of the countries behind in food production. Although it has an abundance of natural gas and oil resources, Bolivia is one of the poorest countries in South America. Many of the people in Bolivia live with only enough money for their families to scrape by. According to the CIA World Factbook, 64 percent of the population in 2004 is below the poverty line. Most of the people below the poverty line are rural farmers with limited funds, lack of knowledge, and lack of technology.

Because of Bolivia's various climates many different crops can be grown. In La Paz average annual temperatures will vary from 43.5F to 51.8F while in southern Bolivia temperatures can reach 104F ("Bolivia" CIP). Agriculture is primarily performed in the high Altiplano plains and the Andean valley regions. The growing season, depending on temperature conditions, is usually from October to March. Some of the major crops are potatoes, corn, rice, soybeans, tomatoes, nuts, and fruits.

The terrain in many areas has been overused, through "slash and burn" tactics, and worked so hard that the land is completely arid. Bad soil conditions make it hard for any crop to grow, let alone increase yields. Bolivia faces tremendous obstacles when it comes to food production. The farming technology is underdeveloped. Many farmers are out on their own trying to make a living with only the knowledge of their parents to rely on. With some simple tips and techniques farmers can become self sufficient and increase their profit as well as production.

### Family Farm

The agricultural class of Bolivia is mostly of Quechua and Aymara pre-columbian cultures. The common rural family of Bolivia lives in poverty, with the average rural family earning only \$150 a year (Latin - America Bolivia). This is barely enough money for a family to sustain itself. The average cost of living in most of Bolivia, including urban areas, is close to \$500 a month ("Cost of Living in Bolivia"). The infant mortality rate, in Bolivia, is 51.77 deaths for every 1,000 live births ("Bolivia"), while 26.8 percent of children under five suffer from chronic malnutrition ("Bolivia - Low Wages Leave Bolivians Starving"). Most farmers eat whatever they can grow themselves. Their meals include mostly carbohydrates with very little meats. They live with just the basic necessities. Their homes are usually made out of cheap material. They live in small square buildings with mud bricks and roofing tile. It's a very primitive setting, only 29 percent of the entire population has access to sanitary services, which are almost only provided in larger urban areas (Latin - America Bolivia).

Students are encouraged to go to school at the age of six. However average attendance in rural areas is less than attendance in urban areas, because of the need of children in the fields. On the average, children in rural areas attend school for 4.2 years, which is less than half of the years in urban areas (“Education in Bolivia”). Most families are made up of a mother, father, and the dependent children. Everyone in the family is expected to perform daily farming tasks. Mothers and children are often found selling in the marketplaces what the family harvested. Children learn very early about work and adult responsibilities. Family life is important in most homes. Husbands and wives are loyal because of their dependence on each other. Because family is so important, people who aren’t related are sometimes incorporated into the family, as godparents for children. It’s an important part of Bolivian culture and usually the godparents share responsibility for the child’s education and finances.

There are few government social welfare or assistance programs. This creates a problem because a lot of farmers lack knowledge to grow high yielding crops every year. Most people are left to take care of themselves, because government assistance is hard to find. With no social security, elderly people usually rely on their family to take care of them. Since there aren’t many large rural communities, many people have moved to urban areas where conditions are better. If Bolivia’s agricultural problems can be corrected farmers will have incentives to stay in rural areas and produce more food.

### Slash and Burn Agriculture

One of the biggest agricultural problems in Bolivia is called “slash and burn” farming. This technique is used when a forest, and/or vegetation, is cut down, or burned down, to make room for farming. The plot of land that is left is called swidden. The process consists of the conversion of forest land into farmland. It creates farmland for a couple years, but in the long term the process exhausts the land of its nutrients. Unless the soils nutrients are replenished, the soil eventually will become infertile. When this happens the farmer will move on to another stretch of land where the process is just repeated. Eventually the farmers are forced back to their original land, where it is nearly impossible to yield a substantial crop. Not only is it an inefficient process, it also hurts the environment through deforestation, which is at a current rate of 135,200 hectares per year (“World Deforestation Rates and Forest Cover Statistics, 2000-2005”). (A hectare is 10,000 square meters).

When using “slash and burn” farming the fertility of the land is washed away by the rain. Over the next couple of years every harvest depletes the land of its important nutrients even more. Because many farmers are too poor to invest in inputs, like chemical fertilizers, that can improve the land, the soil quality and growing conditions worsen year after year. Eventually weeds take over and the soil erodes until the plot of land is completely infertile.

When the vegetation is burned, in the first process of “slash and burn” agriculture, it releases tons of nutrients like phosphorus, potassium, and nitrogen, but the nutrients are quickly dissolved. A study in south western Nigeria showed that after the first year of burning and cropping, nitrogen soil content declined from 0.26 percent to 0.22 percent. That’s about a 15 percent decrease. The following year it decreased another 13.6 percent. In that same study phosphorus decreased about 28.6 percent, magnesium by 50 percent, calcium by 19 percent, and most substantially potassium decreased by 79 percent (“Ecological Dynamics Associated with Slash-and-Burn Agriculture in a Tropical Rain forest Area”). The nutrients decreased mostly because after burning they were naturally drained by water. Through better farming techniques, soil quality can be maintained and problems with “slash and burn” agriculture can be resolved.

### Crop Rotation

Crop rotation is one of the best ways to improve soil quality and conserve nutrients. The process is done by growing diverse crops in either sequence, in association, or after each other to benefit one or

both crops. Certain plants use soil and nutrients their own unique way; crop rotation uses that as an advantage. If a certain plant uses excess amounts of a particular nutrient, then the other plant would help restore the nutrient by not continuously using it or by helping replenish it. When the same crop is used over and over again the soil quality becomes worse over the years because the soil is being used the same way. Nature didn't intend for one plant to grow on its own and all by itself.

Combining different types of crops in a rotation creates a balanced relationship that in turn produces better yields. When mixing crops it is best to maximize the use of land as much as possible. Root systems should be studied so that there is no root competition below land. Above ground, plants should be close enough to protect, but not smother each other. There should be enough room for cultivation. Adverse crops usually work the best together. For example root vegetables would be grown with leafy vegetables, nitrogen fixers with nitrogen users, rapid growing with slow growing, and deep rooted with shallow rooted.

Sometimes cover crops are used by farmer to occupy the land between growing cycles. This will reduce soil erosion and will help weed suppression. The cover crops are rooted in the soil which helps keep the soil in place. If the land is left bare it makes it easier for weeds to grow freely and for water to wash away soil and important nutrients. Certain cover crops can also be used to help the main crop, when its growing cycle begins, by providing it with additional nutrients and to act as mulch for the primary crop.

The best part of crop rotation is that it doesn't take additional equipment or treatments. It's just a matter of having a good plan and knowing what plants work best with each other. The overall goal when crop rotating should be to design a balanced ecosystem, that way everything complements itself resulting in higher yields. Crop rotation is a simple and efficient way to maintain soil, reduce weeds, and eliminate nutrient loss.

### Nitrogen through Legumes

An effective way to replenish soil with nitrogen is through the planting of legumes. Some common legume plants are peanuts, beans, peas, and alfalfa plants. Legumes are nitrogen fixers. They turn atmospheric nitrogen, which plants can't use, into a source that can be absorbed by soil and used to help plant growth. Since 80 percent of the atmosphere is nitrogen gas, there is enough of an abundant source that expensive fertilizers wouldn't be needed at all. Profit could be increased by decreasing cost. This simple technique would help replenish soil nutrients that would normally decrease after "slash and burn" farming and because the nitrogen source would be natural, the environment would also benefit.

The conversion of the nitrogen gas to a usable source isn't actually done by the plant. The process is completed by microorganisms in nodules that form on the roots of the legumes. The microorganism is a common soil bacterium called Rhizobium. It feeds off of the plant while creating ammonia out of the nitrogen gas. The ammonia is then absorbed by the plant. The plant will then die and when it decomposes it releases the ammonia into the soil. This relationship between the legumes and Rhizobium is symbiotic.

A study conducted by an extension service of The University of Minnesota studied corn and soybean, which is a legume, crop rotations. This study was conducted from 1975 to 1986. The results supported the use of legumes in crop rotation. Corn yields in a corn-soybean rotation average 14 percent higher yields than corn alone. It was also determined that 50 percent of the nitrogen from the legume plants was put to use by the corn crop that followed ("Providing Proper N Credit for Legumes").

The best way to maximize yields through the planting of legumes is through crop rotation. The crop that is planted after a legume crop will have the highest yields. All plants need a good source of nitrogen, so almost anything will benefit from using legumes. Some plants that are especially prone to added nitrogen are cabbages and plants from the solanaceae family. Some of the solanaceae plants are potatoes, tomatoes, eggplants, and chili peppers. These plants are a little more susceptible to added nitrogen in soil. Tomatoes and potatoes are especially good, because they grow in warm conditions and they are regional vegetables

## Weed Management

Overpopulating weeds can become a huge hassle and problem. They can negatively affect crops through nutrient and food competition and ultimately reduce yields substantially. A common misconception is that the only way to get rid of weeds is through the use of herbicides. This is false; the best way to get rid of them is through prevention. Not having any weeds to begin with. Weeds start growing due to poor soil quality or because they have similar growing cycles as a crop. If soil quality can be increased and weed growth cycles disrupted, weeds won't be a problem.

Crop rotation is again a great tool for weed management. Usually a weed will start to grow because it shares a similar cycle as the crop. When rotating to a different crop with a different growth cycle it disrupts the weed's cycle. The soil enriching effects of crop rotation also keeps weeds from taking over because weeds grow better in poor soil conditions. If crops are being mixed correctly they can also be preventative when it comes to weeds. Forage crops or canopy crops help blanket the soil so that competing weeds are choked out or shaded from sunlight. They grow more densely to suppress weeds.

A great cover crop for reducing weeds is Rye. It is an allelopathic crop, which releases natural chemical toxins that stop other plants from growing. This can be very helpful when reducing weeds. In the United States lots of farmers plant this as a fall crop and then use it as mulch for their primary crop. In Michigan large seeded crops in rye mulch were observed. The rye mulch reduced ragweed by 43 percent, pigweed (an herbicide resistant weed) by 95 percent, and purslane was completely eliminated ("Principles of Sustainable Weed Management for Croplands"). Although conducted in Michigan, rye is grown all over the world. Other great cover crops with allelopathic power include wheat and sunflowers.

Tillage can result in unwanted weeds if the right technique isn't used. Tilling is the preparation of soil for growing crops by digging soil up. When tilling the soil gets turned, but sometimes this causes the weed's dormant seeds to be introduced to oxygen. This promotes weed growth creating an opposite effect of what is trying to be accomplished. If a second tillage is performed it can eliminate the weeds that grow from the first tillage. This is recommended before seeding, otherwise weeds will get the head start on the crop. Certain crops, like corn, rely pretty heavily on tillage, but it should be avoided if at all possible.

## Organizations to Help Educate Farmers

Aid in Bolivia would be most beneficial in the form of technical assistance in rural communities. That way instead of trying to support the agriculture in Bolivia, it can learn to support itself. If farmers were taught some of the simple techniques, like crop rotation, they could improve their own living conditions. It's the whole teach a man to fish theory. Most farmers just want a fair chance at making a living through agriculture. Currently there are a couple programs in Bolivia that work towards educating rural communities. These programs are the first steps.

One of the most successful organizations that help farmers through multiple projects is The Strategies for International Development (SID). SID has been in Bolivia since 1994. Since then there

have been projects in 98 Bolivian communities. It is so successful that it has expanded to Peru, Guatemala, and Burundi. One of its recent projects was helping farmers reclaim and transform parched land into productive pastures. It was conducted in Huanucollo an impoverished community in Bolivia's altiplano. Families of the community, on average, increased their income from \$320 a year to \$600 a year ("Huanucollo: A Community's Transformation"). The goal is to raise the income to \$900 a year, but the community needs more money and training.

The Small Farmers Technical Assistance Service Project (PROSAT). Through the International Fund for Agricultural Development is a 6 year World Bank pilot program to strengthen rural communities through technical assistance. It is targeting 206,000 poor rural families. The total estimated cost will be \$28.3 million.

Programs like these are important to the success of Bolivian farming. A study conducted by the Centro Internacional De La Papa in the 1990's analyzed potato productivity in Bolivia. A quarter of the farmers received technical assistance, in forms of training and information, along with access to inputs. The results showed that the estimated effect of technical assistance was an increased yield of 2.5 tons per hectare ("Program 1: Analyzing Potato Productivity in Farmers' Fields in Bolivia").

## Conclusion

As the world population increases, arable land decreases. Any wasted space will work against the process of increasing food supply. The land that is currently being farmed has to be used as efficiently as possible. That means that useless tactics like slash and burn agriculture have to be controlled more efficiently. So the process only has to be used once. That is why maintaining good soil quality through crop rotation and beneficial plants is very important. Soil is the source that all our food grows on. The area and quality of it is very important.

Some will argue that genetic engineering, to create better yielding crops, is the only solution to food security. While it is definitely a huge aspect, that can revolutionize food production, other measures can be taken right away to improve agriculture in third world countries, like Bolivia. All it would take is some basic farming education for underprivileged farmers. This could be a more immediate solution while other methods are developed. Genetic engineering could also be used in combination with crop rotation. Instead of seeds being engineered to grow in certain conditions, they could also be engineered to grow in a symbiotic relationship with different plants.

Farming techniques like crop rotation and crop diversity have been around forever. Farmers in the United States have used the tactics discussed for a long time, but in Bolivia everything is very primitive and even these simple farming techniques are new to a lot of farmers. Most farmers don't know any better. If crop rotation can improve yields in the Midwest farms of the United States, why not Bolivia, or any other country? All it would take is some funding for educational programs, that teach these simple farming techniques, proper management of the programs, and getting the assistance to the people who really need it. These steps could and should be taken to help Bolivia, and other countries, improve their food security. Hunger is an awful thing that no one should be subject to, yet many face it everyday without any help. Something needs to be done before it is too late.

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