Rural Poverty, Vulnerability and Food Insecurity

The Case of Bolivia

Victor Oviedo Treiber

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1 Introduction

Bolivia is facing a potential challenge in terms of food security. The sharp rise in food prices between 2006 and 2008 and the impact of natural disasters faced in some regions of Bolivia have provoked serious concern about the food security situation, especially on those individuals and households who spend a large share of their income buying food. Bolivia is one of the poorest countries in Latin America, with most of its poverty (80 percent) concentrated in rural areas (WFP, 2012). Rural poverty is manifested partly in the high rates of chronic malnutrition (32 percent), which partly explains why the situation of food insecurity is chronic rather than transitory (Mallea, 2010). We will analyze whether rural poverty increases the incidence of food insecurity and whether food insecurity perpetuates the condition of poverty among the rural poor in Bolivia.

The World Food Program (WFP, 2006) consumption and nutrition survey reveals that almost half of all Bolivian municipalities face a high or very high degree of vulnerability to food insecurity.[1] This indicator provides a picture of the level of food insecurity in the country (known as Vulnerability Analysis and Mapping: VAM). In general, vulnerability to food insecurity is given primarily by the difference between the risk to present food insecurity and the capacity of households to mitigate this risk. We will identify the causes and severity of vulnerability to food insecurity among households located in Bolivian rural areas. In order to achieve this, we must first identify the risks that households face and find out the capacity of households to implement coping strategies in order to mitigate vulnerability shocks. We suggest that efforts by households to become food secure may be difficult in rural areas because of poverty and the vulnera-

[1] As a base for the study, we use the survey conducted in 2005 (WFP, 2006). The survey covers 4,536 households in 9 departments. The characteristics of the households determine the classification according to the level of vulnerability to food insecurity.

bility associated with a lack of physical assets, low levels of human capital, poor infrastructure, and poor health; as well as the precarious regional environment aggravating the severity of vulnerability to food insecurity.

The structure of the thesis is as follows. In chapter two, we introduce the theoretical background related to poverty and food security in rural Bolivia. First, we present the components and determinants of a country's food security (availability, access and utilization) and conclude by introducing the theory of vulnerability as a potential determinant which jeopardizes a country's state of food security. In section three, we present a descriptive analysis of food security and vulnerability in Bolivia. To start with, we characterize the area of analysis and describe the statement of the problem of food security in Bolivia, as well as the limitation of food access in rural Bolivia. We conclude the section by presenting the principal risks associated with food insecurity in Bolivia: natural events (droughts and floods) and rises in food prices, as well as the coping strategies implemented by households in order to mitigate shocks. In section four, we emphasize the role of the government in combatting food insecurity. We also identify some strategies to improve the precarious situation of the households in rural areas, which in most cases are forced to implement coping strategies that put their medium and long term socio-economic development at risk. We conclude with a summary of the main aspects of the work, offering a better understanding of the problematic of vulnerability to food insecurity.

2 Theoretical Literature Review

2.1 Rural Poverty and Food Security

There is no more visible characteristic of economic underdevelopment than poverty. It is also the most shocking characteristic; it is difficult to describe the characteristics of poverty and its correlates: illiteracy, food insecurity, undernutrition, ill health among others. In this section, we describe some of the correlates of poverty, focusing on rural poverty, nutrition and access to food. We consider an individual to be poor if he falls below a given poverty line. This is a critical threshold of income, consumption or more generally, access to goods and services below which individuals are declared to be poor (Ray, 1999).

A characteristic of poverty is that it is significantly higher in rural areas. Therefore, it is not surprising that more of the poor are found among the landless (with no assets at all) and small-scale farmers in developing countries, hiring out their labor or being self-employed (Sachs, 2005). A feature of rural poverty is that it is correlated with the lack of ownership of productive assets (Sachs, 2005). Though we must be careful not to establish a one-way relationship between the lack of ownership of assets and poverty, the lack of assets leads to poverty and a condition of poverty leads to the sale of assets, so that scarcity of assets and poverty are closely related. The scarcity of physical assets is connected with low levels of human capital. The determinant of access to human capital is the ability to temporarily remove one's self from the labor force and use this period to acquire skills. Lack of financial access is common among the rural poor, so that they are more likely to have little or no human capital, higher illiteracy rates and fewer years of school attendance. Thus, we expect the rural poor to have no or little physical capital and low levels of human capital.

There is a close relationship between rural poverty, access to food and consequently undernutrition (Ray, 1999). With low levels of income, it is difficult for households to get access to food and nutrients for themselves and their families. The effect of lack of access to food is visible in undernutrition, especially in children (ibid). This has severe consequences, such as muscle wasting, stunted growth, and increased susceptibility to illness and infection. Insufficient intake of food can also affect cognitive skills in children and adults, as well as diminish muscular strength, immunity to disease and capacity to do productive work (ibid). Because poor nutrition hinders the capacity to work, it can perpetuate the state of poverty by creating a vicious cycle. In this sense, we must be careful not to associate a one-way causality between rural poverty and lack of access to food, because insufficient food intake has negative effects on the capacity to do productive work, which feeds back on the incidence of poverty by perpetuating it. However, we expect both phenomena (rural poverty and food insecurity) to be closely related.

Food security is a multi-dimensional concept, which has changed over time. Originally, in the beginning of 70s, the term food security was associated with the ability of a country to provide enough food to all its habitants. However, due to a set of problems linked to the famine in Bangladesh, the world food crisis at the beginning of the 70s, as well as the green revolution's lack of success – despite its technical success – in reducing the levels of poverty and malnutrition, the FAO recognized the limitation of this one dimensional approach. As a result, the food security term includes nowadays issues related to the limitation of food access

One of the first scholars to question the limitation of the concept was Amartya Sen.[2] He observed that the availability of food in a country does not per se lead to access to food, despite the potential of a country to provide each inhabitant with sufficient food. As a consequence, the term food security was amplified to incorporate both physical and economic access to food as a fundamental part of its definition (FAO, 2003a). Among the several definitions currently used, the following definition proposed at The World Food Summit in 1996 is widely accepted. It considers a country as food secure when "all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life".

[2] See also Sen, A. (1981), Poverty and Famines. Oxford, Clarendon Press.

The lack of food access both physical and social, as well as the lack of food in a country is related to food insecurity (FAO, 2003a). There are mainly two forms of food insecurity: transitory and chronic. Transitory food insecurity is related to a shortfall in the food consumption of a household; whereas chronic food insecurity is understood as a continuous deficit in dietary needs caused by the inability to access food. According to the FAO (2003a:32) "The major sources of transitory food insecurity are year-to-year variations in international food prices, in foreign exchange earnings, in domestic food production and variation of household incomes. These sources are often related with each other".

However, not all households are exposed in the same level of volatility in temporary declines in consumption. Vulnerable households in rural areas, like those of farmers, landless agricultural workers and small- scale subsistence farmers are more prone to suffer from food insecurity. This shortfall in consumption can push them into harder conditions of already existing food insecurity. Often temporary sharp reductions in a population's ability to produce or purchase food and other essentials undermine long term development and cause loss of human capital from which it takes years to recover. Understanding the risks faced by households in vulnerable areas, as well their strategies for coping with these risks, define the level of exposure to food insecurity and the capacity of households to prevent the severeness of the problem or improve the household's situation.

There is no single indicator to measure the food security of a country. There are three main features used to interpret the food security status of a country: food availability, food access and food utilization. All three dimensions must be fulfilled simultaneously at all times to assure food access stability. There are other complementary aspects which cover even a larger spectrum of the food security of a country, such as: access to education, having a job, health services and the quality of the food instead of the quantity.

Figure 1 suggests a hierarchical relationship between the components of food security. As can be appreciated, food availability is a function of domestic food stocks, net commercial imports, food aid, and domestic production. This determines the supply of food in the national market and therefore in part the food prices, which in turn determines the food purchase price. Food availability is a fundamental pillar to assure a country's food security. This feature is commonly

examined at a national level. A widely used way of projecting the food supply of a country is using the Food Balance Sheet (FBS) from FAOSTAT data[3], which presents a comprehensive picture of the food availability situation, considering imports, exports as well as the waste and use of food in industry. We will turn to the FBS to examine Bolivia's food availability in section 3.3. In addition, food access depends on the capacity of the households or individuals to obtain food through their own production, market purchases or other resources. This capacity in turn depends on the endowment of resources of households and the reallocation strategies within households to assure an equal distribution among all members of the household. We will return to the food access approach and explain it in more detail in the next section.

Finally, having access to food is not sufficient for an effective utilization of food. An individual must be in proper physical condition in order to use and efficiently absorb the nutrients. An adequate food utilization demands proper water use, hygienic conditions, sanitation service, maternal nutritional status, etc (FANTA and FAM, 2003). In short, food utilization rests on three pillars: quality of child care, dietary intake (quantity and quality) and health care. An important aspect of effective food utilization is to achieve a diversified diet in order to provide the body with the required micronutrients. Micronutrient deficits are common among poor individuals because they are more likely to choose the cheapest food in order to meet their dietary needs.

[3] For further literature on the topic see for example the ftp://ftp.fao.org/docrep/fao/011/x9892e/x9892e00.pdf, 15.04.2014.

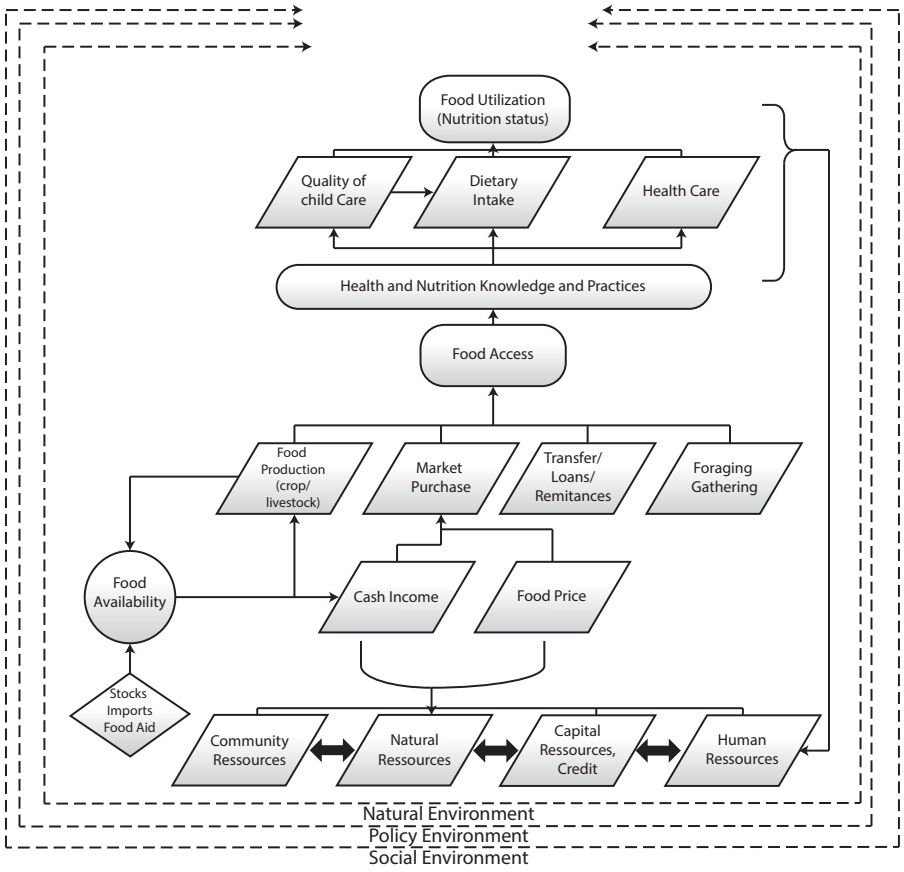

Figure 1: Food Security Conceptual Framework; Source: FANTA and FAM (2003: 10).

The lack of access to food threatens food utilization. The negative effects of insufficient access to food vary widely. Some outcomes of insufficient food intake might be muscle wasting, retardation of growth, increased illness, vulnerability to infection and diminution of work capacity (Ray, 1999). The relationship between lack of access to food and the capacity to do sustained work is more likely to be negative and might create a vicious cycle in the labor market because poverty leads to lack of access to food and inadequate standards of food consumption, hence the ability to work, which feeds back on the incidence of poverty. This lack of access to food plays a functional role because it affects the func-

tioning of labor markets, especially in rural areas. Labor markets do not only generate income and therefore create the principal potential source of nutrition and good health, but in turn affect the capacity of the body to perform activities that generate income (Ray, 1999). This cycle suggests that a significant fraction of the rural poor may be caught in a poverty trap resulting from the lack of access to food. Thus, we expect that low incomes or high levels of poverty threaten access to nutrition or lead to inadequate unhealthy nutrition. In the same manner, the lack of access to nutrition or unhealthy nutrition is capable of creating low incomes, having a direct impact on the ability to earn. An increment of the nutrition quality and quantity could lead to a substantial improvement of the person's capacity to work and thus increase the productivity and consequently improve income generating activities (Ray, 1999).

2.2 Food Access: Sen's Entitlement Approach

Food availability is an essential, but by itself insufficient condition for assuring households' access to food. Sen argues that the availability of food in the market does not entitle a person to access and consume it. Before Sen's observations, food availability was the heart of the food security concept. The writing of Amartya Sen (1981) caused a great breakthrough in this common view. This new approach explained that famine was not the result of lack of food, but the difficulty faced by households accessing enough food.[4] According to his view, people are exposed to food insecurity when they are unable to afford food.

It is important to begin with the formal characteristic of the entitlement relation. Entitlement should be understood as a system that connects "one set of ownerships to another through certain rules of legitimacy" (Sen, 1997: 1). The success of the process is determined by the legal, economic, political and social conditions of the individual and his/her society. The entitlement approach is built upon three basic categories: the endowment set, the entitlement set and the entitlement mapping or, in short, E-mapping. They are related as shown in the following diagram:

Endowment Set → E- Mapping → Entitlement Set

[4] This section is based on the textbook of Sen, A. (1981) and Sen, A. (1997).

The endowment set is defined as the set of all possible combinations of goods and services that a person can legally obtain by using the resources of her/his endowment set. This set of resources owned by a person can be divided between tangible assets such as land, livestock and equipment and intangible assets such as knowledge, labor power and skills. The use of resources can be differently combined in order to obtain goods and services. This entitlement exchange is determined by:

1) the ability of a person to find a job and its respective wage rate earned over time,
2) the relation of earnings obtained through selling non- labor assets and the cost of buying whatever one individual needs,
3) the individual's capacity to produce with her/his own labor power or resources and what he can buy or exchange with this;
4) the relation of the cost of purchasing resources and the products one can sell and
5) the social security system provided by the government and taxes that must be paid.

For instance, farmers may use a combination of their resources in terms of land, labor and other resources to produce the commodities they want. Similarly, a fisherman uses his labor to fish, has a fishing boat and other equipment to catch fish as assets and exchanges fish for other commodities. In contrast, a landless individual has labor power as his only source to exchange for a wage and to then exchange this for some other commodity bundle.

The entitlement mapping reflects the relationship between endowment and entitlement set. This is described in a ratio, which presents how much of the endowment set can be converted into the entitlement set. In an economy where exchange constitutes the principal form of access to a commodity bundle, the rate is determined by the capacity of the person to exchange its endowment set for another commodity bundle. Thus the E-mapping is characterized by "the production opportunities as well as trade possibilities of resources and products" (Sen, 1981: 435). For example, in the case of natural disasters such as droughts or floods, part of the crop is destroyed and a reduction of labor is inevitable in the agricultural sector. As a consequence, agricultural work is reduced, which leads

to a restriction or even collapse- depending largely on the severity of the natural disaster- of the entitlement exchange. In this case, an agricultural worker suffers a greater burden from the dependence on wage labor in gaining access to the exchange of her/his endowment set with the food he needs to buy. Similarly, in times of rising food prices, share croppers are in a relatively favorable position to changes in relative prices due to their direct access to food; while others depend solely on their exchange capacity to convert their set of endowments into another commodity bundle. In general, it can be said that wage laborers are expected to be more exposed to vulnerability when food prices rise.

A change or failure in the endowment set or E-mapping can lead to a deficit of food access and finally, in the worst case, to a collapse of the entitlement exchange resulting in famine. A person is considered to be an endowment failure when, despite the reallocation of his resources, he cannot get enough food to cover his daily dietary needs. We identify four important source of entitlement failure: endowment loss, production failure, exchange failure and transfer failure. People who do not rely primarily on exchange to obtain food, such as farmers, for example, are more likely to be exposed to entitlement failure through the first two sources. According to Sen, this is known as a direct entitlement failure. However, if exchange is involved, as in the case of an agricultural wage laborer, inflation would reduce his exchange ratio and he would receive less of a given commodity for his exchange than before. In addition, a production failure resulting from external factors such as drought restrains the capacity to work and therefore the worker's capacity to obtain the wage necessary to exchange for maize, rice, potatoes, etc. This mechanism synthesizes the principal channel through which a person may become vulnerable to a reduction or complete loss of access to food.

The following figure illustrates the fall of an endowment bundle, as well as the shift of the exchange entitlement mapping of a person. Figure 2 represents a simple form of trade, which involves only food and non- food commodities. First, it is assumed that a constant price for the entitlement mapping is given by p and x is an endowment vector of an individual i. The region AOB reflects the area, where the minimum amount of food consumption of i is satisfied. The figure shows that in the initial situation i can satisfy the minimum amount of food due to the endowment vector x above the AOB line. However, there are two

potential risks, which put a person into a vulnerable condition in terms of food security. First, an increase of price p to p*, which shifts the area of minimum food requirement from AOB to AOC area. As a result, i fails in satisfying his food needs because the endowment vector x is now below the new minimum food requirement represented by AOC. Second, food insecurity also results from a fall or collapse of the endowment vector x. This can happen due to, for example, the loss of employment. Consequently, the endowment vector x falls to x* which also puts in risk the food security of i because in the area represented by AOB, i can no longer afford to meet the minimum food requirements to lead a healthy life.

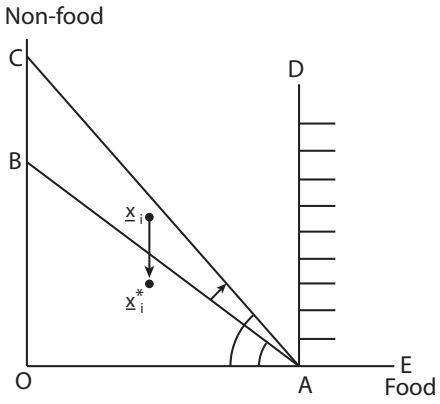

Figure 2: Changes in E-mapping and endowment bundle; Source: Sen (1981: 437).

This simple example illustrates the particular case of a specific group of individuals who are more exposed to a particular collapse of the endowment vector x or to upward changes in price p. For instance, rural households who rely mostly on agricultural work are more exposed to fluctuations in their production for several reasons. The consequence of natural disasters, such as floods or droughts, for instance, might, however, differ among different groups. It may hit harder those who already have fewer resources to exchange for food. Both the collapse of the endowment vector, as well as rising prices can have severe consequences in access to food and thus perpetuate the poverty of the group.

2.3 Vulnerability as Driver of Food Insecurity

Poor people are more vulnerable to risk because they are not able to invest or accumulate assets or save money in order to prevent shocks (World Bank, 2001). They tend to spend a larger share of their income in covering basic food requirements. In this thesis, we understand vulnerability to food insecurity as the probability of a household being affected by a sharp decrease in the food consumption below a certain threshold (Lovendal et al., 2004). A fall in food consumption may be caused by internal or external factors, which affect individuals or households.

Vulnerability to food insecurity is given primarily by the difference between the risk of food insecurity and households' ability to mitigate this. Thus, vulnerability is not only the result of exposure to risk factors (whether of climatic origin or macroeconomic policy), but also socioeconomic processes that determine the ability of people to address these risks (Chambers, 1989). According to this definition, vulnerability involves two aspects: the exposure to risk and the capacity of a household to cope effectively with risks. Using the concept of vulnerability and its components, the problem can be expressed using the following relationship:

$$\text{Vulnerability} = \text{risks} - \text{coping capacity}$$

The term risk refers to an expected loss or exposure to shock over a future period of time. The classification of risks depends on the nature of the risks and the extent of the shock. The nature of the event can be diverse and involves natural, health, social, economic, political and environmental shocks. In contrast, if risks affect individuals or households and are uncorrelated to the market, it is considered an idiosyncratic risk. However, if the shock affects a large number of people, a region or a nation, such as a flood, drought or civil war, it is considered a covariant risk (see Table 1). The focus of this work is limited to covariant and economic risks, which are two of the most important sources that affect the welfare of households in rural areas.

	Idiosyncratic	Covariant			
Type of risks	**Risks affecting an individual or household (micro)**		**Risks affecting groups of households or communities**		**Risks affecting regions or nations (macro)**
Natural	←		→		
			Reinfall Landslide Volcanic eruption		Earthquake Flood Drought High Winds
Health	Illness Injury Disability Old Age Death		Epidemic		
Social	Crime Domestic violence		Terrorism Gang activity		Civil strife War Social upheaval
Economic		Unemployment Resettlement Harvest failure		Changes in food prices	Growth collapse Hyperinflation Balance of Payment, financial, or currency crisis technology shock Transition costs of economic reforms
Political			Riots		Political default on social programs coup d'etat
Environmental			Pollution Deforestation Nuclear disaster		

Table 1: Types of risks, Source: World Bank, 2001: 136.

3 Rural Bolivia: Descriptive Analysis of Food Security and Vulnerability

3.1 Characteristics of Rural Bolivia and its Inhabitants

Bolivia is a landlocked country located in the center of South America. Its total land area is 1,098,581 km² with only a 3.4 percent devoted to arable farming (See Table 2). Bolivia is bordered by Brazil on the northeast, Paraguay on the southeast, Argentina on the south, and Chile and Peru on the west. Although the whole country is located in the same latitude of the Tropic of Cancer, three ecological areas can be distinguished: the highland region in the west, which covers 19 percent of the country and presents altitudes over 3,000 meters above sea level. The departments of La Paz, Potosí and Oruro are located in this region. The valley area is located in the central region of the country, covering 16 percent of the territory. The territory covers parts of Potosí, Santa Cruz and La Paz, as well as a large extension of the department of Cochabamba, Chuquisaca and Tarija. The valley's altitude is between 500 and 3,000 meters above the sea level. Lowland regions are located in the department of Beni, Pando and Santa Cruz and cover 65 percent of the country's territory, being the largest extensive area of the country. The diversity of the ecological areas is also reflected in the different weather types. This diversity of weather zones leads to a variety of crop types (FAO, 2001 a). The high land, for example, features a temperature fluctuation of 5º to 10ºC. In winter, temperatures are extremely adverse, reaching as low as -20ºC. This region is characterized by the lack of rainfall in winter and rainy summers. The main primary product in this region is quinoa (a kind of cereal) and a large variety of tubers, especially potatoes. In the valley area, mild weather conditions predominate. Weather conditions are less harsh than

in the highlands. In this region, the production of wheat, rice, maize, cassava, potatoes, fruits and vegetables predominates (FAO, 2001 a). The north and center of the lowland features tropical weather with significant rainfall. However, the southeast (known as the Chaco region) is arid with a high risk of drought. The lowland region of Santa Cruz concentrates the highest production of soya, sorghum, maize, rice and sugar cane (WFP, 2007).

In year 2010, Bolivia had 10 million inhabitants. Of those, one out of three people live in rural areas. Although rural population has decreased, it is still relevant in regions where the concentration of small farmers is still high, as in La Paz, Chuquisaca, Potosí and Cochabamba (Ormachea, 2009). In the whole country, the agricultural production involves 446,000 households. The highlands present the highest concentration of farmers. The valley regions concentrate about 164,000 farmers and in contrast only 57,000 farmers are located in the lowland regions (Ormachea, 2009). This low concentration of farmers in the lowlands results from the dominance of medium and large farmers, who own large cultivable areas. Within the lowland region, Santa Cruz is considered to be the country's main provider of food. Santa Cruz alone generates 44 percent of the country's agricultural GDP. The larger amount of cultivable land available, the higher use of machinery and higher soil fertility give Santa Cruz its ability to expand its supremacy over the agricultural sector (Ormachea, 2009). Bolivian agriculture is characterized by dry land farming, with little use of irrigation systems. In regions where a lack of rainfall is common, as in Cochabamba, Tarija and Potosí (WFP, 2007), about five percent of the cultivable area has an irrigation system. With the exception of Santa Cruz, the use of machinery for agricultural purposes is limited in Bolivia (WFP, 2007). In general, small farmers tend to use family labor, which replaces agricultural machinery. In the highland regions where the Aymara ethnic group is concentrated, there is a deeply rooted production system based on solidarity and communitarian work called the "aynoca" (WFP, 2007). All of these features suggest low productivity rates in agricultural production and indicate that farming in Bolivia involves arduous labor and, as a result, precarious living conditions.

The Bolivian poverty rate reveals that almost three-quarters of rural inhabitants are considered to be poor (see Table 2). It is estimated that poverty affects more than two million Bolivians, of which 1.6 million live in extreme pover-

ty (many of those are subsistence farmers). The indigenous population is disproportionately represented among the poorest, as are women. Rural poverty is concentrated mainly in the highlands and valleys and is not only reflected in poor agricultural techniques but also low education levels, access to services, per capita income, assets and health conditions (see Table 2). Rural poverty becomes even more evident when compared to urban life conditions. For example, in relation to basic services, 83 percent of the urban population has basic pipe water sanitation. In contrast, 70.3 percent in rural areas are supplied by rivers and wells. Furthermore, 98.4 percent of the rural population does not have a sewage system (compared to 52 percent in urban areas). This increases the risk of disease and raises even more their vulnerability to food insecurity (Mallea, 2010). It is also important to highlight that despite some achievements in health, there is still an astonishingly high level of mortality rate under five years, of 54.2 out of 1,000 births. Rural poverty indicates the severity of the relationship between poverty, vulnerability and food insecurity (Mallea, 2010). We therefore expect in this work that rural poverty in Bolivia increases the risk of vulnerability to food insecurity. Therefore, we examine how they are associated in rural Bolivia.

Social Indicators	
Population, total (2010)	9,929,849.0
Rural population (2010)	3,326,499.4
Rural population (% of total population) (2010)	33.5
Mortality rate, infant (per 1,000 live births) (2010)	41.7
Mortality rate, under 5 (per 1,000) (2010)	54.2
Life expectancy at birth, total (years) (2009)	66.0
Poverty Indicators	
Number of rural poor (million, approximate) (2010)	2,571,384.0
Poverty headcount ratio at rural poverty line (% of rural population) (2007)	77.3
Poverty headcount ratio at national poverty line (% of population) (2007)	60.1

Table 2: Key Country Profile: Selected Indicators in Bolivia; Source: Adapted from data of IFAD (2012), section statistics.

3.2 Food Security: Statement of the Problem in Bolivia

In order to identify the severity and the impetus of the food security problem in all Bolivian regions, the World Food Program (WFP) in cooperation with the Bolivian Social and Economic Policy Analysis Unit (in Spanish Unidad de Análisis de Políticas Económicas, UDAPE) and the ministry of Planning and Development (in Spanish Ministerio de Planificación y Desarrollo) designed the Vulnerability Analysis and Mapping (VAM).[1] The VAM helps to monitor and identify communities with different levels of vulnerability to food insecurity. The measurement of the VAM is based generally on two types of indicators: 1) indicators of risk and 2) indicators of the capacity of a household to cope with shocks, which will determine the VAM categories.

The indicators go from food supply, access to employment, basic services like education, health care, sanitation, clean water, as well as safe housing. Additionally, the indicators are complemented with the incidence of natural disasters such as frost, drought and hailstorm, which rural households are more likely to be exposed to (WFP, 2006).

The municipalities are classified on a scale from 1 to 5 according to the vulnerability risk related to food insecurity. Municipalities classified with VAM 4 and VAM 5 are those with a severe and chronic risk of vulnerability to food insecurity, respectively (see Figure 3, where VAM 4 and 5 have the darkest colors). In contrast, communities with VAM 1 denote a lower risk of vulnerability to food insecurity and are classified as "safe" (see Figure 3, where VAM 1 is presented in white). The VAM analysis was conducted twice: the first time in 2003 and the second time in 2007. In 2003, 53 percent of the municipalities belonged to the categories VAM 4 and VAM 5. This means that more than half of the municipalities suffered from chronic and/or severe food insecurity. However, a significant progress was achieved in 2007, where the probability of a municipality of belonging to VAM 4 or 5 dropped from 53 percent to 44 percent. Though progress was achieved in the category of VAM 4, the incidence of VAM 5 did not disappear, and the incidence of VAM 3 is still especially present. Bolivia has only 9 "urban centers" which are represented by their names in Figure 3. The rest of the represented

[1] The VAM is a commonly used framework of different NGOs, international cooperation agencies and of the government with the aim of planning intervention policies in different regions.

areas are mainly rural areas. Thus, we can confirm that in general vulnerability to food insecurity (scale 2-5) is very present in rural areas.

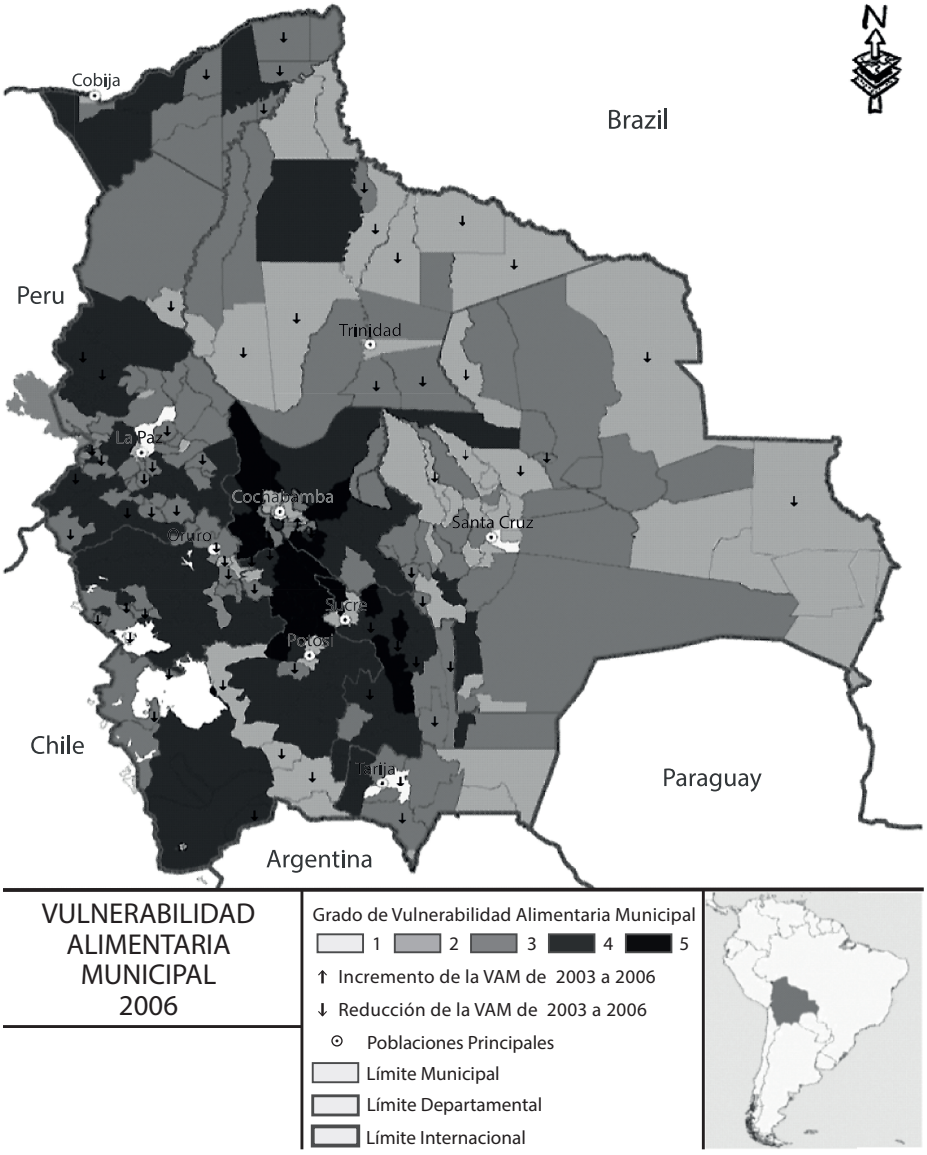

Figure 3: Vulnerability and analysis mapping to food insecurity; Source: Baldivia et al. (2011: 3).

3.3 Food Availability in Bolivia

In this section, we focus on analyzing domestic supply of the most important food commodities for the Bolivian diet. First, we take a look at the per capita food supply (measured in calories per day) during the last 17 years. This is presented in the following figure. The food energy requirement per day of a person depends on several factors, such as weight, height, age, gender and activity level. According to the World Health Organization, a person needs on average 2000 kcal per day to cover his minimum caloric intake. In the following figure, we see that only in 1994 was the food supply quantity sufficient to meet the energy needs of 2000 Kcal per day. We observe the irregular ups and downs of the food supply between 1992 and 1998; this period culminates with a drop in the number of calories in 1998. After this period of decreasing tendency, in 1998 the food supply level begins to return to its previous levels. This increasing tendency ends in 2003 after reaching its highest food supply level. Since then, the trend begins to fall. We can conclude that there is enough food available to feed each Bolivian in order to meet their 2000 caloric needs per person and day, although the negative trend puts this at risk.

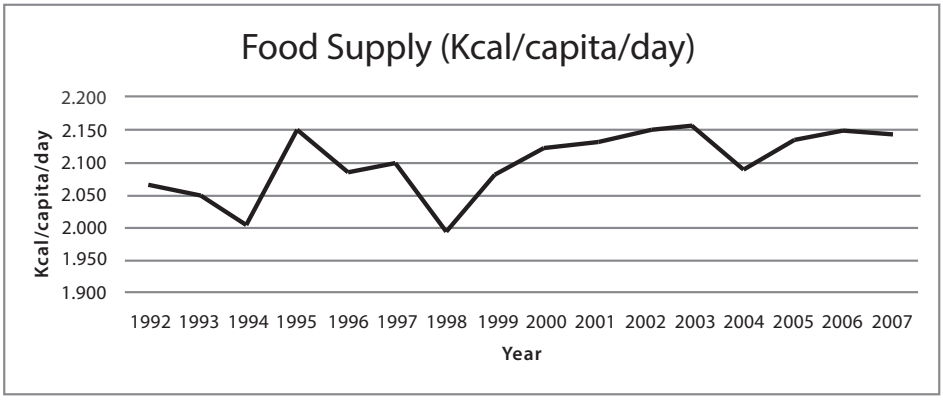

Figure 4: Food supply in Bolivia (1992–2007); Source: Food Supply data by FAOSTAT (2012).

Furthermore, it is important to analyze the production trend of certain commodities which are essential for the dairy consumption within the Bolivian diet.

Commodities	1994	1996	1998	2000	2002	2004	2006	2008	2009	2010
Top Commodity Production										
Cassava	282,921	301,779	307,889	342,261	345,850	362,866	371,280	361,329	363,133	364,500
Maize	493,533	498,414	479,601	653,271	672,772	538,091	894,436	1,001,800	813,586	981,700
Potatoes	631,999	625,794	590,530	721,466	728,785	748,095	754,807	747,968	762,719	782,800
Rice, paddly	247,333	343,520	296,253	299,083	259,452	331,336	446,462	337,800	395,651	362,700
Sorghum	50,003	105,050	120,795	94,521	172,257	165,275	271,001	404,446	314,231	403,200
Soybeans	708,968	867,488	1,120,290	1,197,250	1,246,500	1,585,850	1,618,970	1,259,680	1,499,380	1,637,000
Sugar cane	3,898,760	3,927,830	3,502,100	3,601,750	4,735,100	5,496,110	6,201,130	7,009,200	7,437,700	7,437,700
Wheat	82,323	98,820	175,426	101,510	119,102	116,037	143,677	199,990	239,367	310,700
Top Commodity Import										
Malt	12,619	12,072	18,310	17,830	18,037	21,760	30,826	40,785	40,137	n.a*
Potatoes	16	195	350	1,161	319	1,449	1,887	22,697	10,371	n.a*
Rice Milled	304	227	264	7,919	5,350	2,594	330	41,746	15,636	n.a*
Wheat+Flour,	348,635	223,140	187,503	447,198	461,350	339,720	347,640	411,794	478,496	n.a*
Wheat Equiv.+ (Total)										
Cereals (Total)	350,522	224,603	194,421	459,676	474,110	345,293	352,803	461,202	498,346	n.a*
Top Commodity Export										
Cake of Soybeans	129,645	335,565	489,916	628,560	1,034,780	1,101,560	1,112,990	808,350	961,024	n.a*
Soybean oil	30,476	62,608	102,115	154,998	187,478	213,129	225,421	147,687	204,595	n.a*
Soybeans	189,858	265,546	192,165	215,955	29,173	89,622	70,235	86,681	125,686	n.a*
Sugar Refined	107,265	53,470	42,977	9,640	39,906	103,264	24,034	133,312	170,414	n.a*
Sunflower Cake	670	12,629	27,086	49,411	36,591	31,793	59,420	86,935	127,652	n.a*
Sunflower oil	1,305	1,073	5,288	15,491	28,263	21,523	51,298	77,848	112,609	n.a*

* Non Available Data

Table 3: Domestic food supply between 1994 and 2010 (in tons); Source: Author's calculations by FAOSTAT .

Shortfalls in production or import of basic commodities may result in changing consumption patterns or affect some specific groups of the population whose diet is heavily based on a few commodities (which is more likely to be the case for the rural poor). The most consumed commodities in Bolivia are maize, rice, wheat, potatoes and sugar. Table 3 features the domestic supply of these main commodities between 1994 and 2010.[2] There is an increasing trend of domestic supply in the mentioned period. This, however, does not automatically imply that food production meets domestic demand, and it certainly does not provide information about the state of food security in rural Bolivia. A detailed description of the trends in production, import and export of the main commodities of Bolivian food consumption in the following section provides us a better description.

3.3.1 Cereals

Cereals represent the main staple of the Bolivian food diet. Of the diverse cereal types, we will concentrate on maize, rice and wheat due to their importance for the domestic production of cereals, as well as their importance for basic dietary needs. The production of cereals has more than doubled between 1994 and 2010, achieving its record value of more than two million tons of cereals in 2010, with a remarkable variation of around one million tons within this period (see Table 4). Table 4 summarizes the trend in harvested cereals, showing that the total harvested area of cereals increased in the past 16 years by 39 percent: from 670 to 931,000 hectares with an increment of productivity of 64 percent. This increase results partly from increasing maize production. Despite this growth of cereal production, there is still insufficient production of cereals in order to meet domestic demand. This necessity is reflected in the increased quantity of imported cereals, which mainly derives from the lack of wheat production (see Table 3). In 1009, for example, 498,000 tons of cereals were imported, of which only 478,000 tons represent wheat imported to cover domestic necessities.

[2] Domestic supply is composed by domestic production, import and export.

Year	Area Harvested (Ha)	Yield (Tons/Ha)	Production (tons)
1994	670,717	1.4267	956,890
1996	705,745	1.6136	1,138,768
1998	774,802	1.4946	1,157,992
2000	757,864	1.6420	1,244,427
2002	768,443	1.7120	1,315,586
2004	775,942	1.6187	1,255,985
2006	888,530	2.1001	1,865,967
2008	1,018,121	2.0164	2,052,969
2010	931,550	2.3328	2,173,090
Difference %	39	64	127

Table 4: Trend of cereals' production in Bolivia; Source: Author's calculations by FAOSTAT.

A reason for increasing the import of cereals, especially in recent years, is in part related to export restrictions and weather conditions which encourage the import of cereals in order to maintain the domestic supply of cereals. In the past year, imports accounted for almost 20 percent of the total cereal availability (Baldivia, 2011).

In the following section we will describe the main production and consumption characteristics of the main cereals in Bolivia.

3.3.1.1 Maize

Maize is one of the most demanded cereals in Bolivia. It represents half of the total produced cereals and its cultivation area is the largest dedicated to agricultural production (Baldivia, 2011). The production of maize is concentrated principally in two regions: Santa Cruz and Tarija, which together cover 80.5 percent of the domestic production of maize, followed by Cochabamba and La Paz with 7.90 and .60 percent, respectively (see Table 5) (Campero, 2008).

Chuquisaca	La Paz	Cochabamba	Potosí	Tarija	Santa Cruz	Beni	Pando	Total
1.40	3.60	7.90	3.40	10.40	70.1	1.80	1.40	100

Table 5: Domestic maize production by department (%) in 2007; Source: Campero (2008: 8).

The production of maize is allocated mainly to the domestic market. The poultry industry is the main sector demanding maize, accounting for more than half of all maize production. About 30 percent of domestic maize production goes to animal feed, especially pigs, in the form of balanced food provender. Only about 10 percent of maize production is dedicated to human consumption (Campero, 2008).

The harvest area of maize covered 00 297,000 hectares in 2010. This is equal to 981,700 tons of maize with a national average yield of 3.50 tons per hectare (see Table 6). In Table 6, we see a remarkable increase of around 500,000 tons in maize production between 2004 and 2008. This increase is explained by the winter cultivation of maize that began in 2005 (Baldivia, 2011), enabling an extra production of maize. In general, there is not a deficit in the supply of maize. However, the harvest of maize declined between 2008 and 2010 due to climatic conditions, as well as the export restrictions imposed by the government as a strategy to maintain the domestic price and to often the effects of the global food crisis. This had a disincentive effect on agricultural producers. Since then, the import of maize has gained relevance and an increase of import is identifiable (Campero, 2008).

Year	Production (tons)	Area Harvested (Ha)	Yield (Tons/Ha)
1994	493,533	272,567	1.8107
1996	498,414	276,721	1.8011
1998	479,601	263,633	1.8192
2000	653,271	307,292	2.1259
2002	672,772	310,465	2.1670
2004	538,091	313,849	1.7145
2006	894,436	343,080	2.6071
2008	1,001,800	433,300	2.3120
2010	981,700	297,000	3.3054
Difference %	98	8	82

Table 6: Trend of maize production in Bolivia; Source: Author's claculations by FAOSTAT.

The increase in maize production in the period 2004–2008 is related more to the increase of the harvested area than to the increase in productivity. Crop productivity of maize in Bolivia is one of the lowest in South America, far behind the productivity rates of countries like Chile or Argentina (see Table 7). Only Peru and Ecuador have lower productivity rates than Bolivia. Maize crops require a high degree of mechanization and use of technologies which involve soil preparation, planting, phytosanitary treatment, harvesting, post harvest processes, etc. (Campero, 2008). The principal restraints, in comparison to other South American countries, are linked to the use of low quality seeds, lack of infrastructure in irrigation systems, and a shortage of knowledge in pest control, as well as in regard to soil fertility. All these factors explain the limitation that producers face in Bolivia in increasing productivity. For this reason, some scholars suggest the extensive use of modified genetically modified seeds. The Bolivian government has refused to use genetically modified seeds to increase the productivity of maize, despite large quantities of imported maize which comes from Argentina, where the use of genetically modified seeds is extensive (Baldivia et al., 2011).

Chile	Argentina	Uruguay	Venezuela	Brazil	Bolivia	Colombia	Peru	Ecuador
11.08	7.81	5.51	4.38	4.37	3.30	3.30	3.09	2.23

Table 7: Maize's productivity (tons/hectare) in selected South American countries in year 2010; Source: Author's calculations by FAOSTAT.

3.3.1.2 Wheat

The production of wheat represents about 30 percent of total cereal production in Bolivia. Wheat is one of main commodities due to its importance in the basic Bolivian diet. The largest part of wheat is used in the production of bread and noodles (durum wheat). About 75 percent of wheat is produced in the department of Santa Cruz and Chuquisaca, followed by Cochabamba and Potosí with 9 and 10 percent, respectively. La Paz and Oruro also contribute lower proportions to national wheat production (Baldivia, 2011: 47).

There is a high disparity between the quantity of production of large farmers in Santa Cruz and Chuquisaca and that of small farmers in other regions of the country. This disparity is reflected in the dimensions of harvested area, which manifest two economic realities behind the production of wheat – especially that by small farmers – in Bolivia (see Figure 5). On the one hand, small farmers run mainly family farms or self-subsistence farms (self-consumption patterns with a little proportion for selling), which is concentrated principally in the valleys – Cochabamba, Tarija and the highlands – limited parts of La Paz and Oruro. In the valley region, for example, about 70,000 households are involved in the production of wheat. These households feature a reduced number of hectares and possess rudimentary tools to cultivate wheat. The lack of adequate infrastructure, the limited use of mechanization, irrigation systems and low quality seeds is common. Households with these characteristics are more likely to be vulnerable when production shrinks due to external conditions like natural disasters. Their weak capacity and poor conditions for coping with these risks is what makes them vulnerable (Campero, 2008).

In contrast, large farms are located in Santa Cruz and Chuquisaca. In Figure 5, we see the main centers of wheat production, with a dominant role in the de-

partments of Santa Cruz and Chuquisaca. Farms feature larger extensive areas, higher productivity and more frequent use of mechanization systems.

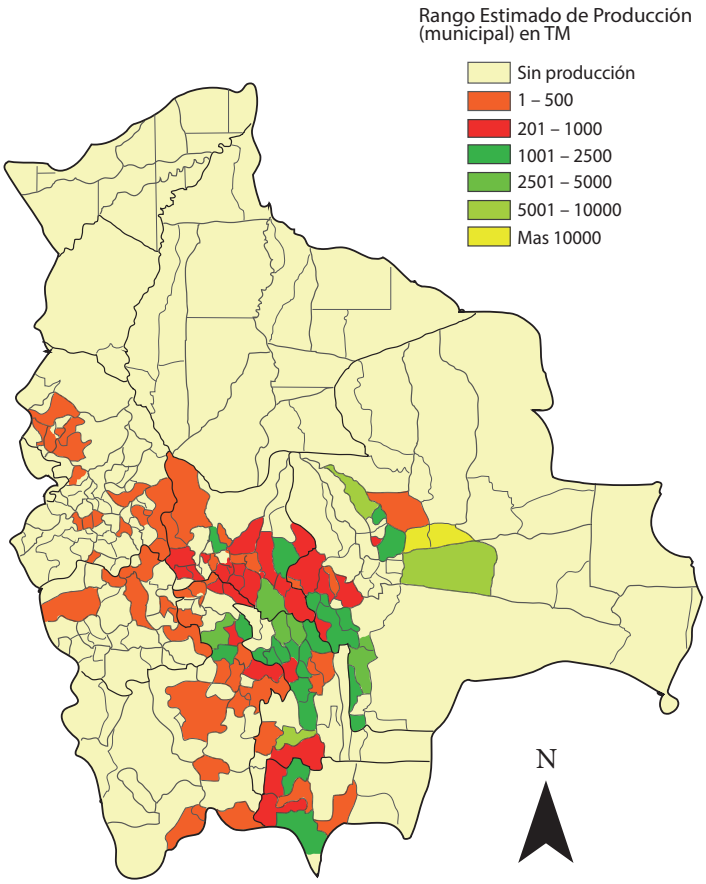

Figure 5: Main zones of wheat production according to their level of production in tons; Source: Campero (2008: 13).

On average, small wheat farmers dedicate about 30 percent to selling, 40 percent to self-consumption, 15 percent to processing other commodities and 15 percent to seed. In contrast, in Santa Cruz, where about 14, 000 households are defined as producers, 83 percent dedicate their production to selling and only 9 percent meets self-consumption. About 5 and 3 percent is used for processing other commodities and seeds, respectively (Herbas, 2008). This shows that the charac-

ter of wheat production for small farmers is self-consumption. Thus, wheat is a basic commodity for assuring food security to these households.

Furthermore, the domestic production of wheat is not sufficient to meet the national demand. Estimates point out that the domestic demand for wheat is 650,000 tons. In 2010, the production of wheat was 310,700 tons, which was only sufficient to cover less than half of the dietary demand (see Table 8). Bolivian wheat consumption depends on imports. This is reflected in the quantity of imports, which in some years involves more than half of the demanded quantity (Herbas, 2008).

In comparison with other cereals, wheat presents the best trend in production, productivity and growth of harvested area in the last 16 years (see Table 8). About 50,000 new hectares have led to a rise in production levels. This overall increase improves the availability of wheat.

Year	Production (tons)	Area Harvested (Ha)	Yield (Tons/Ha)
1994	82,323	109,491	0.75
1996	98,820	131,929	0.75
1998	175,426	194,004	0.9
2000	101,510	119,538	0.85
2002	119,102	134,579	0.88
2004	116,037	108,797	1.07
2006	143,677	129,290	1.11
2008	199,990	154,658	1.29
2010	310,700	198,200	1.57
Difference %	277	81	109

Table 8: Trend of wheat production in Bolivia; Source: Author's calculations by FAOSTAT.

However, the increase in wheat production is mostly related to the increment of harvested area rather than significant increases in productivity. If we take a look at the productivity level of wheat in Bolivia in comparison to other South American countries (see Table 9), we appreciate the low productivity level of wheat. Only Ecuador and Venezuela present lower productivity levels than Bolivia. The major constraint in wheat production is technical and due to the lack of

irrigation systems, which are crucial for it. Small farmers in particular lack the resources to solve the serious problem of erosion which is more present in their regions. Scholars suggest that the use of seeds of higher quality alone would lead to higher productivity rates (Herbas 2008: 14).[3]

Chile	Argentina	Uruguay	Brazil	Colombia	Bolivia	Peru	Ecuador	Venezuela
5.65	3.41	3.22	2.77	1.74	1.57	1.42	0.89	0.39

Table 9: Wheat's productivity (tons/hectare) in selected South American countries in year 2010; Source: Author's calculations by FAOSTAT.

3.3.1.3 Rice

Rice is the second largest cereal after maize in terms of production (tons). Like other cereals such as tubers and roots, rice is a key commodity of the basic Bolivian diet. About 9 of 10 households rely on rice, independent of their income levels (Baldivia et al., 2011). Furthermore 72,000 households are involved both in the production and trade of rice (Ortiz and Soliz, 2008).

The production of rice is mainly concentrated in two departments: Santa Cruz and Beni. Together they cover 76 percent of national production (Baldivia et al., 2011). La Paz, Cochabamba, Chuquisaca, Tarija and Pando account for 24 percent of rice production. In Figure 6, we see rice production in Bolivia. In the red area, rice production is more intensive. This covers part of Santa Cruz and Beni. In contrast, the green area depicts areas where rice production is principally dedicated to self -consumption. The blue area presents a mix of both production goals. About 70 percent of the farmers involved in the production of rice are small farmers and rice represents their main commodity for trade (Campero, 2008: 10).

[3] It is important to mention that wheat can be a good alternative in winter for the rotation of oilseed crops like soybean and sunflower, which cover large extensions of land. However, farmers' decisions to cultivate depend largely on international commodity prices. For instance, if the price of soybean in winter is expected to be low, it is more likely that rotation takes place and wheat is cultivated (Campero, 2008).

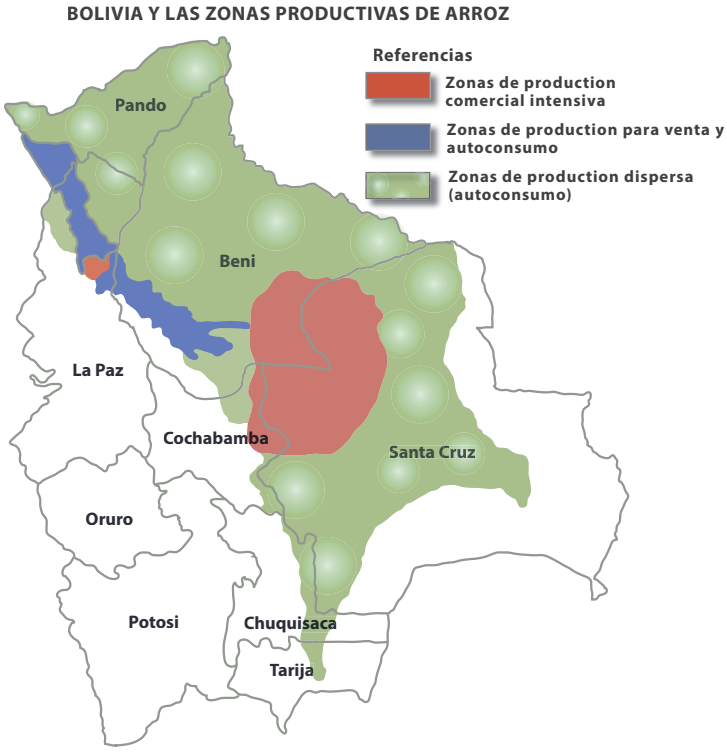

Figure 6: Bolivian regions of rice production; Source: Ortiz and Soliz (2008: 35).

The production system of rice in Bolivia is characterized by its dependence on rainfall due to the lack of irrigation systems in the production areas. The rice production has experienced an increase of 16 percent during the past 16 years. In Santa Cruz and Chuquisaca, where the production of rice is higher, the productivity rate is also above the average level. The most remarkable productivity increase took place between 2002 and 2006 as a result of increasing harvested area by 40,000 hectares (see Table 10). Part of this productivity increase was also related to more suitable weather conditions in the time period. These favorable conditions resulted in a record production of 446,462 tons in 2006. We observe a constant pattern in rice (see Table 10), but in 1996, due to natural disasters caused by El Niño and La Niña in 2006, drought and pests resulted. Both natural phenomena had a negative impact on rice production; large rice cultivation areas

were affected and destroyed. Despite this, the cultivated area and the production levels seem to have recovered slowly.

Year	Production (tons)	Area Harvested (Ha)	Yield (Tons/Ha)
1994	247,333	136,389	1.8134
1996	343,520	130,966	2.6230
1998	296,253	142,063	2.0854
2000	299,083	156,312	1.9134
2002	259,452	129,884	1.9976
2004	331,336	152,193	2.1771
2006	446,462	168,399	2.6512
2008	337,800	155,401	2.1737
2010	362,700	171,900	2.1099
Difference %	46	26	16

Table 10: Trend of rice production in Bolivia; Source: Author's calculations by FAOSTAT.

Moreover, if we compare the productivity rate of rice in Bolivia to the productivity in other South American countries, Bolivia presents the lowest productivity rate (see Table 11). As with other cereals, this results from lack of technology and the limited use of irrigation systems, which are used in only five percent of the total rice cultivation area.

Peru	Uruguay	Argentina	Colombia	Venezuela	Ecuador	Brazil	Chile	Bolivia
7.28	7.09	5.76	5.18	5.11	4.33	4.17	3.85	2.109

Table 11: Rice's productivity by selected countries in South America in 2010; Source: Author's calculations by FAOSTAT.

Small farms in particular present difficulties in implementing innovative agricultural techniques. According to Ortiz and Soliz (2007), irrigation systems are more likely to be used in Santa Cruz, where the soil type shows more favorable conditions for rice production and yield areas show larger extension as a result. The authors suggest that the use of irrigation systems in Santa Cruz has contributed to the increment of the productivity rate, achieving an average rate of six tons per hectare (Campero, 2008).

3.3.2 Roots and Tubers

3.3.2.1 Cassava

According to the FAO (2001 b), cassava is the fourth most important commodity after rice, wheat and maize in the world due to its relevance in the food basket of more than 1,000 million people in developing countries. In Bolivia, cassava is a very important commodity in the diet, especially in lowland rural areas. Due to its relevance in rural areas, it is considered a strategic commodity both for food security and as a source of income in lowland regions prone to drought, as well as in regions lacking soil fertility. Cassava is adaptable to "precarious" areas. This makes the cultivation of cassava an important commodity in rural areas with high levels of poverty because it is a good alternative food source for covering food needs. The production of cassava is mainly located in the lowland regions of Santa Cruz, Cochabamba, Beni and Pando (Egedorf and Aguilar, 2007). Table 12 shows that the annual production in 2010 was 364,500 tons. This is 28 percent more than 16 years ago. This relative increase in production may result from a 15 percent increase of the harvested area and a marginal increase of 11 percent in yield. As of 2000, we see stagnation in the production pattern which may result from the La Niña and consumption patterns changing towards maize and wheat, which is importance (Baldivia et al., 2011).

Year	Production (tons)	Area Harvested (Ha)	Yield (Tons/Ha)
1994	282,921	33,027	8.5664
1996	301,779	33,404	9.0342
1998	307,889	33,883	9.0868
2000	342,261	34,559	9.9037
2002	345,850	35,214	9.8214
2004	362,866	35,883	10.1125
2006	371,280	36,432	10.1910
2008	361,329	36,764	9.8283
2010	364,500	38,100	9.5669
Difference %	28	15	11

Table 12: Trend of cassava production in Bolivia; Source: Author's calculation by FAOSTAT.

3.3.2.2 Potatoes

Potatoes are important for small highland farmers because they are a source of income, consumption and employment. About 70 percent of poor households in the Andean region produce 600 kg of potatoes per year on average (Aldunate, 2006). This generates on average an income of 600 US Dollars per year. However, considering retention for seed production, post-harvest losses and self-consumption, only 327 US Dollars remain (Aldunate, 2006: 13). The process of potato production features work intensive characteristics and is thus considered the principal source of employment. In La Paz 200,000 households are involved in the production of potatoes and report its production as their main source of income due to their intensity both in the sowing and harvest season. Shortfalls in the production of potatoes due to weather conditions push these households into serious risks, which threaten their already precarious food insecurity situation (Baldivia et al., 2011).

The production of potato is concentrated principally in four departments: La Paz (26 percent of potato production), followed by Potosí (20 percent), Cochabamba (18 percent) and Chuquisaca (15 percent) (Baldivia et al., 2011). Tarija (8 percent), Santa Cruz and Oruro (4 percent) also contribute a lower proportion to total pro-

duction. It is important to mention that Santa Cruz features higher productivity rates than the national average rate (Aldunante, 2006). The domestic supply of potatoes in 2010 was 782,800 tons. The harvested area was around 147,000 hectares with an average yield of 5, 31 tons per hectare (see Table 13). In general, the production of potatoes has experienced an increase of 23 percent during the last 16 years. However, Table 12 shows that both the harvested area and yield have remained stable during the last 16 years.

Year	Production (tons)	Area Harvested (Ha)	Yield (Tons/Ha)
1994	631,999	133,660	4.7284
1996	625,794	125,703	4.9784
1998	590,530	131,787	4.4809
2000	721,466	125,404	5.7531
2002	728,785	127,477	5.7170
2004	748,095	132,588	5.6423
2006	754,807	135,370	5.5759
2008	747,968	138,340	5.4067
2010	782,800	147,200	5.3179
Difference %	23	10	12

Table 13: Trend of potato production in Bolivia; Source: Author's calculations by FAOSTAT.

The productivity of potatoes in Bolivia is the lowest in comparison to other countries of the region. The productivity gap is immense in comparison to countries like Argentina, Brazil, Chile and Venezuela. In some cases, the difference is more than 20 tons per hectare (see Table 14). Potato farmers face constraints related to the lack of capital and infrastructure for maximizing the exploitation of their area of cultivation. In the production regions, farmers tend to adopt low productivity strategies to avoid the lack of irrigation systems by cultivating a type of potato which requires scarce rain fall. For this reason, some scholars recommend the production of other varieties of potatoes from among the 350 types available in Bolivia with better productivity performance.[4]

[4] Furthermore, the import of potatoes is generally not significant, but in periods of poor harvest plays an important role (see Table 1).

Argentina	Chile	Brazil	Venezuela	Colombia	Peru	Ecuador	Bolivia
22.58	21.04	14.45	13.36	12.85	12.15	6.73	6.02

Table 14: Potatoes' productivity by selected countries in South America in 2010; Source: Author's calculation by FAOSTAT.

3.3.3 Sugarcane

Sugarcane is an important raw material for the Bolivian food industry. The department of Santa Cruz and Tarija concentrates almost its total production of sugarcane. Santa Cruz alone covers 90 percent of the production (Baldivia et al., 2011). In 2010, the domestic production of sugar achieved a record value of 7.437,700 tons. The harvested area in this year covered 163,704 hectares, which represents around 5 percent of the total cultivated area in Bolivia (see Table 15). Sugar production in 2011 was around 8,554,294 tons, which results from increased harvested areas rather than productivity increases (Campero, 2008). The latter took place in Tarija, Chuquisaca and Beni, where rice cultivation was replaced by the cultivation of sugarcane. This explains the remarkable rise of harvested area between 2006 and 2010 (Ormachea, 2009). The yield of sugarcane in 2010 was 45 (see Table 15). This reflects stagnation in the last 16 years. However, between 2002 and 2006 we appreciate an increase, but the following years depict a negative trend towards the initial rate.

Year	Production (tons)	Area Harvested (Ha)	Yield (Tons/Ha)
1994	3,898,760	86,510	45.0672
1996	3,927,830	91,874	42.7524
1998	3,502,100	86,341	40.5613
2000	3,601,750	83,838	42.9608
2002	4,735,100	102,325	46.2751
2004	5,496,110	107,207	51.2663
2006	6,201,130	115,862	53.5217
2008	7,009,200	159,950	43.8212
2010	7,437,700	163,704	45.4338
Difference %	91	89	1

Table 15: Trend of sugarcane production in Bolivia; Source: Author's calculations by FAOSTAT.

If we compare the yield of sugarcane to that of other South American countries, there is a significant gap, especially relative to productivity in Peru and Colombia (see Table 16). Low productivity rates in Bolivia are related to three factors: 1) the lack of irrigation systems, which limit production to periods of rainfall and causes shortfalls in production in drought periods 2) limited use of mechanization. Almost half of the harvested area applies manual technology and 40 percent applies semi-mechanized technology (Campero, 2008). This characteristic of production leads to low productivity rates and explains the stagnation of productivity rates in the sugarcane sector. 3) Furthermore, the majority of sugarcane farmers produce in small farms with limited access to capital, which limits investments in technology as well as resources to improve the soil fertility by using, for example, genetically improved seed or irrigation systems (ibid).

Peru	Colombia	Argentina	Brazil	Ecuador	Venezuela	Uruguay	Bolivia
125.49	118.11	81.69	79.19	78.06	76.00	45.61	45.43

Table 16: Sugar's productivity by selected countries in South America in 2010; Source: Author's calculations by FAOSTAT.

3.3.4 Soybeans

Soybean is one of the main agricultural export commodities of Bolivia and represents 27 percent of the total exports (Campero, 2008). This sector generates a large amount of employment; 50,000 individuals are directly related to soybeans production and 65,000 indirectly (Hernandez, 2011). The domestic demand for soybean is about a quarter of the annual production. The basic domestic use of soybean is for the production of oil (107,000 tones), solvent flour for feed animal use (195,000 tons) and whole meal flour (130,000 tones).

The export of soy is oriented primarily to the Andean community: Venezuela (37 percent), Colombia (28 percent), Peru (23 percent), Chile (6 percent) and Ecuador (5 percent) (Hernandez, 2011). Soybeans are exported in three forms: soybeans, cake of soybeans, and soybean oil (see Table 1), cake of soybeans being the principal form of export.

In the 90's, soy production started with 316,689 harvested hectares; in 1994, harvested areas climbed to 617,000 (see Table 17). Soy cultivation continued to expand reaching over a million hectares by 2010. This positioned Bolivia within the eight largest producers of soy in the world (Campero, 2008). The United States, Brazil and Argentina cover three quarters of world soy production and Bolivia contributes to less than one percent of the world's soybeans production.

Santa Cruz monopolizes soybean production, covering 70 percent of the total cultivated area (Baldivia et al., 2011). The expansion in this department has still a great potential for soybean production. It is estimated that in Santa Cruz there are about 4 million hectares for agricultural use and only half the hectares is actually being used. However, despite the importance of soybean for the macroeconomic development in Bolivia, there are some risks associated with the expansion of this commodity. Soybean cultivation is characterized as a monoculture system, which limits the practice of multi-cropping and deteriorates the soil fertility. Despite the "negative" impact that production may have in the long term due to the dependence on this commodity and its negative impact on soil fertility, the government is still encouraging the production of soybean because of the favorable international demand and the high international price, which results in the high demand for soybean as a raw material in the production of

biofuels (Baldivia et al., 2011). This fact can limit the production of other commodities, which are crucial for the basic food diet in Bolivia.

Year	Production (tons)	Area Harvested (Ha)	Yield (Tons/Ha)
1994	708,968	316,689	2.2387
1996	867,488	463,243	1.8726
1998	1,120,290	588,667	1.9031
2000	1,197,250	616,964	1.9406
2002	1,246,500	637,124	1.9564
2004	1,585,850	803,990	1.9725
2006	1,618,970	950,118	1.704
2008	1,259,680	785,793	1.6031
2010	1,637,000	1,086,000	1.5074
Difference %	130	243	-33

Table 17: Trend of soybean production in Bolivia; Source: Author´s calculation by FAOSTAT.

In short, we can conclude that the availability of food in Bolivia is sufficient in order to meet the 2000 kcal necessities per person and day. However, we observed a negative trend during the last years, which can put the food security situation at risk for those who are more exposed to shocks, depend on the production of specific commodities and are more vulnerable. In 2008, for example, due to negative climatic condition, the availability of food was severely affected, and it was necessary to increase the import of cereals in order to satisfy domestic food demand.

We observed that in general the productivity of the main commodities in Bolivia present low rates due to several restraints linked especially with the low quality of seeds, lack of infrastructure in irrigation systems, scarce know-how in pest control and field management and lack of or obsolete machinery. Moreover, soybean production represents a threat to the production of other commodities, because its production results in the reduction of production of other commodities which are more important for the daily Bolivian diet. The improvement of the efficiency and productivity in the production of main commodities should be targeted in order to increase competitiveness of the food industry, which may

result in declining prices for more sectors of the population. This would have a positive impact, especially for the rural poor, whose food consumption trend is poor and mostly based on the few primary products they produce. For instance, small farmers living in extreme poverty would benefit from higher productivity rates, because for them agriculture represents their main source of labor/income and simultaneously their source of access to food. These limitations in terms of low productivity rates represent a major problem for Bolivia and hinder the achievement of food security in rural Bolivia. Though availability of food in the domestic market per se is not sufficient to assure food security, it is an important determinant of it.

3.4 Food Access in Bolivia

Sen's entitlement approach suggests that food access is related to an individual's ability to transform his or her own resources into food or the capacity to obtain sufficient income in order to buy a nutritionally acceptable amount of food. In Bolivian rural areas, household resources can be understood as physical capital (e.g., land ownership, livestock and machinery to cultivate land) and the capacity to transform these resources into "food" through labor. Thus, we expect that food security and access to it depends on physical capital, income sources of labor (which also depend on human capital) and covariant and economic risks, which as we already mentioned affect households through vulnerability. In addition, the availability and the quality of households' assets, as well as the infrastructure available to them, will determine the capacity of a household to cope with shocks. A description of the assets available, the composition of the household and the identification of the main sources of income will be crucial in order to understand the severity and the limitation on households to improve their food security status (Egedord and Aguilar, 2007). In this section, we examine these factors.

Our analysis focuses primarily on the agricultural sector due to its vital role as source of income and food. According to the survey conducted by the World Food Program (WFP, 2006b) covering 4,525 households, 88 percent of these households are involved in agricultural labor. Thus, we assume that land repre-

sents a key asset for those households involved in agricultural activities and the lack of it determines poverty.

The structure of land tenure in Bolivia is characterized by a high degree of fragmentation and inequality. According to the last census in the agricultural sector, around 314,000 farmers are registered to own a fraction of land for agricultural purposes. [5] However, this is characterized by a highly unequal distribution of land. 68 percent of owners are declared small-scale owners (they have less than 5 hectares) . This represents only 1.5 percent of the cultivable land area of Bolivia. In addition, the agricultural census informs that 18 percent of farmers have less than 20 hectares. In contrast, a minority of 4 percent are large landowners who possess 90 percent of the cultivable area, having on average more than 100 hectares. This expresses the high inequality of land ownership in Bolivia (Fundación Tierra, 1990).

Generally, small farmers are concentrated in the highlands and valleys. On average, a household has 1.5 hectares, but, due to inheritance from parents, this value can be lower. In most of the cases, households possess less than a quarter of a hectare (WFP, 2007). In contrast, in the east Bolivia (lowlands) farmers feature the largest land holding areas.

The scarce access to land forces small scale owners to search for new access to land in remote areas with serious lack of infrastructure and thus with low levels of quality of life. In these remote areas, only 2.3 percent of households have access to irrigation systems, demonstrating the low capacity of production as well as the low capacity to prevent drought. In addition, the geographical isolation reduces their opportunities to trade and sell their products in comparison to households located closer to rural markets (Velásquez, 2005). Thus, most of these households are very likely to live in extreme poverty with a significant dependence on agriculture as their main source of income. Over 80 percent of rural household are involved in agricultural production as a source of income. About 16 percent of rural households report agriculture as their only source of income. For 58 percent, it represents the first source of income; for 30 percent, their second source of income. In contrast, for about 42 percent of households, non-agrarian work represents their main

[5] The official data has not been actualized since 1984. In 2008 the Government declared to conduct a new census for the agricultural sector, however this did not take place until today.

source of income, which is complemented normally by other work, especially in non-seasonal time, as in mining, fishing, the craft sector, etc. The diversification of income sources is a common strategy adopted in rural areas to improve the already precarious income levels (WFP, 2006). Households face the necessity of diversifying their work in order to generate other sources of income under poor infrastructure conditions and limited land tenure (WFP, 2006).

Households in rural areas are not involved exclusively in agricultural production, but also have livestock. About 12 percent of rural households' income comes from livestock and products derived from livestock, both in the form of sale and consumption. Livestock activities are an important source for increasing the income of rural households because they expand the capacity to consume food (Jimenez and Lizárraga, 2003). In addition, livestock is also an important asset for rural households in order to mitigate both internal and external shocks. A large proportion of households reports having llamas, alpacas, sheep and goats. However, the endowment of animals is low. The VAM group "safe" presents the largest asset of animals, whereas the chronic and the highest risk (VAM 4 and 5) group have only a few livestock (WFP, 2006). Households with a reduced livestock are more likely to be more vulnerable to food insecurity, because of the limited capacity to relieve the impact of risks.

Moreover, it is widely assumed that human capital plays an important role in the process of the economic growth of a country. Education in rural areas may help to develop technical capacities and raise awareness of the potential of new agricultural practices (Velásquez, 2006). However, the principal characteristic of the most vulnerable households in rural areas is the low level of education (especially of women). Between 60 percent and 80 percent of household heads feature less than 8 years of school attendance (WFP, 2006). The physical distance from village to school presents a prohibitive limitation on school attendance. According to WFP (2006), 73 percent of the communities have a primary school only near the main villages. However, there are high deficiencies in access to the secondary school level. Only 23 percent of the communities have a secondary school available and the level of attendance from primary school to secondary falls from 95 to 50 percent. The long distance to secondary schools, the bad roads and the time spent walking to school increase the drop-out rate in secondary school (WFP, 2006). Also, the fact that the young are required to help their par-

ents in farm or non-farm activities explains in part the lower school attendance rates in secondary school in rural areas. Low levels of school attendance combined with deficient quality of education result in lower productivity, which, combined with hard geographical conditions, increases the vulnerability of rural households.

Furthermore, households with high levels of poverty have serious limitations in access to food. In 2008, around 60 percent of Bolivian households were living below the poverty line. Of those, 30 percent were classified as living in extreme poverty, with the epicenter in rural areas (see Table 18). Poverty rates vary among regions in Bolivia. According to Baldivia et al. (2011), Potosí is the region with the highest level of poverty, followed by Beni and Pando. In contrast, La Paz, Cochabamba, Tarija and Santa Cruz show lower rates of poverty, respectively. Santa Cruz presents the lowest poverty rate, below 50 percent. The incidence of poverty also reflects the consumption capacity, so that in places where poverty rates are high we expect to see insufficient capacity to purchase an adequate quantity and quality of food.

Poverty indicator	**2008**	**Extreme Poverty indicators**	**2008**
Poverty incidence	57.33 %	Extreme poverty incidence	30.14 %
Total Population	9,999,829	Total Population	9,999,829
Poor Population	5,732,617	Population in extreme poverty	3,014,177
Urban area		**Urban area**	
Poverty incidence	48.72 %	Extreme poverty incidence	18.89 %
Total population	6,546,521	Total Population	6,546,521
Poor Population	3,189,499	Population in extreme poverty	1,236,677
Rural area		**Rural area**	
Poverty incidence	73.64 %	Extreme poverty incidence	51.47 %
Total Population	3,453,308	Total Population	3,453,308
Poor Population	2,543,118	Population in extreme poverty	1,777,500

Table 18: Poverty and extreme poverty indicators according to geographical areas in year 2008; Source: Author's calculations based on the data of Bolivia Bureau of Statistics – INE.

To sum up, households in rural areas are affected by a significant lack of physical assets and deficiencies in infrastructure. The lack of infrastructure (water resources to irrigate, absence of technical resources, including access to technology and lack of roads to bring their products to market), translates into poorly functioning markets and a high incidence of poverty (WFP, 2008 b). This is reflected in the poor quality of productivity in the agricultural market; as well as in low human capacities (education level), which consequently restrict the ability of households to turn their "assets" into income to get healthy nutrition. Thus, under this situation, food security is jeopardized.

This description of access to food provides only static information and thus fails to provide time dimensions for food access, which is essential in the agricultural sector due to production fluctuations from year to year. Rural households are influenced to a great extent by seasonal variations of crop cycles, which leads to income fluctuations and variations in food consumption levels. Weather variations, such as flood and drought, affect farm production levels and directly affect food prices. All these factors make households more likely to be vulnerable to covariant and economic risks. The latter can be understood as fluctuations in food prices, or political instability, e.g., social riots and road blockades, which may raise the likelihood of decreasing consumption levels and the difficulty of accessing food.

3.5 Vulnerability and Food Insecurity in Bolivia

From section 2.3, we expect that vulnerability involves exposure to risks and the capacity of a household to cope effectively with risks. Moreover, risk is related to an expected loss or exposure to shock over a future period of time. The classification of risks depends on the nature of the risks and the extension of the shock. The nature of the event can be diverse and involves natural, health, social, economic, and political risks. If the shock affects a large number of people, region or nation, such as a flood, drought or civil war, it is considered a covariant risk. From the upper description of lacking assets, low human capital and incomes, we expect that Bolivian rural households are highly exposed to risks and their coping strategies are limited, so that they are vulnerable and thus cannot meet food necessities.

According to the study conducted by the WFP (2006) in Bolivian vulnerable rural areas, it was found that in the previous five years, 75 percent of households reported being exposed to a shock that reduced their consumption level. Most of them declared that they suffer more of one shock, which reflects their exposure to risks and their vulnerability to food insecurity, because the lack of a buffer in terms of assets, money and human capital to prevent or cope with risks. In general, the principal source of risk is related to natural risks (70 percent). In contrast, only 8 percent of households in rural areas declare that the reduction of the level of consumption is linked to an increase in prices of the main commodities (WFP, 2006).

In the following section, we present two natural risks associated with the creation of vulnerability to food insecurity in Bolivian rural areas: natural hazards and the rise of food prices.

3.5.1 Drought

In the current context of climate change, drought becomes more frequent. In Bolivia, drought is the major factor related to food shortages in comparison to floods, pests and diseases (see Table 19). In the last twenty years in Bolivia, six periods of drought were declared (Egedorf and Aguilar, 2007). The intensity and the severity of drought goes beyond the lost harvest and extends to reduces in yield, increases of livestock deaths, diseases and soil degradation, etc. (FAO, 2011 b).

Drought	Floods	Storm	Pest	Livestock disease
46.5	6.8	31.4	12.5	2.8

Table 19: Percentage of Households affected by natural shocks; Source: WFP (2006:48).

Given the diversity of geographical characteristics of the Bolivian territory, drought risk affects each region differently. There are large differences between risks to which Bolivian regions are exposed. For example, according to a study by WFP (2006), it has been established that the regions that suffer most from drought are located in the western parts of the department of Oruro, Potosí and southern La Paz (see Figure 7, left). In these areas, the annual rainfall tends to

be lower than elsewhere in the country. As with drought, frost is also located in this same highland zone. These facts explain in part the restraints on agricultural practices and the prevalence of food limitations in these regions, reflecting the higher probability of vulnerability to food insecurity (ibid).

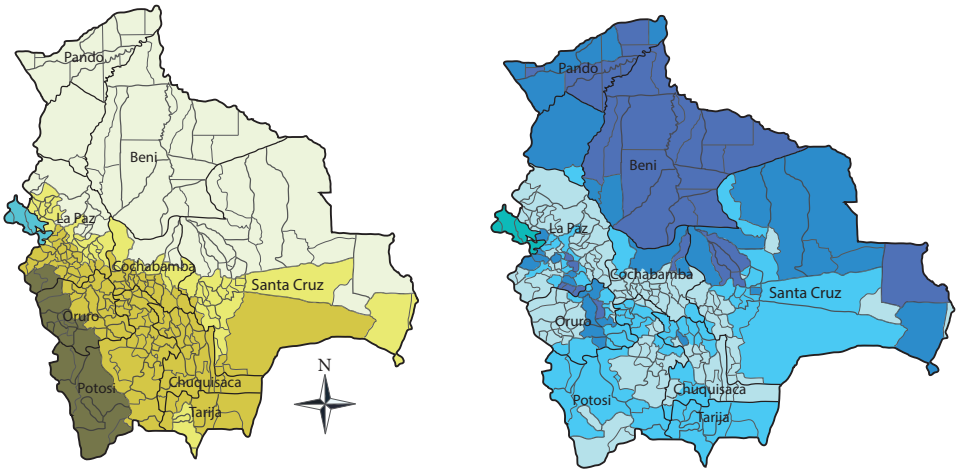

Figure 7: Drought and flood prone areas; Source: Egedorf and Aguilar (2007: 40).

3.5.2 Flood

The rain season starts in November and ends mostly in March. The incidence of floods tends to be concentrated in valleys and lowlands (see Figure 7, right). According to WFP (2006), the Beni, Pando and some municipalities of Santa Cruz and La Paz are more likely to be exposed to flood. Since 2006, periods of flood have been more recurrent in Bolivia.

About 75 percent of the households affected by floods, work in agriculture (WFP, 2008). The most vulnerable group affected by floods is subsistence farmers. Subsistence farmers are most affected by natural hazard because their only source of access to food is destroyed or partially destroyed. One immediate effect is the resulting lack of resources to access food or seed for the next planting season. Linking this with the entitlement theory of Sen, we appreciate a failure

or change both in the endowment set and entitlement mapping which affect directly both the availability and food access which puts households at risk of suffering food shortage. For instance, in 2008, the government declared a national emergency in response to the flood resulting from *La Niña* phenomenon in all regions. It is roughly estimated that 73,000 households were affected in different parts of the country at the end of 2007 and the beginning of 2008 (WFP, 2008). Of the 73,000 households affected by *La Niña* phenomena, 56 percent lost all of their agricultural production. However, 18 percent of households lost more than half of their production. In addition, 12 percent of households lost half of their production and only 6 percent lost less than half of production. In contrast, 7 percent of households confirm not being exposed to any loss by *La Niña* phenomena (WFP, 2008). The damage was concentrated in the harvest of rice, maize, cassava and bananas, as well as in infrastructure and livestock. Thus, excessive rainfall has an immediate impact on agricultural and livestock production and directly affects households in terms of food security and quality of food.

In short, both drought and flood phenomena destroy the already precarious living conditions of the poor and especially subsistence farmers. This jeopardizes both the short and long term food consumption of farmers and creates a situation of food insecurity for these households. The capacity to cope with risk will be decisive in recovering previous levels.

3.5.3 Increasing food prices

Another type of risk is increasing food prices. The rise of food prices has a major impact on the real income of poor households and in the access to food. Increasing food prices negatively affect low income households, because they experience a large welfare loss in spending more than half of their income on staple food. Rise in food prices restricts access to food both in quantity and quality.[6] The sharp global rise in food prices in 2008 resulted in a world food crisis. According to the World Bank (2011), the price of food commodities rose 83 percent between 2006 and 2008. A significant rise in food prices took place, especially for commodities such as maize, rice, sugar and wheat. After months of fast raising

[6] For further information about the linkages between nutritional outcomes and higher food prices see FAO (2008: 28).

of food commodity prices, in July 2008 the international food prices index (FPI) plummeted and reached its minimum in February 2009 (see Figure 9). After that, prices began to increase progressively and in July 2010 the prices hiked abruptly, exceeding even the previous levels reached during the food crisis of 2008 (World Bank, 2012). Food prices fell during the last months of 2011 and stayed constant in the beginning of 2012. However, they are still high (FAO, 2011 a).

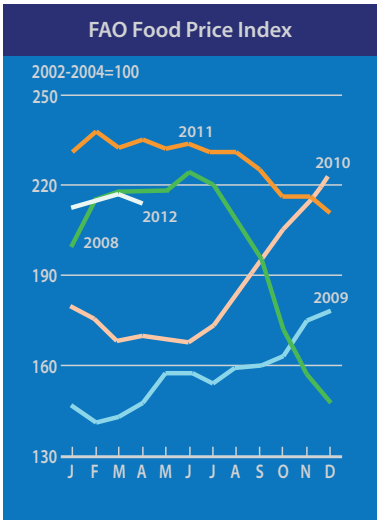

Figure 8: Food Price Index; Source: FAO (2012).

The forces behind the rise of world food prices are diverse and closely related. The main drivers are: 1) *Decline in growth of agricultural production.* Extreme weather conditions, such as drought and flood during the period 2005 to 2007 and 2009 to 2011, have contributed to the decline of cereal production in the major cereal producer countries like Ukraine, Australia and the United States, and thus to rising prices of cereals. 2) *Biofuel demand.* The demand for cereals, sugar and cassava for the production of biofuel has contributed to the gradual decrease of the global corn supply, which led to higher food prices. In addition, in a context of concern over energy security resulting from higher energy and fuel prices, the demand for biofuels is expanding (Mittal, 2009: 7). 3) *Increased demand from the emerging economies.* Sustainable economic growth in China, India and other emerging countries led to overall increases of food demand, especially of cereals, although this point is highly questionable, because China and India are net exporters of cereals and their high demand could be met by national production (Mitta, 2009: 5). Furthermore, it is estimated that global grain consumption – excluding biofuels – between 2000 and 2007 has experienced only an increase of 1,7 percent (Ibid). Other factors such as trade policies and the decline of global grain stock are considered drivers behind the rise of basic food prices (Cuesta et al., 2009).

The volatility of international food prices was not an exception in Bolivia. There, food prices increased progressively during the last six years (see Figure 10). In

Figure 10, there are three marked phases as of year 2006. The first phase is characterized by a dramatic increase of food prices between 2006 and 2008 and ends in the mid of 2008 with the international food crisis. In contrast, the second phase presents a period of substantial stabilization but no decline towards the earlier stage. Additionally, in 2010 food prices experienced another sharp increase. This led food prices to an historical peak. Despite some fall in the international prices of cereals and other commodities, in Bolivia food prices still remain high and do not appear to be returning to previous levels.

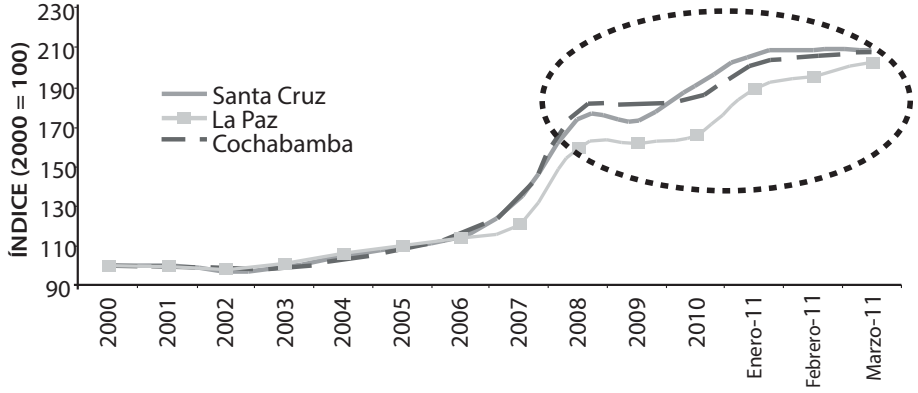

Figure 9: Food price index for basic food basket years 2000-2011; Source: Baldivia et al. (2011:.37).

The impact of rising prices has not yet been quantified and we can assume that it was not equal in all regions or for all households. The dependence of households on some commodities may characterize the effect. For rural households, we need to take a look at their consumption behavior, and more specifically at which products are part of the basic food basket. Thus a disaggregated presentation of the main consumed commodities is needed in order to analyze the impact of rising food prices on their access to food. From section 3.3 of this paper, we know that cereals, roots and tubers are vital to the daily caloric intake in Bolivia, so that an analysis of the price development of cereals, roots and tubers may give us an idea of the impact of households' food access. For instance, in Santa Cruz the price of wheat flour increased by 30 percent between 2007 and 2011. In the case of maize, both in Santa Cruz and La Paz, the increase of maize prices rose to 13 bolivianos in 2011 in comparison to 6 Bolivianos in 2007. This

reflects an overall increase of 117 percent.[7] Furthermore, the price of potatoes has doubled between 2007 and 2011 and the price of rice has increased by 60 percent. In Cochabamba, sugar prices experienced the largest price increase of all regions between 2007 and 2011. It increased by 175 percent, from 4 to 11 Bolivianos for one kilogram (Baldivia et al., 2011). Although wages increased by 32 percent, this is not enough to compensate the sharp rise of basic food prices (WFP and UNICEF, 2009: 57). We can suggest that the rapid rise of prices in a short span of time increases the risk of households falling into vulnerability to food insecurity or falling into food insecurity completely due to the large effect of price increases on their real income.

Furthermore, internal factors such as 1) weather variability, 2) trade policies and 3) oil prices are also considered major drivers of the continuous rise of food prices in domestic markets. As we have already mentioned, natural risk has been more recurrent the last few years, contributing in large proportion to the reduction of food. In addition, the impact of floods is not restricted only to harvest damage, but also to the temporary destruction of roads. The physical lack of access to food in remote rural areas is also a principal factor of the rise of food prices (WFP, 2009). Between 2007 and 2010, the government introduced protectionist policies in order to protect national markets from food price volatility. Export restrictions on maize, rice, wheat, etc. were a common method adopted by the government in order to maintain constant prices. This strategy was a disincentive for farmers to produce. In addition, at the end of 2010, the government issued a decree to stop gasoline subvention. Gasoline prices increased sharply within a few hours. The general social agitation forced the government to abolish the decree. Despite the subvention and relative decline in gasoline prices, transport costs were already high (Baldivia et al., 2011).

Moreover, the impact of increasing food prices on vulnerable households in rural areas depends on their consumption level. Net consumer households are most affected by food price increases because they spend a larger share of income on food (Ivanic and Martin, 2008).[8] In Bolivia, 77 percent of the consumed food is purchased rather than produced, which shows that households in rural areas are

7 Bolivianos: the Bolivian currency

8 We must note that the focus of this paper is concentrated in vulnerable households in rural areas, which have less than one dollar per day. Only the group of VAM 1 (safe) is above the one dollar per day indicator.

net buyers facing the largest losses in welfare due to the rise of food prices. Linking this with the entitlement approach of Sen, the erosion of real income will lead to a failure in the exchange entitlement mapping, which will lead to a reduction on the households' purchasing power of food. A sensitive indicator to examine the impact of rising food prices on vulnerable households is the structure of households' consumption. Table 20 shows households' expenditures on food and non-food goods. In 2005, before the increase of food prices took place in Bolivia, the composition of households' expenditure was distributed as follows: the largest expenditure went to meet the basic food needs (56 percent). The second largest income expenditure was designated to services (12 percent). Additionally, education and health represented 13 percent of households' expenditure and therefore ranked as the third most important income expenditure, followed by "other" expenditures, which covered 10 percent of households' expenditure. Households featuring high levels of poverty are less able to invest or save (only about 6 percent of the income can be saved) (WFP, 2006). Nevertheless, in 2009 households spent 65 percent on food consumption. The changing pattern of expenditure is reflected in the fact that two thirds of the income go to meeting food needs. Moreover, rising food prices affect disproportionally those households which spend an already large proportion of their income on food. Thus, we can suggest that this expenditure pattern restricts and "forces" reductions in spending on health and education. The changing expenditure pattern can, in the short and long term, lead to deep levels of food insecurity and enforce poverty traps on vulnerable households.

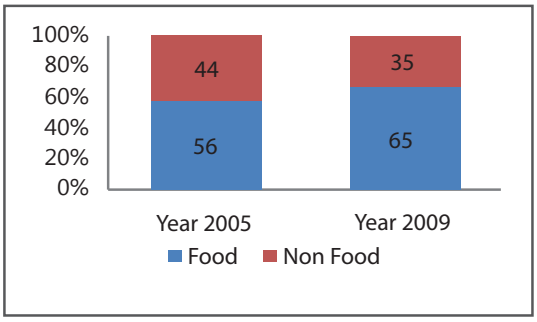

Figure 10: Vulnerable Households' expenditures structure of income between 2005 and 2009 (%); Source: WFP (2009: 8).

3.5.4 Coping Strategies

In this section, we will analyze coping strategies adopted by rural households in order to reduce or mitigate vulnerability. Depending on the severity, frequency and duration of a shock, the adopted strategy may vary. For instance, when food prices increase, households will respond by changing consumption patterns, reducing the amount of consumed food or seeking alternative activities to generate income (see Table 20). Table 20 suggests that one of the most recurrent strategies is to temporarily immigrate to areas where there are more job opportunities, in order to get a more constant wage. This diversification of sources of income is a common practice in the agricultural sector, where in non-seasonal periods farmers engage in other income-generating activities as an alternative way of securing an income.

In addition, another coping strategy is that households try to smooth consumption by selling agricultural products or livestock to generate income. Alternatively, households try to borrow money from friends, relatives or neighbors in order to cope with shock periods and secure their food consumption. In extreme food insecurity situations, households tend to ask for money from landlords or moneylenders, who normally charge a higher interest rate due to the lack of formal credit markets. Thus, despite the importance of such strategies in the short term, in the medium and long term this strategy is considered to be less reliable for coping with shocks because it can strengthen even more the poverty trap in which households are involved.

Besides this common strategy, households also practice other coping strategies, such as reducing the amount of consumed food. In such a case, households have no other choice than to reduce the quality and quantity of food intake. As a consequence, the already poor diet is affected by a reduction of meat and dairy product consumption, which are rich in micronutrients. Thus, this strategy can have a severe impact on malnutrition both in the medium or long term, as well as strengthen poverty traps.[9]

[9] See figure 24 in the „*FAO* „(2008)

	Actions	Costs
New economic activities	• Increased participation in income-generating activities (especially women) • Migration to areas where there are job opportunities • Return migration to village/ country of orogin	• Reduced leisure or other activities maternal care, nutricion, education may suffer • Loss of community cohesion, break-up of family • Reduced wages on local labour markets
Consumption smoothing	• Sale of assets • Borrowing from formal/informal markets	• Loss of future earning potential, possible poverty trap • Reduced future earning potential, increased risks
Change in consumption pattern	• Shifting dietary patterns toward cheaper (starchy) foods and away from micronutrient-rich foods such as milk, meat, fruits and vegetable • Reduced expenditures on health education, durable and semi-durable goods to maintain expenditure on food	• May cause malnutrition and micronutrient deficiencies with serious health consequences • May negatively affect health of houshold members an jeopardize future eardning potential

Table 20: Coping mechanisms in time of crisis: how households respond to declines in income; Source: FAO (2009: 27).

According to the information provided by the WFP (2006), households in Bolivia do not restrict themselves to one coping strategy. Bolivian rural households adopt different strategies at the same time in order to compensate shortfalls in income or consumptions levels (ibid). The most frequently used coping strategies are: finding paid work, getting loans of money, migration, selling livestock and reducing consumption levels. About 20 percent of vulnerable households get paid work. Especially women with lower education levels tend to increase their participation on the labor market, which in turn may lead to the reduction of maternal care and often malnutrition (FAO, 2009: 26). In addition, 13 percent of households are more likely to compensate adverse shocks by selling animals. The third largest strategy is consuming less (11 percent). The strategies focused on seeking financial support or migration only cover 7 percent or 6 percent as an alternative plan to mitigate shocks (WFP, 2006: 49).

Coping strategies adopted by households may differ according to their socioeconomic characteristics and regions where households are located (see table 21).

For example, households who have agriculture as the main source of income tend to compensate shortfalls by selling their livestock. However, households who rely on another source of income (non-agricultural work) compensate the shortfall by selling assets (WFP, 2006). In the following table, we contemplate different strategies adopted in the departments of Chuquisaca, Tarija and Santa Cruz. Despite some differences in the strategies implemented by households in different departments, we observe some common patterns within them. For example, households are more likely to work or borrow money as well as to sell livestock in order to mitigate the shocks. In contrast, other strategies such as selling some households objects or using food reserves seem to have a secondary role in the strategies of these households.

Strategies	Chuquisaca	Tarija	Santa Cruz
Work more	45.46	47.4	44.61
Borrow money	17.73	11.74	18.33
Sell livestock	9.09	12.68	9.96
consumption of donated food	5	2.53	5.98
Borrow food	4.55	7.51	4.38
Eat less	4.09	1.88	1.99
Sell of household objects	3.64	0.94	0.8
Reduce essential food counsumption	2.27	1.88	0.4
Use of reserve food	1.36		
Work in the informal market	1.36	3.76	2.39
Other	5.45	9.86	11.16
Total	100	100	100

Table 21: Coping strategies by households in the Chaco region of Bolivia (%); Source: (FAO, 2006: 61).

Similar results are found in the empirical work of Velasquez (2007). He finds that rural households with higher levels of education in Bolivia are more likely to adopt the strategy of spending savings and selling animals instead of working more. Additionally, he identifies that households in more vulnerable regions like Oruro are more likely to implement the coping strategy of being helped by NGOs instead of selling animals or spending savings (Ibid). The severity of

poverty in this department and the lack of a significant number of livestock may explain in part this strategy over others.

In all these cases, implemented strategies are more likely to be insufficient to cope with the risk. The evidence suggests that the response of households is limited and therefore impacts households' welfare in the long term. Short term "benefits" resulting from the coping strategy strengthen in the long term the poverty trap spiral, which under precarious living conditions is difficult to escape. Thus actions by the government are needed in order to strengthen or restore the capacity of households to cope and avoid this food insecurity situation.

4 Policy Implications

Bolivia is facing a potential challenge in terms of food security. Households are forced to implement short term strategies to cope with higher prices or natural disasters. This can threaten the medium and long term economic development of these households, who already live under precarious life conditions. The implemented strategies can turn into a negative cycle enforcing poverty and reducing the welfare of households, putting in risk future development.

In risky situations, households adopt a range of strategies to cope with different shocks. The most common strategies are a reduction of quality and quantity of consumption levels of food; as well as the selling of their few assets, such as land and livestock in this case. Thus, households sacrifice their long term welfare by spending less on food, school, medical treatment or water. Such strategies are, in most of the cases, limited to the short term. However, households become more vulnerable by adopting the above mentioned strategies because they increase the risk of intensifying the problem of food insecurity. Given the scarce resources available and the incidence of food insecurity in rural areas, an active intervention from the government is required in order to prevent and eradicate food insecurity, because households are not able to break this negative poverty cycle on their own. Thus, policies are urgently needed to assure food access, sustainability and improve mechanisms to strengthen resilience to internal and external shocks.

According to Haen and Hemrich (2006), the implemented strategy should take the form of a triple track approach, which is basically based on the twin-track approach developed by the FAO to combat hunger (FAO 2003b). The twin-track aims to improve food security by strengthening access to food both in the short and long term. This policy can be appropriated in times of rising food prices (FAO, 2008). However, the twin-track approach dismisses in part natural events which are also a key factor of vulnerability in rural areas. Haen and Hemrich

(2006) implemented a third track which considered the need of developing countries to build up resilience against natural disasters, which especially affect households in rural areas who depend on income and food intake resulting from subsistence agriculture. The following table provides an overview of the main determinants involved in the triple-track approach (Haen and Hemrich, 2006).

Track	Availability	Access	Stability	Utilisation
One Rural Development an Productivity Enhancement	Improving productivity and production capacity, esp. of low-income farmers Investing in infrastructure Improving the functioning of input and output markets	Promoting income earning opportunities Enhancing access to assets Faciliating the creation of rural enterprises Improving the functioning of rural financial systems and labour markets	Faciliating diversification Reducing production variability (irrigation, water harvesting, pest control, etc.) Monotoring production and consumption shortfalls Improving access to credit and saving services	Food handling and storage infrastructure Food safety regulation and institutions Safe drinking water and sanitation
Two Direct Immediate Access to Food	Food Aid Market information Transport and communication	Cash transfer School meals Food for work programmes Community and extended family structures	Safety nets	Nutrition intervention, health and education programmes
Three Building greater resilience against natural disasters	Risk information analysis and early warning Legislation; Settlement and lad use planning Uppgrading physical infrastructures Diversification Risk transfer mechanism (insurance and capital markets) Improving transition and sequencing of emergency rehabilitation-development efforts			

Table 22: A triple-track approach to food security in disaster-prone countries; Source: Haen and Hemrich (2006: 13).

In general, the twin-track approach pursues two overall objectives. The first track focuses on the improvement of the income-generating capacity of small land holders in rural areas by increasing their production and productivity. The

second track aims to provide sustainable solutions by providing safety nets and ensuring social protection from immediate negative impacts, for example, sharp rising food prices or natural disasters. The interaction of both components is essential to achieve an integral improvement in order to reduce the vulnerability and risks.

A prerequisite in times of food insecurity is to facilitate an immediate access to food for all affected people in order to protect or prevent long lasting development effects. In the short term, it is important that small farmers restore as quickly as possible their capacity to produce or generate income in order to "activate" their economy again. This is only possible if an effective increase of production or productivity takes place in the agricultural sector. We mentioned in the second section of the work that productivity rates of the main commodities in Bolivia present practically the lowest rates of all South American countries. This results in part from the poor subsistence agriculture practiced by small farmers due to the lack of infrastructure and use of technology.

Improvement in agricultural productivity requires investment in technology adaptable to the particular necessities of small farmers in the Bolivian valley and the highland. Only 5 percent of the arable land in Bolivia uses irrigation systems. Thus, it is expected that the extensive use of irrigation systems on drought-prone areas may contribute to the increase of productivity; especially for those commodities which depend on rainfall. Alternatively, the use of drought-tolerant crops can be implemented to improve or assure production in times of lack of rainfall. In addition, the use of fertilizers or genetic seeds could also play an important role in the improvement of productivity. An increase of productivity can translate into additional income and contribute to an improvement of the availability of food. Paradoxically, the Prime Minister of Bolivia, Evo Morales, restricts the use of genetic seeds for agricultural purposes, while Bolivians consume indirectly a large amount of genetically modified cereals imported principally from Argentina, where its use is extensive.

In addition, previous policies should be complemented by medium and long term policies to support long term development. Thus, efforts should also be expanded to include improvement of road infrastructure, transportation systems, access to credit, education, etc. (see the second track, Table 22) in order to create a sustainable development. Investment in agriculture plays a key role in rural

areas and should concentrate on small farmers due to their dependence on the sector and due to the fact that agriculture is mostly hit by natural disasters. The application of the twin-track approach is essential to strengthening the food security of households in rural areas, but is by itself insufficient.

A complementary third track is needed in order to create an integral policy to strengthen the resilience of households in rural areas and to reduce natural disaster risks. In this case, an analysis of the disaster-prone areas is essential in order to prevent and improve risk awareness. In chapter 3.5.1 and 3.5.2 of this work, we noted that some departments of Bolivia are more exposed to drought. These regions are commonly located in the western parts of the department of Oruro, Potosí and southern La Paz (see Figure 6, left). In addition, Beni, Pando and some municipalities of Santa Cruz and La Paz are more likely to be exposed to floods (see Figure 6, right). In this case, strategies to improve disaster awareness can be implemented for households living in these regions. In some cases, a relocation of people would be needed, for example, for those living along river shorelines (Haen and Hemrich, 2006).

Once vulnerable risk areas to food insecurity are identified, it is necessary to invest in physical infrastructure in order to improve resilience against such events. For example, investment in the construction of dams and dikes to control floods is necessary, as well as irrigation system and increasing access to safe drinking water could be a form to improve resilience in food insecurity areas.

It is evident that risk will remain, independent of the different strategies and investments to improve the resilience in disaster prone area. However, the first policies will have positive impacts in regions affected periodically by natural disasters. The mitigation of the negative cycle of food insecurity can turn into multiple benefits for households, starting with the reduction of vulnerability and poverty. In the same manner, alleviating poverty and vulnerability can reduce the food insecurity of rural households and thus break the perpetuation of rural poverty in Bolivia.

5 Conclusions

In this paper, we analyzed whether rural poverty causes food insecurity and food insecurity perpetuates the state of poverty of the rural poor in Bolivia. We found evidence that Bolivia is facing a huge challenge in terms of food security, which was intensified in the last years due to harvest failures and the rise of food prices; especially for rural households, who depend largely on the agricultural sector.

We observed that low incomes or high levels of poverty in rural areas threaten access to food or lead to inadequate nutrition, despite the theoretical availability of a sufficient food supply in Bolivia for meeting the dietary needs of each Bolivian. In the same manner, the lack of access to nutrition and the persistence of poor nutrition results in low work-capacity, which simultaneously translates into low ability to earn and consequently low incomes. This double causality is manifested especially in vulnerable rural areas where food insecurity is mostly concentrated.

We identified three potential sources of risk which jeopardize the food security of rural households: floods, droughts and the rise of food prices. The Bolivian regions most likely to suffer from drought are located in the western parts of the department of Oruro, Potosí and southern La Paz. In addition, Beni, Pando and some municipalities of Santa Cruz and La Paz are more likely to be exposed to floods. All of these regions feature agriculture as a principal source of income. The most vulnerable group affected by natural hazards tend to be subsistence farmers because their principal source of access to food is destroyed or partially destroyed. At the same time, they were negatively impacted between 2006 and 2008 by the sharp rise of prices which was intensified at the end of 2010. The price of commodities such as maize, rice, sugar and wheat peaked and they play an essential role in the Bolivian diet.

As a consequence and response to vulnerability, households tend to implement strategies to cope with the negative effects of shocks. For instance, households try to smooth consumption by selling agricultural products or livestock to generate income. Alternatively, households try to borrow money from friends. Very often, households have no other choice than to reduce the quality and quantity of food intake. In most of the cases, they are forced to reduce expenditure in health and education putting at severe risk their medium and long term development, which in the long-run can intensify the food insecurity situation.

Given households' scarce resources, their poor socio-economic characteristics and the incidence of food insecurity in rural areas, households are unable to reduce or break the negative cycle of food insecurity by themselves. Therefore, active intervention by the government is required to assure food access, sustainability and improve the build up mechanism to strength resilience to internal and external shocks. Since poverty is mainly rural, efforts should concentrate on the agricultural sector, which presents one of the poorest productivity levels in South America.

In addition, different strategies should be complemented with medium and long term policies to support long term development. Efforts should expand the improvement of infrastructure, such as roads, transportation, access to credit, and education in order to pursue a sustainable development. Despite the huge challenge ahead for the Bolivian government, it is important to articulate efforts with the aim of achieving food security in rural Bolivia, especially in the regions more exposed to vulnerability. Steps taken in this direction can significantly contribute to the promotion of food security and to the reduction of poverty. The success of development will partly depend on the creation of a policy environment which can articulate a sustainable development nationally. A triple-track approach can be a good instrument to start with.

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Bolivia is one of the poorest countries in Latin America. This study analyzes whether rural poverty increases the incidence of food insecurity and whether food insecurity perpetuates the condition of poverty among the rural poor in Bolivia. In order to achieve this aim, the risks that households face and the capacity of households to implement coping strategies in order to mitigate vulnerability shocks are identified. We suggest that efforts by households to become food secure may be difficult in rural areas because of poverty and the vulnerability associated with a lack of physical assets, low levels of human capital, poor infrastructure, and poor health; as well as the precarious regional environment aggravating the severity of vulnerability to food insecurity.

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